Child Mental Health Problems in General Practice

Lukas Koet

Child Mental Health Problems in General Practice

Lukas Koet

Child Mental Health Problems in General Practice

Psychische klachten bij kinderen in de huisartspraktijk

Proefschrift

ter verkrijging van de graad van doctor aan de
Erasmus Universiteit Rotterdam
op gezag van de
rector magnificus

Prof.dr.ir. A.J. Schuit

en volgens besluit van het College voor Promoties.

De openbare verdediging zal plaatsvinden op woensdag 27 Augustus 2025 om 15.30
uur

door

Lukas Ben Maria Koet
geboren te Amsterdam.

Erasmus University Rotterdam

Promotiecommissie:

Promotor: Prof.dr. P.J.E. Bindels

Overige leden: Prof.dr. R.C.M.E. Engels
                   Prof.dr. M.H.J. Hillegers
                   Prof.dr. M.E. Numans

Copromotor: Dr. H. Gerger

Table of contents

Chapter 1

General Introduction

In this thesis, the mental health problems of children and adolescents in the context of Dutch general practice are investigated. In this introductory chapter, the background of the topic is outlined, followed by a discussion of key research-related aspects and challenges in studying mental health problems in children. The chapter concludes with the aims of the thesis and an overview of its structure.

Terminology and classification

The WHO defines mental health as "A state of mental well-being that enables people to cope with the stresses of life, realize their abilities, learn well and work well, and contribute to their community. It is an integral component of health and well-being that underpins our individual and collective abilities to make decisions, build relationships and shape the world we live in." [1] Broadly, *mental health problems*[a] can be described as significant disturbances in an individual's cognition, emotion regulation, or behavior.[2] When these problems are severe and persistent, they may be classified as *mental health disorders*.

Currently, two major classification systems are used to categorize mental health disorders: the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) and the International Classification of Diseases, 11th revision (ICD-11). Both systems require specific criteria to diagnose a mental health disorder, such as the presence of predefined symptoms for a certain duration. The DSM-5 contains 20 categories of disorders (e.g., anxiety disorders, depressive disorders) and includes nearly 300 individual mental health conditions (e.g., separation anxiety disorder, major depressive disorder). It emphasizes quantitative, operationalized criteria—for example, to diagnose disorder X, a person must meet a specified number of criteria for a certain duration of time.[3] In contrast, the ICD-11 typically relies on fewer diagnostic criteria and places greater emphasis on clinical judgment. As a result, its definitions of psychiatric disorders are often more descriptive and general, providing broader guidance on the typical presentation of various conditions.[3]

---

[a] In literature different terminology and definitions are used to describe similar concepts. For example, mental health problems and psychosocial problems are often used exchangeable. In this thesis we used the term mental health problems. In chapter 5, we were explicitly interested in both psychological and social problems and used the term psychosocial problems.

1

Classification of mental health problems in Dutch general practice

The two major classification systems, DSM-5 and ICD-11, are central to psychiatric practice and research worldwide. However, Dutch general practitioners (GPs) do not use these systems. Instead, they rely on the Dutch version of the International Classification of Primary Care (ICPC) to code and classify mental health problems.[4] The ICPC has been in use since 1988 and enables GPs to register various reasons for patient encounters, including symptoms, complaints, diagnoses, and interventions.

This approach is significant because, in many cases, GPs are unable to make a definitive diagnosis. For example, a patient presenting with a cough might be coded with the symptom "cough" rather than the formal diagnosis of "bacterial pneumonia." This is particularly relevant in the context of childhood mental health problems, where GPs rarely provide formal mental health diagnoses. Instead, they often describe the symptoms (e.g., "anxiety before going to school") rather than using specific diagnostic labels (e.g., "separation anxiety disorder"). This is reflected in the coding practices of Dutch GPs, who typically assign a symptom code (e.g., P01 "Feeling anxious/nervous/tense") for consultations related to children's mental health problems. Diagnostic codes (e.g., P74 "Anxiety disorder") are used less frequently.[5] In daily practice, GPs encounter a broad spectrum of mental health problems, ranging from mild to more severe conditions. Therefore, this thesis does not focus solely on formal mental health disorders but instead takes a broader view of the mental health spectrum, encompassing both mild and more severe mental health problems.

Epidemiology

A meta-analysis of prevalence studies using standardized diagnostic interviews estimated the global prevalence[b] of mental health disorders in children and adolescence at 13.4%.[6] The most common disorders included anxiety disorders (pooled estimate of 6.5%), followed by disruptive behavioral disorders (5.7%), attention-deficit disorders (3.4%), and depressive disorders (2.6%). The meta-analysis found no significant differences in prevalence rates across geographical regions. However, it is important to realize that data from lower- and middle-income countries are notably scarce.[7]

In the Netherlands, the prevalence of mental health disorders in children and adolescents is typically assessed through questionnaire-based surveys and clinical interviews.[8-10] The

---

[b] Prevalence is a measure of disease frequency. It is the proportion of individuals in a population who have a disease or health condition at a specific moment in time.

Tracking Adolescents' Individual Lives Survey (TRAILS) is currently the largest Dutch epidemiological study in this area, and used questionnaires and clinical interviews to estimate the lifetime prevalence[c] and the age of onset of mental health disorders in participants living in the northern part of the Netherlands.[10]

In the TRAILS study, the lifetime prevalence of anxiety disorders, depressive disorders, and ADHD before the age of 19 were 28.0%, 17.3%, and 1.6%, respectively. Anxiety disorders and ADHD tended to develop early, with mean ages of onset of 8.8 and 5.4 years, respectively. Depressive disorders, on the other hand, were more common in adolescence, with a mean age of onset of 14.2 years.

Risk factors

The etiology of mental health problems is multifactorial, with various risk and protective factors playing a role.[11, 12] These can be broadly categorized in child, family and environmental factors.[12] Child factors include genetic predisposition, sex and gender, physical health, as well as cognitive and psychological functioning.[11] Family factors encompass the caregivers' education level, parenting style, experiences of child maltreatment, family income, and the (mental) health of caregivers. Environmental factors include experiences such as bullying, exposure to violence (including sexual violence), and growing up in a war-affected environment.[11] In Dutch studies, factors linked to mental health problems in children and adolescents include female sex, chronic illness, exposure to adverse life events, and social disadvantage.[10, 13, 14]

Unfortunately, the causal pathways connecting these factors to mental health problems are not well understood.[15] Many studies in this area are observational, and risk and protective factors often co-occur or interact, making it difficult to draw definitive causal conclusions.[16, 17] For example, children of parents with mental health problems are at increased risk of developing similar problems themselves. At the same time, parents with mental health problems are more likely to experience lower socioeconomic status (e.g., financial difficulties) and face challenges in parenting. Since these factors often overlap, pinpointing the precise causal role of individual risk factors remains challenging.

---

[c] This study presents their results as lifetime prevalence. The lifetime prevalence is the rate of individuals in a population that at some point in their life (up to the time of assessment) have experienced an event or disease (e.g., experienced a period of a depressive disorder). In this study it is the number of children with or with a former mental health diagnosis by the age of 18-19 as assessed by questionnaires and clinical interviews.

Burden of disease and prognosis

The physical and mental development that children undergo is foundational for leading a healthy and successful adult life.[18] For children to reach their full potential, it is essential that they grow up with good mental health.[11] Child mental health problems disrupt a healthy development and can as such have long-term negative consequences. In fact, many adult mental disorders have their origins in childhood.[19]

Childhood mental health problems can significantly affect daily functioning (e.g., poor academic performance) and the overall quality of life for affected children.[20-22] One major challenge faced by children with mental health problems is an increased risk of dropping out of education, which can, in turn, negatively impact future employment opportunities.[23, 24] Globally, mental health problems contribute substantially to disability-adjusted life years (DALYs) in children and adolescents.[25, 26] In high-income countries, mental health disorders are actually the leading cause of DALYs.[27] Moreover, suicidal ideation is common among children and adolescents with mental health problems, and suicide is one of the leading causes of death in this age group.[28, 29] Childhood mental health problems also impose a significant economic burden. In the Netherlands, these problems contribute notably to both the direct costs borne by affected families and the broader economic impact on society as a whole.[30, 31]

Treatment

Effective treatments for child mental health problems are available, including pharmacological and psychological interventions.[32-34] Evidence-based pharmacological treatments include stimulant medications for ADHD and selective serotonin reuptake inhibitors (SSRIs) for anxiety and depressive disorders.[35-37] Psychological interventions can target the child directly (e.g., cognitive behavioral therapy), focus on the child's interactions with caregivers (e.g., parent training in behavior management for ADHD), or address the environment (e.g., behavioral classroom interventions for ADHD).[37] Caregivers and children often prefer interventions that help the child develop coping strategies, such as cognitive behavioral therapy.[38]

Both pharmacological and psychological interventions have been shown to provide lasting benefits in the short and medium term.[39] However, their long-term effectiveness (i.e., over ≥2 years) and their ability to prevent future problems remain unclear.[40] Nevertheless, the current paradigm is that early detection and intervention are crucial for improving

child mental health and potentially preventing the development of severe mental health disorders later in life.[41, 42] Emerging treatments in the field of mental health include animal assisted therapy (e.g., hippotherapy) and life-style interventions (e.g., exercise interventions).[43, 44] Exercise interventions, in particular, are of great interest due to their dual benefits for mental and physical well-being.[45] Unfortunately, numerous barriers prevent children and caregivers from accessing professional help.[46] Even in high-income countries like the Netherlands, fewer than half of children with mental health disorders receive treatment.[47, 48]

The role of Dutch GPs in pathways-to-care

Pathways-to-care are defined as the "sequence of contacts with individuals and organizations prompted by the distressed person's efforts, and those of his or her significant others to seek help, as well as the help that is supplied in response to such efforts".[49] A variety of factors, including characteristics of the child and family, influence the process of seeking help.[50]

Due to factors such as limited knowledge of mental health problems and fear of stigma, children and adolescents often hesitate to seek help for mental health problems.[51] As a result, they typically rely on nearby adults—such as caregivers and teachers—as well as health professionals like GPs, to recognize these problems. In the Netherlands, GPs are central to the healthcare system, providing primary care for children and adolescents. They also act as gatekeepers to specialized services like hospitals and mental health care. Consequently, GPs are often the first point of contact for children and their caregivers seeking help for mental health-related questions.[52]

GPs often have a long-lasting relationship with the child and its family and are aware of the context of family problems.[53] Therefore, GPs would theoretically be well-positioned to recognize mental health problems in children and adolescents early on. However, in daily practice, it can be challenging for GPs to recognize and manage mental health problems in children, which limits their role in the pathway-to-care.[53-56] A systematic review found that GPs struggle to recognize mental health problems in children and feel they lack the appropriate tools to do so.[53] This finding is supported by a Dutch vignette study that showed that GPs had trouble recognizing child anxiety problems.[56]

1

Supporting GPs in recognition and management

Given that GPs often face difficulties in recognizing and managing child mental health problems, it is crucial to enhance their ability to address these problems. One approach to tackling this challenge is to provide GP-tailored guidelines, training programs, and tools that can improve GPs' knowledge and skills in identifying and managing child mental health problems.[53] In the Netherlands, however, such tools and training programs are largely lacking, with the notable exception of a guideline on recognition and treatment of ADHD in children.[57] Another potential solution is to support GPs with prediction tools. For example, there has been growing interest in using existing healthcare data to identify children at risk of developing mental health problems. This information could help GPs more effectively recognize children at higher risk. In a recent study, Dutch researchers used a GP database to develop a prediction model for the one-year risk of a first recorded mental health problem.[58] The study identified several age-independent predictors of mental health problems in children, such as more than two GP visits in the past year or having had one or more laboratory tests. A third approach to supporting GPs is to improve collaboration between GPs and mental health services by integrating child mental health care into general practice. This integration could facilitate earlier identification and more comprehensive management of mental health problems in children.

Youth mental health practice nurse

In the last decade an important effort has been undertaken in the Netherlands to support GPs in the management of child mental health problems. One of the key developments has been the introduction of the *Youth Mental Health Practice Nurse* (YMHPN, Dutch: *praktijkondersteuner Jeugd en Gezin*), a role designed to integrate child mental health care into general practice settings. A YMHPN is a professional with a background in youth care (e.g., psychiatric nurse, psychologist, or social worker) who works within a GP practice. The primary responsibilities of a YMHPN include providing short-term treatment for children with psychosocial problems, serving as a liaison with external services, and making referrals for more specialized care when necessary.[59-61] Typically, there is no waiting list for the YMHPN in general practices.[62, 63]

The financing of the YMHPN differs per practice and is determined through collaboration between GPs, municipalities, and insurance companies. Although exact numbers are

lacking, the number of YMHPNs working in general practice has steadily increased since the role was introduced in 2015.[64, 65] GPs and patients have reported positive experiences with the presence of YMHPNs in Dutch general practice.[66] However, as the introduction of YMHPN in general practice is relatively new, research on the long-term effects and outcomes of this care model is still limited.

Reorganization of Dutch youth care

In 2015, the Netherlands underwent a major reform of its youth care system, which includes mental health services, under the *Youth Law 2015*. The reform was driven by a growing demand for youth care and the fragmentation of the previous system.[67] The goals of these reforms were to simplify and improve the efficiency of youth care.[68] The key goals of the reform were to stimulate integrated care, improve proximity of care, reduce waiting lists, and focus on prevention of psychosocial problems. Additionally, it aimed to reduce the reliance on more intensive and specialized forms of care, such as outpatient and institutional services.

Under the new legislation, children and their families can seek help for mental-health related problems from newly established community-based teams, which consist of professionals from diverse fields, including youth mental health, child safety, welfare, and financial support. However, they can also still approach their GP as first point of contact. GPs can decide to offer treatment themselves or to refer the child to either the community-based support teams or directly to specialized services. Although these community teams have assumed part of the gatekeeping role traditionally held by GPs, GPs still remain responsible for a significant portion of referrals to specialized mental health. In Rotterdam, for example, about one-third of children accessing specialized mental health services were referred by their GP.[69]

COVID-19 pandemic

During the course of this PhD research, the world was struck by the COVID-19 pandemic, a crisis that likely had significant effects on child mental health. While COVID-19 infections in children and adolescents are typically mild or asymptomatic,[70, 71] the pandemic and the public health measures associated with it had profound impacts on the daily lives of young people. There is much concern that the COVID-19 pandemic negatively affected their mental health.[72] A meta-analysis found that the global prevalence

1

of depression and anxiety symptoms in children and adolescents doubled during the first year of the pandemic.[73] In the Netherlands, studies investigating the mental health effects of the COVID-19 pandemic on children have yielded conflicting results.[8, 74-77] However, most of these studies indicate that the pandemic had a detrimental effect on mental health, though to varying degrees.[8, 75, 76]

Challenges in research of child mental health problems

Research on child mental health faces several challenges, particularly when children are directly involved, such as in clinical trials. Ethical considerations must be carefully weighed to ensure that the potential risks are justified by the possible benefits for the child and their family.

Considering epidemiological studies into child mental health other challenges play a role. There is no standard method for assessing the occurrence of mental health problems, and different studies use varying approaches—such as surveys, registry data, cohort studies, and different measures of frequency (e.g., incidence, point prevalence, lifetime prevalence). Each approach has its advantages and disadvantages, and the different approaches are often difficult to compare 'like with like'.[78] Many studies in this area are cross-sectional, capturing a snapshot of mental health at one point in time. However, there is a need for more longitudinal cohort studies, which offer several advantages over cross-sectional studies. These advantages include the possibility to investigate changes over time and the long-term effects of influential events such as the COVID-19 pandemic. These studies also enable the exploration of developmental trajectories of child and adolescent mental health problems, which can reveal causal pathways and help identify risk and protective factors in the development and persistence of mental health problems. Moreover, these studies can provide information on the effectiveness of preventive and treatment strategies. Unfortunately, setting up and maintaining such longitudinal cohort studies is time-intensive and costly. As a result, longitudinal cohort studies are especially lacking in lower and middle-income countries.[11]

Readily available electronic health records are a promising new source of data that can be used to answer different types of research questions and is increasingly often used.[79] Databases of electronic health records can be used to create large cohorts which can serve as alternative to the traditional cohort study. The use of health records is cost-effective and provides access to large dataset sizes, but it also has potential pitfalls.[79]

In the Netherlands, GPs have long used electronic health records, and several general practice databases have been established over the years to support both the evaluation of care and research. Also, in Rotterdam a general practice database was created which was used as data source for several of the studies presented in this thesis. The next section describes important features of this database.

Figure 1. The Rijnmond region

The Rijnmond Primary Care Database

The Rijnmond Primary Cara Database (*RPCD; Dutch: Rijnmond Gezond Database*) is a region-specific derivative of the Integrated Primary Care Information database.[80] The database was set up in 2018 and aims to enable regional targeted research to improve health care in the Rijnmond region which includes the city of Rotterdam. This is necessary because the experienced health, including physical and mental health, of people in the Rijnmond region is on average much lower than those living in other parts of the Netherlands.[81] The RPCD is a pseudonymized database, meaning that the database is completely anonymized for the researchers using it as a data source. The RPCD consists

of pseudonymized electronic medical records of participating general practices, including complete GP notes, diagnostic codes (ICPC codes), referrals, laboratory findings, GP prescriptions, and specialists' letters.[80] The RPCD is a dynamic cohort, which means that GP practices can join and leave the cohort over time. At the time of writing, the RPCD contains data of more than 600,000 GP patients covering approximately one-third of the population of the Rijnmond region.

Aims and outline of this thesis

To date, research on child mental health within the context of general practice is still limited. Therefore, the first aim of this thesis is to explore the epidemiology of child mental health problems in general practice, as well as how GPs currently manage these problems. The second aim is to assess the impact of the recently introduced Youth Mental Health Practice Nurse (YMHPN) role on the management of child mental health problems in general practice. The third objective is to investigate potential improvements and innovations that could support GPs and YMHPNs in managing child mental health problems.

Chapter 2 presents a study on the incidence and management of anxiety problems in children within general practices in the Rijnmond region, using data from the Regional Primary Care Database (RPCD). Chapter 3 describes the results of an interview study exploring the current collaboration between GPs and YMHPNs in managing childhood anxiety. The study also identifies the barriers and facilitators GPs and YMHPNs experience in addressing these problems. Chapter 4 evaluates the care provided by YMHPNs to children with mental health problems, based on an analysis of records for nearly 400 children under their care. Chapters 5 and 6 present two related RPCD studies that examine trends in GP consultations and the incidence of mental health problems in children, adolescents, and young people (<25 years) over time. Chapter 5 specifically investigates the potential effects of the COVID-19 pandemic on these consultation rates. Chapter 7 explores whether the introduction of YMHPNs in general practices is associated with changes in the use of specialized outpatient mental health services for children and adolescents. This study used linked data from the RPCD and the municipal registry data of Rotterdam. Chapter 8 presents the results of a network meta-analysis that evaluates the effects of physical exercise interventions on ADHD symptoms and executive functions in children and adolescents with ADHD. Chapter 9 provides a general discussion of the studies presented in this thesis. In this final chapter, we reflect on the clinical implications of the findings, assess the methods used, and suggest directions for future research in the field.

References

1.   WHO: Fact sheet: Mental health. https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response (2022). Accessed 13/11/2023.

2.   WHO: Fact sheets: Mental disorders. https://www.who.int/news-room/fact-sheets/detail/mental-disorders#:~:text=A%20mental%20disorder%20is%20characterized,in%20important%20areas%20of%20functioning. (2022). Accessed 13/11/2023 2023.

3.   Tyrer P. A comparison of DSM and ICD classifications of mental disorder. Adv Psychiatr Treat. 2014;20(4):280-5. doi: DOI: 10.1192/apt.bp.113.011296.

4.   Napel HT, van Boven K, Olagundoye OA, van der Haring E, Verbeke M, Härkönen M, et al. Improving Primary Health Care Data With ICPC-3: From a Medical to a Person-Centered Perspective. Ann Fam Med. 2022;20(4):358-61.

5.   Van der Linden MW. Tweede Nationale Studie naar ziekten en verrichtingen in de huisartspraktijk: het kind in de huisartspraktijk. Nivel; 2005.

6.   Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA. Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry. 2015;56(3):345-65.

7.   Erskine HE, Baxter AJ, Patton G, Moffitt TE, Patel V, Whiteford HA, Scott JG. The global coverage of prevalence data for mental disorders in children and adolescents. Epidemiol Psychiatr Sci. 2017;26(4):395-402. doi: Doi: 10.1017/s2045796015001158.

8.   Boer M, Dorsselaer van S, Looze de M, et al. *[HSBC 2021 health and well-being of youth in the Netherlands]. [Report in Dutch].* Utrecht: University Utrecht. Utrecht: University Utrecht: Utrecht University; 2022.

9.   CBS: Gezondheid en zorggebruik; persoonskenmerken, 2014-2021. https://www.cbs.nl/nl-nl/cijfers/detail/83005NED (2022). Accessed 14/11/2023 2023.

10.   Ormel J, Raven D, van Oort F, Hartman CA, Reijneveld SA, Veenstra R, et al. Mental health in Dutch adolescents: a TRAILS report on prevalence, severity, age of onset, continuity and co-morbidity of DSM disorders. Psychol Med. 2015;45(2):345-60. doi: S0033291714001469 [pii] 10.1017/S0033291714001469.

11.   Kieling C, Baker-Henningham H, Belfer M, Conti G, Ertem I, Omigbodun O, et al. Child and adolescent mental health worldwide: evidence for action. Lancet. 2011;378(9801):1515-25.

12.   Merikangas KR, Nakamura EF, Kessler RC. Epidemiology of mental disorders in children and adolescents. Dialogues Clin Neurosci. 2009;11(1):7-20. doi: 10.31887/DCNS.2009.11.1/krmerikangas.

13.   Bot M, de Leeuw den Bouter BJE, Adriaanse MC. Prevalence of psychosocial problems in Dutch children aged 8–12 years and its association with risk factors and quality of life. Epidemiol Psychiatr Sci. 2011;20(4):357-65. doi: Doi: 10.1017/s2045796011000540.

14.   Adriaanse M, Veling W, Doreleijers T, van Domburgh L. The link between ethnicity, social disadvantage and mental health problems in a school-based multiethnic sample of children in the Netherlands. Eur Child Adolesc Psychiatry. 2014;23(11):1103-13. doi: 10.1007/s00787-014-0564-5.

15. Lai ETC, Lange T, Straatmann VS, Andersen A-MN, Strandberg-Larsen K, Taylor-Robinson D. Pathways to inequalities in child mental health: a causal mediation analysis of evidence from two national birth cohorts. Lancet. 2019;394:S3. doi: https://doi.org/10.1016/S0140-6736(19)32800-4.

16. Essex MJ, Kraemer HC, Armstrong JM, Boyce WT, Goldsmith HH, Klein MH, et al. Exploring Risk Factors for the Emergence of Children's Mental Health Problems. Arch Gen Psychiatry. 2006;63(11):1246-56. doi: 10.1001/archpsyc.63.11.1246.

17. Ohlsson H, Kendler KS. Applying Causal Inference Methods in Psychiatric Epidemiology: A Review. JAMA Psychiatry. 2020;77(6):637-44.

18. Clark H, Coll-Seck AM, Banerjee A, Peterson S, Dalglish SL, Ameratunga S, et al. A future for the world's children? A WHO–UNICEF–Lancet Commission. Lancet. 2020;395(10224):605-58. doi: https://doi.org/10.1016/S0140-6736(19)32540-1.

19. Mulraney M, Coghill D, Bishop C, Mehmed Y, Sciberras E, Sawyer M, et al. A systematic review of the persistence of childhood mental health problems into adulthood. Neurosci Biobehav Rev. 2021;129:182-205. doi: https://doi.org/10.1016/j.neubiorev.2021.07.030.

20. Danckaerts M, Sonuga-Barke EJS, Banaschewski T, Buitelaar J, Döpfner M, Hollis C, et al. The quality of life of children with attention deficit/hyperactivity disorder: a systematic review. Eur Child Adolesc Psychiatry. 2010;19(2):83-105. doi: 10.1007/s00787-009-0046-3.

21. Sawyer MG, Whaites L, Rey JM, Hazell PL, Graetz BW, Baghurst P. Health-related quality of life of children and adolescents with mental disorders. J Am Acad Child Adolesc Psychiatry. 2002;41(5):530-7.

22. Gustafsson J-E, Allodi M, Alin Åkerman B, Eriksson C, Augustine L, Fischbein S, et al. School Learning And Mental Health: A Systematic Review. Stockholm: The Royal Swedish Academy of Sciences, The Health Committee 2010.

23. Veldman K, Reijneveld SA, Ortiz JA, Verhulst FC, Bultmann U. Mental health trajectories from childhood to young adulthood affect the educational and employment status of young adults: results from the TRAILS study. J Epidemiol Community Health. 2015;69(6):588-93. doi: jech-2014-204421 [pii] 10.1136/jech-2014-204421.

24. Smith JP, Smith GC. Long-term economic costs of psychological problems during childhood. Soc Sci Med. 2010;71(1):110-5. doi: https://doi.org/10.1016/j.socscimed.2010.02.046.

25. Whiteford HA, Degenhardt L, Rehm J, Baxter AJ, Ferrari AJ, Erskine HE, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. Lancet. 2013;382(9904):1575-86.

26. Whiteford HA, Ferrari AJ, Degenhardt L, Feigin V, Vos T. Global burden of mental, neurological, and substance use disorders: an analysis from the Global Burden of Disease Study 2010. Mental, Neurological, and Substance Use Disorders. PLoS One 2015 Feb 6;10(2):e0116820. doi: 10.1371/journal.pone.0116820

27. Erskine HE, Moffitt TE, Copeland WE, Costello EJ, Ferrari AJ, Patton G, et al. A heavy burden on young minds: the global burden of mental and substance use disorders in children and youth. Psychological Medicine. 2015;45(7):1551-63. doi: 10.1017/s0033291714002888.

28. Global Burden of Disease Pediatrics C. Global and National Burden of Diseases and Injuries Among Children and Adolescents Between 1990 and 2013: Findings From the Global Burden of Disease 2013 Study. JAMA Pediatr. 2016;170(3):267-87. doi: 10.1001/jamapediatrics.2015.4276.

29. Orri M, Scardera S, Perret LC, Bolanis D, Temcheff C, Séguin JR, et al. Mental Health Problems and Risk of Suicidal Ideation and Attempts in Adolescents. Pediatrics. 2020;146(1).

30. Hakkaart-van Roijen L, Zwirs BWC, Bouwmans C, Tan SS, Schulpen TWJ, Vlasveld L, Buitelaar JK. Societal costs and quality of life of children suffering from attention deficient hyperactivity disorder (ADHD). Eur Child Adolesc Psychiatry. 2007;16(5):316-26. doi: 10.1007/s00787-007-0603-6.

31. Bodden DHM, Stikkelbroek Y, Dirksen CD. Societal burden of adolescent depression, an overview and cost-of-illness study. J Affect Disord. 2018;241:256-62. doi: https://doi.org/10.1016/j.jad.2018.06.015.

32. Weisz JR, Kuppens S, Ng MY, Eckshtain D, Ugueto AM, Vaughn-Coaxum R, et al. What five decades of research tells us about the effects of youth psychological therapy: A multilevel meta-analysis and implications for science and practice. Am Psychol. 2017;72(2):79-117.

33. Dobson ET, Bloch MH, Strawn JR. Efficacy and Tolerability of Pharmacotherapy for Pediatric Anxiety Disorders: A Network Meta-Analysis. J Clin Psychiatry. 2019;80(1):17r12064. doi: 10.4088/JCP.17r12064.

34. Catalá-López F, Hutton B, Núñez-Beltrán A, Page MJ, Ridao M, Macías Saint-Gerons D, et al. The pharmacological and non-pharmacological treatment of attention deficit hyperactivity disorder in children and adolescents: A systematic review with network meta-analyses of randomised trials. PLoS One. 2017;12(7):e0180355.

35. Walter HJ, Abright AR, Bukstein OG, Diamond J, Keable H, Ripperger-Suhler J, Rockhill C. Clinical Practice Guideline for the Assessment and Treatment of Children and Adolescents With Major and Persistent Depressive Disorders. J Am Acad Child Adolesc Psychiatry. 2023;62(5):479-502. doi: https://doi.org/10.1016/j.jaac.2022.10.001.

36. Walter HJ, Bukstein OG, Abright AR, Keable H, Ramtekkar U, Ripperger-Suhler J, Rockhill C. Clinical practice guideline for the assessment and treatment of children and adolescents with anxiety disorders. J Am Acad Child Adolesc Psychiatry. 2020;59(10):1107-24.

37. Wolraich ML, Hagan JF, Jr., Allan C, Chan E, Davison D, Earls M, et al. Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents. Pediatrics. 2019;144(4).

38. Langer DA, Kritikos TK, Asarnow JR, Tompson MC. Parent and Youth Preferences in the Treatment of Youth Depression. Child Psychiatry Hum Dev. 2021;52(2):236-47.

39. Pilling S, Fonagy P, Allison E, Barnett P, Campbell C, Constantinou M, et al. Long-term outcomes of psychological interventions on children and young people's mental health: A systematic review and meta-analysis. PLoS One. 2020;15(11):e0236525. doi: 10.1371/journal.pone.0236525.

40. Roest AM, de Vries YA, Wienen AW, de Jonge P. Editorial Perspective: Are treatments for childhood mental disorders helpful in the long run? An overview of systematic reviews. J Child Psychol Psychiatry. 2022 Aug 29;64(3):464–469. doi: 10.1111/jcpp.13677

41. Uhlhaas PJ, Davey CG, Mehta UM, Shah J, Torous J, Allen NB, et al. Towards a youth mental health paradigm: a perspective and roadmap. Mol Psychiatry. 2023;28(8):3171-81. doi: 10.1038/s41380-023-02202-z.

1

42. Dekkers TJ, Groenman AP, Cuijpers P, Hoekstra PJ, Luman M, Orobio de Castro B, et al. Commentary: Why treatment is the best choice for childhood mental disorders – a commentary on Roest et al. (2022). J Child Psychol Psychiatry. 2023;64(3):470-3. doi: https://doi.org/10.1111/jcpp.13715.

43. Doan T, Pennewitt D, Patel R. Animal assisted therapy in pediatric mental health conditions: A review. Curr Probl Pediatr Adolesc Health Care. 2023;53(12):101506. doi: https://doi.org/10.1016/j.cppeds.2023.101506.

44. van Tetering EMA, Muskens JB, Deenik J, Pillen S, Cahn W, von Rosenstiel I, et al. The short and long-term effects of a lifestyle intervention in children with mental illnesses: a randomized controlled trial (Movementss study). BMC Psychiatry. 2023;23(1):529. doi: 10.1186/s12888-023-04884-9.

45. Carney R, Firth J. Exercise interventions in child and adolescent mental health care: An overview of the evidence and recommendations for implementation. JCPP Advances. 2021;1(4):e12031. doi: https://doi.org/10.1002/jcv2.12031.

46. Reardon T, Harvey K, Baranowska M, O'Brien D, Smith L, Creswell C. What do parents perceive are the barriers and facilitators to accessing psychological treatment for mental health problems in children and adolescents? A systematic review of qualitative and quantitative studies. Eur Child Adolesc Psychiatry. 2017;26(6):623-47.

47. Barican JL, Yung D, Schwartz C, Zheng Y, Georgiades K, Waddell C. Prevalence of childhood mental disorders in high-income countries: a systematic review and meta-analysis to inform policymaking. Evid Based Ment Health. 2022;25(1):36-44.

48. Tick NT, van der Ende J, Verhulst FC. Ten-year increase in service use in the Dutch population. Eur Child Adolesc Psychiatry. 2008;17(6):373-80.

49. MacDonald K, Fainman-Adelman N, Anderson KK, Iyer SN. Pathways to mental health services for young people: a systematic review. Soc Psychiatry Psychiatr Epidemiol. 2018;53(10):1005-38.

50. Zwaanswijk M, Verhaak PFM, Bensing JM, van der Ende J, Verhulst FC. Help seeking for emotional andbehavioural problems in children and adolescents. Eur Child Adolesc Psychiatry. 2003;12(4):153-61. doi: 10.1007/s00787-003-0322-6.

51. Radez J, Reardon T, Creswell C, Lawrence PJ, Evdoka-Burton G, Waite P. Why do children and adolescents (not) seek and access professional help for their mental health problems? A systematic review of quantitative and qualitative studies. Eur Child Adolesc Psychiatry. 2021;30(2):183-211. doi: 10.1007/s00787-019-01469-4.

52. Zwaanswijk M, van Dijk CE, Verheij RA. Child and adolescent mental health care in Dutch general practice: time trend analyses. BMC Fam Pract. 2011;12:133. doi: 1471-2296-12-133 [pii]10.1186/1471-2296-12-133.

53. O'Brien D, Harvey K, Howse J, Reardon T, Creswell C. Barriers to managing child and adolescent mental health problems: a systematic review of primary care practitioners' perceptions. Br J Gen Pract. 2016;66(651):e693-707.

54. O'Brien D, Harvey K, Creswell C. Barriers to and facilitators of the identification, management and referral of childhood anxiety disorders in primary care: a survey of general practitioners in England. BMJ open. 2019;9(4):e023876-e. doi: 10.1136/bmjopen-2018-023876.

55. Zwaanswijk M, Van Der Ende JAN, Verhaak PFM, Bensing JM, Verhulst FC. Help-seeking for child psychopathology: pathways to informal and professional services in the Netherlands. J Am Acad Child Adolesc Psychiatry. 2005;44(12):1292-300.

56. Aydin S, Crone MR, Siebelink BM, Vermeiren RRJM, Numans ME, Westenberg PM. Recognition of anxiety disorders in children: a cross-sectional vignette-based survey among general practitioners. BMJ Open. 2020;10(4):e035799. doi: 10.1136/bmjopen-2019-035799.

57. Stijntjes F, Hassink-Franke L, Kruishoop A, Beeres MPJ, Eekhof H, Van Manen S. NHG-Standaard ADHD bij kinderen. Huisarts Wet. 2014;57(11):584-94.

58. Koning NR, Buchner FL, Vermeiren R, Crone MR, Numans ME. Identification of children at risk for mental health problems in primary care-Development of a prediction model with routine health care data. EClinicalMedicine. 2019;15:89-97.

59. Verhaak PFM, van Dijk M, Walstock D, Zwaanswijk M. A new approach to child mental healthcare within general practice. BMC Fam Pract. 2015;16(1):132. doi: 10.1186/s12875-015-0354-2.

60. Otten E, Geuijen P, Zwaanswijk M, Koopman I. Specialistische ondersteuner huisartsenzorg jeugd-GGZ (SOH-JGGZ). Bijblijven. 2018;34(8):596-615.

61. Zwaanswijk M, Geuijen P, Boelhouwer M, Spijk-de Jonge M, Serra M. Verwijspatronen bij praktijkondersteuners jeugd. Huisarts Wet. 2020;63(5):14-8.

62. Spijk-de Jonge MJ BM, Geuijen P, Zwaanswijk M, Serra M. Jeugdhulp bij de huisarts. Onderzoek naar inzet en effect van de Praktijkondersteuner Jeugd. Assen: Accare Child Study Center; 2019.

63. Koet LBM, Bennenbroek JJM, Bruggeman AYS, de Schepper EIT, Bohnen AM, Bindels PJE, Gerger H. GPs' and practice nurses' views on their management of paediatric anxiety problems: an interview study. BMC Prim Care. 2022;23(1):235.

64. Theunissen MHC, Dijkshoorn JJA, Velderman MK. Specialistische ondersteuning in de basiszorg voor jeugd: verbindingen maken in het sociale domein. TSG Tijdschr Gezondheidswet. 2018;96(8):354-60.

65. van Schaaijk A, Flinterman L, de Geit E, Keuper J, Vis E, Batenburg R. De praktijkondersteuner huisartsenzorg (POH) in de huisartsenpraktijk: diversiteit en capaciteit. Utrecht: NIVEL; 2022.

66. Jonker T, Remmelts H, Huyghen A-M, van der Woude G, Knot-Dickscheit J. Ervaringen en perspectief van de POH-Jeugd. Huisarts Wet. 2020;63(10):33-7.

67. Mieloo C, van der Ende J, van Zijl AL, Schuring M, Steijn B, Jansen W. Changes in youth care use after the implementation of community-based support teams: repeated measurement study using registry data and data on team characteristics. BMJ Open. 2022;12(2):e048933. doi: 10.1136/bmjopen-2021-048933.

68. Friele RD BM, Bastiaanssen ILW, de Boer R, Bucx AJEH, de Groot JF, Pehlivan T, Rutjes L, Sondeijker F, van Yperen TA, Hageraats R. Eerste evaluatie Jeugdwet: na de transitie nu de transformatie [First evaluation of the Youth Act.: After the transition comes the transformation]. Den Haag2018. p. 637.

69. Gemeente Rotterdam. Tussenrapportage evaluatie inzet Praktijk ondersteuner Huisartsen Jeugd en Gezin in de Rotterdamse huisartspraktijken. 2021.

1

70. Bhopal SS, Bagaria J, Olabi B, Bhopal R. Children and young people remain at low risk of COVID-19 mortality. Lancet Child Adolesc Health. 2021;5(5):e12-e3.

71. Nikolopoulou GB, Maltezou HC. COVID-19 in Children: Where do we Stand? Arch Med Res. 2022;53(1):1-8. doi: https://doi.org/10.1016/j.arcmed.2021.07.002.

72. Kauhanen L, Wan Mohd Yunus WMA, Lempinen L, Peltonen K, Gyllenberg D, Mishina K, et al. A systematic review of the mental health changes of children and young people before and during the COVID-19 pandemic. Eur Child Adolesc Psychiatry. 2023;32(6):995-1013.

73. Racine N, McArthur BA, Cooke JE, Eirich R, Zhu J, Madigan S. Global Prevalence of Depressive and Anxiety Symptoms in Children and Adolescents During COVID-19: A Meta-analysis. JAMA Pediat. 2021;175(11):1142-50. doi: 10.1001/jamapediatrics.2021.2482.

74. van der Velden PG, van Bakel HJA, Das M. Mental health problems among Dutch adolescents of the general population before and 9 months after the COVID-19 outbreak: A longitudinal cohort study. Psychiatry Res. 2022;311:114528.

75. Luijten MAJ, van Muilekom MM, Teela L, Polderman TJC, Terwee CB, Zijlmans J, et al. The impact of lockdown during the COVID-19 pandemic on mental and social health of children and adolescents. Qual Life Res. 2021;30(10):2795-804. doi: 10.1007/s11136-021-02861-x.

76. Reep C, Hupkens C. [Experienced impact of COVID-19 on mental health and lifestyle] [Report in Dutch]. CBS: CBS; 2021.

77. Fischer K, Tieskens JM, Luijten MAJ, Zijlmans J, van Oers HA, de Groot R, et al. Internalizing problems before and during the COVID-19 pandemic in independent samples of Dutch children and adolescents with and without pre-existing mental health problems. Eur Child Adolesc Psychiatry. 2023;32(10):1873-83. doi: 10.1007/s00787-022-01991-y.

78. Collishaw S. Annual research review: secular trends in child and adolescent mental health. J Child Psychol Psychiatry. 2015;56(3):370-93.

79. Sauer CM, Chen L-C, Hyland SL, Girbes A, Elbers P, Celi LA. Leveraging electronic health records for data science: common pitfalls and how to avoid them. Lancet Digit Health. 2022;4(12):e893-e8. doi: https://doi.org/10.1016/S2589-7500(22)00154-6.

80. de Ridder MAJ, de Wilde M, de Ben C, Leyba AR, Mosseveld BMT, Verhamme KMC, et al. Data Resource Profile: The Integrated Primary Care Information (IPCI) database, The Netherlands. Int J Epidemiol. 2022(51(6)):e314-e23. doi: 10.1093/ije/dyac026.

81. RIVM: Gezonde levensverwachting Regionaal. https://www.vzinfo.nl/gezonde-levensverwachting/regionaal (2022). Accessed 22/11/2023 2023.

Chapter 2

Anxiety problems in children and adolescents: a population-based cohort study on incidence and management in Dutch primary care

Lukas BM Koet, Evelien IT de Schepper, Arthur M Bohnen,
Patrick JE Bindels, Heike Gerger

Abstract

Background

Due to a large strain on youth mental health care, general practice is suggested as an alternative treatment setting for children and adolescents with anxiety problems. However, research on the current management of these children and adolescents within general practice is scarce.

Aim

To investigate the incidence of coded anxiety in general practice using the International Classification of Primary Care (ICPC), and GPs' management of children and adolescents presenting with anxiety problems.

Design and setting

Population-based cohort study using electronic medical records of 51 212 children (aged 0–17 years) in primary care in the Rotterdam region between 1 January 2012 and 31 December 2018.

Method

Incidence of ICPC codes for anxiety were calculated, then the characteristics of children and adolescents consulting their GP with anxiety and the GPs' management were assessed qualitatively using quantitative content analysis.

Results

Incidence of ICPC codes for anxiety in children and adolescents was 5.36 (95% confidence interval [CI] = 5.02 to 5.71) per 1000 person–years. Adolescent females had the highest incidence with 14.01 (95% CI = 12.55 to 15.58) per 1000 person–years. Of the 381 children and adolescents consulting their GP with an initial anxiety problem (median age 13.3 years, 40.4% male), GPs referred 59.3% to mental health care in the first year while 26.5% of children and adolescents were managed by a specialised practice nurse within general practice. Of the 381 children and adolescents, 10.5% received psychiatric medication during the first year, with the trend being for increased prescriptions during adolescence.

Conclusion

In general practice children and adolescents frequently received one of two ICPC codes for anxiety, especially adolescent females. Most children presenting to their GP with anxiety problems are referred externally or seen by a specialised practice nurse within general practice.

2

Introduction

Anxiety disorders form the most common mental health problem in children and adolescents and cause significant burdens.[1] A recent meta-analysis estimated the global prevalence of anxiety disorders among children and adolescents at 6.5%.[2] Anxiety disorders have significant negative effects on quality of life and the overall development of affected children and adolescents and their next of kin,[3–6] and are associated with an increased risk of suffering from mental health disorders in adulthood.[7–10]

Despite the existence of effective treatments,[11–13] paediatric anxiety disorders seem under-recognised and undertreated.[14–20] Factors like stigmatisation, financial costs, or limited access to services, for example, waiting lists, form major barriers to appropriate care.[21] General practice has been advocated as an appropriate treatment setting for paediatric mental health problems because it is easily accessible and not associated with stigmatisation.[22]

GPs already play an important role in the help-seeking process to care, being a familiar and trusted source of help for children, adolescents, and parents.[23–25] In the Netherlands, GPs have a gatekeeper role. GPs' care is covered by health insurances, which are compulsory for all. During the past years in pilot projects, youth mental health practice nurses (YMHPNs) have been introduced to Dutch general practice aiming to integrate mental health care to general practice. YMHPNs are involved in managing and referring children and adolescents with psychosocial problems.[26, 27] YMHPNs work independently under the responsibility of GPs, and are allotted more time per consultation.

Several studies on the prevalence of paediatric anxiety disorders have been published,[2, 6, 28–33] but there is sparse knowledge on the incidence of paediatric anxiety symptoms and disorders in general practice.[34, 35]

Little is known about how GPs actually manage these problems. In a 2019 UK survey, 51% of GPs felt confident identifying anxiety disorders in children and adolescents, but only 13% felt confident managing them.[36] More information on how GPs currently manage anxiety problems in children and adolescents is needed.

The authors, therefore, aimed to conduct two analyses: first, to calculate the incidence of International Classification of Primary Care (ICPC)-coded anxiety (P01 or P74) among children and adolescents. Second, using a broader sample of children and adolescents with anxiety problems, to describe the characteristics of children and adolescents presenting to their GP, and the GPs' management of these problems using qualitative analyses.

Method

Design

A population-based retrospective cohort study of children and adolescents (aged 0–17 years) registered in the Rijnmond Primary Care Database (RPCD) between 1 January 2012 and 31 December 2018 was performed. The RPCD is a region-specific derivative of the Integrated Primary Care Information (IPCI) database, focused on the greater Rotterdam area.[37, 38] The RPCD contains pseudonymised longitudinal medical data of general practice patients, including complete GP notes, diagnostic codes, referrals, laboratory findings, GP prescriptions, and specialists' letters.[37] Dutch GPs use the International Classification for Primary Care 1 (ICPC-1) to code symptoms and diagnosis.[39] The RPCD currently contains data for approximately 300,000 individuals.

Incidence of ICPC-coded anxiety (P01 or P74; quantitative analyses)

The incidence of ICPC-coded anxiety: P01 (feeling anxious/nervous/tense) or P74 (anxiety disorder/panic disorder) was calculated (see flowchart in Figure 1). For pragmatic reasons, the authors combined the codes P01 and P74 for the incidence calculation because the codes were used interchangeably by GPs in the database. The following characteristics of children and adolescents receiving a first ICPC code P01 or P74 were extracted from the database: date of coding, age, and sex.

Case selection (qualitative analyses)

Since paediatric anxiety problems in general practice often reflect symptoms rather than strict diagnostic categories, the authors were interested in children and adolescents presenting with anxiety problems to their GP. Therefore, selected cases do not necessarily fulfil the diagnostic criteria of anxiety disorders but are rather a broader range of anxiety problems, for example, anxiety problems of short duration.[40] In this study, children and adolescents presenting with a first anxiety problem to their GP (Figure 1 and Supplementary Table S1) were selected. A search algorithm combining ICPC codes P01 and P74, ICPC code P02 (acute stress reaction/post-traumatic stress syndrome), and a free-text search for the terms 'anxiety disorder' and 'anxiety problems' were used to increase the sensitivity for detecting children and adolescents with anxiety problems. To make valid inferences on the run-up period and GPs' management, the authors limited inclusion to children and adolescents with valid database information from 2 years before until 2 years after the first record of their anxiety problem. Full medical files from this

period (600 cases) were examined by the first author (principal investigator) to exclude cases not registering an initial anxiety problem (see Supplementary Table S1). Unclear cases were reviewed by the second author and final decisions regarding their addition were consensual (first and second authors). The ICPC code P02 had a low positive predictive value (PPV) for anxiety problems and was therefore not included in the quantitative analysis (see Supplementary Table S2).

Characteristics of children and adolescents presenting with anxiety problems and GPs' management (qualitative analyses)

The following variables were extracted automatically for each case: age at presentation, sex, history of psychosocial problems (any P code/any Z code) and healthcare use (any blood tests and number of consultations with GP) in the 2 years before presentation, pharmacological management from 2 years before until 2 years after presentation (psychiatric medication including antipsychotics, antidepressants, anxiolytics, and hypnotics [Anatomical Therapeutic Chemical {ATC} classification system N05–N07] and beta-blockers [ATC C07]).

The following information was extracted manually by the first author using quantitative content analysis, by reading medical files from 2 years before until 2 years after presentation, and by counting the respective occurrence: healthcare use in the 2 years before presentation, that is, any referrals to specialist medical care and any visits to emergency care; associated factors described in the GPs' notes/specialists' letters in 2 years before until 2 years after presentation, that is, marital status of parents, presence of domestic violence/maltreatment, victim of sexual violence/crime/bullying, fear of failure, sleep problems, school problems/absenteeism, and concentration problems; and GPs' management in the first year after presentation, that is, any referral, type of referral, and number of consultations until referral. Referrals were classified as: a) referral to primary or specialised mental health care; and b) referral to paediatrician. Additionally, involvement of YMHPNs within general practice and the number of consultations with YMHPNs were extracted manually.

Statistical analysis

Incidence rates were determined by dividing the number of cases that received a first ICPC code for anxiety (P01 or P74) by the total number of person–years-at-risk (PYAR) and are expressed per 1000 person–years. Incidence rates were analysed by age group

(young children: aged 0–6 years; children: aged 7–12 years; and adolescents: aged 13–17 years) and sex (male versus female).[41] PYAR was defined as actual time at risk in years that children and adolescents (aged <18 years) without ICPC-coded anxiety contributed to the study's database. Descriptive statistics were used to describe patient characteristics and the GPs' management. Statistical analysis of differences in proportions between sex and age categories were performed using the Pearson χ2 test and Fisher's exact test. Student's t-test was used for testing statistical significance of observed means. Due to the exploratory nature of this study, no adjustments for multiple testing were performed. Analyses were performed using R (version 4.0.0).

Reporting and ethical considerations

The authors adhered to the RECORD guidelines for the reporting of studies using electronic health records.[42]

Figure 1. a) Patient selection for incidence of ICPC coded anxiety calculation; b) qualitative analyses of children presenting with anxiety problems. ICPC = International Classification of Primary Care.
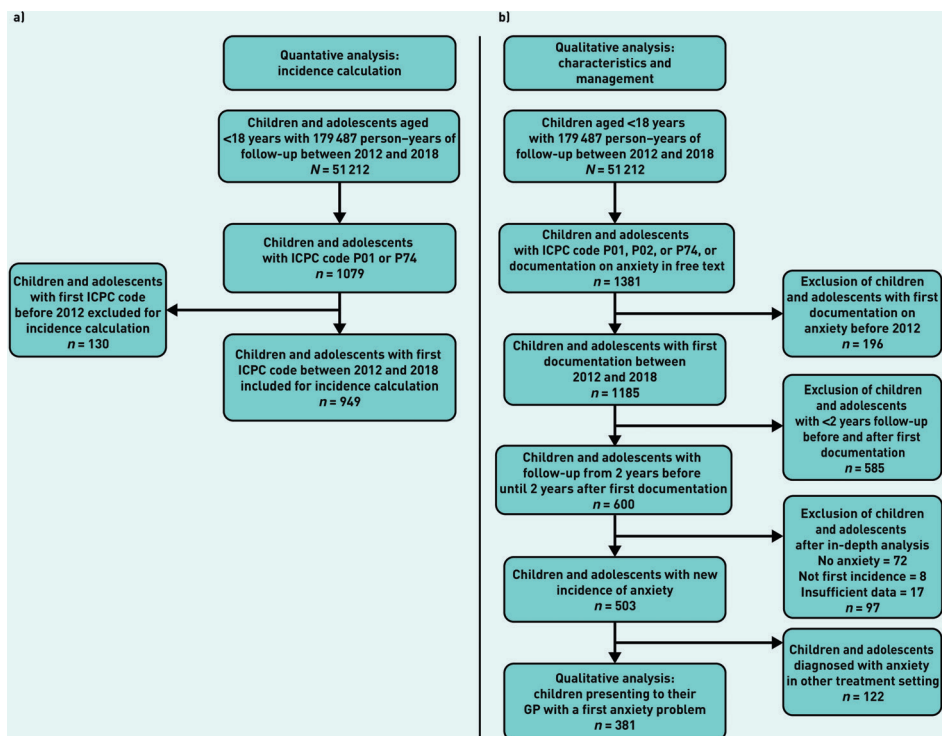
Results

Study population

In total, 51 212 children and adolescents aged 0–17 years were included in the cohort between 2012 and 2018. The median age was 8.7 years and 50.8% were male. The number of registered children and adolescents in the database increased from 21 140 children and adolescents in 2012 to 35 190 children and adolescents in 2018. The general characteristics of children and adolescents remained comparable over time (see Supplementary Table S3).

Incidence of ICPC-coded anxiety (P01 or P74; quantitative analyses)

During the study period, 949 children and adolescents were coded for the first time with ICPC code P01 or P74. Median age at coding was 13.2 years (interquartile range [IQR] 9.1–16.3) and 61.6% were female (data not shown). The overall incidence was 5.36 (95% confidence interval [CI] = 5.02 to 5.71) per 1000 PYAR. The incidence was higher for females than males with an incidence rate ratio (IRR) of 1.66 (95% CI = 1.46 to 1.89). Females aged 13–17 years had the highest incidence rate with 14.01 (95% CI = 12.55 to 15.58) per 1000 PYAR (see Figure 2 and Supplementary Table S4 and S5 for incidence rate per category and year).

Figure 2. Incidence of ICPC-coded anxiety per age category. ICPC = International Classification of Primary Care. IR = incidence rate.
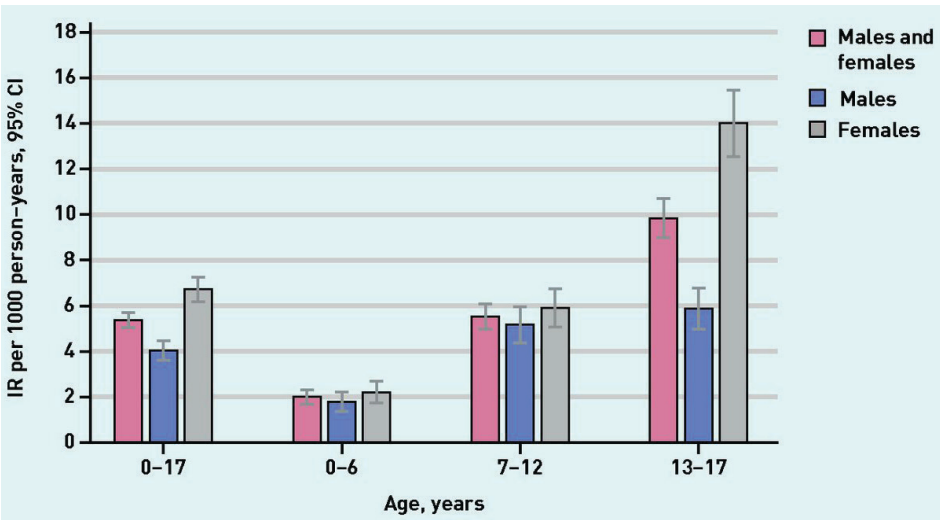
Characteristics of children and adolescents presenting with anxiety problems (qualitative analysis)

In total, 381 children and adolescents presenting with anxiety problems to their GP (Figure 1) were included in the study. Of these, 154 were male (40.4%) and 227 were female (59.6%) (Table 1). Median age at presentation was 13.3 years (data not shown). Females were older at presentation than males (14.0 years versus 12.2 years, p = 0.02). During the 2-year run-up period, children and adolescents consulted their GP a median of 5 times in 2 years (Table 1). In this period, 22.6% were coded with a psychosocial problem (any P code other than P01, P02, or P74), and 6.0% received ≥1 prescriptions of psychiatric medication (ATC N05–N07). Healthcare use in the run-up period was comparable for males and females. There was a trend in different healthcare use between age groups, with young children (aged 0–6 years) being referred more often and adolescents (aged 13–17 years) undergoing more blood tests. The medical dossiers frequently contained information on the presence of problems associated with anxiety (see Supplementary Table S6).

Table 1. Comorbidities and healthcare use in two years before presentation with an anxiety problem

Comorbidities & healthcare use	Overall N=381	Boys N=154	Girls N=227	0-6 years N=37	7-12 years N=146	13-17 years N=198	Boys vs Girls**	Age categories**
Median consultations in general practice (IQR)	5 (3-9)	5 (3-8)	5 (3-9)	7 (5-9)	4 (2-7)	5 (3-9)	p=0.16	p=0.002
Previous mental health problem (ICPC, any P code*)	22.6%	21.4%	23.3%	21.6%	28.1%	18.7%	p=0.75	p=0.12
Previous social problem (ICPC, any Z code)	9.4%	12.3%	7.5%	18.9%	8.2%	8.6%	p=0.16	p=0.12
≥1 Prescription of psychiatric medication	6.0%	5.2%	6.6%	0.0%	3.4%	9.1%	p=0.73	p=0.03
≥1 Blood test	35.4%	31.8%	37.9%	21.6%	24.7%	46.0%	p=0.27	p<0.001
≥1 Referrals to mental health or hospital specialist	42.3%	46.8%	39.2%	62.2%	47.3%	34.8%	p=0.17	p=0.003
≥1 Visit to emergency department in the year before diagnosis	24.9%	29.9%	21.6%	48.6%	24.0%	21.2%	p=0.09	p=0.002

*Any P code other than P01, P02, or P74. ** Percentages among boys compared with girls, percentages among age categories, compared with the Chi2 test. These hypothesis tests are of exploratory nature, and are therefore not corrected for multiple testing.*

GPs' management (qualitative analysis)

During the first year after presentation with an anxiety problem, children and adolescents had a median of 1 consultation (IQR 1–2) with their GPs concerning the anxiety problem (Table 2). In total, 72.7% of children and adolescents were referred within the first year, either externally to mental healthcare providers or paediatricians, or internally to the YMHPN. If additional mental health providers were engaged, in 78.7% of cases the GP decided to involve them at the first consultation (data not shown). In 59.3% of cases children and adolescents were referred to external mental healthcare providers. In cases of referral to paediatricians (5.0%), anxiety problems were accompanied by physical symptoms. Overall, 26.5% of cases were seen by a YMHPN, with a median of 3 contacts (IQR 1–4.5). Of the 57.4% of children and adolescents seen by a YMHPN, 15.2% were also referred externally to mental healthcare providers in the year after presentation (Table 2). Usually, these children and adolescents were first seen by a YMHPN and later referred to mental healthcare providers but the exact order of referral could not always be verified. Of all children and adolescents referred to mental health care, 40.0% of the medical records contained a specialist letter with conclusive information about diagnosis or treatment. Regarding these children and adolescents, 31.5% received an anxiety disorder diagnosis by a psychologist or psychiatrist, 28.7% received treatment for anxiety problems without receiving a formal anxiety disorder diagnosis, 9.3% were diagnosed with post-traumatic stress disorder, and 30.5% of children and adolescents received other diagnoses (either autism, ADHD, or behavioural disorders) (data not shown).

Pharmacological treatment

In the first year after presentation, 10.5% of children and adolescents received at least one GP-prescribed psychiatric medication (ATC N05–N07; see Table 3). The prescription rate was the highest for adolescents aged 13–17 years (14.1%). Benzodiazepines were prescribed to 5.5% of children and adolescents in the first year after presentation, mainly to adolescents, with 9.1% of adolescents receiving at least one prescription. Beta-blockers were only prescribed to adolescents, with 16.7% of adolescents receiving at least one prescription within 1 year.

Discussion

Summary

The incidence of ICPC codes P01 and P74 was 5.36 per 1000 PYAR. Females were more often affected than males. The highest incidence rate of 14.01 per 1000 PYAR was in adolescent females. GPs referred 59.3% of children and adolescents presenting with an initial anxiety problem to external mental healthcare providers, YMHPNs were involved in 26.5% of cases. In the year after presentation, 10.5% of children and adolescents, especially adolescents, received a psychiatric prescription. In general practice, children and adolescents frequently receive one of two ICPC codes for anxiety, especially adolescent females. Most children and adolescents presenting to their GP with anxiety problems are referred externally or seen by a specialised practice nurse within general practice.

Strengths and limitations

This study combines the advantages of a large dynamic cohort (using quantitative data from medical files) with in-depth qualitative analyses of selected medical files. In the qualitative analysis, the authors reviewed children and adolescents with a clinically relevant follow-up period of ≥4 years who presented to their GP with anxiety problems. The authors were able to create a sensitive search algorithm for children and adolescents presenting with first anxiety problems to their GP using both ICPC codes and free text (see Supplementary Table S4 and S5).

This study has limitations. First, for logistical reasons, GPs' notes are often concise, and information on symptoms and associated problems might not always have been documented. Second, incorrect or imprecise coding by healthcare professionals is a disadvantage of using electronic healthcare databases and can cause under- and overestimation of symptom and disease frequency. In the presented qualitative search, the authors found that children and adolescents coded with P02 sometimes had relevant anxiety complaints without receiving an ICPC code for anxiety (P01 or P74). Therefore, the incidence rate of ICPC coded anxiety (P01 or P74) may underestimate the frequency of paediatric anxiety problems. Third, because GPs do not usually give a formal diagnosis of anxiety disorders nor do they use standardised screening/classification tools, it is difficult to differentiate between milder and severe anxiety problems in the database used. Fourth, only GPs' prescriptions of medications can be extracted from the RPCD,

without clarity on whether the medication was started by the GP or a specialist. Fifth, the RPCD consists of practices in a restricted (sub)urban area, so it remains uncertain whether the present results are generalisable to other regions. Finally, not all practices in the RPCD had a YMHPN during the study period. Because of anonymised information, the authors were not able to differentiate between practices with and without YMHPNs in the analyses.

Table 2. GPs' management of anxiety problems in first year after presentation

	Overall N=381	Boys N=154	Girls N=227	0-6 years N=37	7-12 years N=146	13-17 years N=198	Boys vs Girls**	Age categories**
Median contacts with GP for anxiety (IQR)	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	1 (1-2)	p=0.87	p=0.87
Referral for anxiety either external or by internal involvement of YMHPN (%)	72.7%	67.5%	76.2%	86.5%	78.1%	66.2%	p=0.08	p=0.007
External referral to mental health care (%)	59.3%	58.4%	60.0%	78.4%	71.9%	46.5%	p=0.86	p<0.001
External referral to paediatrician (%)	5.0%	4.5%	5.3%	5.4%	4.8%	5.1%	p=0.09	p=0.13
Involvement YMHPN (%)	26.5%	20.1%	30.8%	8.1%	21.2%	33.9%	p=0.03	p<0.001
Median contacts with practice nurse (IQR)	3 (1-5)	2 (1-5)	3 (1-4)	2 (2-2)	2 (1-4)	3 (1-5)	p=0.52	p=0.40
Involvement of YMHPN and external referral mental health care (%)*	15.2%	11.7%	17.6%	5.4%	15.1%	17.2%	p=0.15	p=0.19

*Children seen by YMHPN and externally referred to mental health care in first year after presentation. 57.4% of children seen by YMHPN were also externally referred. **Percentages among boys compared to girls, percentages among age categories, compared with chi2 test. These hypothesis tests are of exploratory nature, and are not corrected for multiple testing.*

Comparison with existing literature

In a UK primary care registry study and a Danish secondary care registry study the incidence of anxiety disorders varied between 1.8 and 2.6 cases per 1000 PYAR,[34, 35] considerably smaller incidences as compared with the presented study's incidence of ICPC-coded anxiety of 5.36. In the present study females had an increased risk of receiving an ICPC code for anxiety compared with males (IRR 1.66 [95% CI = 1.46 to 1.89]), which is in line with previous studies.[28, 34, 35] Compared with the present findings, a Norwegian study using primary and secondary healthcare data found a higher prescription

rate of anxiolytic medication.[43] Further, the present finding that GPs frequently involve additional mental health specialists and YMHPNs when confronted with children and adolescents with a new anxiety problem confirms conclusions from previous studies that GPs refrain from managing children and adolescents with psychological problems,[18, 36] and that GPs saw their role mainly as gatekeepers, referring children and adolescents to specialised healthcare providers.[18]

Table 3. Psychiatric medication prescriptions

	Overall N=381	Boys N=154	Girls N=227	0-6 years N=37	7-12 years N=146	13-17 years N=198	Boys vs Girls**	Age categories**
Psychiatric prescription:* 1st year after diagnosis	10.5%	8.4%	11.9%	2.7%	7.5%	14.1%	p=0.36	p=0.03
Psychiatric prescription: 2nd year after diagnosis	8.4%	7.1%	9.3%	2.7%	4.1%	12.6%	p=0.59	p=0.01
Psychiatric prescription: 0-2 years after diagnosis	13.6%	9.7%	16.3%	5.4%	8.2%	19.2%	p=0.09	p=0.004
SSRI prescription: 1st year after diagnosis	1.0%	0.0%	1.8%	0.0%	0.0%	2.0%	p=0.15	p=0.15
SSRI prescription: 2nd year after diagnosis	1.6%	0.6%	2.2%	0.0%	0.0%	3.0%	p=0.43	p=0.06
SSRI prescription: 0-2 years after diagnosis	1.8%	0.6%	2.6%	0.0%	0.0%	3.5%	p=0.26	p=0.05
Benzodiazepine prescription: 1st year after diagnosis	5.5%	3.9%	6.6%	0.0%	2.1%	9.1%	p=0.36	p=0.006
Benzodiazepine prescription: 2nd year after diagnosis	2.1%	2.6%	1.8%	0.0%	0.0%	4.0%	p=0.72	p=0.03
Benzodiazepine prescription: 0-2 years after diagnosis	6.0%	5.2%	6.6%	0.0%	2.1%	10.1%	p=0.73	p=0.004
Beta-blocker prescription: 1st year after diagnosis	8.7%	6.5%	10.1%	0.0%	0.0%	16.7%	p=0.29	p<0.001
Beta-blocker prescription: 2nd year after diagnosis	2.1%	2.0%	2.2%	0.0%	0.0%	4.0%	p=1.00	p=0.04
Beta-blocker prescription: 0-2 years after diagnosis	9.2%	6.5%	11.0%	0.0%	0.0%	17.7%	p=0.19	p<0.001

*≥1 psychiatric prescriptions of ATC classification N05–N07. ** percentages among boys compared to girls, percentages among age categories, compared with chi2 test. These hypothesis tests are of exploratory nature, and are not corrected for multiple testing. ATC = Anatomical Therapeutic Chemical. SSRI = selective serotonin reuptake inhibitor.

Differences between the present findings and findings from other countries are probably partially explained by methodological differences, for example, differences in inclusion criteria, but may also indicate relevant differences in the occurrence and management of anxiety problems between countries.

Implications for research and practice

In line with other studies, the authors found a peak incidence of ICPC-coded anxiety in adolescent females.[28, 34, 35] Therefore, it seems relevant for GPs to consider anxiety problems in children and adolescents, especially adolescent females, presenting with possibly related problems, such as headaches, recurrent abdominal pain, and sleep problems.[44–46] The hesitancy of GPs to manage paediatric anxiety problems combined with a comparably high prescription rate of benzodiazepines and beta-blockers raises concerns regarding the adequate management of paediatric anxiety problems in general practice, given both medications are not routinely indicated for children and adolescents, and that benzodiazepines pose a risk of abuse.[47] In this context, it seems advisable for GPs to refer not only younger children but also adolescents with anxiety problems to additional screening and counselling by a mental healthcare professional, rather than prescribing benzodiazepines or beta-blockers.

Since 2015, YMHPNs have been introduced to Dutch general practices in order to support the management of psychological problems within general practice settings.[26, 27] The present study shows that YMHPNs were already involved in the management of more than one-quarter of children and adolescents aged 7–17 years with anxiety problems. Future research should investigate whether the introduction of YMHPNs has improved the availability of treatment opportunities for children and adolescents with anxiety problems and should evaluate the effectiveness of the shared approach involving GPs and YMHPNs. If proven effective, the introduction of YMHPNs could offer an integrational solution to the observed treatment gaps for paediatric psychological problems, and to the apparent hesitancy of GPs to become involved with psychological problems.

References

1. Whiteford HA, Degenhardt L, Rehm J, et al. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. Lancet 2013; 382(9904): 1575–1586.

2. Polanczyk GV, Salum GA, Sugaya LS, et al. Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry 2015; 56(3): 345–365.

3. Hofstra MB, van der Ende J, Verhulst FC. Child and adolescent problems predict DSM-IV disorders in adulthood: a 14-year follow-up of a Dutch epidemiological sample. J Am Acad Child Adolesc Psychiatry 2002; 41(2): 182–189.

4. Veldman K, Reijneveld SA, Ortiz JA, et al. Mental health trajectories from childhood to young adulthood affect the educational and employment status of young adults: results from the TRAILS study. J Epidemiol Community Health 2015; 69(6): 588–593.

5. Fong G, Garralda E. Anxiety disorders in children and adolescents. Psychiatry 2005; 4(8): 77–81.

6. Franz L, Angold A, Copeland W, et al. Preschool anxiety disorders in pediatric primary care: prevalence and comorbidity. J Am Acad Child Adolesc Psychiatry 2013; 52(12): 1294–1303. e1.

7. Bittner A, Egger HL, Erkanli A, et al. What do childhood anxiety disorders predict? J Child Psychol Psychiatry 2007; 48(12): 1174–1183.

8. Pine DS, Cohen P, Gurley D, et al. The risk for early-adulthood anxiety and depressive disorders in adolescents with anxiety and depressive disorders. Arch Gen Psychiatry 1998; 55(1): 56–64.

9. Copeland WE, Shanahan L, Costello EJ, Angold A. Childhood and adolescent psychiatric disorders as predictors of young adult disorders. Arch Gen Psychiatry 2009; 66(7): 764–772.

10. Brückl TM, Wittchen H-U, Höfler M, et al. Childhood separation anxiety and the risk of subsequent psychopathology: results from a community study. Psychother Psychosom 2007; 76(1): 47–56.

11. Yuan S, Zhou X, Zhang Y, et al. Comparative efficacy and acceptability of bibliotherapy for depression and anxiety disorders in children and adolescents: a meta-analysis of randomized clinical trials. Neuropsychiatr Dis Treat 2018; 14: 353–365.

12. Zhou X, Zhang Y, Furukawa TA, et al. Different types and acceptability of psychotherapies for acute anxiety disorders in children and adolescents: a network meta-analysis. JAMA Psychiatry 2019; 76(1): 41–50.

13. Wang Z, Whiteside SPH, Sim L, et al. Comparative effectiveness and safety of cognitive behavioral therapy and pharmacotherapy for childhood anxiety disorders: a systematic review and meta-analysis. JAMA Pediatr 2017; 171(11): 1049–1056.

14. Kramer T, Garralda ME. Child and adolescent mental health problems in primary care. Adv Psych Treat 2000; 6(4): 287–294.

15. Sayal K, Taylor E. Detection of child mental health disorders by general practitioners. Br J Gen Pract 2004; 54(502): 348–352.

16. Sawyer MG, Arney FM, Baghurst PA, et al. The mental health of young people in Australia: key findings from the child and adolescent component of the national survey of mental health and well-being. Aust N Z J Psychiatry 2001; 35(6): 806–814.

17. Sourander A, Helstelä L, Ristkari T, et al. Child and adolescent mental health service use in Finland. Soc Psychiatry Psychiatr Epidemiol 2001; 36(6): 294–298.

18. O'Brien D, Harvey K, Howse J, et al. Barriers to managing child and adolescent mental health problems: a systematic review of primary care practitioners' perceptions. Br J Gen Pract 2016; DOI: https://doi.org/10.3399/bjgp16X687061.

19. Richardson LP, Russo JE, Lozano P, et al. Factors associated with detection and receipt of treatment for youth with depression and anxiety disorders. Acad Pediatr 2010; 10(1): 36–40.

20. Emslie GJ. Pediatric anxiety — underrecognized and undertreated. N Engl J Med 2008; 359(26): 2835–2836.

21. Owens PL, Hoagwood K, Horwitz SM, et al. Barriers to children's mental health services. J Am Acad Child Adolesc Psychiatry 2002; 41(6): 731–738.

22. Vallance AK, Kramer T, Churchill D, Garralda ME. Managing child and adolescent mental health problems in primary care: taking the leap from knowledge to practice. Prim Health Care Res Dev 2011; 12(4): 301–309.

23. Zwaanswijk M, Van Der Ende J, Verhaak PFM, et al. The different stages and actors involved in the process leading to the use of adolescent mental health services. Clin Child Psychol Psychiatry 2007; 12(4): 567–582.

24. Rickwood DJ, Deane FP, Wilson CJ. When and how do young people seek professional help for mental health problems? Med J Aust 2007; 187(S7): S35–S39.

25. MacDonald K, Fainman-Adelman N, Anderson KK, Iyer SN. Pathways to mental health services for young people: a systematic review. Soc Psychiatry Psychiatr Epidemiol 2018; 53(10): 1005–1038.

26. Verhaak PFM, van Dijk M, Walstock D, Zwaanswijk M. A new approach to child mental healthcare within general practice. BMC Fam Pract 2015; 16(1): 132.

27. Jonker T-J, Knot-Dickscheit J, Huyghen A. [The Youth Mental Health Practice Nurse: an exploratory study]. [Article in Dutch]. Groningen: University of Groningen, 2017.

28. Zwaanswijk M, van Dijk CE, Verheij RA. Child and adolescent mental health care in Dutch general practice: time trend analyses. BMC Fam Pract 2011; 12: 133.

29. Bitsko RH, Holbrook JR, Ghandour RM, et al. Epidemiology and impact of health care provider-diagnosed anxiety and depression among US children. J Dev Behav Pediatr 2018; 39(5): 395–403.

30. Chavira DA, Stein MB, Bailey K, Stein MT. Child anxiety in primary care: prevalent but untreated. Depress Anxiety 2004; 20(4): 155–164.

31. Husky MM, Boyd A, Bitfoi A, et al. Self-reported mental health in children ages 6–12 years across eight European countries. Eur Child Adolesc Psychiatry 2018; 27(6): 785–795.

32. Lawrence D, Johnson SE, Hafekost J, et al. The mental health of children and adolescents: report on the second Australian child and adolescent survey of mental health and wellbeing. 2015. https://www.health.gov.au/sites/default/files/documents/2020/11/the-mental-health-of-children-and-adolescents_0.pdf (accessed 5 Apr 2022).

33. Ormel J, Raven D, van Oort F, et al. Mental health in Dutch adolescents: a TRAILS report on prevalence, severity, age of onset, continuity and co-morbidity of DSM disorders. Psychol Med 2015; 45(2): 345–360.

34. John A, Marchant AL, McGregor JI, et al. Recent trends in the incidence of anxiety and prescription of anxiolytics and hypnotics in children and young people: an e-cohort study. J Affect Disord 2015; 183: 134–141.

35. Dalsgaard S, Thorsteinsson E, Trabjerg BB, et al. Incidence rates and cumulative incidences of the full spectrum of diagnosed mental disorders in childhood and adolescence. JAMA Psychiatry 2020; 77(2): 155–164.

36. O'Brien D, Harvey K, Creswell C. Barriers to and facilitators of the identification, management and referral of childhood anxiety disorders in primary care: a survey of general practitioners in England. BMJ Open 2019; 9(4): e023876-e.

37. Vlug AE, van der Lei J, Mosseveld BM, et al. Postmarketing surveillance based on electronic patient records: the IPCI project. Methods Inf Med 1999; 38(4–5): 339–344.

38. van der Lei J, Duisterhout JS, Westerhof HP, et al. The introduction of computer-based patient records in The Netherlands. Ann Intern Med 1993; 119(10): 1036–1041.

39. Lamberts H, Wood M, WONCA, eds. ICPC: International Classification of Primary Care. Oxford: Oxford University Press, 1987.

40. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders fifth edition: DSM-5. Washington, DC: American Psychiatric Publishing, 2013, 70.

41. Spronk I, Korevaar JC, Poos R, et al. Calculating incidence rates and prevalence proportions: not as simple as it seems. BMC Public Health 2019; 19(1): 512.

42. Benchimol EI, Smeeth L, Guttmann A, et al. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) statement. PLoS Med 2015; 12(10): e1001885.

43. Ask H, Handal M, Hauge LJ, et al. Incidence of diagnosed pediatric anxiety disorders and use of prescription drugs: a nation-wide registry study. Eur Child Adolesc Psychiatry 2020; 29(8): 1063–1073.

44. Dufton LM, Dunn MJ, Compas BE. Anxiety and somatic complaints in children with recurrent abdominal pain and anxiety disorders. J Pediatr Psychol 2009; 34(2): 176–186.

45. Crawley SA, Caporino NE, Birmaher B, et al. Somatic complaints in anxious youth. Child Psychiatry Hum Dev 2014; 45(4): 398–407.

46. Walter HJ, Bukstein OG, Abright AR, et al. Clinical practice guideline for the assessment and treatment of children and adolescents with anxiety disorders. J Am Acad Child Adolesc Psychiatry 2020; 59(10): 1107–1124.

47. Ipser JC, Stein DJ, Hawkridge S, Hoppe L. Pharmacotherapy for anxiety disorders in children and adolescents. Cochrane Database Syst Rev 2009; (3): CD005170.

Supplementary files

Supplementary table S1. *Stepwise selection of cases "children presenting with anxiety problems to their GP" for qualitative analysis*

Step 1 The search algorithm searched all medical dossier (children < 18 years) for the presence of ICPC codes "P01, P02, P74" or free-text "anxiety problems", "anxiety disorder". In children meeting one or more of search algorithm elements, the date of the first search criteria hit was automatically extracted, the "*first documentation on anxiety*". This gave 1381 cases

Step 2 All cases with a "*first documentation on anxiety*" before January 1st 2012 were automatically removed: after 2012 the RPCD information was of high quality. 196 cases were excluded, this gave 1185 cases.

Step 3 In order to make valid inferences on the run-up period before presentation, and management of GPs after presentation, cases with information from 2 years before until 2 years after presentation were selected for in-depth analysis. Cases that did not have valid information in the RPCD database from 2 years before until 2 years after the "*first documentation on anxiety*" were excluded. 585 cases were excluded, this gave 600 cases.

Step 4 Full medical files of these 600 cases were read from 2 years before until 2 years after "first documentation on anxiety" by primary researcher (LK). Unclear cases were reviewed by a second researcher (ES), and included bases on consensus. 503 cases with anxiety problems were included, 97 cases in which there was no (verifiable) first anxiety problem.

Inclusion: -Children with code P01 (feeling anxious/nervous/tense) or P74 (anxiety disorder/panic disorder) with GPs' notes, or specialists' letter on anxiety or psychosocial problems

-Children with code P02 (acute stress reaction/post-traumatic stress syndrome) with GPs' notes or specialists' letter clearly describing anxiety symptoms "fear" or "anxiety"

-Children without code P01/P02/P74 but with free-text hit on "anxiety problems" or "anxiety disorders" which concerned the child

Exclusion: -Children with a code for P01/P74, without any documentation attached to the code, an "empty code"

-Children with a code for P01/P74, in which it was clear that the code did not describe an anxiety problem of the child, e.g. anxiety problem of the parent documented in child's medical file

-Children with code P02, but without GPs' notes, specialist letters, on specific anxiety symptoms

-Children with a free-text hit on "anxiety problems" or "anxiety disorder" in context of a negation e.g. "no evidence of an anxiety disorder"

Step 5 Full medical files from 2 years before until 2 years after "*first documentation on anxiety*" were read by primary researcher (LK) and variables were extracted manually by keeping track which characteristics were mentioned in the medical file in the 4 years follow-up. Cases of children presenting with a first anxiety problem to their GP. 122 cases were excluded, 381 cases were included in our qualitative analysis.

Inclusion: Case of child presenting with anxiety problems to their GP

Exclusion: Cases with anxiety problems diagnosed in different setting e.g. by psychologist or specialist

Supplementary table S2. *Positive predictive value of search algorithm for qualitative analysis*

Search term	Number of hits	Positive Predictive value
Complete algorithm	600	83.8%
P01.00	194	89.7%
P02.00	104	50.0%
P74.00, P74.01, P74.02	148	94.5%
Free text: "Anxiety disorder" or "Anxiety problems"	154	89.0%

Note: Our search algorithm selected the first documentation on anxiety in children's medical file which was either a first code for anxiety ICPC P01, P02 or P74, or a documentation on anxiety disorder" or "anxiety problems". Our search algorithm identified a total of 1381 children between 2012-2018. (Figure 1 Flowchart) Of these, 600 children had valid follow-up data from 2 years before until 2 years after first documentation on anxiety. In 503 of these 600 children, the algorithm correctly identified the first documentation of anxiety. 97 children were excluded because of misclassification, prior anxiety, or insufficient data. The overall algorithm had a positive predictive value of 83.8% for detecting a first-ever incidence of anxiety. The PPV of the different elements of the search algorithm are shown above.

Supplementary table S3. *Characteristics Rijnmond Primary Care Database (RPCD) (Children <18 years)*

Year	Number of registered children	Total person-years	Median age (IQR)	Sex (male %)
2012	21140	19397.9	8.8 (8.9)	50.8%
2013	25387	21556.5	8.7 (9.0)	50.8%
2014	26466	24383.2	8.7 (9.1)	50.8%
2015	27103	25004.7	8.6 (9.0)	50.8%
2016	30321	27614.0	8.7 (9.0)	50.8%
2017	34594	29990.8	8.7 (9.0)	50.9%
2018	35190	31551.8	8.7 (9.0)	50.8%
2012–2018	51212	179487.1	8.7 (9.0)	50.8%

Supplementary table S4. *Incidence rate of ICPC coded anxiety (P01/P74) per sex and age category*

Age categories	Overall	Boys	Girls	Incidence rate ratio (girls vs boys)
0-17 years	5.36 (5.02-5.71)	4.04 (3.64-4.48)	6.72 (6.18-7.28)	1.66 (1.46-1.89)
0-6 years	1.99 (1.68-2.36)	1.79 (1.37-2.29)	2.21 (1.74-2.77)	1.24 (0.89-1.73)
7-12 years	5.53 (4.94-6.17)	5.16 (4.37-6.05)	5.90 (5.05-6.86)	1.14 (0.92-1.43)
13-17 years	9.84 (8.99-10.76)	5.87 (4.97-6.89)	14.01 (12.55-15.58)	2.39 (1.97-2.89)

Note: Incidence of first ICPC code for anxiety P01 or P74, recurring ICPC codes not included. Incidence rate with 95% CI per 1000 person-years at risk

Supplementary table S5. *Incidence rate of ICPC coded anxiety (P01/P74) per year*

Year	Incidence rate	95% CI
2012	4.30	3.42-5.33
2013	4.81	3.92-5.84
2014	6.05	5.10-7.11
2015	6.17	5.22-7.23
2016	5.92	5.04-6.91
2017	5.46	4.65-6.37
2018	4.61	3.89-5.43
2012-2018	5.36	5.02-5.71

Note: Incidence of first ICPC code for anxiety P01 or P74, recurring ICPC codes not included. Incidence rate with 95% CI per 1000 person-years at risk

Supplementary table S6. *Associated problems reported in patient journal (qualitative analysis)*

Percentage with*	Overall N=381	Boys N=154	Girls N=227	0-6 years N=37	7-12 years N=146	13-17 years N=198	Boys vs Girls**	Age categories**
Divorced parents or single caregiver	19.4%	13.0%	23.8%	16.2%	21.2%	18.7%	p=0.01	p=0.73
Domestic violence or child maltreatment	9.4%	8.4%	10.1%	16.2%	6.2%	10.6%	p=0.71	p=0.15
Victim of sexual violence	6.3%	5.2%	7.0%	2.7%	3.4%	9.1%	p=0.61	p=0.08
Victim of crime	10.2%	11.7%	9.3%	16.2%	11.0%	8.6%	p=0.55	p=0.35
Victim of bullying	15.0%	16.2%	14.1%	10.8%	17.8%	13.6%	p=0.67	p=0.43
Fear of failure	26.0%	23.4%	27.8%	21.6%	18.5%	32.3%	p=0.40	p=0.01
Sleeping problems	37.0%	36.4%	37.4%	40.5%	43.8%	31.3%	p=0.91	p=0.05
School problems	46.2%	44.2%	47.6%	45.9%	45.9%	46.5%	p=0.58	p=0.99
School absenteeism	20.7%	22.7%	19.4%	5.4%	21.2%	23.3%	p=0.51	p=0.05
Concentration problems	20.0%	19.5%	20.3%	10.8%	18.5%	22.7%	p=0.95	p=0.21

*Percentage known with characteristic at any point from 2 years before presentation until 2 years after presentation. **Percentages among boys compared to girls, percentages among age categories, compared with chi2 test. These hypothesis tests are of exploratory nature, and are not corrected for multiple testing.*

Chapter 3
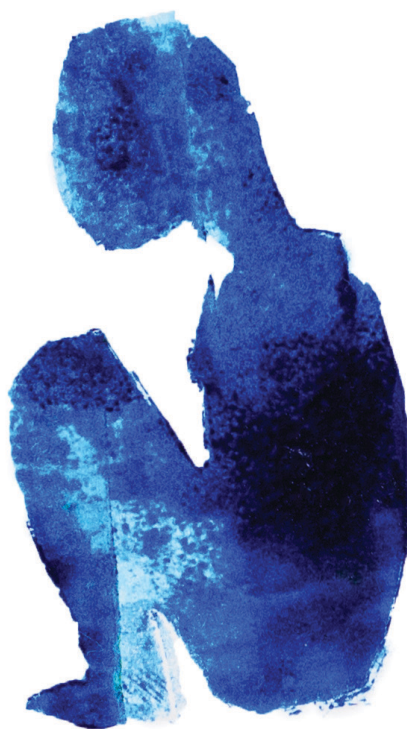
GPs' and practice nurses' views on their management of paediatric anxiety problems: an interview study

Lukas BM Koet, Jessie JM Bennenbroek, Annouk YS Bruggeman,
Evelien IT de Schepper, Arthur M Bohnen, Patrick JE Bindels, Heike Gerger

Abstract

Background

Anxiety problems are common in both children and adolescents, and many affected children do not receive appropriate treatment. Understaffing of mental healthcare services and long waiting lists form major barriers. In the Netherlands, practice nurses have been introduced into general practice to support general practitioners (GPs) in the management of psychosocial problems. In this study we investigated the views of GPs and practice nurses on their management of paediatric anxiety problems.

Methods

We performed an exploratory study using semi-structured interviews with 13 GPs and 13 practice nurses in the greater Rotterdam area in 2021. Interviews were transcribed and coded into topics, which were categorized per research question.

Results

In their management of paediatric anxiety problems, both GPs and practice nurses try to explore the case and the needs of affected children and their parents. GPs rarely follow up affected children themselves. They often refer the child, preferably to their practice nurse. Practice nurses regularly initiate follow-up consultations with affected children themselves. Practice nurses reported using a variety of therapeutic techniques, including elements of cognitive behavioural therapy. In more severe cases, practice nurses refer the child to external mental healthcare services. GPs reported being satisfied with their collaboration with practice nurses. Both GPs and practice nurses experience significant barriers in the management of paediatric anxiety problems. Most importantly, long waiting lists for external mental health care were reported to be a major difficulty. Improving cooperation with external mental healthcare providers was reported to be an important facilitator.

Conclusions

In their management of paediatric anxiety problems, GPs and practice nurses experience major challenges in the cooperation with external mental healthcare providers and in the long waiting lists for these services. GPs and practice nurses believe that thanks to their shared approach more children with anxiety problems can remain treated in general practice. Future research is needed to evaluate the treatment outcomes of the shared efforts of GPs and practice nurses in their management of paediatric anxiety problems.

Introduction

Anxiety disorders are among the most common mental health problems in children and adolescents.[1,2] Anxiety disorders are a significant burden for affected children and their next of kin.[3,4] Furthermore, paediatric anxiety disorders are associated with psychosocial problems in adulthood.[5–7] Fortunately, effective therapies exist,[8,9] e.g. cognitive behavioural therapy (CBT), which has been shown to improve long-term outcomes in affected minors.[10–12] Although paediatric anxiety disorders occur frequently, affected minors often do not receive adequate therapy.[13–15] Previous research identified three main barriers to appropriate care. Firstly, affected minors and their caregivers often do not seek help.[16–19] Secondly, key people in the recognition of anxiety disorders, e.g. teachers and general practitioners (GPs), often do not recognize signs of underlying anxiety.[16,20–22] Thirdly, in many countries mental health care is under major pressure, with understaffing and long waiting lists forming another barrier to obtaining appropriate help.[23–25]

To tackle this last barrier, initiatives have been taken in many countries to improve access to youth mental health care.[26–30] Dutch policy-makers have made significant changes to the organization of youth mental health care in the past years to make it more accessible and cost-effective. In the Netherlands, mental health care for children (≤17 years) is free of charge. Youth mental health care was recently decentralized and it now falls under the responsibility of local municipalities (Dutch Youth Act 2015). As part of this process, local 'neighbourhood teams' have been established to provide or organize care for children and their caregivers. At the same time, policy-makers have sought to integrate mental health services into general practice.

Dutch GPs have a gatekeeper role and provide most primary care for children. GP care is complemented by the work of youth physicians, who work in schools or institutions and mostly provide preventive care, such as vaccinations and screening. In addition, paediatricians provide specialized medical care for which a referral from a GP is needed. To access mental health care, families can also approach a local 'neighbourhood team' or youth-care institution (Centrum Jeugd en Gezin). Since 2008 GPs can employ 'mental health practice nurses' (MHPNs) to assist them in management of psychosocial problems.[31] Although MHPNs are primarily involved in care for adults, some MHPNs also provide services to children and adolescents. In 2015, a specialized position of 'youth mental health practice nurse' (YMHPN) was introduced into general practice. These YMHPNs are professionals with a background in youth care who provide help by examining, screening, giving short-term treatment and referring minors with psychosocial problems.[32]

Concerning the treatment of paediatric anxiety problems and disorders in primary care settings, a few small-scale studies have been performed internationally, showing promising results.[33–35] In the Netherlands, GPs reported being satisfied with the presence of YMHPNs in their practice.[32] To our knowledge, however, no studies so far have evaluated the current management of paediatric anxiety problems either by GPs alone, or by GPs in cooperation with practice nurses. Therefore, in this study we evaluated the experiences of GPs, MHPNs and YMHPNs with their combined management of children (≤17 years) with anxiety problems. We addressed the following research questions. How do GPs, MHPNs and YMHPNs currently manage paediatric anxiety problems? What are barriers and facilitators in this process? What changes in the management of paediatric anxiety problems have taken place since the involvement of MHPNs and YMHPNs? This study focused on anxiety problems on symptomatic description, rather than focusing on individual anxiety diagnoses. This is in line with GP practice, because GPs often prefer describing patient symptoms rather than giving formal diagnoses in the context of paediatric anxiety.

Methods

Participants and study design

Based on the literature and previous related studies, we aimed to include 10–13 GPs and 10–13 YMHPNs for semi-structured interviews.[36–40] We included 13 GPs and 13 MHPNs or YMHPNs from 15 practices in our study. Two junior researchers conducted the interviews in July and August 2021 (GPs by JB, MHPNs by AYSB) after following internal training on interviewing and qualitative analysis.

We intended to reach a sample of GPs and YMHPNs involved in managing paediatric psychosocial problems from one geographical region only (to control for regional differences in healthcare organization). Because the position of YMHPN was only recently introduced, the exact job requirements and financing of the position are not well-established. Although YMHPNs work in general practices, they can be employed either by GPs or by the local municipality. YMHPNs are expected to have relevant work experience e.g. as a MHPN, psychiatric nurse, social worker or psychologist. However, the GPs or the local municipality themselves decide which qualifications are exactly required when hiring a MHPN. Additionally, it became clear that in many practices MHPNs were involved in the management of both adults and minors. Therefore, we

decided to include both YMHPNs only managing minors, and MHPNs managing both adults and minors, which best reflects the current practice. We will refer to our study group as MHPNs.

We invited 30 general practices from the greater Rotterdam area to take part. First, we sent an e-mail with information on the study and its goals, and subsequently we contacted them by phone to confirm participation. Fourteen of the 30 practices were contacted via our academic GP network (PRIMEUR), and the others were identified via their practice websites, or via the professional networks of the researchers.

The greater Rotterdam area has a population with diverse backgrounds (e.g. in cultural and socio-economic characteristics) and includes urban and more rural regions. Sampling was purposeful in the sense that only practices with MHPNs involved in managing minors were invited. We did not define additional inclusion criteria with respect to other characteristics of the practice, GPs or MHPNs, in order to include a wide range of practices with varied patient populations reflecting the population of the greater Rotterdam area. Inadvertently, one GP was included in the sample even though he did not employ a MHPN who managed minors. Relevant information from this interview was included in our analyses for the research questions not specifically related to the collaboration between the GP and MHPN.

Reasons for not participating were: no response or final decision (eight practices), no time (three practices), currently no MHPN managing minors (three practices), no reason (one practice). One interviewer knew one GP before the interview because of a previous internship in their practice. No other private or work relationships existed between the interviewers and interviewees before study commencement.

Materials

Survey

We gathered relevant characteristics of the interview partners using a short online survey (LimeSurvey, version 2.06) in order to reduce the time required for the actual interview. This pre-interview survey contained questions about practice characteristics, participants' characteristics, and their experience with diagnosing and treating paediatric anxiety problems (Supplementary file S4).

Interview

Semi-structured interviews with GPs and MHPNs provided the main data for our analyses for answering our research questions. The interviews addressed the GP's and MHPN's management of children presenting with anxiety problems, the barriers and facilitators they experienced, and the changes in management since the involvement of MHPNs in managing minors with psychosocial problem. As the study was conducted in July to August 2021, possible influences of the ongoing COVID-19 pandemic on the study were checked with two interview questions. An interview guide was constructed, consisting of open interview questions (Supplementary file S5). The interviews were pilot-tested with two GP researchers, which led to minor changes in the phrasing and order of the interview questions.

Vignette

Each interview started with the interviewee silently reading a vignette describing a child and their mother consulting their GP with symptoms as manifestations of underlying anxiety problems (Supplementary file S5). This served as a reference case onto which the interviewees could project their responses during the interview. To develop the vignette, two clinical cases were formulated as potential vignettes (AYSB/JB/HG) based on a literature review. Experts were then consulted (three GPs and two psychologists/ psychotherapists), and one of the two cases was chosen based on the experts' feedback.

Data collection

After they had agreed to participate in the study, participants were invited to complete the online survey and interview dates were planned. Depending on the participant's preference, the interviews were performed at the participants' practice or via encrypted video-calls, and in two cases by phone due to technical problems. Interviews were performed one-on-one, with the exception of one interview, which was conducted with two MHPNs at their explicit request. Interviews took approximately 30 minutes (GPs: 20–30 minutes, MHPNs: 20–45 minutes), were audio-recorded and transcribed verbatim. Participants' names were pseudonymized and identifying words were removed. Transcripts were not returned to participants.

3

Analysis

We used descriptive statistics (SPSS version 25.0) for the analysis of the characteristics of the interview partners which we gathered using an online survey (see Table 1). Transcripts of the interviews were coded using an online coding tool (QCAMAP. org, v.1.0.9).[41] We read the interview transcripts sentence by sentence and assigned a code (topic) to each unit of information relating to one of our research questions in line with the coding procedure described by Boeije.[42] The coding was data-driven and new codes were added to the coding tree if a new topic was mentioned in an interview. Subsequently, we categorized the emerged topics into a hierarchy of main topics, topics, and subtopics per research question (See supplementary file S2). The initial coding of the interview transcripts was performed by one junior researcher (GPs by JB, MHPNs by AYSB). During the coding process, the emerging code trees were regularly reviewed and discussed in group consensus meetings (AYSB/JB/HG/LK). Finally, all interviews were re-read and all codes were checked (LK), which led to minor changes in the labelling of individual topics. The final code tree with main topics, topics and subtopics was checked and approved by the research team (AYSB/JB/HG/LK).

Our main research goal was to explore first, the current management of paediatric anxiety problems by GPs and MHPNs, as well as second, barriers and facilitators experienced by GPs and MHPNs. Therefore, we chose to analyse the qualitative data close to the original data (i.e., the interview transcripts) by summarising interview statements into relevant topics and by organizing the emerged topics into a hierarchy of main topics, topics and subtopics (See supplementary file S2). More in-depth analyses using transformation and interpretation of data regarding latent meaning and content was not the goal of our research. Data saturation occurred in the interviews with GPs between interviews 9–10, and in the interviews with the MHPNs between interviews 11–12. Nevertheless, all recruited participants were interviewed in order to check for the robustness of data saturation.

Data protection and ethics

Ethical approval was obtained from the ErasmusMC's ethics board (MEC-2021-0406) before study commencement. Participants were informed about the confidentiality and data security agreements. Participants gave their consent for participation in the online survey and at the beginning of each interview. Participation in the study was voluntary

and there was no financial compensation. Data was stored securely at the Department of General Practice, ErasmusMC. In this study, we adhered to the COREQ guidelines (Supplementary files S6).

Results

Participants

In total 13 GPs (8 men, 5 women) participated in our study. They had a mean age of 46.6 (SD 6.5) and 16.7 years of work experience as a GP (SD 6.7 years). In total, 13 MHPNs (1 man, 12 women) participated with a mean age of 47.1 (SD 10.1), and with a mean of 3.7 years of work experience as MHPN (SD 2.9 years). Four MHPNs (30.8%) worked exclusively with children and adolescents. Nine MHPNs (69.2%) managed both adults and minors. Table 1 summarizes the survey findings.

Themes

The interviews conducted with GPs revealed 655 text elements, ordered in 90 topics. Eleven main topics, 65 topics, and 4 subtopics referred directly to our research questions. The 10 remaining topics provided additional information (e.g. referring to the control questions due to the COVID-19 pandemic). In the MHPN interviews we coded 625 text elements, which led to the identification of 105 topics. Ten main topics, 68 topics, and 14 subtopics referred directly to the three main research questions of our study. The 13 remaining topics provided additional information (Supplementary files S2).

How do GPs and MHPNs currently manage paediatric anxiety problems?

In the shared management of paediatric anxiety problems, MHPNs take on much of the management, often in an early stage. This is illustrated by a GP and a MHPN explaining their approach to the vignette.

> "But with such a girl, I would be inclined to ask the YMHPN to see the child… to explore for underlying problems." (GP-5) "First, I would explore the case … and possibly I would contact her school … Depending on the severity of the case, I would start (therapeutic) sessions with the child, perhaps together with her mother.." (MHPN-2)

Table 1. Summary of characteristics of the interview participants

	13 GPs	13 MHPNs
Sex	8 male (61.5%), 5 female (38.5%)	1 male (7.7%), 12 females (92.3%)
Mean Age (SD)	46.6 (6.5) years	47.1 (10.1) years
Work experience in years (SD)	GP since 16.7 (6.7) years	MHPN since 3.7 (2.9) years
Full-time (≥36 hours)	7 Full-time (53.8%), 6 Part-time (46.2%)	13 Part-time MHPN (100%)
General Practice Social economic status	Social economic status: 76.9% normal, 14.4% low, 7.7% high	Social economic status: 84.6% normal, 14.4% low
MHPN patient population	N.a.	Manages exclusively children/ adolescents: 30.7% Manages children, adolescents and adults: 69.3%
Experience diagnosing anxiety problems	Much: 14.4% Neutral: 46.2% Limited: 30.8% Very limited: 7.7%	Much: 7.7% Neutral: 38.5% Limited: 46.2% Very limited 7.7%
Experience treating anxiety problems	Neutral: 61.5% Limited: 14.4% Very limited: 23.1%	Very much: 7.7% Much: 30.7% Neutral: 23.1% Limited: 23.1% Very limited: 15.4%
Possibility to refer to 'neighbourhood team'	9 GPs (69.2%)	11 MHPNs (84.6%)
Usual approach to child with anxiety problems	Investigate the problem yourself after which referral for treatment: 53.8% Direct referral for additional examination and treatment: 23.1% Wait-and-see: 7.7% Other: 14.4%	Investigate the problem myself and start treatment: 23.1% Investigate the problem yourself after which referral for treatment: 46.2% Direct referral for additional examination and treatment: 7.7% Other: 23.1%
Referral to (most commonly)	MHPN: 53.8% Child psychologist 30.8% Specialized mental health: 15.4%	Child psychologist: 53.8% Specialized mental health: 23.1% Neighbourhood team: 7.7% Other: 15.4%

Management of paediatric anxiety problems

In their management of paediatric anxiety problems, GPs and MHPNs try to earn the trust of the child, and explore the severity, duration and background of the problem, and the needs of the child and the parents. GPs and MHPNs investigate the extent to which the anxiety problem influences daily functioning (e.g. at home and in school). Both professional groups pay special attention to the family situation and traumatic events.

GPs often investigate associated physical complaints, and eating and sleeping problems. In severe cases, GPs explore the presence of compulsive or suicidal thoughts, self-harm and substance abuse. Both GPs and MHPNs regularly give advice to child and parents to contact schools. GPs rarely contact the school themselves, while MHPNs contact teachers or school social workers more regularly to receive information and to coordinate the management approach. If the anxiety problem is assessed as moderate to severe, most GPs opt for referral of the child. MHPNs refer more severe cases to external mental health services. In mild to moderate cases, MHPNs usually initiate treatment themselves. Helpful factors in the medical decision-making process are shown in Table 2.

Type of treatment

GPs rarely treat paediatric anxiety problems themselves. Some GPs mentioned holding supportive conversations in exceptional cases. Some MHPNs remarked that they have no formal registration for psychological treatment, and prefer defining their treatment efforts as supportive follow-up. Nevertheless, MHPNs reported using several specific therapeutic tools. Firstly, they use psycho-education to explain the physiological function of fear to the children and their parents. MHPNs explicitly mentioned an aim to involve the child's social network (especially the parents and school), and to encourage children to expand their social network and to continue/start pleasant habits. They help parents to respond to the child's behaviour in a supportive but not overprotective way. MHPNs mentioned using elements of CBT, explaining (e.g. by using schematic models) the relationship between thoughts, feelings, physical sensations and behaviour, and stimulating children to interpret situations in a neutral or positive way by establishing positive and helpful thoughts. MHPNs also reported using tools such as an evidence-based workbook (Dutch Youth Institute) or anxiety hierarchy models, and encouraging children to set goals using appropriate exercises. Some MHPNs use e-health e.g. online platforms with information, exercises and the possibility for peer support. Several MHPNs also mentioned teaching affected children breathing and relaxation techniques. In certain cases, children are encouraged to seek help from other care professionals, e.g. creative therapists or psychosomatic physiotherapists. Some MHPNs described their treatment as "eclectic", using methods from different psychological and therapeutic fields.

Table 2. GPs and MHPNs experienced helpful factors in medical-decision making

GPs' helpful factors	MHPNs' helpful factors
Overview of the local social and mental health care	Knowledge and experience with anxiety problems
	To take sufficient time for exploration
Extensive information on case and its context	To have a connection with the patient
Expertise with anxiety problems**	To have a helpful working experience/
To take sufficient time for exploration**	professional background
Clear reason of consultation*	Intuition of the MHPN
To have Diagnostic certainty*	To have possibility to discuss cases with
Agreement between GP and parents on	colleagues/GP/other caregivers
management*	Overview of the local social and mental health care*
	To use a therapeutic model*

Topics mentioned by GPs and MHPNs.

* Mentioned by one interviewee ** mentioned by two interviewees

Referral

GPs prefer referring affected children to their MHPN because of the short waiting time and because they can remain involved in such cases. However, GPs and MHPNs believe severe and complex cases are often better treated by external mental healthcare providers. GPs and MHPNs reported several factors which make them more likely to refer affected children (Table 3).

Table 3. GPs' and MHPNs' reasons to choose for external referral

Reasons for external referral
Severe anxiety problem
Suicidality
Self-harm
No improvement despite treatment
(Comorbid) psychiatric disorders
Complex family situation
Traumatic experiences
Indication for extensive diagnostic assessment
Explicit request for referral
Child maltreatment¥
No availability of / with MHPN¥
Indication other type of treatment±
Long duration of anxiety problem±
Young children**±

Topics mentioned by GPs and MHPNs.

¥ only mentioned by GPs ± only mentioned by MHPNs

* Mentioned by one interviewee ** mentioned by two interviewees

Cooperation with external mental health services

Communication with other mental healthcare providers was described by GPs as limited, and experienced as difficult. MHPNs reported being much more involved in working with mental healthcare providers. They try to have a good overview and good contacts with the available mental health institutions and social care providers. Most MHPNs said they were in regular contact with the neighbourhood team, and used these contact moments to discuss cases. They refer children to the neighbourhood team if it can offer more appropriate care. More rarely, MHPNs discuss cases with youth care services or child protection services. Figure 1 summarizes the current management of paediatric anxiety problems by GPs and MHPNs.

What are barriers in the management of paediatric anxiety problems?

One the most important barriers experienced by GPs and MHPNs is time constraint, which is illustrated the by the dilemmas mentioned by two interviewees.

> "We notice that (managing children with these kind of problems), takes much more time than just the duration of consultation … We simply do not have that time." (GP-13) "(after I refer a child) everyone wants me to follow up on the child to 'bridge' the waiting time. But if you do this, your agenda will fill up quickly, which makes it difficult to see new cases, so I find that a difficult dilemma." (MHPN-2)

Barriers experienced by GPs

Overall, GPs believed they lack expertise for managing paediatric anxiety problems. They attributed this to limited training and the low frequency of paediatric anxiety problems in their practice. They also reported that they lacked the time for managing paediatric anxiety problems. Some GPs said that it was a challenge to deal with the family of affected children without harming the physician-family relationship. GPs need to take several complicating factors into account: the different needs of child and caregivers, divorce, parenting styles, and the high expectations of parents. Concerning cooperation with mental health services, GPs often do not know where to refer the child and expect their referrals to be frequently rejected. All GPs are very concerned about the long waiting lists for mental health care, especially for specialized services. Because of limited communication with mental healthcare providers, GPs frequently lose track of the treatment process. Table 4 shows the barriers experienced by GPs and MHPNs.

Figure 1. Infographic of the management of paediatric anxiety problems by GPs and MHPNs
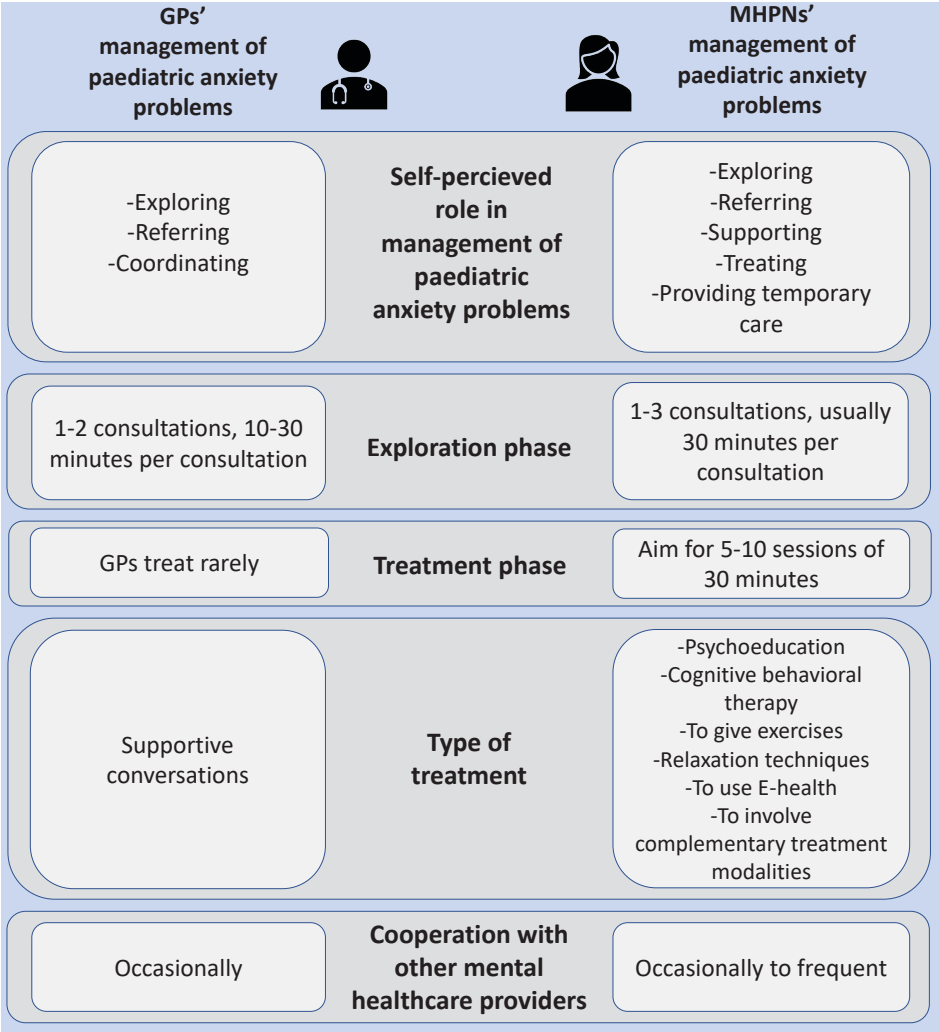
Barriers experienced by MHPNs

Some MHPNs reported having insufficient time in their schedules to plan consultations. At times MHPNs experience difficulty deciding on the appropriate management. Some MHPNs reported more difficulty managing young children, for which they lack tools. Differences between the needs of children and their caregivers can also form barriers in their view. Usually caregivers initiate the search for help, but the children are not always motivated for treatment. Furthermore, caregivers can sometimes behave demandingly towards the MHPN without reflecting on their own impact as parents. Complex family

situations e.g. divorce and addictions, are additional barriers. The long waiting lists form a major barrier to the access of external mental health care according to MHPNs, which puts them in a dilemma: either they place children on a waiting list without any treatment at all, or they 'bridge' the waiting time by supporting these children as well as they can at the expense of seeing other children. Some MHPNs remarked that care by other professionals such as creative therapists or psychosomatic physiotherapists can be useful, but that it is often not reimbursed by health insurance.

Table 4. Barriers in the management of anxiety problems

GPs' Barriers	MHPNs' Barriers
GPs' personal and practice barriers	**MHPNs' personal and practice barriers**
-Insufficient time	-Insufficient time in agenda to plan patients
-Insufficient expertise/knowledge	-Difficulty choosing best approach/
-No overview/knowledge of mental health care	management
institutions	-Not appropriate care while on waiting list
-Concern to damage Patient-Family-Physician	-No experience managing young children
relationship**	with anxiety**
-Limited availably of MHPN/ No other expert	-Working with confidential information*
in general practice**	
Child and family barriers	**Child and family barriers**
-Difficult cooperation with child/family	-Low motivation of children
-Unrealistic expectations of family**	-Complex / non-supportive family situation
-Disagreement between GP and parents on	-Children difficulty expressing themselves /
management*	verbal approach less suitable
-Child's barrier to seek help with GP*	-Unrealistic expectations / non-proactive
	caregivers*
	-Difference in needs of child and parents*
	-Parents with different cultural background*
External mental health care barriers	**External mental health care barriers**
-Long Waiting lists for external mental health care	-Long waiting lists for external mental
-Obscurity towards efficient referral process	health care
-Low quality mental health care*	-Not covered treatment options by insurance

Topics mentioned by GPs and MHPNs. Main topics in bold.

* Mentioned by one interviewee ** mentioned by two interviewees

What are facilitators in the management of paediatric anxiety problems?

Both GPs and MHPNs believed that wide availability of a specialized YMHPNs in general practice facilitates the management of paediatric anxiety such as illustrated in the following statements:

"… to have an YMHPN in your practice who is available and easily accessible … so if you make an early intervention, so to speak, you can prevent a lot of problems. And it can be very stressful, I think, for the child and parents to consult a psychologist." (GP-12). "Yes, (it would be helpful) to have a specialised YMHPN, because (managing adults and children) is much different … If you are keener on managing adults, like myself, then you are short-changing the children." (MHPN-4)

Facilitators described by GPs

Although GPs see the management of paediatric anxiety problems not as their primary task, GPs mentioned that they would like to have more training in paediatric anxiety problems, especially on how to recognize them. GPs would benefit from having more time and tools (e.g. patient questionnaires / patient information) to identify and help affected children. Many GPs would like to increase the availability of YMHPNs, preferably solely managing minors, in their practices. GPs had a strong wish to improve access to, and cooperation with, mental healthcare providers. They mentioned that they would like to have a better overview of the internal structure of mental healthcare institutions. Other improvements they mentioned include the reduction of waiting lists, and the enhancement of triage systems for urgent cases. In order to improve communication with mental healthcare providers, several GPs suggested creating a central point for referral and sharing patient information efficiently and confidently. GPs would benefit a great deal from possibilities to consult with an expert (e.g. child psychiatrist), especially in urgent cases. Some GPs noted that children are under considerable societal pressure, and said there was a need for a supportive, non-judgmental network of parents, friends and teachers for the affected children. Facilitators mentioned by GPs and MHPNs are shown in Table 5.

Facilitators described by MHPNs

Several MHPNs expressed a need for continued schooling to learn about the newest insights and to develop new tools and strategies to help affected children. Additionally, some MHPNs expressed the need for GPs to receive training in recognizing and evaluating the severity of anxiety problems. One MHPN, managing both adults and minors, suggested that practices would benefit from having a specialized YMHPN. MHPNs reported a strong wish to reduce the bureaucracy in the referral process. MHPNs would like to have a better overview of the internal structure of mental healthcare institutions. Preferably, they would like to discuss cases verbally with a designated person in the mental

healthcare institution to make the referral process more efficient. The most urgent need mentioned by MHPNs is the reduction of waiting lists, especially for specialized mental health care. MHPNs said that they hoped for improvements in the recognition of anxiety problems by schools and GPs. Interestingly, some MHPNs were opposed to labelling children too quickly with an anxiety disorder diagnosis in order to avoid stigmatization, which they believed can be counterproductive.

Table 5. Facilitators in the management of anxiety problems

GPs' Facilitators	MHPNs' Facilitators
GPs' personal and practice facilitators	**MHPNs' personal and practice facilitators**
-More education	-Continued schooling/intervision
-More availability of a YMHPN in practice	-Wish for improved recognition by GPs
-More time for consultations**	-More training schooling for GPs**
-More tools and treatment options**	-Wish for YMHPN, dedicated only for children*
-Availability of E-health / information websites**	-More child friendly rooms*
Wishes for societal changes	**Wishes for societal changes**
-More supportive network (e.g. parents, schools)	-Good cooperation with schools
-Less societal pressure on children	-Wish for improved recognition at school
	-Wish for less labelling as disorder by GPs and mental health care**
	-More holistic vision in management*
Facilitators external mental health care	**Facilitators external mental health care**
-Shorter waiting lists	-Shorter waiting lists
-Improved communication with mental health care institutions	-External mental health care easier accessible
-Possibility to consult mental health care expert	-Less bureaucracy in referral process and cooperation with external care
-Mental care in close vicinity*	-Wish for change in finance system of mental health care*
-Improved triage for referred patients*	

Topics mentioned by GPs and MHPNs. Main topics in bold.

* Mentioned by one interviewee ** mentioned by two interviewees

What changes in the management of paediatric anxiety problems have taken place since the involvement of MHPNs and YMHPNs?

GPs reported that they remain more involved with cases of paediatric anxiety due to the introduction of MPHNs.

> "Yes, the cooperation (with the MHPN) works very well. Otherwise, you lose track of people (the referred child) after a while. Now, I keep up-to-date about what happens to them." (GP-6)

GPs considered it easier to discuss cases with their MHPN than with external mental healthcare providers. Also, GPs reported remaining more involved in the treatment process after they involved a MHPN in their practice. As another positive aspect, GPs mentioned that in contrast to external care providers, MHPNs have full access to the GPs' information system. GPs believed that care for affected children has improved since the involvement of MHPNs because affected children receive treatment in a safe and familiar environment. Also, the waiting time for the MHPNs is short, ranging from days to two weeks only. GPs thought that nowadays a substantial proportion of affected children can be treated within general practice thanks to the presence of MHPNs. GPs reported that a smaller number of referrals to external mental health services was being declined, because MHPNs were more aware of the possible referral options in their view. Additionally, MHPNs provided temporary 'bridging' care for children on waiting lists for external mental health care, a possibility most GPs could not offer in the past. GPs are satisfied about their cooperation with MHPNs in the management of paediatric anxiety problems. Since MHPNs could not compare the current shared management with situation before they started, they found it difficult to report on possible changes.

Impact of the COVID-19 pandemic

GPs and MHPNs believed that the COVID-19 pandemic did not change their management and the experienced difficulties significantly.

> "These are all things that were the case before COVID-19. And COVID-19 didn't solve it, and I don't expect it to become better after COVID-19." (GP-9) "No, I believe I would have answered the questions exactly the same (if the interview had taken place before the COVID-19 pandemic)." (MHPN-3)

Most GPs and MHPNs had the impression that paediatric anxiety problems have become more common and more severe due to the COVID-19 pandemic, which has led to delayed care and increased waiting lists. However, according to both groups of professionals, this has not led to a significant change regarding the management of affected children. GPs and MHPNs said they would not have answered our questions differently before the COVID-19 pandemic.

Discussion

Key findings

In this study we assessed the views of 13 GPs and 13 MHPNs on their management of anxiety problems in children and adolescents using short surveys and in-depth semi-structured interviews. As a first step, both GPs and MHPNs described exploring the problem and assessing the needs of the children and their caregivers. After exploration, GPs generally refer affected children either to MHPNs or to external mental healthcare providers. In contrast, MHPNs regularly initiate follow-up meetings with the children themselves, and they mentioned a variety of techniques and approaches which they use when confronted with paediatric anxiety problems. The barriers that GPs and MHPNs experience in the management of paediatric anxiety problems partially overlap. Important barriers, mentioned primarily by the GPs but also in part by MHPNs, include limited time and expertise in managing children (young children in particular). Important potential facilitators for a good approach in managing paediatric anxiety problems relate to the cooperation between the GP practice and external mental healthcare institutions, which needs to be improved according to both GPs and MHPNs. But importantly, the reduction of waiting lists for external mental health care for children with anxiety problems was considered most urgent by GPs as well as MHPNs.

Strengths and limitations

Our research has several strengths. Because MHPNs became involved in managing paediatric psychosocial problems in Dutch general practice recently, only a limited number of small-scale studies assessing the role of the MHPN in managing these problems are currently available.[32, 43–45] The combination of an online survey and in-depth semi-structured interviews gave the possibility to address a wide range of topics in our research questions. Because anxiety problems include a broad spectrum of symptoms and complaints, the use of a vignette offered a well-defined starting point for our interviews. In both interviewee groups, we started analysing the interview material while still conducting the interviews. This way we were able to detect the point of data saturation, and to plan further interviews if saturation had not been reached. In both samples saturation was observed before the final interviews were conducted. The sample of participating practices included urban and more rural areas and represented patients with different socio-economic statuses. Participating GPs were diverse in terms of sex and age. Participating MHPNs showed variation regarding relevant characteristics. Only

one male MHPN was interviewed, which fits with the female-dominated profession of MHPNs in the Netherlands.

Our research also has some limitations. We initially aimed to include YMHPNs. However, it became clear that only a few practices had a YMHPN who exclusively managed minors. Instead, many practices had a MHPN involved in managing both adults and minors. Although our sample reflects daily practice best, our study results may have differed if only YMHPNs solely managing minors had been included. Additionally, in the survey many GPs, as well as some MHPNs, reported having little experience with paediatric anxiety problems. However, we decided not to use GPs' and MHPNs' level of experience with paediatric anxiety problems as a selection criterion in order to get a full range of experiences from an unselected sample of GPs and MHPNs. Our study did not aim to address the views of affected children and parents, or the efficacy and treatment outcomes of the approach of GPs working in combination with MHPNs. Future research should, therefore, focus on addressing these issues and research questions. In our analyses we remained close to the original data and did only limited data transformation, which seemed most fitting to our aim to explore the current shared management of paediatric anxiety problems within general practice. This method is highly informative, especially in a new domain of inquiry such as our study. The chosen approach would best be considered at the rather descriptive pole in qualitative research.[46] Future research might complement our findings by more deeply exploring latent content using more interpretative analysis strategies of qualitative data.

Comparison with existing literature

Although comparisons across countries might be limited due to significant differences between healthcare systems, some comparable initiatives to the introduction of YMHPNs in the Netherlands have taken place in other countries. In the USA, a new specialization of 'paediatric primary care mental health specialist' was introduced for nurse practitioners.[47] These nurse practitioners often work in a primary care practice, and are regularly involved in the management of paediatric anxiety problems. Another US initiative, a pilot study, showed that a CBT-based, nurse-led intervention was feasible in treatment of anxious children in primary care.[34]

In our present research, GPs expressed missing expertise and proper tools to manage paediatric anxiety problems. This is supported by findings in our previous study:

using a primary care database, we showed that GPs referred the majority of children presenting with anxiety problems, usually immediately at first consultation.[48] Also, the GPs' prescription behaviour raised concern about their pharmacologic knowledge. GPs prescribed benzodiazepines to 1 in 11 adolescents and off-label beta-blockers to 1 in 6 adolescents in the year after presenting to their GP with an anxiety problem. SSRIs, the first-choice medication, were prescribed to only 1 in 50 adolescents.[48] Our current results are in line with other studies in which GPs felt ill-equipped to recognize and treat paediatric mental health problems, and anxiety problems in particular.[38, 49, 50] In accordance with previous literature, GPs and MHPNs mentioned that more training for GPs, especially in recognizing anxiety problems, could be a possible improvement.[38, 39, 51] In a US study, a video-based training programme improved the knowledge of paediatric residents about child anxiety disorders. In this study, participating residents improved most significantly in determining the referral urgency by recognizing 'red flags'.[52] This is a relevant finding since GPs have reported difficulty in determining the referral urgency, when to refer children and to whom to refer them in the case of paediatric mental health problems.[40] In our study, GPs, and to a lesser extent MHPNs, mentioned similar difficulties in the referral process. Indeed, GPs' referral criteria for paediatric mental health problems are often much less well established in protocols or as 'red flags', when compared with other paediatric problems.[53, 54] In line with other research, our participants mentioned long waiting lists as the most prominent barrier for the proper treatment and management of paediatric anxiety problems.[38, 39, 50]

Implications for clinical practice and future research

The limited knowledge of GPs about paediatric anxiety problems and the difficulty they experience in recognizing these problems are reasons for concern. Future research should focus on providing effective learning and other materials for GPs. For instance, there is a lack of tools that could help improve recognition of paediatric anxiety problems in general practice, but also tools to clearly identify the need for referral, for instance by identifying relevant 'red flags'. MHPNs reported having difficulty at times choosing the appropriate therapeutic approach. Therefore, evidence-based treatment guidelines for paediatric anxiety problems specifically aimed at the primary care settings could also help both MHPNs and GPs. However, such guidelines are lacking to date. Also, while MHPNs reported a variety of therapeutic approaches, these are not necessarily always proven to be effective. Thus, training for MHPNs should also be standardized, incorporating

and promoting therapeutic approaches with proven efficacy and safety. Although GPs reported being enthusiastic about the involvement of MHPNs, it remains important to provide evidence on the effectiveness of the inclusion of MHPNs in primary care, other than the subjective evaluation of GPs. Accordingly, before advocating the introduction of MHPNs on a larger scale, it seems important to investigate whether the presence of the MHPN has indeed led to improved recognition of mental health problems, fewer referrals to external mental health care, and improved outcomes for affected children.

Conclusion

The study demonstrates that the collaboration between GPs and MHPNs, can facilitate children's access to treatment, with more affected children remaining treated in the general practice. Therefore, based on our interviews with GPs and MHPNs we conclude that shared efforts of GPs and MHPNs in the management of paediatric anxiety problems might help resolve at least some of the observed current problems in the management of children and adolescents with anxiety problems. To date, however, important information regarding the effectiveness of the shared efforts of GPs and MHPNs in GP practice is missing. Also, no evidence-based guidelines and trainings exist for an integrated treatment approach to paediatric anxiety problems by MHPNs and GPs at present. The findings from our interview study demonstrate an urgent need for improving the management of paediatric anxiety problems in general practice.

References

1.   Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Arch Gen Psychiatry. 2005;62(6):593–602.

2.   Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA. Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry. 2015;56(3):345–65.

3.   Whiteford HA, Degenhardt L, Rehm J, Baxter AJ, Ferrari AJ, Erskine HE, et al. Global burden of disease attributable to mental and substance use disorders: findings from the global burden of disease study 2010. Lancet. 2013;382(9904):1575–86.

4.   Towe-Goodman NR, Franz L, Copeland W, Angold A, Egger H. Perceived family impact of preschool anxiety disorders. J Am Acad Child Adolesc Psychiatry. 2014;53(4):437–46.

5.   Woodward LJ, Fergusson DM. Life course outcomes of young people with anxiety disorders in adolescence. J Am Acad Child Adolesc Psychiatry. 2001;40(9):1086–93.

6.   Copeland WE, Shanahan L, Costello EJ, Angold A. Childhood and adolescent psychiatric disorders as predictors of young adult disorders. Arch Gen Psychiatry. 2009;66(7):764–72.

7.   Pape K, Bjørngaard JH, Holmen TL, Krokstad S. The welfare burden of adolescent anxiety and depression: a prospective study of 7500 young Norwegians and their families: the HUNT study. BMJ Open. 2012;2:e001942. https:// doi. org/ 10. 1136/ bmjop en- 2012- 001942.

8.   James AC, Reardon T, Soler A, James G, Creswell C. Cognitive behavioural therapy for anxiety disorders in children and adolescents. Cochrane Database Syst Rev. 2020;11(11):CD013162. https:// doi. org/ 10. 1002/ 14651 858. CD013 162. pub2.

9.   Wang Z, Whiteside SPH, Sim L, Farah W, Morrow AS, Alsawas M, et al. Comparative effectiveness and safety of cognitive behavioral therapy and pharmacotherapy for childhood anxiety disorders: a systematic review and meta-analysis. JAMA Pediatr. 2017;171(11):1049–56.

10. Barrett PM, Duffy AL, Dadds MR, Rapee RM. Cognitive–behavioral treatment of anxiety disorders in children: long-term (6-year) follow-up. J Consult Clin Psychol. 2001;69(1):135.

11. Kodal A, Fjermestad K, Bjelland I, Gjestad R, Öst L-G, Bjaastad JF, et al. Long-term effectiveness of cognitive behavioral therapy for youth with anxiety disorders. J Anxiety Disord. 2018;53:58–67.

12. Saavedra LM, Silverman WK, Morgan-Lopez AA, Kurtines WM. Cognitive behavioral treatment for childhood anxiety disorders: long-term effects on anxiety and secondary disorders in young adulthood. J Child Psychol Psychiatry. 2010;51(8):924–34.

13. Chavira DA, Stein MB, Bailey K, Stein MT. Child anxiety in primary care: prevalent but untreated. Depress Anxiety. 2004;20(4):155–64.

14. Emslie GJ. Pediatric anxiety — underrecognized and undertreated. N Engl J Med. 2008;359(26):2835–6.

15. Richardson LP, Russo JE, Lozano P, McCauley E, Katon W. Factors associated with detection and receipt of treatment for youth with depression and anxiety disorders. Acad Pediatr. 2010;10(1):36–40.

16. Reardon T, Harvey K, Baranowska M, O'Brien D, Smith L, Creswell C. What do parents perceive are the barriers and facilitators to accessing psychological treatment for mental health problems in children and adolescents? A systematic review of qualitative and quantitative studies. Eur Child Adolesc Psychiatry. 2017;26(6):623–47.

17. Chavira DA, Bantados B, Rapp A, Firpo-Perretti YM, Escovar E, Dixon L, et al. Parent-reported stigma and child anxiety: a mixed methods research study. Child Youth Serv Rev. 2017;76:237–42.

18. Zachrisson HD, Rödje K, Mykletun A. Utilization of health services in relation to mental health problems in adolescents: a population based survey. BMC Public Health. 2006;6(1):34.

19. Radez J, Reardon T, Creswell C, Lawrence PJ, Evdoka-Burton G, Waite P. Why do children and adolescents (not) seek and access professional help for their mental health problems? A systematic review of quantitative and qualitative studies. Eur Child Adolesc Psychiatry. 2021;30(2):183–211.

20. Aydin S, Crone MR, Siebelink BM, Vermeiren RRJM, Numans ME, Westenberg PM. Recognition of anxiety disorders in children: a crosssectional vignette-based survey among general practitioners. BMJ Open. 2020;10(4):e035799.

21. Wren FJ, Scholle SH, Heo J, Comer DM. Pediatric mood and anxiety syndromes in primary care: who gets identified? Int J Psychiatry Med. 2003;33(1):1–16.

22. Neil L, Smith M. Teachers' recognition of anxiety and somatic symptoms in their pupils. Psychol Sch. 2017;54(9):1176–88.

23. Remschmidt H, Belfer M. Mental health care for children and adolescents worldwide: a review. World Psychiatry. 2005;4(3):147–53.

24. Belfer ML. Child and adolescent mental disorders: the magnitude of the problem across the globe. J Child Psychol Psychiatry. 2008;49(3):226–36.

25. Das JK, Salam RA, Lassi ZS, Khan MN, Mahmood W, Patel V, et al. Interventions for adolescent mental health: an overview of systematic reviews. J Adolesc Health. 2016;59(4):S49–60.

26. CAMHS. CYP IAPT principles in CAMH services values and standards: 'delivering with and delivering well'. CAMHS Press. 2014.

27. Tyler ET, Hulkower RL, Kaminski JW. Behavioral health integration in pediatric primary care. Milbank Memorial Fund. 2017;15:1–24

28. Rickwood D, Paraskakis M, Quin D, Hobbs N, Ryall V, Trethowan J, et al. Australia's innovation in youth mental health care: the headspace Centre model. Early Interv Psychiatry. 2019;13(1):159–66.

29. Bassilios B, Nicholas A, Reifels L, King K, Spittal MJ, Fletcher J, et al. Improving access to primary mental health care for Australian children. Aust N Z J Psychiatry. 2016;50(11):1074–84.

30. Sarvet B, Gold J, Bostic JQ, Masek BJ, Prince JB, Jeffers-Terry M, et al. Improving access to mental health care for children: the Massachusetts child psychiatry access project. Pediatrics. 2010;126(6):1191–200.

31. Magnée T, de Beurs DP, Schellevis FG, Verhaak PF. Ontwikkelingen in de Nederlandse huisartsenzorg voor psychische problemen: een overzicht van recente studies. Tijdschr Psychiatr. 2019;61(2):126-34.

32. Zwaanswijk M, Geuijen P, Boelhouwer M, Spijk-de Jonge M, Serra M. Verwijspatronen bij praktijkondersteuners jeugd. Huisarts Wet. 2020;63(5):14–8.

33. Chavira DA, Drahota A, Garland AF, Roesch S, Garcia M, Stein MB. Feasibility of two modes of treatment delivery for child anxiety in primary care. Behav Res Ther. 2014;60:60–6.

34. Kozlowski JL, Lusk P, Melnyk BM. Pediatric nurse practitioner management of child anxiety in a rural primary care clinic with the evidence-based COPE program. J Pediatr Health Care. 2015;29(3):274–82.

35. Weersing VR, Brent DA, Rozenman MS, Gonzalez A, Jeffreys M, Dickerson JF, et al. Brief behavioral therapy for pediatric anxiety and depression in primary care: a randomized clinical trial. JAMA Psychiatry. 2017;74(6):571–8.

36. Guest G, Bunce A, Johnson L. How many interviews are enough? An experiment with data saturation and variability. Field Methods. 2006;18(1):59–82.

37. Vasileiou K, Barnett J, Thorpe S, Young T. Characterising and justifying sample size sufficiency in interview-based studies: systematic analysis of qualitative health research over a 15-year period. BMC Med Res Methodol. 2018;18(1):1–18.

38. O'Brien D, Harvey K, Creswell C. Barriers to and facilitators of the identification, management and referral of childhood anxiety disorders in primary care: a survey of general practitioners in England. BMJ Open 2019;9(4):e023876-e.

39. Leahy D, Schaffalitzky E, Saunders J, Armstrong C, Meagher D, Ryan P, et al. Role of the general practitioner in providing early intervention for youth mental health: a mixed methods investigation. Early Interv Psychiatry. 2018;12(2):202–16.

40. Hinrichs S, Owens M, Dunn V, Goodyer I. General practitioner experience and perception of child and adolescent mental health services (CAMHS) care pathways: a multimethod research study. BMJ Open 2012;2:e001573. https:// doi. org/ 10. 1136/ bmjop en- 2012-001573.

41. Mayring P, Fenzl T, editors. Qualitative content analysis program qcamap–an open access text analysis software. 15th Biennial EARLI Conference for Research on Learning and Instruction, Munich, Germany; 2016.

42. Boeije H. Analysis in qualitative research. London: Sage publications; 2009.

43. Jonker T, Remmelts H, Huyghen A-M, van der Woude G, Knot-Dickscheit J. Ervaringen en perspectief van de POH-Jeugd. Huisarts Wet. 2020;63(10):33–7.

44. Jonker TJ, Knot-Dickscheit J, Huyghen A. De praktijkondersteuner huisarts-jeugd: een verkennende studie. Groningen: University of Groningen; 2017.

45. Jonker TJ, Knot-Dickscheit J, Huyghen A. De praktijkondersteuner huisarts-jeugd: een verkennende studie. Groningen: University of Groningen; 2017.

46. Kiger ME, Varpio L. Thematic analysis of qualitative data: AMEE guide no. 131. Medical teacher. 2020;42(8):846–54.

47. Hawkins-Walsh E, Van Cleve SN. A job task analysis of the expanding role of the pediatric mental health specialist and the nurse practitioner in pediatric mental health. J Pediatr Health Care. 2019;33(3):e9–e17.

48. Koet LBM, de Schepper EIT, Bohnen AM, Bindels PJE, Gerger H. Anxiety problems in children: a population-based cohort study on incidence and management. Br J Gen Pract. 2022;72(719):e405–e412. https:// doi. org/ 10. 3399/ BJGP. 2021. 0557.

49. Zarafshan H, Wissow LS, Shahrivar Z, Mojtabai R, Khademi M, Jafari Nia M, et al. Children and adolescents' mental health in Iran's primary care: perspectives of general practitioners, school staff and help seekers. Glob Soc Welf. 2021;8(1):1–10.

50. O'Brien D, Harvey K, Howse J, Reardon T, Creswell C. Barriers to managing child and adolescent mental health problems: a systematic review of primary care practitioners' perceptions. Br J Gen Pract. 2016;66(651):e693–707.

51. Horwitz SM, Storfer-Isser A, Kerker BD, Szilagyi M, Garner A, O'Connor KG, et al. Barriers to the identification and management of psychosocial problems: changes from 2004 to 2013. Acad Pediatr. 2015;15(6):613–20.

52. Nicholas N, Pincus D, Perrin E, Bair-Merritt M. Identifying and making recommendations for pediatric anxiety disorders in primary care settings: a video-based training. MedEdPORTAL. 2020;16:11033.

53. Ramanayake RPJC, Basnayake BMTK. Evaluation of red flags minimizes missing serious diseases in primary care. J Family Med Prim Care. 2018;7(2):315–8.

54. AACAP. Recommendations for pediatricians, family practitioners, psychiatrists, and non-physician mental health practitioners. J Am Acad Child Adolesc Psychiatry. 2022. [Cited 2022 Jul 7]. Available from: https:// www.aacap.org/ aacap/ Member_Resources/ Practice_ Information/ When_ to_Seek_Referral_or_Consultation_ with_a_CAP.aspx.

3

Supplementary files

Supplementary file S1a. GPs' survey

Participant number	Age (years) / Sex (M/F)	Years working as GP	Full time	Number of children in practice	Experience with diagnosing anxiety symptoms in children	Experience treating anxiety problems in children	Average socioeconomic status (SES) of patient population	Since when can you refer children to MHPN?	Can you refer to a neighbourhood team?	If yes, since when?	Approach in children with anxiety problems	To whom did you usually refer?
1	38 M	10	Yes	Average	Limited	Very limited	Average	2020	Yes	2018	Direct referral for additional examination and treatment	Specialised mental health care
2	56 M	30	Yes	Average	Neutral	Neutral	Average	2014	No	-	Investigate the problem yourself after which referral for treatment	MHPN
3	46 M	20	Yes	Low	Limited	Limited	Low	2018	Yes	2000	Investigate the problem yourself after which referral for treatment	MHPN
4	49 M	19	Yes	Average	Neutral	Neutral	Average	2015	Yes	2018	Investigate the problem yourself after which referral for treatment	MHPN
5	32 M	2.5	No	Average	Neutral	Neutral	Average	2016	No	-	Others: Often in consultation with MHPN to determine management	MHPN
6	48 M	15	Yes	Average	Neutral	Neutral	Average	2017	No	-	Direct referral for additional examination and treatment	Child psychologist
7	51 F	20	No	Average	Neutral	Neutral	Average	2018	Yes	2015	Others: all of the options	MHPN
8	50 F	15	Yes	Average	Limited	Limited	High	2019	Yes	2011	Investigate the problem yourself after which referral for treatment	MHPN
9*	51 M	22	Yes	Low	Limited	Very limited	Average	-	Yes	2018	Wait and see	Child psychologist

3

Participant number	Age (years)/Sex (M/F)	Years working as GP	Full time	Number of children in practice	Experience with diagnosing anxiety symptoms in children	Experience treating anxiety problems in children	Average socioeconomic status (SES) of patient population	Since when can you refer children to MHPN?	Can you refer to a neighbourhood team?	If yes, since when?	Approach in children with anxiety problems	To whom did you usually refer?
10	41 M	11	No	Average	A lot	Neutral	Low	2020	Yes	2017	Investigate the problem yourself after which referral for treatment	Child psychologist
11	52 F	20	No	Low	Very limited	Very limited	Average	2020	Yes	2016	Direct referral for additional examination and treatment	Specialised mental health care
12	48 F	18	No	High	A lot	Neutral	Average	2019	No	-	Investigate the problem yourself after which referral for treatment	Child psychologist
13	44 F	14	No	Average	Neutral	Neutral	Average	2020	Yes	2018	Others: MHPN	MHPN

*GP 9 could not refer to a MHPN that managed minors

Supplementary file S1b. *MHPNs' survey*

Participant number	Age (years) / Sex (M/F)	Education	Exclusively treats children and adolescents?	Years working as a MHPN	Experience diagnosing anxiety problems in children	Experience treating anxiety problems in children	Average socioeconomic status (SES) of patient population	Can you refer to a neighbor-hood team?	If yes, since when?	Approach in children with anxiety problems	To whom did you usually refer?
1	36 F	UAS* Social work	Yes	1	Limited	Very much	Average	Yes	2021	Investigate the problem myself and start treatment	Specialized Mental Health Services
2	48 F	UAS* master	Yes	1	Neutral	Limited	Average	Yes	2021	Investigate the problem myself and referral for treatment	Specialized Mental Health Services
3	34 F	UAS* Social work / MHPN	No	2	Limited	Neutral	Low	Yes	2019	Investigate the problem myself and start treatment	Specialized Mental Health Services
4	52 F	UAS*	No	4	Limited	Very limited	Average	No	na	Investigate the problem myself and referral for treatment	Child psychologist
5	54 F	Post-graduate MHPN	No	1,5	Limited	Limited	Average	Yes	2015	Investigate the problem myself and referral for treatment	Other: non-specialized Mental Health Care
6	58 F	UAS*	No	10	Neutral	Neutral	Average	Yes	2016	Investigate the problem myself and referral for treatment	Child psychologist
7	52 F	UAS* social pedagogy / grief therapy / trauma informed therapy	Yes	3	Neutral	Much	Average	Yes	2018	Other: All of the four answers	Other***

3

Participant number	Age (years) / Sex (M/F)	Education	Exclusively treats children and adolescents?	Years working as a MHPN	Experience diagnosing anxiety problems in children	Experience treating anxiety problems in children	Average socioeconomic status (SES) of patient population	Can you refer to a neighborhood team?	If yes, since when?	Approach in children with anxiety problems	To whom did you usually refer?
8	34 F	UAS* nursing / post-graduate MPHN	No	3	Limited	Limited	Average	Yes	2018	Investigate the problem myself and referral for treatment	Child psychologist
9	30 F	University psychology	No	3	Neutral	Neutral	Average	Yes	2020	Other: investigate more and refer or treat depending on severity and reason of consultation	Child psychologist
10	60 F	UAS* social work	No	8	Much	Much	Average	Yes	2019	Investigate the problem myself and start treatment	Child psychologist
11	48 F	UAS*	No	2	Very limited	Very limited	Low	Yes	2019	Direct referral for additional examination and treatment	Neighborhood team
12	56 M	UAS* social psychiatric nursing / MPHN	No	7	Limited	Limited	Average	Yes	2018	Investigate the problem myself and referral for treatment	Child psychologist
13	50	University psychology	Yes	2	Neutral	Much	Average	No	na	Other: treat child depending on reasons of the anxiety	Child psychologist

*University of applied sciences **none of participants reported working ≥36 hours/week as MHPN ***"Depending on the nature of the complaints! Sometimes I treat patients myself in general practice (trauma- informed working), sometimes in collaboration with physiotherapy. Very often I provide 'bridging' care to children on waiting list."

Supplementary file S2. Main topics and subtopics per research question
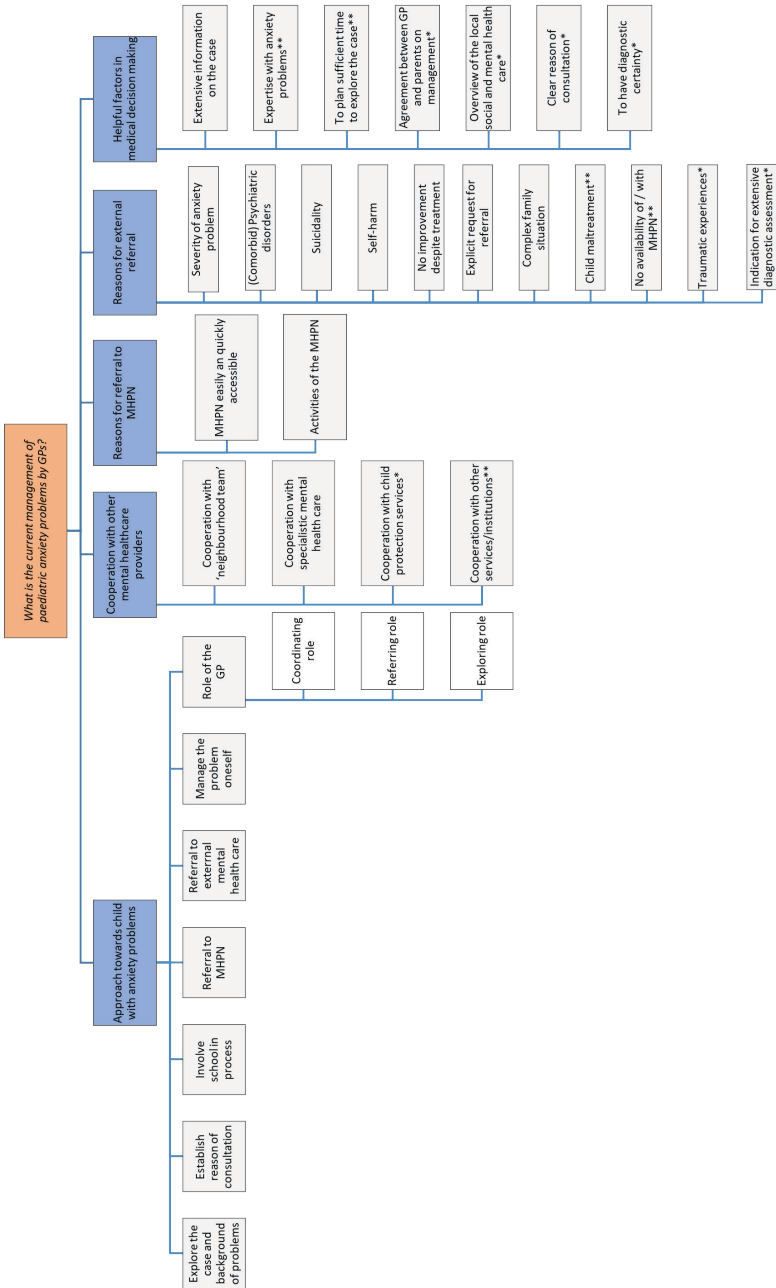
Supplementary file S2a. *Code tree: What is the current management of paediatric anxiety problems by GPs? (research question: orange, main topic: blue, topic: grey, subtopic: white. * mentioned by one interviewee ** mentioned by two interviewees)*
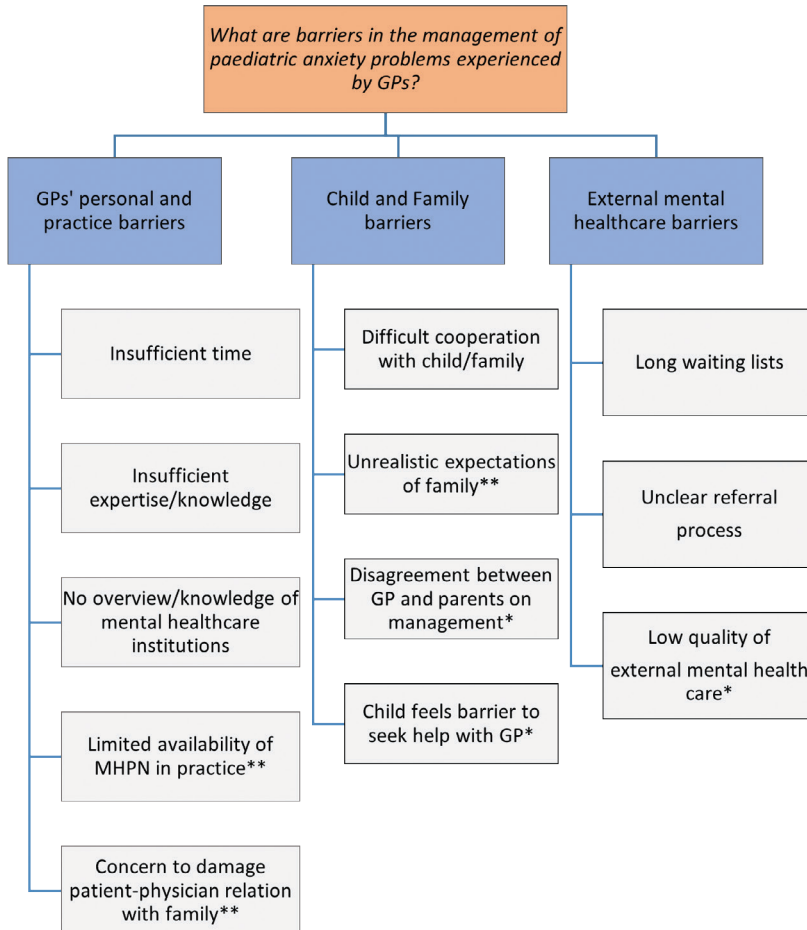
Supplementary file S2b. *Code tree: What are barriers in the management of anxiety problems in children experienced by GPs? (research question: orange, main topic: blue, topic: grey. * mentioned by one interviewee ** mentioned by two interviewees)*
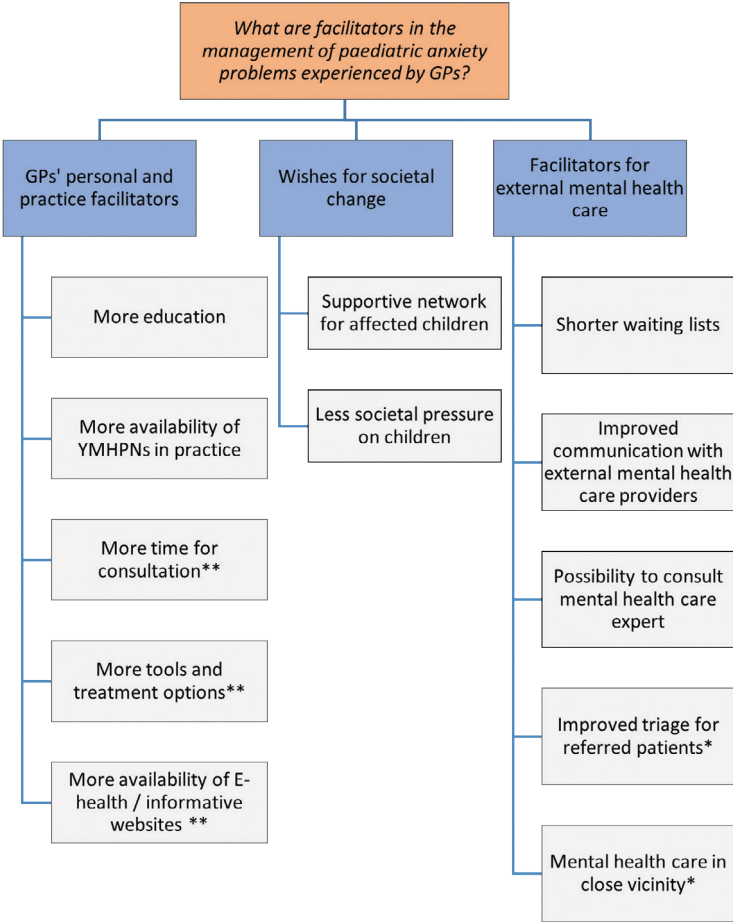
Supplementary file S2c. *Code tree: What are facilitators in the management of paediatric anxiety problems experienced by GPs? (research question: orange, main topic: blue, topic: grey. * mentioned by one interviewee ** mentioned by two interviewees)*

3
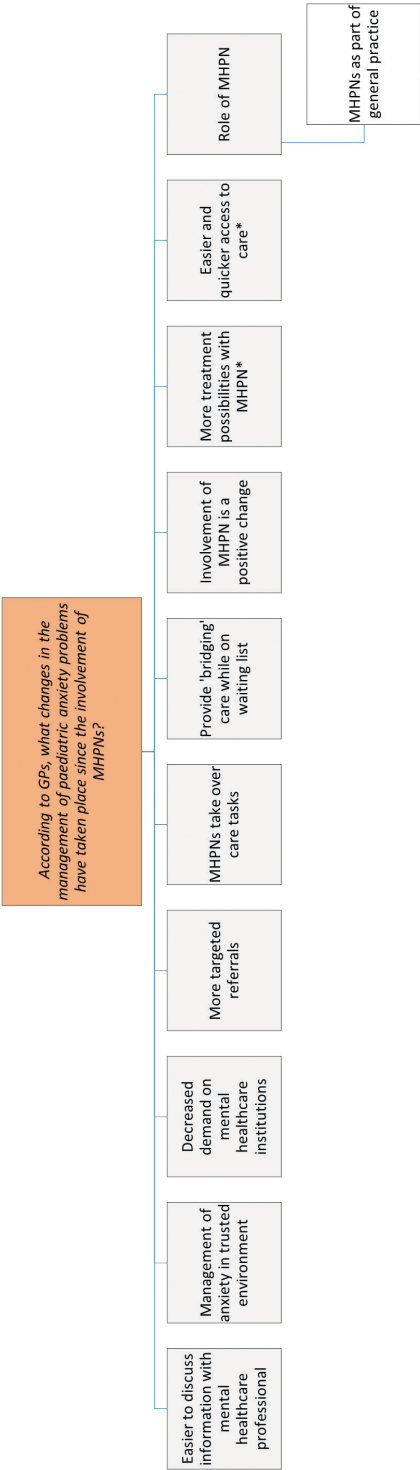
Supplementary file S2d. Code tree: *According to GPs, What changes in the management of paediatric anxiety problems have taken place since the involvement of MHPNs? (research question: orange, main topic: blue, topic: grey, subtopic: white. * mentioned by one interviewee ** mentioned by two interviewees)*
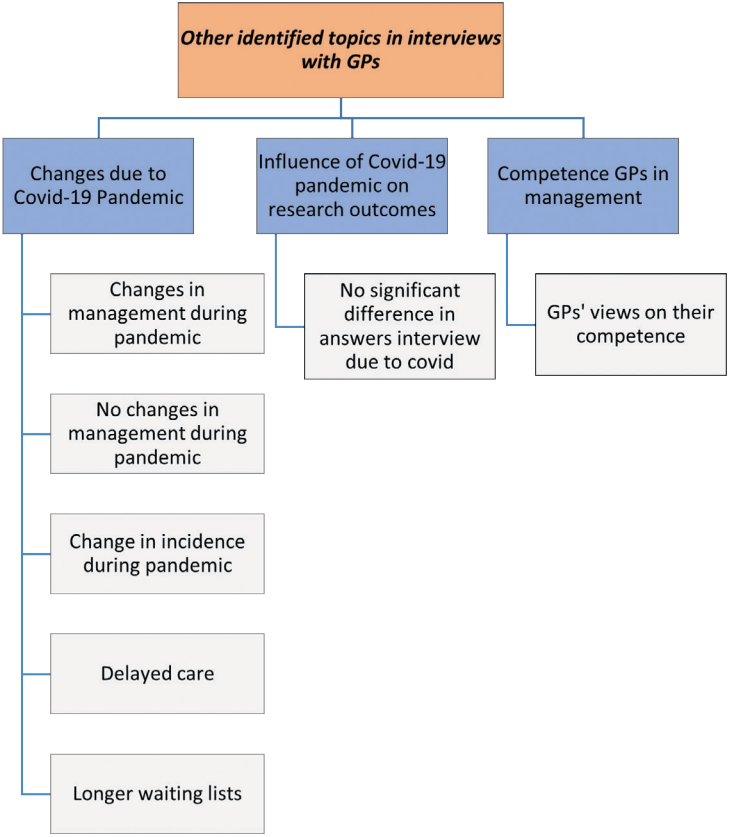
Supplementary file S2e. *Code tree: other identified topics in the interviews with GPs (main topic: blue, topic: grey, subtopic: white. * mentioned by one interviewee ** mentioned by two interviewees)*

3
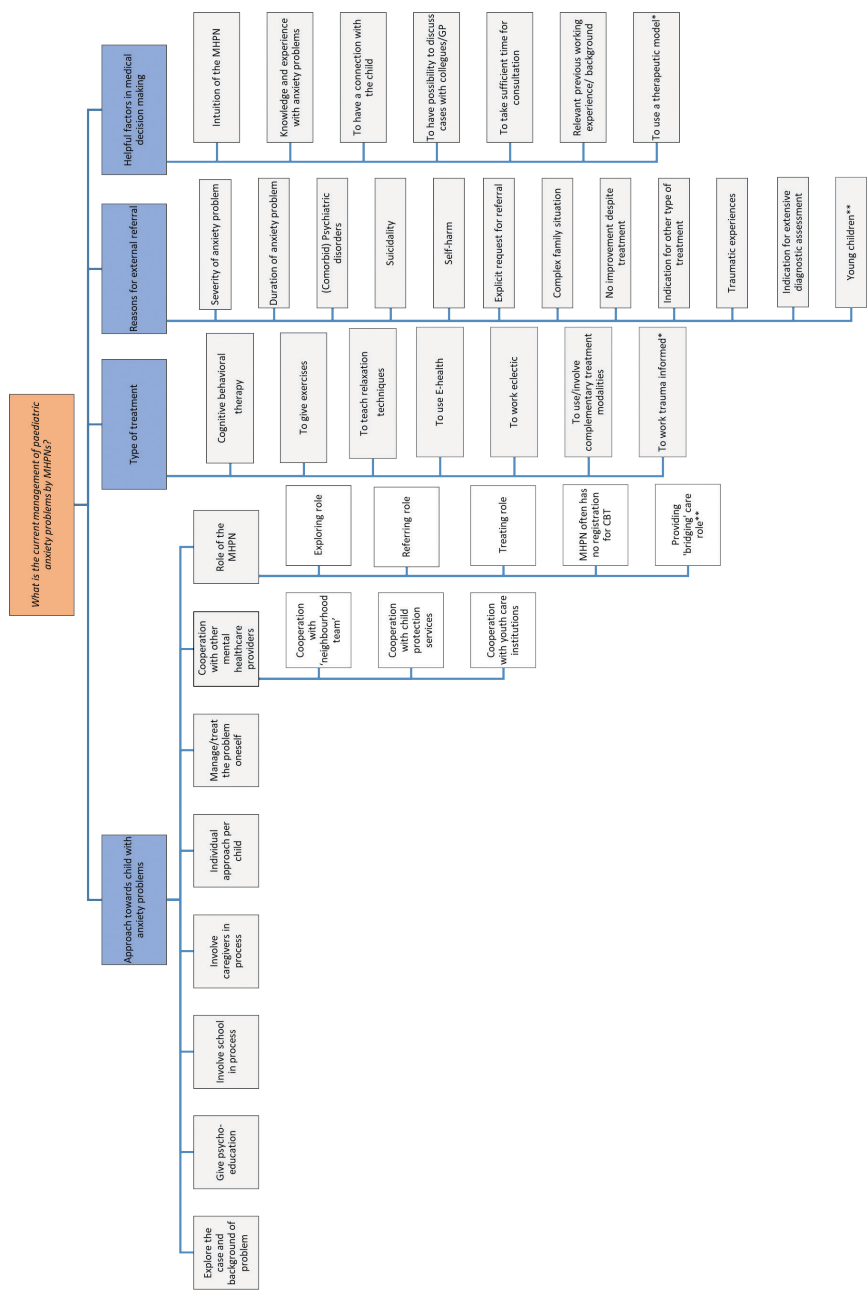
Supplementary file S2f. *Code tree: What is the current management of paediatric anxiety problems by MHPNs? (research question: orange, main topic: blue, topic: grey, sub-topic: white. * mentioned by one interviewee ** mentioned by two interviewees)*

What are barriers in the management of anxiety problems in children experienced by MHPNs?

- MHPNs' personal and practice barriers
  - Insufficient time to schedule patients
  - Difficulty choosing best approach/management
  - Not appropiate care while on waiting list
  - No experience managing young children**
  - Dilemmas when working with confidential information*
- Child and family barriers
  - Complex/non-supportive involvement family
  - Limited motivation of children for treatment
  - Difficulty children to express themselves
  - Differences in needs of child and parents*
  - Parents with different cultural background*
  - Unrealistic expectations caregivers*
- External mental health care barriers
  - Long waiting lists
  - Non-covered treatment options

Supplementary file S2g. Code tree: What are barriers in the management of pediatric anxiety problems experienced by MHPNs (research question: orange, main topic: blue, topic: grey. mentioned by one interviewee ** mentioned by two interviewees)*
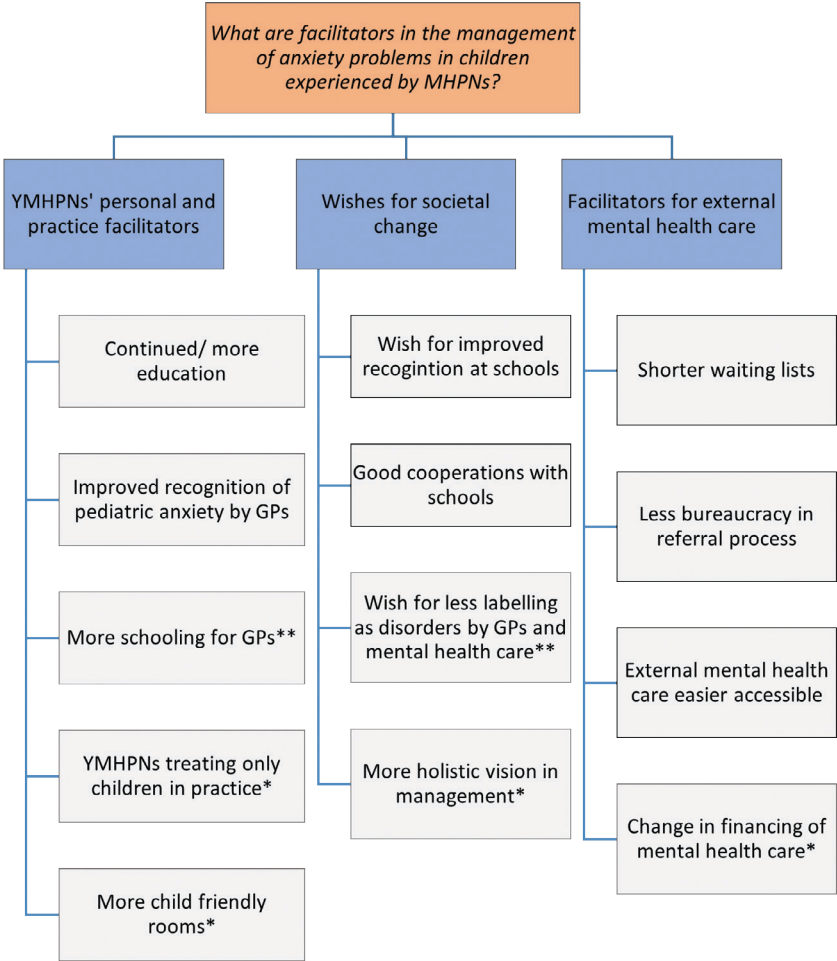
Supplementary file S2h. *Code tree: facilitators in management of paediatric anxiety problems experienced by MHPNs (research question: orange, main topic: blue, topic: grey.* mentioned by one interviewee ** mentioned by two interviewees)*
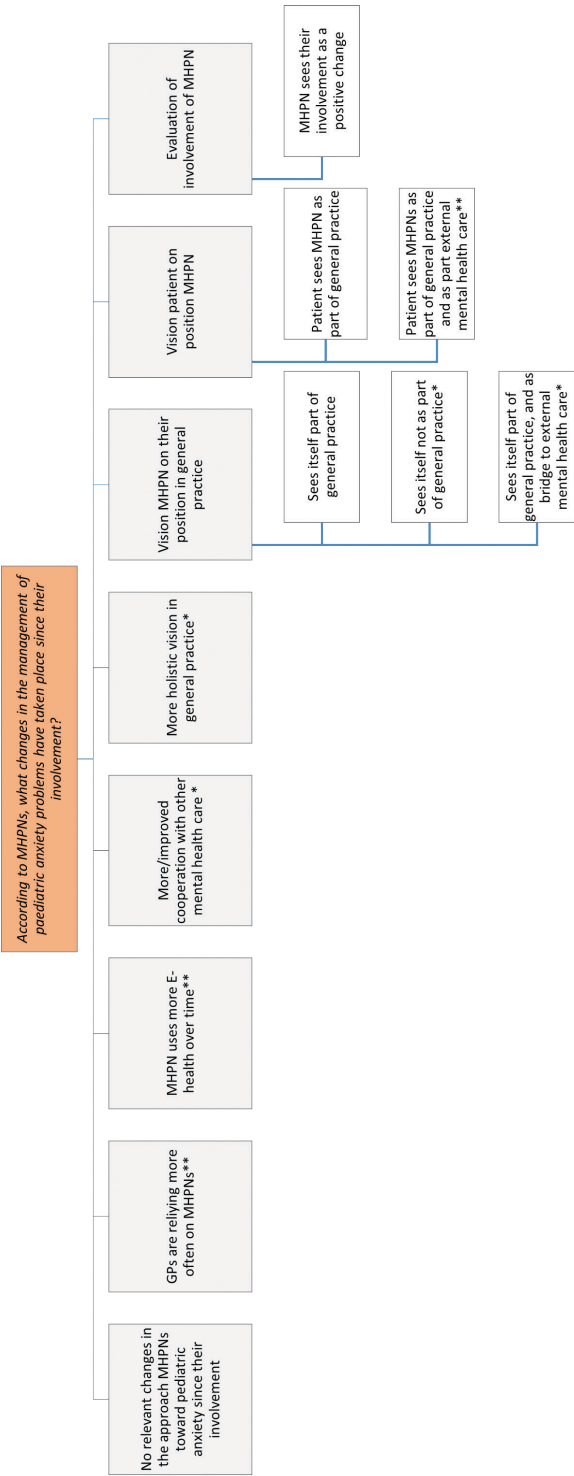
Supplementary file S2i. *Code tree: According to MHPNs, what changes in the management of paediatric anxiety problems have taken place since their involvement? (research question: orange, topic: grey, sub-topic: white. * mentioned by one interviewee ** mentioned by two interviewees)*
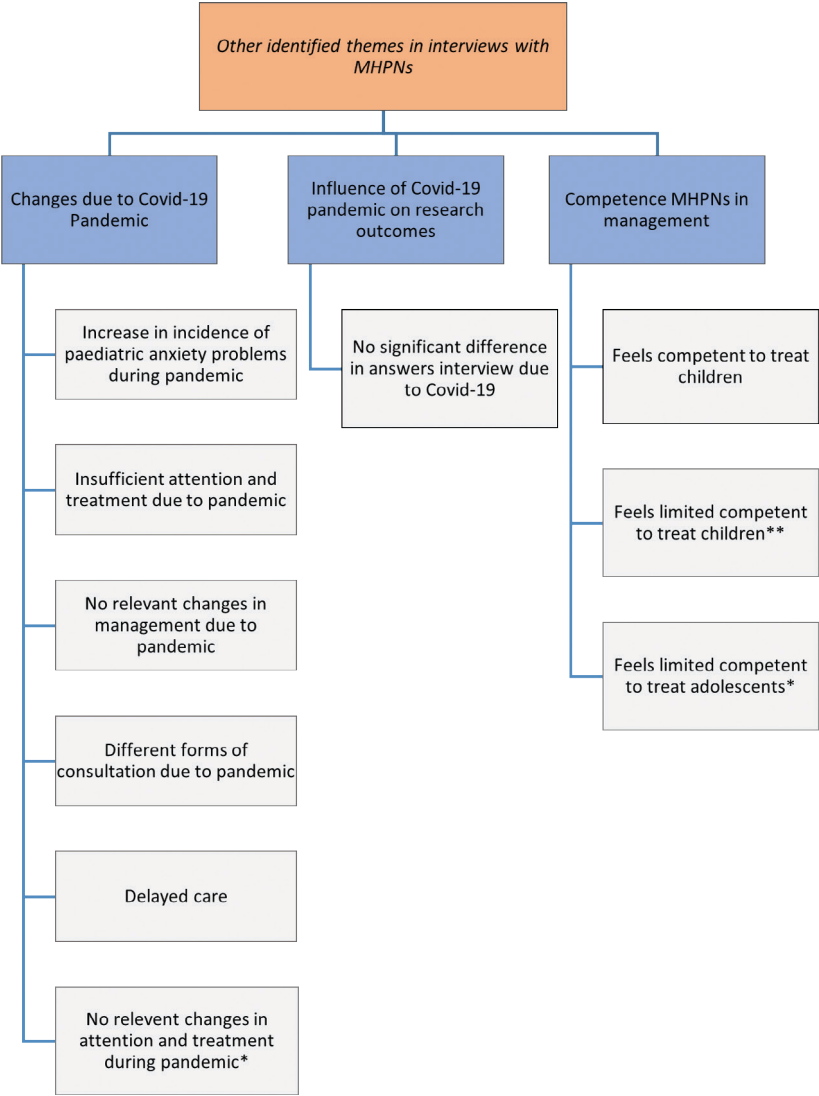
Supplementary file S2j. *Code tree: Other identified topics in interviews with MHPNs (research question: orange, main topic: blue, topic: grey. * mentioned by one interviewee ** mentioned by two interviewees)*

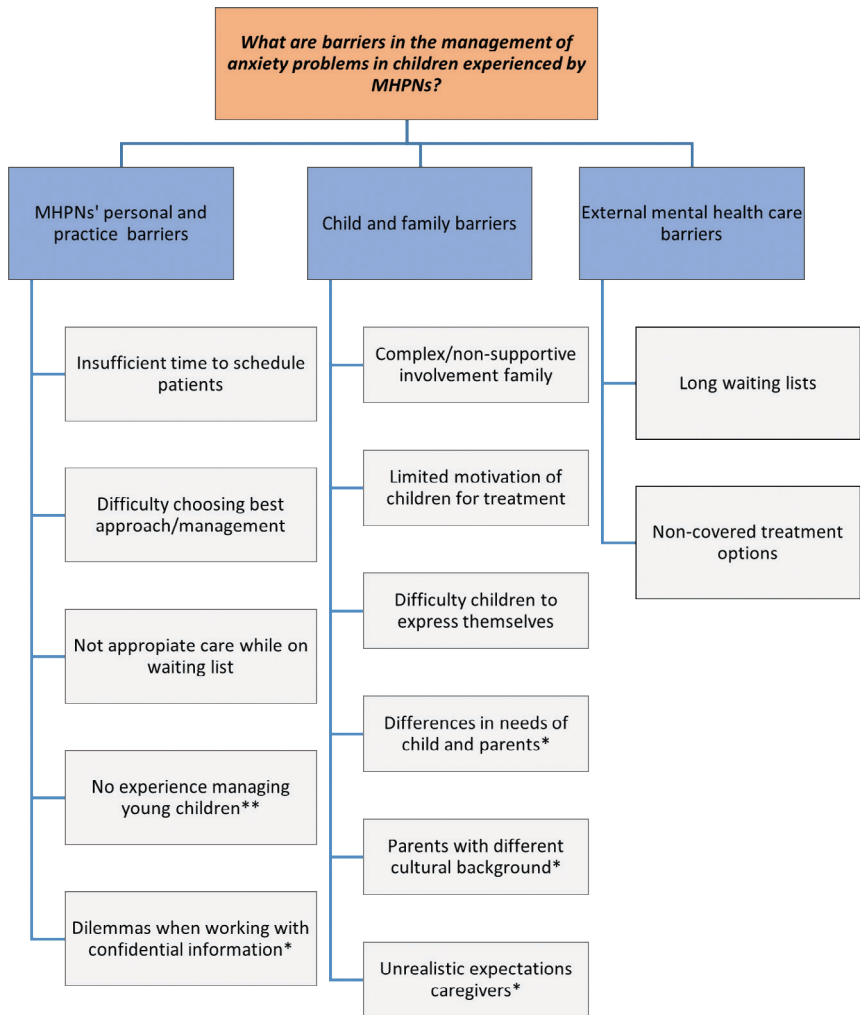**Supplementary file S4.** *Survey: Questionnaire for GPs / MHPNs*

Participant characteristics:	
What is your age?	**free text**
What is your sex?	M/F/other
How many years are you working as GP? ¥	**free text**
How many years are you working as MHPN? ±	**free text**
Type of education / highest grade obtained? ±	**free text**
In your position as (youth) mental health practice nurse, Do you solely manage children and adolescents? ±	Yes / No, also adults
Do you currently work full time as MHPN/GP (≥36hours/week)?	Yes / No
Practice characteristics:	
What is the average social economic status of your patient population?	Relative low / Average / Relative high
How is your patient population characterized?	Relatively few children/ average number of children/ relatively many children
Since when can you refer a child with psychosocial problems to a (youth) mental health practice nurse? ¥	**free text**
Do you have the possibility in your practice to refer children with psychosocial problems to the 'neighbourhood team'	Yes / No
If yes, since what year can you refer to the 'neighbourhood team'	**free text**
Child population and approach:	
Do you have experience diagnosing anxiety problems in children?	Very limited / limited / neutral / much/ very much
Do you have experience treating anxiety problems in children?	Very limited / limited / neutral / much / very much
What did you usually do when confronted with a child with excessive anxiety problems?	Direct referral for additional diagnostics and treatment/ Explore the case oneself, and subsequently refer for treatment/ Explore the case oneself, and subsequently initiate treatment oneself/ Wait and see/ Other, namely.. **free text**
In you referred a child with anxiety problems, to whom did you usually refer?	(Y)MHPN¥ / the 'neighourhood team' / Child psychologist / Specialised mental health care – other, namely **free text**

¥ only in GPs questionnaire

± only in MHPNs questionnaire

Supplementary file S5a. *Vignette: Case description of child with anxiety problems*

English translation:

Eva is a 13-year-old girl, who visits your practice together with her mother. They want to discuss with you some of her problems that have increased over the past year. The mother tells you that Eva has always been a shy girl fearing rejection. At her previous school, she had several friends who she got on well with. At her new school, however, her mother tells, Eva is unable to connect with the children in her class. Her mother asks Eva to tell about a recent incident in school. Eva tells you she had to give a presentation last week. During the presentation, she burst out into tears, without knowing why. After a conversation with her teacher, her mother found out that Eva had not yet made new friends in her new school and that she often spends breaks alone. According to her mother, Eva does not respond to birthday invitations. She recently took a trial lesson at the hockey club, but did not continue playing hockey. Eva tells you she believes her classmates don't like her. According to her mother, Eva has been complaining occasionally about stomach ache when she is at home lately. Usually, she spends her evenings alone in her room with her cat. Her mother attributed this to her introverted personality. Eva gets good grades at school. But after the latest outburst, her teacher informed Eva's mother about her situation. They are now consulting you, and her mother asks you for advice.

Supplementary file S5b. *Guide for interview questions with GPs (translation)*

How do you usually treat a child with problems similar to those described in the vignette in general practice?

- *Why?*

- *In this vignette, what would have to change to opt for a referral?*

What do you find most helpful when you are confronted with such a case in coming to a decision how to treat such a child or what exactly to recommend/advise?

- *Why?*

- *More education/more time/skills/a MHPN/sufficient space at the MHPN for long-term treatment?*

What are difficulties which you experience when confronted with such a case?

How would you define your role as GP/MHPN in the treatment / management of such a case?

- *Do you see the MHPN / yourself as part of general practice or rather as an external health care service?*

- *Do you think the treatment / management of anxiety problems as described in the case vignette in children and adolescents in general practice has changed since the involvement of the MHPN?*

- *What has changed?*

- *Why do you think this occurred?*

- *Is this better or worse than before?*

If you could make a wish, what would be required for improving treatment of paediatric anxiety in general practice in your view?

- *Why?*

- *What is required to improve the quality of collaborations with other mental health care services?*

What has changed in the management of anxiety problems in your practice / your experience during the last year of the pandemic?

- *Do you have the impression you saw more or less children and adolescents with anxiety-related problems as the one described in the vignette during the last year?*

- *Do you think these children / adolescents got adequate attention / treatment during the last year of pandemic?*

Do you think you would have answered the questions differently if you were asked before the COVID-19 pandemic?

- *What would be different?*

Supplementary file S5c. *Guide for interview questions with MHPNs (translation)*

How do you usually treat a child with problems similar to those described in the vignette in general practice?

- *Why?*

- *In this vignette, what would have to change to opt for a referral?*

What do you find most helpful when you are confronted with such a case in coming to a decision how to treat such a child or what exactly to recommend/advise?

- *Why?*

- *More education/more time/do you feel competent?*

What are difficulties which you experience when confronted with such a case?

- *Why?*

- *Do you feel competent to treat anxiety problems in children and adolescents yourself?*

- *What is a sign for you to decide to refer to secondary care/a mental health specialist?*

How would you define your role as MHPN in the treatment / management of such a case?

- *Do you see yourself, as a MHPN, as part of general practice or rather as an external health care service?*

- *What do you think about how the patient sees you?*

What have you changed in the treatment of paediatric anxiety problems as described in the vignette in general practice since your involvement as MHPN?

- *Why did you change this?*

- *Do you reckon this to be an improvement?*

What if you could make a wish, would be required for improving treatment of paediatric anxiety problems in general practice in your view?

- *Why?*

What is required to improve the quality of collaborations with other mental health care services?

- *What does the collaboration with the 'neighbourhood team' look like?*

What has changed in the management of paediatric anxiety problems in your practice / your experience during the last year of the pandemic?

- *Do you have the impression you managed more or less children and adolescents with anxiety-related problems as the one described in the vignette during the last year*

- *Do you think these children / adolescents got adequate attention / treatment during the last year of pandemic?*

Do you think you would have answered the questions differently if you were asked before the COVID-19 pandemic?

- *What would be different?*

Chapter 4

Evaluation of practice nurses' management of paediatric psychosocial problems in general practice

Lukas BM Koet, Heike Gerger, Wilma Jansen, Patrick JE Bindels, Evelien IT de Schepper

Abstract

Background

Child mental health services are under major pressure worldwide. In the Netherlands, Youth Mental Health Practice Nurses (YMHPNs) have been introduced in general practice to improve access to care. In this study, we evaluated care delivered by YMHPNs.

Methods

We used medical records of a population-based cohort (21 717 children, 0–17 years). Characteristics of children consulting a YMHPN, type of problem, care delivered by YMHPNs and referrals were assessed using quantitative content analysis.

Results

Records of 375 children (mean age 12.9 years, 59.2% girl) were analysed. These children were often in their adolescence (57.3% was between 13 and 17 years), and more often female than male (59.2% vs 40.8%). YMHPNs had a median of four consultations (IQR 2–7) with the child. YMHPNs managed a variety of psychosocial problems. YMHPNs managed 22.4% of children without need of referral, 52.0% were eventually referred for additional care. 13.3% of children dropped out during the treatment trajectory. In the remaining 12.3% of children, the treatment trajectory was stopped because the child was already attending specialized services, the treatment trajectory was still ongoing or the medical record was inconclusive.

Conclusions

YMHPNs successfully managed one in four children with psychosocial problems without need for referral. Nevertheless, most children were eventually referred for additional care.

Introduction

Worldwide, child mental health services have been under much strain for years.[1, 2] A lack of resources and trained professionals result in long waiting-lists and rejection of referrals.[3] These form major barriers to appropriate care for children and adolescents with mental health problems.[4] In fact, even in high-income countries only a minority of children and adolescents with mental health problems attend mental health services.[5–8] The recent COVID-19 pandemic has negatively affected the mental health of children,[9, 10] and it seems to have led to an increase in the demand for child mental health services.[11, 12]

In the Netherlands, the use of youth care, including child mental health services, has increased strongly over the past two decades.[13] In response, the Dutch youth care system has been reformed drastically in 2015 (Dutch Youth Act).[14] In this new legislation, the organization and financing of youth care was transferred from national and regional governmental levels to the municipalities. This legislation aimed to make child mental health care more accessible and to improve integrated care (e.g. by implementing community-based support teams).[15]

Parallel to the Youth Act, a new position was introduced to integrate child mental health care into general practice: the Youth Mental Health Practice Nurse (YMHPN). YMHPNs are care professionals with a background in youth care (e.g. psychiatric nurse, psychologist, or social worker) working within general practices. YMHPNs provide a variety of tasks, such as problem clarification, support for problems concerning raising children, psycho-education, short-term treatment based on cognitive behavioural therapy and specific family interventions.[16] Additionally, they support the GP with information and advice, act as the contact for external parties such as schools and specialized mental health services, and refer children in name of the GP if more specialized care is needed.[17] YMHPNs are not licensed to prescribe medication. Consultations with a YMHPN usually take 30–60 minutes.[18] Typically, there is no waiting list for the YMHPN.[19, 20]

The financing of the YMHPN differs per practice, and is determined in consensus by GPs, municipalities, and insurance companies. Although exact numbers are lacking, the number of YMHPNs working in general practice has been growing steadily since 2015.[21, 22] GPs and patients have reported positively about the presence of YMHPNs in Dutch general practice. [18,20] However, only limited information is available to date on the type of psychosocial problems managed by YMHPNs and how they exactly manage these problems.[16–18, 23, 24]

Therefore, we evaluated the care delivered by YMHPNs in-depth by investigating the electronic records of children consulting a YMHPN. We aimed to describe (1) the characteristics and the type of problems of children consulting YMHPNs and (2) the YMHPNs' management of these problems.

Methods

Design

We used electronic records of children (0–17 years) in the Rijnmond Primary Care Database (RPCD), a region-specific derivative of the Integrated Primary Care Information database, focussed on the greater Rotterdam area. Rotterdam is the second largest city of the Netherlands (670,000 inhabitants), with a large community of ethnic minorities and the highest percentage of children living in a low-income household.[25]

The RPCD contains pseudonymised longitudinal medical data of general practice patients, such as symptoms, diagnoses, referrals, laboratory findings, drug prescriptions and specialists' letters.[26] Medical problems and diagnoses are coded with the International Classification for Primary Care 1 (ICPC-1).[27, 28] From the database, general practices exclusively located in the municipality of Rotterdam were selected that employ a YMHPN.

Selection of relevant cases for medical record analysis

We developed a search-algorithm (see Supplementary Tables S1–S2) to detect medical records of children consulting a YMHPN for the first time between 1 July 2017 and 31 June 2021. Our algorithm selected the first date in the medical record of a child that contained either (1) free-text 'practice nurse' (including abbreviations) or (2) a specific insurance code used for care delivered by a practice nurse. The search algorithm automatically excluded records with less than 6 months of follow-up data after the first contact with the YMHPN, as we considered a minimum of 6 months of follow-up time as adequate for our research question to allow valid inferences on the treatment trajectories of the YMHPN. The search algorithm detected a total of 576 medical records. We extracted the date of contact, age at contact, sex, ICPC code (type of psychosocial problem) at contact.

Analysis of the care delivered by YMHPNs

We studied the selected medical records using quantitative content analysis.[29] We developed a checklist to describe and categorize the care delivered by the YMHPN, focussing on the first year after the YMHPN got involved with the patient (see Supplementary Table S3). To improve the reliability of the content analysis the first 50 cases were coded by two researchers and discussed case-by-case to improve subsequent coding. The following information was extracted manually by the first author from the medical record to describe care delivered during a treatment trajectory: number of consultations with a YMHPN; number of contacts of YMHPNs with external professionals; number of no shows; in case of referral, we recorded whether it was to (1) mental health services providing specialized mental health care or (2) to other care, defined as either a community-based support team or a centre for youth and family (CYF). A support team provides (social) help such as parenting support. A CYF is a regional institution with a focus on prevention. It monitors physical, psychosocial and cognitive development of children and also provides specific courses (e.g. social skills trainings). Both the support team and the CYF can refer children to specialized mental health services.

A treatment trajectory was defined as all care delivered by the YMHPN up to 1-year follow-up (ranging 6–12 months) from the moment the YMHPN got involved with the child. The following end-of-treatment trajectory were defined: (1) drop-out (ie, child/caregiver cancels treatment trajectory unilaterally or does not respond to request to make a new appointment); (2) child/caregiver and YMHPN decide together to end trajectory because no additional help is deemed necessary; (3) treatment trajectory ends in referral; (4) YMHPN stopped the treatment trajectory during intake because of no added value (i.e, it became clear that child was already receiving specialized care); (5) Treatment trajectory with YMHPN was not yet finished after 1-year follow-up; and (6) end-of-treatment trajectory is unclear from the record.

We aimed to extract the type of care delivered (e.g. psychoeducation, interventions based on cognitive-behavioural-therapy, etc.). However, in 128 of 375 records, YMHPNs used an additional electronic record for documentation of consultations which we had no access to. In these cases, the YMHPNs used the medical file of the GP only for recording summaries of the consultations but information on the used therapeutic approaches lacked. Therefore, we only extracted information on type of care from the 247 complete

records. These 247 children did not differ substantially in characteristics from the overall group (see Supplementary Table S4).

Statistics

We used descriptive statistics for the care delivered by YMHPNs by sex and age (young children: 0–6 years; school-age children: 7–12 years; adolescents: 13–17 years). Student's t-test was used to compare mean age of girls and boys. Due to the exploratory nature of our study, no other statistical test to compare groups were performed.

Reporting and ethical considerations

We adhered to the RECORD guidelines for the reporting of studies using electronic health records.[30] RPCD is a pseudonymized, opt-out database of GP records. RPCD data are stored confidentially on a local server of ErasmusMC. Under Dutch GDPR law, our study does not require ethical approval. Our study was approved by the RPCD scientific steering committee (project-number 2020-013).

Results

Study population

The cohort consisted of 21,717 children (0–17 years, 49.2% female) registered in 17 general practices that employed a YMHPN during the study period. Our algorithm identified 576 possible relevant records (see eFigure 1: Flowchart) which were included in the next step of manual screening. Of these 576 records, 42 records were excluded because they did not concern a YMHPN delivering mental care. In 52 records, the YMHPN assisted the GP (e.g. discussing cases) but no consultations with child or family took place. In 54 records, the GP clearly advised a child or its caregivers to make an appointment with the YMHPN, but appointments were either not planned or cancelled. In 53 records, GPs noted the possibility to involve the YMHPN, but it was unclear from the record to what extend the GP actually recommended to consult the YMHPN.

The remaining 375 children had one or more consultations with a YMHPN for psychosocial problems and were included in our analysis. These 375 children had a mean age of 12.9 years (SD 3.8) and 59.2% was female (Table 1). Girls consulting a YMHPN were on average older than boys (13.6 vs 12.0 years, p < 0.001).

Table 1. Treatment trajectories with a YMHPN per sex and age group

	All children consulting a YMHPN N=375	0-6 years N=30	7-12 years N=130	13-17 years N=215	Girls N=222	Boys N=153
Mean Age (SD)	12.9 (3.8)	n.a.	n.a.	n.a.	13.6 (3.7)	12.0 (3.8)
Female (%)	59.2%	40.0%	46.9%	69.3%	n.a.	n.a.
Median number of consultations (IQR)	4 (2-7)	3 (1.25-5)	3 (2-6)	4 (2-8)	4 (2-7)	3 (2-6)
≥1 External referral for psychosocial problem (%)[a]	51.7%	43.3%	59.2%	48.4%	49.6%	54.9%
Referral to (%)						
Mental health care services	42.4%	30.0%	43.1%	43.7%	39.2%	47.1%
Other services[b]	17.3%	13.3%	28.5%	11.1%	18.5%	15.7%

[a]*Some children received referrals for both mental health services and other services.* [b]*Either the community-based support team or the centre for youth and family.*

Type of psychosocial problems

Children consulted YMHPNs with a large variety of psychosocial problems. The three most common ICPC codes describing the psychosocial problem of the child were P22 ('Other worries about child's behaviour', 13.1%), P74 ('Anxiety disorder', 8.5%) and P03 ('Down/ Depressive feelings', 6.9%). The most common code (P22 'Other worries about child's behaviour') is typically used for a range of worries (e.g. problems functioning in school, behavioural problems at home). Table 2 lists the 15 most commonly coded problems with the corresponding percentage of children that were eventually referred. The psychosocial problem that most often (91.7%) led to referral was P76 ('Depressive disorder').

Treatment trajectories

Children had a median of 4 (IQR 2–7) consultations with the YMHPN during their treatment trajectory. In 44.8% of trajectories, the child missed one or more of their appointments due to no show or last-minute cancellation. In 51.7% of all trajectories, the YMHPN wrote one or more referrals for additional care. Of these first referrals, 44.3% was accepted and 26.8% was rejected. In 28.9% of first referrals, it was unclear from the record whether the referral was accepted. Table 1 summarizes the treatment trajectories per sex and age group (see Supplementary Table S5 for details). There were no large differences in treatment trajectories between sex and age groups. Referral rate to mental health services seemed somewhat more common in boys than in girls (47.1% vs 39.2%).

Table 2. Common psychosocial problems managed by YMHPNs and referral rate per problem

	ICPC Code	Code description	Number of children (% of total) [a]	Referral rate per ICPC code[b]
1	P22	Other worries about child's behaviour	49 children (13.1%)	69.4%
2	P74	Anxiety disorder	32 children (8.5%)	59.4%
3	P03	Down/Depressive feelings	26 children (6.9%)	65.3%
4	P29	Other psychiatric symptoms/complaints	26 children (6.9%)	42.3%
5	P01	Anxious/nervous/tensed feelings	23 children (6.1%)	52.3%
6	P21	Attention deficit- / hyperactivity disorder	23 children (6.1%)	56.5%
7	P99	Other psychiatric disorders including autism	14 children (3.7%)	57.1%
8	P76	Depressive disorder	12 children (3.2%)	91.7%
9	P02	Crisis/temporary stress reaction including post-traumatic stress disorder	12 children (3.2%)	33.3%
10	P04	Irritable/ angry feeling/ behaviour	10 children (2.7%)	50.0%
11	P20	Memory/concentration/orientation disorders	10 children (2.7%)	80.0%
12	Z20	Relationship problem with parents/family	9 children (2.4%)	33.3%
13	P23	Other worries about adolescent's behaviour	9 children (2.4%)	44.4%
14	Z25	Problems as a consequence of (sexual) violence	9 children (2.4%)	44.4%
15	A80	Trauma/injury	9 children (2.4%)	25.0%

[a]A treatment trajectory by the YMHPN is coded with an ICPC code to describe the type of problem of the child. The proportion represents the percentage of children out of the total sample of N = 375 who were coded with a certain ICPC code. [b]The percentage of children that were eventually referred to external health care providers per ICPC code.

End of treatment trajectories

In 22.4% of cases, the child or caregivers decided together with the YMHPN to end treatment sessions because no other consultations were deemed necessary. In 13.3% of cases, the child dropped out of the treatment trajectory. In 52.0% of cases, the trajectory ended with a referral. In 4.8% of cases, the trajectory with the YMHPN was not yet finished after follow up (range 183–365 days). In 7.5% of cases, the YMHPN stopped the treatment trajectory, or it was unclear from the record how the trajectory ended. Table 3 shows the end of trajectory per age group and sex, and the median number of consultations with the YMHPN per group. Overall, there were no large differences in outcome of the treatment trajectory between sex and age groups. However, adolescents had a drop-out rate that was more than twice that of younger age categories.

Table 3. Outcomes of the treatment trajectory with the YMHPN per sex and age group

Outcome		All children N=375	Girls N=222	Boys N=153	0-6 years N=30	7-12 years N=130	13-17 years N=215
Child discontinues trajectory (drop-out):	-%	13.3%	15.8%	9.8%	6.7%	8.5%	17.2%
	-number of consultations (median, IQR)	2 (1-4)	2 (1-4)	1 (1-4.5)	2 (1.5-2.5)	1 (1-3.5)	2 (1-4)
Treatment trajectory ends in referral	-%	52.0%	51.8%	52.3%	40.0%	59.2%	49.3%
	-number of consultations (median, IQR)	4 (2-7)	4 (2-7.5)	3 (2-6.25)	3 (1.75-6.75)	3 (2-6)	4 (2-8)
Patient and YMHPN decide together to end trajectory, no referral takes place.	-%	22.4%	17.6%	29.4%	33.3%	19.2%	22.8%
	-number of consultations (median, IQR)	4 (2-6)	3 (2-5)	4 (2-7)	3.5 (1.25-4.75)	4 (2-7)	4 (2-6)
YMHPN declines trajectory because child was already in specialized care	-%	1.1%	1.4%	0.7%	6.7%	0.8%	0.5%
	-number of consultations (median, IQR)	1 (1-1.25)	1 (1-1.5)	1 (1-1)	1 (1-1)	2 (2-2)	1 (1-1)
Trajectory with YMHPN is not yet finished after 1 year	-%	4.8%	7.2%	3.9%	3.3%	2.3%	6.5%
	-number of consultations (median, IQR)	10 (9-11.75)	10 (9-11.25)	11 (8.5-13.5)	10 (10-10)	11 (9.5-15.5)	9.5 (9-13.5)
End of trajectory is unclear from record	-%	6.4%	6.3%	6.5%	10.0%	10.0%	3.7%
	-number of consultations (median, IQR)	2 (1-4.25)	2.5 (1.25-5.75)	2 (1.25-3.0)	2 (2-4)	2 (1-4)	2.5 (1-3.5)

4

Type of care delivered by YMHPNs

In the 247 records with complete documentation in the RPCD, YMHPNs reported to have one or more contacts to discuss treatment options with external care providers (e.g. school, mental health services) in 50.2% of records. YMHPNs recorded using psychoeducation (25.9%) and CBT-based treatment (13.4%) in a minority of cases. In 17.0% of records, the YMHPN provided E-health interventions for psychological problems. Complete details on the activities of YMHPNs and on the used treatment techniques are shown in Table 4.

Table 4. Activities of YMHPN during treatment trajectory

	Children with complete medical file N=247	0-6 years N=20	7-12 years N=88	13-17 years N=139	Girls N=135	Boys N=112
YMHPN had one more contacts concerning the child with external care provider.	50.2%	70.0%	52.3%	46.0%	50.4%	50.0%
YMHPN had contact with:						
School	14.2%	25.0%	18.2%	10.1%	14.1%	14.3%
Child protective services	5.7%	10.0%	3.4%	6.5%	8.1%	2.7%
Mental health services	23.5%	20.0%	26.1%	22.3%	21.5%	25.9%
Other services[a]	28.7%	50.0%	30.7%	24.5%	28.9%	28.6%
Psycho-education	25.9%	10.0%	23.9%	29.5%	31.9%	18.8%
Cognitive Behavioural Therapy	13.4%	5.0%	14.8%	13.7%	17.8%	8.0%
E-health	17.0%	5.0%	10.2%	23.0%	19.3%	14.3%
Exercises and assignments	40.1%	25.0%	39.8%	42.4%	42.2%	37.5%

[a] *Support team and/or centre for youth and family*

Discussion

Main findings of this study

In our study we evaluated how YMHPNs manage psychosocial problems in children and adolescents within general practice using electronic records from an extensive GP database. In daily practice, YMHPNs are confronted with a large variety of psychosocial problems. Managed children were often in their adolescence (57.3% was between 13 and 17 years) and were more often female than male (59.2% vs 40.8%). In more than half of cases, the YMHPN eventually referred the child for additional care to external services. In almost one in four cases, the YMHPN successfully managed the problem, and no additional referral or intervention was needed. Approximately one in eight children dropped out during the treatment trajectory.

What is already known on this topic

It has been suggested that integration of child mental health services into primary care, leads to improved access and quality of mental health care.[31] A systematic review showed beneficial effects (e.g. improved health outcomes of affected children) of integrating child mental health services in primary care.[32] The included studies used different approaches to integrate mental health care into primary care and are mostly not directly comparable to our study design. One of the included studies, however, used a similar approach to our study.[33] It investigated a nurse-led psychosocial intervention within primary care for children with behavioural problems as compared to usual care. Children treated in primary care with the nurse-led intervention completed treatment more often and showed better, albeit modest, clinical improvement than children receiving usual care.[33]

There are some indications that the introduction of YMHPNs within general practices led to more identification of psychosocial problems without reducing the number of referrals to specialized care.[16] An earlier study showed that 55% of children managed by a YMHPN were eventually referred to specialized services.[17]

What this study adds

The goal of this study was to describe characteristics and the type of problems of children consulting YMHPNs, and how YMHPNs managed these problems. We found that children consulting a YMHPN were often in their adolescence, and were more often girl than boy. This findings are in line with the occurrence of mental health problems which increases with increasing age peaking in adolescence.[34] Additionally, mental health problems tend to be more common in boys during early childhood, while girls are more often affected during adolescence.[35, 36]

YMHPNs appear to manage a wide range of mental health problems, and treatment trajectories were usually relatively short (median of 4 consultations). This aligns with earlier findings showing that the majority of treatment trajectories last 8 weeks or less.[37] Besides a variety of techniques and treatment approaches, in a minority of patients, the YMHPN reported to use CBT-based interventions. CBT is a treatment for many mental health problems with the largest evidence base, but it can be time-consuming and therefore less suitable for the general practice setting.[38–40] Brief CBT-based interventions form a promising alternative for traditional CBT, and may be more suitable general practice.[41] Future research should investigate the effectiveness of brief

psychological interventions (e.g. CBT-based) that can easily be used by YMHPNs for managing psychosocial problems. To date, the evidence base is rather scarce. Further, also the effectiveness of E-health in primary care should be subject of more research,[42] as it was common for YMHPNs to use E-health in their management.

One of the presumed benefits of the introduction of the YMHPN was that this would lead to more targeted referrals with less rejections of referrals.[16] However, in our study, at least 26.8% of initial referrals was rejected by specialized health services. This can be burdensome for affected families. Therefore, future research should focus on how to improve and streamline the referral process from primary care to specialized services.

In our study, we observed that YMHPNs were able to successfully manage or treat 22.4% of children. Thus, the YMHPN might fill a treatment gap for those not requiring specialized care but still in need of some treatment for the observed psychosocial problems. Further, for those children and adolescents who are subsequently referred to specialized care, the YMHPN might fulfill an important bridging role, given the long waiting lists for specialized care.[43, 44] Only 13.3% of children dropped out during the treatment trajectories with YMHPNs, which can be interpreted as good adherence with the treatment offered by the YMHPN in our study. The low number of treatment drop-outs might be explained by the high level of familiarity with the general practice setting and by the accessibility of treatments within this setting. However, it should be noted that treatment trajectories in our study were relatively short, which could also be a reason for the observed low number of treatment drop-outs.

Limitations of this study

The use of routinely registered health care data for research has disadvantages. Documentation is often limited and YMHPNs may not always have written down all relevant information. Even more, in 128 of 375 records, the YMHPN used two separate systems for documentation, while we only had access to the GP record but not to the second documentation system. Therefore, these records could not be used to describe the care delivered by YMHPNs. Also, the ICPC codes used for defining the target problem often described the reason for consultation (e.g. 'Worries about child's behavior'), rather than the actual problem of the child (e.g. 'Anxiety disorder'). Additionally, YMHPNs did not report specific outcomes of their treatment trajectory in the medical record (e.g. pre- and post-treatment scores on validated scales). Therefore, it is not possible to quantify the effectivity of the treatment trajectory of the YMHPN. Given the observational nature

of our data, it was not possible to compare integrated care delivered by a YMHPN with treatment as usual, which would have been possible in a trial design. Finally, it is important to realize that our study was performed in an urban population with a relatively low economic status.[45] Hence, our results might not necessarily be generalizable to other populations (e.g. rural or more affluent).

Conclusion

YMHPNs working in Dutch general practices managed a wide variety of psychosocial problems. In one in four children, the YMHPN successfully managed the problem, and no additional treatment was needed. Drop-out rates were low indicating good treatment adherence. The broad range of problems managed by the YMHPN, together with a considerable proportion of children not needing additional referral to specialized care after consulting a YMHPN as well as low drop-out rates observed in our study indicate the potential usefulness of the YMHPN as an additional source of treatment for children and adolescents with psychosocial problems.

References

1. Belfer ML. Child and adolescent mental disorders: the magnitude of the problem across the globe. J Child Psychol Psychiatry 2008;49(3):226–36.

2. Rocha TB-M, Graeff-Martins AS, Kieling C. et al. Provision of mental healthcare for children and adolescents: a worldwide view. Curr Opin Psychiatry 2015;28(4):330–5.

3. Kieling C, Baker-Henningham H, Belfer M. et al. Child and adolescent mental health worldwide: evidence for action. The Lancet 2011;378(9801):1515–25.

4. O'Brien D, Harvey K, Howse J. et al. Barriers to managing child and adolescent mental health problems: a systematic review of primary care practitioners' perceptions. Br J Gen Pract 2016;66(651): e693–707.

5. Hodgkinson S, Godoy L, Beers LS. et al. Improving mental health access for low-income children and families in the primary care setting. Pediatrics 2017;139(1):e20151175.

6. Olfson M, Druss BG, Marcus SC. Trends in mental health care among children and adolescents. N Engl J Med 2015;372(21):2029–38.

7. Merikangas KR, He J-P, Burstein M. et al. Service utilization for lifetime mental disorders in U.S. adolescents: results of the National Comorbidity Survey–Adolescent Supplement (NCS-A). J Am Acad Child Adolesc Psychiatry 2011;50(1):32–45.

8. Barican JL, Yung D, Schwartz C. et al. Prevalence of childhood mental disorders in high-income countries: a systematic review and meta-analysis to inform policymaking. Evid Based Ment Health 2022;25(1):36–44.

9. Racine N, McArthur BA, Cooke JE. et al. Global prevalence of depressive and anxiety symptoms in children and adolescents during COVID-19: a meta-analysis. JAMA Pediat 2021;175(11):1142–50.

10. Kauhanen L, Wan Mohd Yunus WMA, Lempinen L. et al. A systematic review of the mental health changes of children and young people before and during the COVID-19 pandemic. Eur Child Adolesc Psychiatry 2023;32(6):995–1013.

11. Saunders NR, Kurdyak P, Stukel TA. et al. Utilization of physician-based mental health care services among children and adolescents before and during the COVID-19 pandemic in Ontario, Canada. JAMA Pediatr 2022;176(4):e216298.

12. Overhage L, Hailu R, Busch AB. et al. Trends in acute care use for mental health conditions among youth during the COVID-19 pandemic. JAMA Psychiatry 2023;80:924–32.

13. van Yperen T, van de Maat A, Prakken J. [The growing use of youthcare; interpretation and strategy]. [Report in Dutch] [Het groeiend jeugdzorggebruik; Duiding en aanpak]. Netherlands Youth Institute 2020; https://www.nji.nl/system/files/2021-04/Het-groeiend-jeugdzorggebruik-Duiding-en-aanpak.pdf.

14. Mieloo C, van der Ende J, van Zijl AL. et al. Changes in youth care use after the implementation of community-based support teams: repeated measurement study using registry data and data on team characteristics. BMJ Open 2022;12(2):e048933.

15. Bucx F, de Groot J, Hageraats R. et al. Eerste Evaluatie van de Jeugdwet: transformatie in zicht? TSG Tijdschr Gezondheidswet 2018;96(8):342–7.

16. Verhaak PFM, van Dijk M, Walstock D. et al. A new approach to child mental healthcare within general practice. BMC Fam Pract 2015;16(1):132.

17. Zwaanswijk M, Geuijen P, Boelhouwer M. et al. Verwijspatronen bij praktijkondersteuners jeugd. Huisarts Wet 2020;63(5):14–8.

18. Jonker T, Remmelts H, Huyghen A-M. et al. Ervaringen en perspectief van de POH-Jeugd. Huisarts Wet 2020;63(10):33–7.

19. Spijk-de Jonge MJ, Boelhouwer M, Geuijen P. et al. [Youth care in General Practice. Research into the deployment and use of the Youth Mental Health Practice Nurse] [Report in Dutch] [Jeugdhulp bij de huisarts. Onderzoek naar inzet en effect van de Praktijkondersteuner Jeugd], Accare Child Study Center 2019. https://www.jeugdhulpbijdehuisarts.nl/wp-content/uploads/2023/09/rapport-onderzoek-jeugdhulp-bij-de-huisarts.pdf.

20. Koet LBM, Bennenbroek JJM, Bruggeman AYS. et al. GPs' and practice nurses' views on their management of paediatric anxiety problems: an interview study. BMC Prim Care 2022;23(1):235.

21. Theunissen MHC, Dijkshoorn JJA, Velderman MK. Specialistische ondersteuning in de basiszorg voor jeugd: verbindingen maken in het sociale domein. TSG Tijdschr Gezondheidswet 2018;96(8):354–60.

22. van Schaaijk A, Flinterman L, de Geit E. et al. [The practice nurse in general practice: Diversity and capacity][Report in Dutch] [De praktijkondersteuner huisartsenzorg (POH) in de huisartsenpraktijk: diversiteit en capaciteit], NIVEL 2022. https://www.nivel.nl/sites/default/files/bestanden/1004153.pdf.

23. Otten E, Geuijen P, Zwaanswijk M. et al. Specialistische ondersteuner huisartsenzorg jeugd-GGZ (SOH-JGGZ). Bijblijven 2018;34(8):596–615.

24. Koet LB, de Schepper EI, Bohnen AM. et al. Anxiety problems in children and adolescents: a population-based cohort study on incidence and management in Dutch primary care. Br J Gen Pract 2022;72(719):e405–12.

25. CBS . [Statistics on Poverty in Families] [Report in Dutch] CBS. Updated 16 December 2023. Accessed 10 January 2024. https://www.nji.nl/cijfers/armoede-gezinnen#:~:text=In%20Rotterdam%2C%20Heerlen%2C%20Delfzijl%20en,procent%20van%20de%20minderjarige%20kinderen.

26. de Ridder MAJ, de Wilde M, de Ben C. et al. Data resource profile: the Integrated Primary Care Information (IPCI) database, The Netherlands. Int J Epidemiol 2022;51:e314–23.

27. Lamberts H, Wood M. ICPC: International Classification of Primary Care. Oxford, Oxford University Press, 1990.

28. Napel HT, van Boven K, Olagundoye OA. et al. Improving primary health care data with ICPC-3: from a medical to a person-centered perspective. Ann Fam Med 2022;20(4):358–61.

29. Coe K, Scacco JM. Content analysis, quantitative. The International Encyclopedia of Communication Research. Methods 2017;1–11.

30. Benchimol EI, Smeeth L, Guttmann A. et al. The reporting of studies conducted using observational routinely-collected health data (RECORD) statement. PLoS Med 2015;12(10):e1001885.

31. Kolko DJ, Perrin E. The integration of behavioral health interventions in children's health care: services, science, and suggestions. J Clin Child Adolesc Psychol 2014;43(2):216–28.

4

32. Asarnow JR, Rozenman M, Wiblin J. et al. Integrated medical-behavioral care compared with usual primary care for child and adolescent behavioral health: a meta-analysis. JAMA Pediatr 2015;169(10):929–37.

33. Kolko DJ, Campo JV, Kelleher K. et al. Improving access to care and clinical outcome for pediatric behavioral problems: a randomized trial of a nurse-administered intervention in primary care. J Dev Behav Pediatr 2010;31(5):393–404.

34. Solmi M, Radua J, Olivola M. et al. Age at onset of mental disorders worldwide: large-scale meta-analysis of 192 epidemiological studies. Mol Psychiatry 2022;27(1):281–95.

35. Kovess-Masfety V, Husky MM, Keyes K. et al. Comparing the prevalence of mental health problems in children 6–11 across Europe. Soc Psychiatry Psychiatr Epidemiol 2016;51(8):1093–103.

36. Silva SA, Silva SU, Ronca DB. et al. Common mental disorders prevalence in adolescents: a systematic review and meta-analyses. PloS One 2020;15(4):e0232007.

37. Municipality of Rotterdam. [Interim report evaluation deployment of Youth Mental Health Practice Nurse in general practices in Rotterdam][Report in Dutch] [Tussenrapportage evaluatie inzet Praktijk ondersteuner Huisartsen Jeugd en Gezin in de Rotterdamse huisartspraktijken, Municipality of Rotterdam 2021. https://onderzoek010.nl/news/Tussenrapportage-evaluatie-inzet-POH-J--G-in-de-Rotterdamse-huisartspraktijken-Samenvatting/252.

38. Oud M, de Winter L, Vermeulen-Smit E. et al. Effectiveness of CBT for children and adolescents with depression: a systematic review and meta-regression analysis. Eur Psychiatry 2019;57:33–45.

39. Pegg S, Hill K, Argiros A. et al. Cognitive Behavioral therapy for anxiety disorders in youth: efficacy, moderators, and new advances in predicting outcomes. Curr Psychiatry Rep 2022;24(12): 853–9.

40. Kagan ER, Frank HE, Knepley MJ. et al. Beyond 16 sessions: extending manualized treatment of anxious youth. J Child Fam Stud 2021;30(2):493–501.

41. Öst L-G, Ollendick TH. Brief, intensive and concentrated cognitive behavioral treatments for anxiety disorders in children: a systematic review and meta-analysis. Behav Res Ther 2017;97:134-45.

42. Zhou X, Edirippulige S, Bai X. et al. Are online mental health interventions for youth effective? A systematic review. J Telemed Telecare 2021;27(10):638–66.

43. NHS . Waiting times for children and young people's mental health services 2021 - 2022. NHS. Updated 26 September 2022. Accessed 30 October 2023. https://digital.nhs.uk/supplementary-information/2022/waiting-times-for-children-and-young-peoples-mental-health-services-2021-2022.

44. Edbrooke-Childs J, Deighton J. Problem severity and waiting times for young people accessing mental health services. BJPsych Open 2020;6(6):e118 10.1192/bjo.2020.103.

45. CBS . Sociaal-economische status; scores per wijk en buurt, regio-indeling 2021. CBS. Updated 07-04-2022. Accessed 11 December 2023. https://www.cbs.nl/nl-nl/cijfers/detail/85163NED.

Supplementary files

Supplementary eTable 1. *stepwise selection of cases "children consulting a YMHPN for psychosocial problems" for quantitative content analysis*

Step 1	The search algorithm searched all medical dossier (children <18) registered in GP practice that took part in the YMHPN (youth mental health practice nurse) municipal project during the study period for presence of 1) "practice nurse" insurance code or 2) free-text "(Youth) Mental Health Practice Nurse" including abbreviations and parts of the free text to include typing errors for the. The first hit within a medical record within the study period was selected. Because asthmatic problems in children are sometimes managed by a 'somatic' practice nurse, we automatically excluded all consultations for a respiratory problem (ie, hits with insurance code or free-text of YMHPN which was coded with a respiratory ICPC-code). In these cases, if more hits were present in the medical file, the next hit was selected. We automatically excluded hits that had less than less than 180 days of valid follow-up after the date the YMHPN was for the first mentioned in the record. The search algorithm detected in total 576 cases
Step 2	All 576 medical records were screened, studying in detail the first year after the hit. In case of incorrectly selected medical record, the following medical record was studied to check for later involvement of the YMHPN. 42 Medical records selected by the algorithm but with no actual involvement of the YMHPN were excluded (eg, consultations of children with a practice nurse for asthma without respiratory ICPC code, algorithm selected typo, etc). This gave 534 cases in which the YHMPN was mentioned in the medical record.
Step 3	We recorded how the YMHPN was involved in the case. In 52 records, the YMHPN assisted the GP (eg, by discussing the child or helping with the writing of referral letters), but did not have consultations with the child or its caregivers. In 54 records, the GP advised a child or its caregivers to make an appointment with the YMPHN, but subsequently no appointment was made or appointment was cancelled by child or its caregivers. In 53 records the GP wrote down the possibility to involve the YMPHN but it was unclear from the record whether this was recommended to child or its caregiver. This gave 375 cases of children that had one or more consultations with the YMHPN.
Step 4	Full medical files of these 375 cases were read and data was extracted. 129 medical records were impartial (ie, the YMHPN recorded in both the GP record, and a separate file). These partial files could not be used for all type of information (eg, the type of treatment given was at times not mentioned in the GP record), number of consultations and referrals were always written down in the GP record. This gave 247 cases with full information which were used for extraction on the type of delivered care.

Supplementary eTable 2. *Positive predictive value of search algorithm*

Search term	Number of hits	Number of hits that correctly identified mention of YMHPN in medical record	Positive Predictive value for mention of YMHPN
Complete algorithm	576	534	92.7%

Supplementary eTable 3. *Checklist for manual extraction of data*

Step 1	Did the 'hit' select by the algorithm concern a record on the YMHPN (including consultation, advice, exchange of ideas between GP and YMHPN) concerning a psychosocial problem? Choose from: a) Yes b) No (eg, it concerned a practice nurse for respiratory problems), if no check for later involvement of YMHPN, if not stop further coding.
Step 2	In what way was the YMHPN involved in the case, choose from: a) YMHPNs has consultations with the child and/or caregiver b) GP advices child to visit YMHPN but consultations do not take place either because no appointment is made or because child or caregiver cancels the scheduled appointment, and no subsequent consultation takes place c) YMPHNs helps GP but no consultations with child and/or caregiver take place (eg, GP and YMHPN exchange ideas, YMHPN helps GP with writing the referral/choosing appropriate service to refer to) d) GP writes down the possibility to involve the YMHPN, but it is not clear from the medical file whether this was advised to the patient.
Step 3	In case consultations with YMHPN took place Did the YMHPN recorded having contact with one of the following external care providers? -School or school social work a) Yes b) No -Local Neighbourhood team a) Yes b) No -Centre for Youth and Family a) Yes b) No -Child protection a) Yes b) No -Child Mental Health Services a) Yes b) No
Step 5	In case consultations with YMHPN took place Did the YMHPN refer the patient for (additional) help to other caregivers outside of general practice? Referral to: - Local Neighbourhood team a) Yes b) No - Centre for Youth and Family a) Yes b) No - Specialized Child Mental Health Services a) Yes b) No
Step 6	In case consultations with YMHPN took place In case of referral by the YMHPN, was the first referral accepted by the receiving institution? Choose from: a) Yes b) No c) Unclear
Step 7	In case consultations with YMHPN took place -How many consultations with YMHPN took place? (count) -How many contacts did the YMHPN have with external care providers to exchange ideas about the management of the case? (count) -How many no-shows (including last day cancellations) took place? (count)
Step 8	In case consultations with YMHPN took place. With whom did consultations take place? -Child alone a) Yes b) No -Caregiver alone a) Yes b) No -Child and caregiver together a) Yes b) No
Step 9	In case consultations with YMHPN took place. What type of treatment techniques were recorded in the medical record? -psychoeducation to child and/or parent a) Yes b) No -cognitive behavioural therapy (including specific exercises based on CBT) a) Yes b) No -exercises, assignments, homework a) Yes b) No -E-health a) Yes b) No

Step 10 How did the treatment trajectory with YMHPN end? Choose best fitting option:
- a) Child stops from own initiative against advice (including not responding anymore to request to make new appointment)
- b) Child and/or caregiver decide together that problem is sufficiently regressed and no additional treatment is needed at this point
- c) GP or other instance had already referred child to specialised care, however YMHPN provides bridging care while child is on waiting list
- d) YMPHN declines treatment (eg, because child has already other treatment, or finds it none relevant problem)
- e) YMPHN has consultations with child, but during trajectory it is decided that additional care with external provider is more fitting, and child is referred.
- f) The treatment trajectory with YMHPN is still ongoing and no referral has taken place at one year after start of involvement of YMHPN

4

Supplementary eTable 4. Comparison of children with complete and partial medical record

	All children N=376	**Complete medical file** N=247	**Partial medical file** N=129
Age	12.9 (SD 3.8)	12.9 (SD 3.8)	12.9 (SD 3.8)
Female (%)	59.2%	54.7%	68.0%
Median number of consultations (IQR)	4 (2-7)	3 (1-6)	4 (2-9)
Number of contacts with external mental health care providers	0 (0-1)	0 (0-1)	0 (0-1)
Number of no shows	0 (0-1)	0 (0-1)	0.5 (0-2)
≥1 Referral to mental health services(%)	51.7%	52.6%	50.0%
First referral accepted (%)			
Yes	44.3%	46.9%	39.1%
No	26.8%	24.6%	31.3%
Unclear	28.9%	28.5%	29.7%
Referral to (%)	Neighbourhood team – 13.1% Centre Youth and Family – 6.1% Mental health care institution – 42.4%	Neighbourhood team – 13.0% Centre Youth and Family – 6.9% Mental health care institution – 44.1%	Neighbourhood team – 13.3% Centre Youth and Family – 4.7% Mental health care institution – 39.1%

Supplementary eFigure1. *Flowchart of selection of records for analysis*
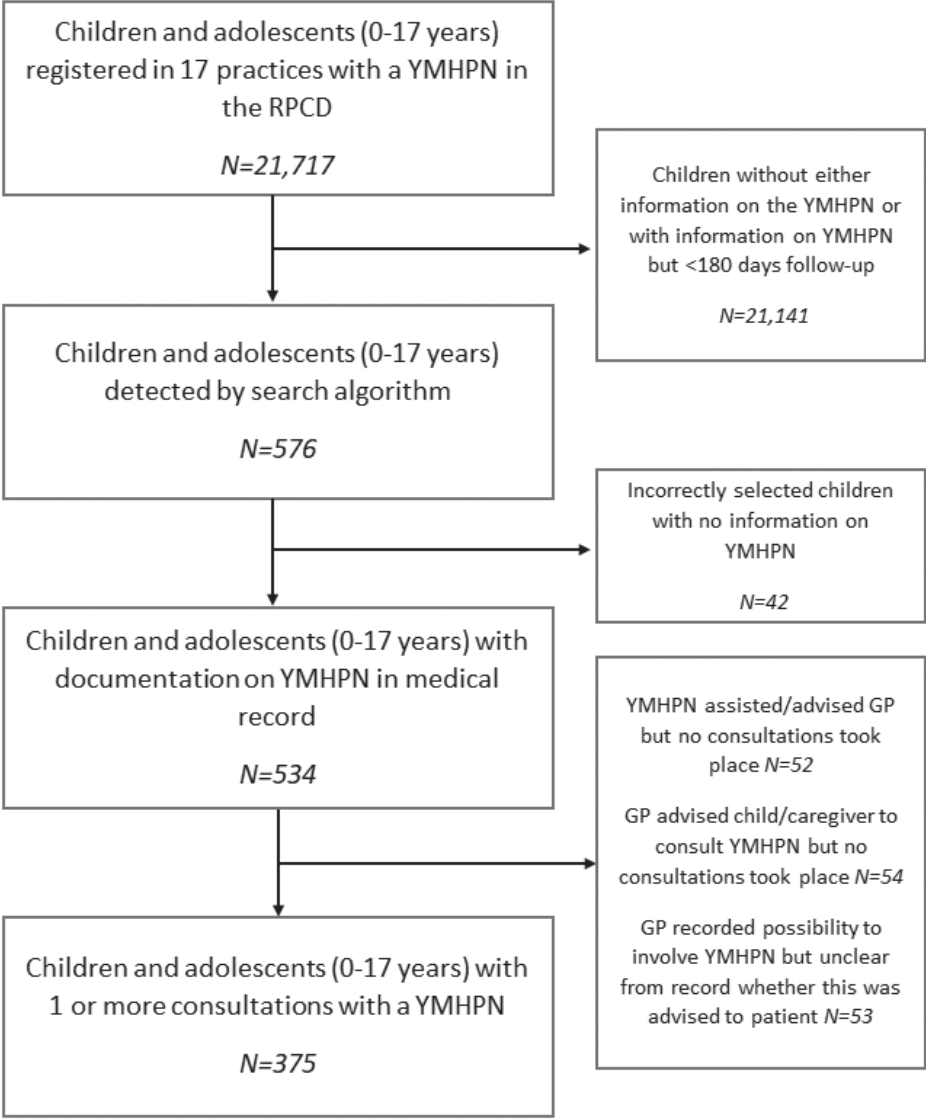
Supplementary eTable 5. *Complete description of characteristics and treatment trajectory per age–group and sex*

	All children consulting a YMHPN N=375	0-6 years N=30	7-12 years N=130	13-17 years N=215	Girls N=222	Boys N=153
Age	12.9 (SD 3.8)	n.a.	n.a.	n.a.	13.6 (SD 3.7)	12.0 (SD 3.8)
Female (%)	59.2%	40.0%	46.9%	69.3%	n.a.	n.a.
Deprived area (%) *	48.1%	57.1%	50.4%	45.5%	49.1%	46.7%
Median number of consultations (IQR)	4 (2-7)	3 (1.25-5)	3 (2-6)	4 (2-8)	4 (2-7)	3 (2-6)
Median number of contacts with external care providers	0 (0-1.5)	1 (0-2.75)	0 (0-2)	0 (0-1)	0 (0-1)	0 (0-2)
Median number of no shows	0 (0-1)	0 (0-1)	0 (0-1)	1 (0-2)	0 (0-1)	0 (0-1)
≥1 Referral to mental health services (%)	51.7%	56.7%	40.8%	51.6%	49.6%	54.9%
Referral to (%)						
Neighbourhood team	13.1%	13.3%	23.1%	7.0%	13.1%	13.1%
Centre Youth and Family	6.1%	3.3%	7.7%	5.6%	7.7%	3.9 %
Mental health care institution	42.4%	30.0%	43.1%	43.7%	39.2%	47.1%
Neighbourhood team and/or Centre Youth and Family	17.3%	13.3%	28.5%	11.1%	18.5%	15.7%
First referral accepted (%)						
Yes	44.3%	23.1%	50.7%	42.3%	42.7%	46.4%
No	26.8%	46.2%	16.9%	31.7%	24.5%	29.8%
Unclear	28.9%	30.8%	32.5%	26.0%	32.7%	23.8%

7 children did not have information on whether they lived in a deprived area.

Chapter 5

Children and young people's consultation rates for psychosocial problems between 2016 and 2021 in the Netherlands

Lukas BM Koet, Premysl Velek, Patrick JE Bindels, Arthur M Bohnen,
Evelien IT de Schepper, Heike Gerger

Abstract

Background

Worldwide, there are concerns about declining mental health of children and young people (CYP).

Objectives

To examine trends in GP consultation rates for psychosocial problems and the impact of the COVID-19 pandemic.

Methods

We performed a population-based cohort study using electronic GP records of CYP (0–24 years) living in the Rotterdam metropolitan area between 2016 and 2021. We calculated monthly consultation rates for psychosocial problems, stratified by age group and sex. We used negative binomial models to model the pre-COVID-19 trend, and estimate expected rates post-COVID-19 onset. We modelled the effect of COVID-19 infection rate and school closure on consultation rates per sex and age group.

Results

The cohort increased from 64801 to 92093 CYP between January 2016 and December 2021. Median age was 12.5 years and 49.3% was female. Monthly consultation rates increased from 2,443 to 4,542 consultations per 100,000 patient months over the six years. This trend (RR 1.009, 95% CI 1.008–1.011) started well before the COVID-19 pandemic. Consultation rates of adolescent girls and young women increased most strongly. Between March and May 2020, there was a temporary reduction in consultation rates, whereupon these returned to expected levels. COVID-19 infection rate and school closures showed small but significant associations with consultation rates for psychosocial problems but this did not affect the overall trend. Although consultation rates for psychosocial problems increased, this increment was stable over the entire study period.

Conclusion

The COVID-19 pandemic did not significantly increase consultation rates for psychosocial problems in CYP. The consultation rates increased, especially in adolescent girls and young women.

Introduction

There is much concern about the adverse effects of the COVID-19 pandemic and the associated public health measures on the mental health of children and young people (CYP).[1] According to a meta-analysis, the global prevalence of depression and anxiety symptoms in children and adolescents doubled during the first year of the pandemic.[2] Also in the Netherlands, CYP reported more mental health problems compared to pre-pandemic periods.[3]

Mental health problems in CYP significantly impair quality of life and have long-term disabling effects.[4,5] To mitigate those effects, CYP should receive appropriate treatment.[6] During the COVID-19 pandemic, temporary closures of many mental health services reduced access to appropriate care.[7,8] Indeed, research shows that the use of mental health services by CYP decreased during the early phase of the pandemic, highlighting potential delays or unmet needs for treatment.[9]

In the Netherlands, CYP presenting with psychosocial problems can be managed within general practice, sometimes by a specialised practice nurse or referred to specialised care.[10,11] Accordingly, Dutch GPs play an important role in identifying, managing and referring CYP with psychosocial problems.[12] The COVID-19 pandemic may have increased the importance of GPs in managing psychosocial problems of CYP (e.g. because of restricted access to specialised mental health services).[13]

Currently, information on the trends of GP consultations by CYP for psychosocial problems particularly during the COVID-19 pandemic is scarce. Also, it is unclear to what extent consultation rates were affected by the severity of the pandemic and the associated public health measures.

In this study, we investigated trends in monthly GP consultation rates for psychosocial problems in CYP between 2016 and 2021 and the impact of the COVID-19 pandemic on consultation rates by sex and age.

Methods

Study design and population

We used electronic records of children and young people (CYP) aged 0–24 years registered in general practices participating in the Rijnmond Primary Care Database (RPCD) between January 1st, 2016 and December 31st, 2021. The RPCD is a region-

5

specific derivative of the Integrated Primary Care Information (IPCI) database, covering the Rotterdam metropolitan area.[14] The RPCD currently consists of more than 600,000 patients. It contains pseudonymised routinely collected medical data of general practice patients, including all written GP notes, diagnostic codes, referrals, laboratory findings, GP prescriptions, and specialists' letters. In the Netherlands, GPs use the International Classification for Primary Care 1 (ICPC-1) to code the reasons for consultations.[15]

Calculation of consultation rates

We extracted (1) all GP consultations and (2) all patients with valid database information for each month. We calculated the monthly consultation rates for psychosocial and non-psychosocial problems (GP consultations per 100,000 patient months) for the complete cohort and per age group and sex. We defined psychosocial consultations as any contact between a GP and a patient (in person, by phone, or online) coded with any P-code (psychological problems, e.g. anxiety disorder), any Z-Code (social problems, e.g. relationship problems with parents/family), R98 (hyperventilation) or T06 (eating disorder). Supplementary Material Table 1 shows an overview of psychosocial ICPC codes, the most common psychosocial problems included ADHD, anxiety problems, depressive problems and learning problems. We classified other contacts as non-psychosocial consultations. We defined four age groups: young children (0–6 years), primary school children (7–12 years), high-school adolescents (13–17 years), and young adults (18–24 years). We also calculated non-psychosocial consultation rates for the complete cohort to assess whether the trend differed between non-psychosocial and psychosocial consultations.

Data-analysis

We fitted negative binomial models to assess our research questions (R version 4.0.0, MASS package).[16] In our models we adjusted for monthly seasonality and a linear trend over time. For selection of our models we used backward stepwise selection and reduced models one-by-one variable using F and likelihood-ratio tests with a cut-off value ($p < 0.05$; Supplementary Material Table 2). Residual plots were used to validate the models' assumptions. In Model 1 we used data from January 2016 until February 2020 to estimate the expected consultation rates for psychosocial problems for the pandemic period (March 2020 to December 2021). We used Model 1 to calculate the expected number of consultations for the first COVID-19 wave (March-May 2020) and the complete

COVID-19 period (March 2020–December 2021) by summing up the expected monthly rates with their 95% CI and compared these with the observed numbers.

We repeated this analysis for non-psychosocial problems (Model 2) to allow for comparisons of trends between psychosocial and non-psychosocial problems (i.e. to critically evaluate whether changes in consultation rates for psychosocial problems are different from overall changes in consultation rates over time). Next, we used the complete study period to investigate in which manner COVID-19 impacted consultation rates (Model 3) and whether this differed between age groups and sexes (Model 4). For this, we used 'OurWorldInData.org,' which contains daily statistics on the COVID-19 pandemic for every country.[17] We considered five indicators of COVID-19 pandemic severity to be of possible relevance: 'COVID-19 infection rate,' 'COVID-19 death rate,' 'COVID-19 hospitalisation rate,' 'COVID-19 stringency index,' 'school-closure index'.[17, 18] School closure is expressed on four levels, ranging from no measures to closing off all school levels.[18] These indices, averaged per month, were tested as covariates. There was multicollinearity between these indicators, with high values on the variance inflation factor (VIF > 10) and significant coefficient changes when removing individual coefficients. We selected the 'school-closure index' and 'COVID-19 infection rate' as predictors in the final models as they were the most relevant predictors showing no multicollinearity. In Model 3 we investigated the overall impact of 'school-closure index' and 'COVID-19 infections' on CYP' consultation rates. In Model 4, we tested for heterogeneity in the effect of 'school-closure index' and 'COVID-19 infections' in different age groups and sexes by testing for interactions between these variables (Supplementary Material Table 2).

Sensitivity analyses

We repeated the previously described analyses using the total number of unique patients consulting per month instead of the total number of consultations per month (i.e. if a patient had two consultations in one month this was counted as one unique patient).

Ethics and data availability

The study was approved by the Governance Board of the RPCD (project number 2020.012). All patient data was pseudonymised. Therefore, by Dutch law, no patient consent is required. We followed the RECORD guidelines for studies conducted using routinely collected health data.[19] Due to legal constraints, data is not publicly available and access requires approval from the Governance Board of RPCD.

Results

Cohort characteristics

The number of CYP (0–24 years) in our database, which consists of practices in the Rotterdam metropolitan area, increased from 64801 patients in January 2016 to 92093 patients in December 2021 due to more general practices providing data to the RPCD. The median age was 12.5 years (IQR 6.5–18.5), and 49.3% were female. Approximately 20% of CYP lived in a socially deprived area.[20] These cohort characteristics remained stable over time (Table 1).

Table 1. Study population demographics

Year	N Population size	Sex (% Female)	Median age (IQR)	Deprivation status (% registered in deprived postal code)
2016	64801	49.3%	12.5 (6.5-18.5)	19.2%
2017	74788	49.2%	13 (6.5-19)	20.6%
2018	80501	49.1%	13 (6.5-19)	20.0%
2019	79210	49.1%	13 (6.5-19)	20.5%
2020	82802	49.1%	13 (6.5-19)	20.4%
2021	96635	49.1%	12.5 (6.5-18.5)	21.9%

The RPCD is a dynamic cohort and the study population differed per month. Numbers represent the month January of each year.

Consultation rates per age and sex categories

By visually inspecting the observed consultation rates for psychosocial problems differences between age groups and sexes can be seen (Figure 1, Supplementary Material Figure 1). Consultation rates for psychosocial problems were lowest in young children (0–6 years), while consultation rates for psychosocial problems were highest in girls (13–17 years) and young women (18–24 years).

Time trend of consultation rates

The monthly consultation rate for psychosocial problems increased strongly from 2,443 consultations per 100,000 patient months in January 2016 to 4,542 consultations per 100,000 patient months in December 2021. Visual inspection showed a linearly increasing trend with reasonable seasonal variation (e.g. lower consultation rates during summer holidays; Figure 2a). Consultation rates for non-psychosocial problems showed a much smaller increase over time (Figure 2b). This is reflected in Model 1 and 2, in which consultation rates for psychosocial problems show a stronger increase in the pre-pandemic period than those for non-psychosocial problems (relative rate (RR) 1.009 [95% CI 1.008–1.011] vs 1.004 [95% CI 1.003–1.005] per month, Supplementary Material Table 3).

Figure 1. Consultation rates per age and sex categories over time

Observed consultation rates for psychosocial problems per age and sex / 100,000 person months
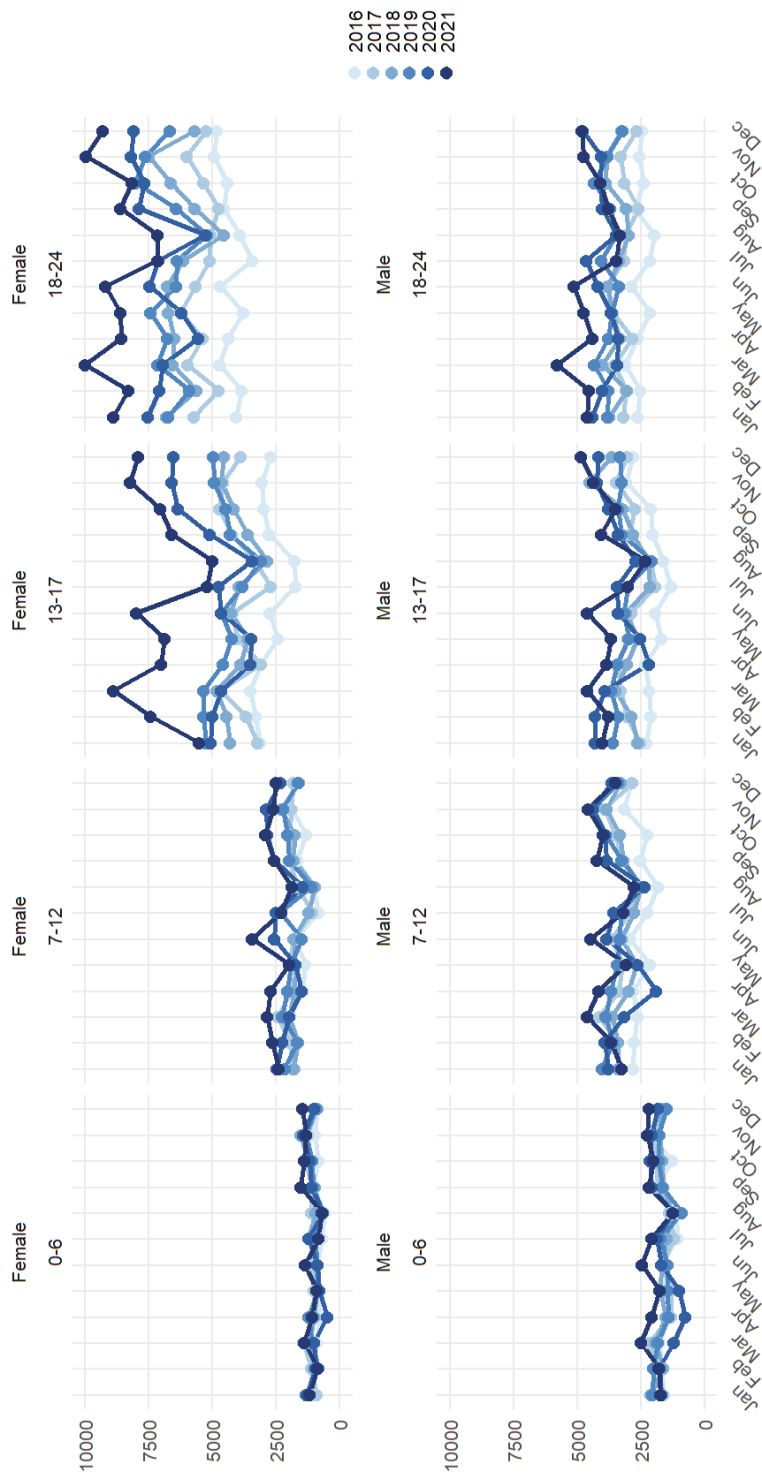
Figure 2. Expected and observed consultation rates over time
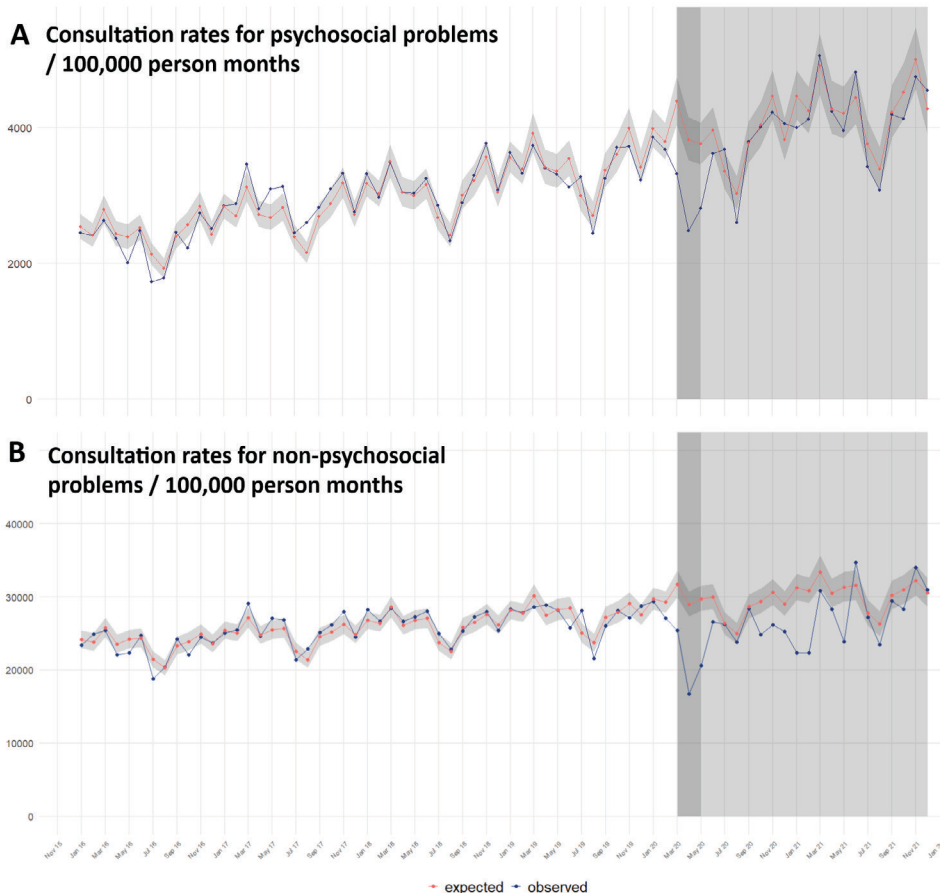
Figure 2a shows the observed monthly psychosocial consultation rates and the expected rates based on Model 1. Figure 2b shows the observed non-psychosocial rates and the expected rates based on Model 2. The shaded area indicates the pandemic period with the first wave in dark grey.

Impact of the COVID-19 pandemic on consultation rates: Observed vs expected consultations

Model 1 and 2 estimated consultation rates for psychosocial and non-psychosocial problems during the COVID-19 pandemic based on pre-pandemic data and aimed to compare expected and observed rates. Using visual inspection, we saw a decrease in consultation rates for both psychosocial and non-psychosocial problems during the first COVID-19 lockdown in March-May 2020 compared to expected rates (Figure 2). Hereafter, the rates for psychosocial problems returned to expected levels without clear

indications of significant changes in subsequent lockdowns. A total of 7,382 psychosocial consultations occurred during the first COVID-19 lockdown (March-May 2020). Based on Model 1 the number of observed consultations was 28.1% significantly lower than expected (expected: 10,262 consultations 95% CI 9,459–11,134; Supplementary Material Table 4). In the complete COVID-19 period (March 2020–December 2021) a total of 82,941 consultations took place which was 5.4% non-significantly lower than expected (87,637 95% CI 80,398–94,876) based on Model 1.

Impact of COVID-19 infection rate and school closures on observed consultation rates

In Model 3 we tested whether COVID-19 infection rates and school closures affected observed consultation rates. In Model 3 seasonality, trend over time, 'COVID-19 infection rate', and 'school-closure index' were all significantly associated with observed consultation rates for psychosocial problems (Table 2). Complete school closure was associated with an overall reduction in observed consultation rates with a RR of 0.786 (95% CI 0.706–0.875) when compared with periods with no school closure. A higher COVID-19 infection rate was associated with a slight increase in observed consultation rates for psychosocial problems. An increase in the average daily number of new COVID-19 infections 1 per 1,000 inhabitants was associated with an increase in observed consultation rates with an RR of 1.010 (95% CI 1.002–1.018).

Table 2. Regression table of Model 3 estimating the effect of COVID-19 indices on consultation rates

Variables	Estimate of relative rate (RR) (95% CI)	P Value
Trend over time (RR per subsequent month)	1.010 (1.008-1.011)	p<0.001
School closure[a]	0.786 (0.706-0.875)	p<0.001
COVID-19 infection rate[b]	1.010 (1.002-1.018)	p=0.010

Only significant variables were kept in the final model. We adjusted for effects of seasonality. For the complete model including seasonality variables see eTable 3.

[a] *School closure is a levelled indices, transformed to a scale from 0 to 1, averaged per month. 0 represents a complete month without restrictions, 1 represents a month with complete school closure.*

[b] *COVID-19 infection rate represents the national number of daily new cases per 1000 inhabitants, averaged per month.*

In Model 4 we tested whether the influence of COVID-19 infection rate and school closures on GP consultation rates for psychosocial problems differed per age group and sex (Table 3). The effect of school closure differed per age group. In children (0–6 years), complete school closure was associated with the most significant decrease in the consultation rate (RR 0.563, 95% CI 0.459–0.692). School closure did not have a different effect on consultation rates between males and females. Additionally, we did not find a significant difference in the effect of the COVID-19 infection rate on consultation rates between different age groups or between sexes.

Sensitivity analyses

Sensitivity analyses showed similar results to our primary analyses (Supplementary Material Figures 3 and 4, Supplementary Material Tables 6 and 7). Our analyses using unique patients showed that the number of CYP consulting the GP with a psychosocial problem increased over time (RR 1.007, 95% CI 1.006–1.008 per month), indicating that the overall increase in consultation rates over time can be explained by both more CYP contacting the GP and more consultations per patient.

Table 3. Regression table of Model 4 estimating the effect of COVID-19 indices in different age categories

Variables	Estimate of relative rate (RR) (95% CI)	P Value
Trend over time (RR per subsequent month)	1.009 (1.007-1.010)	p<0.001
Age 7-12	1.862 (1.725-2.010)	p<0.001
Age 13-17	2.513 (2.329-2.712)	p<0.001
Age 18-24	3.361 (3.116-3.626)	p<0.001
School closure[a] in:		
Age 0-6	0.563 (0.459-0.692)	p<0.001[c]
Age 7-12	0.693 (0.565-0.848)	
Age 13-17	0.951 (0.777-1.163)	
Age 18-24	0.891 (0.729-1.089	
COVID-19 infection rate[b]	1.013 (1.003-1.023)	p=0.009

The reference group is the consultation rate for children aged 0–6 years. Only significant variables and interactions were kept in the final model. Sex was no significant predictor. The effect of the different months (seasonality) is not shown in this table (eTable 5 for complete model). [a] *School closure is a levelled indices, transformed to a scale from 0 to 1, averaged per month. 0 represents a complete month without restrictions, 1 represents a month with complete school closure.* [b] *COVID-19 infection rate represents the national number of daily new cases per 1000 inhabitants, averaged per month.* [c] *There was a significant interaction between school closure and the different age categories, the effect is shown per age category, the presented P-value derives form likelihood-ratio test of the interaction components.*

Our main analyses showed that consultation rates for psychosocial problems increased, especially in adolescent girls (13–17 years) and young women (18–24 years). We, therefore, performed two post-hoc exploratory subgroup analyses for these categories (Supplementary Material Tables 2 and 8). The subgroup analyses with adolescent girls (13–17 years) and young women (18–24 years) were in line with our main analyses, except for a small, temporary increase in the consultation rates for adolescent girls between March–June 2021 (Supplementary Material Figure 5).

Discussion

Main findings

In our study, monthly consultation rates for psychosocial problems have been increasing strongly since 2016, especially among adolescent girls and young women. Consultation rates for both psychosocial and non-psychosocial problems dropped during the first COVID-19 wave. Hereafter consultation rates for psychosocial problems continued increasing following the pattern that was present before the start of the COVID-19 pandemic. Consultation rates for non-psychosocial problems remained lower than expected until the summer of 2021. Overall, the COVID-19 pandemic did not increase GP consultation rates in CYP for psychosocial problems.

Strengths and limitations

Our study has several strengths. First, we used the RPCD, a large population-based dynamic cohort representative of the Rotterdam metropolitan area. Contrary to many other studies on the effects of the COVID-19 pandemic using cross-sectional samples, we used data from six consecutive years, covering the peak of the COVID-19 pandemic in 2020 and 2021. This allowed for considering the trend of increasing health-seeking behaviour that had started before the pandemic. Second, we applied several sensitivity analyses, which yielded very similar results, confirming the validity of our findings. Third, we used information from 'OurWorldinData.org,' to measure the influence of the COVID-19 pandemic on consultation rates.[17] This database offers open access to statistical data on the COVID-19 pandemic for every country worldwide, making it possible to repeat our analysis in different settings. Fourth, we compared the overall trend for consultations for psychosocial problems with the overall trend for consultations for non-psychosocial problems to check whether the observed increases are to be seen as a general trend for more GP consultations by CYP during the study period.

This study also has limitations. First, in electronic healthcare databases, such as the RPCD coding by healthcare professionals may be imprecise. For instance, the ICPC coding systems allow for coding anxiety-related problems as P01 feeling anxious/stressed or as P74 anxiety disorder. However, as we included a broad range of psychosocial problems without differentiating between the individual problem areas, we do not think these imprecisions significantly affected our results. Second, we investigated overall consultation rates related to psychosocial problems without analysing specific mental health problems separately. Third, due to database properties, we could not differentiate between different types of consultation (e.g. by phone or in-person). Fourth, the RPCD is restricted to one metropolitan region in the Netherlands. Our findings might not necessarily generalise to more rural areas or other countries. Fifth, we used a dynamic cohort. Therefore the study population may change with general practices, such as joining or leaving the RPCD. However, in our cohort, the distribution of relevant patient characteristics remained stable. Finally, it is essential to realise that our study investigated help-seeking for psychosocial problems in general practice and not the occurrence of psychosocial problems per se. Our results should therefore be interpreted jointly with those of other types of studies (e.g. prevalence studies).

Comparison with existing literature

A limited number of studies investigated long-term changes in primary care consultations for psychosocial problems in CYP during the COVID-19 pandemic.[21–24] Most of these studies showed an initial sharp decrease in consultation rates, followed by increases later in the pandemic to rates above pre-pandemic levels.[21, 22, 24] Additionally, the increased consultation rates for psychosocial problems seemed most prominent in girls, especially those in adolescence.[21, 22, 24] Our findings confirm initially decreased consultation rates during the first pandemic wave, which increased afterwards. Importantly, we show that the increasing trend in consultation rates began well before the COVID-19 pandemic. This finding complements previous research describing a general increase in clinical diagnoses for psychiatric disorders in CYP over decades up to 2015,[25] as well as increases in medical outpatient visits resulting in mental health diagnoses between 1995 and 2012.[26] COVID-19 lockdowns and school closures have been linked to decreased mental health in CYP.[27, 28] Therefore, one can argue that more CYP would have sought help during forced school closure. Instead school closure was associated with decreased GP consultation rates in our study. Our finding that high COVID-19 infection rate showed

a weak association with higher consultation rates for psychosocial problems suggests that the severity of the pandemic (i.e. quick viral spread) led to a tendency for more help-seeking by CYP. This association might be explained by raised psychological distress and anxiety about the consequences of infection (possibly mediated by extensive media attention to the COVID-19 virus).[29]

Implications

Our analyses focused on consultation rates of CYP for psychosocial problems and showed not only an increase, especially in adolescent girls and young women but also an increasing gap between the sexes. These findings are in line with recent reports on the occurrence of psychosocial problems in CYP, which similarly show a higher prevalence of psychosocial problems in adolescent girls and young women and an increasing gap between sex-related prevalence to the disadvantaged girls.[3, 30, 31] However, it is known that teenage boys and young men are less likely to seek help for psychological problems compared with their female peers,[32] putting them potentially at risk of under detection. Future research should address these two possible explanations for the observed differences in consultation rates between males and females in our study. Additionally, it is crucial to investigate whether the observed increases in consultation rates, seen mainly in adolescent girls and young women, are the same across different psychosocial problems.

Conclusion

Consultation rates for psychosocial problems in CYP within general practices in the Rotterdam metropolitan area have increased strongly between 2016 and 2021. The most significant increase in consultation rates was observed among adolescent girls and young women. Importantly, this trend started well before the COVID-19 pandemic. In our study, consultation rates for psychosocial problems in CYP did not increase due to the COVID-19 pandemic.

References

1. Kauhanen L, Wan Mohd Yunus WMA, Lempinen L, et al. A systematic review of the mental health changes of children and young people before and during the COVID-19 pandemic. Eur Child Adolesc Psychiatry. 2023;32(6):995–1013. doi: 10.1007/s00787-022-02060-0. [DOI]

2. Racine N, McArthur BA, Cooke JE, et al. Global prevalence of depressive and anxiety symptoms in children and adolescents during COVID-19: a meta-analysis. JAMA Pediat. 2021;175(11):1142–1150.

3. Boer M, Dorsselaer van S, Looze de M, et al. HSBC 2021 Gezondheid en welzijn van jongeren. [HSBC 2021 health and well-being of youth in the Netherlands]. [Dutch]. Utrecht: University Utrecht: Utrecht University; 2022.[cited 2024 May 14]. Available from: https://www.trimbos.nl/wp-content/uploads/2022/09/AF2022-HBSC-2021-Gezondheid-en-welzijn-van-jongeren-in-Nederland.pdf.

4. Copeland WE, Shanahan L, Costello EJ, et al. Childhood and adolescent psychiatric disorders as predictors of young adult disorders. Arch Gen Psychiatry. 2009;66(7):764–772. doi: 10.1001/archgenpsychiatry.2009.85.

5. Reef J, Diamantopoulou S, van Meurs I, et al. Child to adult continuities of psychopathology: a 24-year follow-up. Acta Psychiatr Scand. 2009;120(3):230–238. doi: 10.1111/j.1600-0447.2009.01422.x.

6. Pilling S, Fonagy P, Allison E, et al. Long-term outcomes of psychological interventions on children and young people's mental health: a systematic review and meta-analysis. PLoS One. 2020;15(11):e0236525. doi: 10.1371/journal.pone.0236525. 7.The impact for COVID-19 on mental, neurological and substance use services: results of a rapid assessment. Geneva: World Health Organization. 2020. https://www.who.int/publications/i/item/978924012455

8. Rojnic Kuzman M, Vahip S, Fiorillo A, et al. Mental health services during the first wave of the COVID-19 pandemic in Europe: results from the EPA ambassadors survey and implications for clinical practice. Eur Psychiatry. 2021;64(1):e41. doi: 10.1192/j.eurpsy.2021.2215.

9. Wan Mohd Yunus WMA, Kauhanen L, Sourander A, et al. Registered psychiatric service use, self-harm and suicides of children and young people aged 0–24 before and during the COVID-19 pandemic: a systematic review. Child Adolesc Psychiatry Ment Health. 2022;16(1):15. doi: 10.1186/s13034-022-00452-3.

10. Koet LBM, Bennenbroek JJM, Bruggeman AYS, et al. GPs' and practice nurses' views on their management of paediatric anxiety problems: an interview study. BMC Prim Care. 2022;23(1):235. doi: 10.1186/s12875-022-01802-y.

11. Koet LB, de Schepper EI, Bohnen AM, et al. Anxiety problems in children and adolescents: a population-based cohort study on incidence and management in dutch primary care. Br J Gen Pract. 2022;72(719):e405–e412. doi: 10.3399/BJGP.2021.0557.

12. Zwaanswijk M, Van Der Ende J, Verhaak PFM, et al. The different stages and actors involved in the process leading to the use of adolescent mental health services. Clin Child Psychol Psychiatry. 2007;12(4):567–582. doi: 10.1177/1359104507080985.

13. Lee CM, Lutz J, Khau A, et al. Pediatric primary care perspectives of mental health services delivery during the COVID-19 pandemic. Children (Basel). 2022;9(8). doi: 10.3390/children9081167.

14. de Ridder MAJ, de Wilde M, de Ben C, et al. Data resource profile: the integrated primary care information (IPCI) database, The Netherlands. Int J Epidemiol. 2022;51(6):e314–e323. (doi: 10.1093/ije/dyac026.

15. Lamberts H, Wood M, World Organisation of National C . ICPC: international classification of primary care. Oxford: Oxford University Press; 1990. http://www.ph3c.org/PH3C/docs/27/000496/0000908.pdf

16. Venables WNRB. Modern applied statistics with S. 4th ed. New York: Springer; 2002. https://www.mimuw.edu.pl/~pokar/StatystykaMgr/Books/VenablesRipley_Modern AppliedStatisticsS02.pdf

17. Mathieu ERH, Rodés-Guirao L.. Coronavirus pandemic (COVID-19). 2022. [cited 2022 Dec 20]. Available from: https://ourworldindata.org; https://ourworldindata.org/coronavirus.

18. Hale T, Angrist N, Kira B, et al. Variation in government responses to COVID-19. BSG Working Paper Series. 2022. [cited 2022 Dec 20]. Available from: https://www.bsg.ox.ac.uk/sites/default/files/2020-05/BSG-WP-2020-032-v5.0_0.pdf.

19. Benchimol EI, Smeeth L, Guttmann A, et al. The reporting of studies conducted using observational routinely-collected health data (RECORD) statement. PLoS Med. 2015;12(10):e1001885. doi: 10.1371/journal.pmed.1001885.

20. Fonderson MS, Bindels PJE, Bohnen AM, et al. The role of area level social deprivation on childhood and adolescent consultation rate in primary care: a population based, cohort study. BMC Prim Care. 2022;23(1):270. doi: 10.1186/s12875-022-01873-x.

21. Evensen M, Hart RK, Godøy AA, et al. Impact of the COVID-19 pandemic on mental healthcare consultations among children and adolescents in Norway: a nationwide registry study. Eur Child Adolesc Psychiatry. 2023;32(6):1025–1035. doi: 10.1007/s00787-022-02046-y.

22. Grøsland M, Larsen VB, Reneflot A, et al. The COVID-19 pandemic's impact on mental health care use among norwegian students in higher education: a nation-wide register-based pre-post cohort study. BMC Health Serv Res. 2022;22(1):1506. doi: 10.1186/s12913-022-08816-3.

23. Bittner Gould J, Walter HJ, Bromberg J, et al. Impact of the coronavirus disease 2019 pandemic on mental health visits in pediatric primary care. Pediatrics. 2022;150(6). doi: 10.1542/peds.2022-057176.

24. Saunders NR, Kurdyak P, Stukel TA, et al. Utilization of physician-based mental health care services among children and adolescents before and during the COVID-19 pandemic in Ontario, Canada. JAMA Pediatr. 2022;176(4):e216298. doi: 10.1001/jamapediatrics.2021.6298.

25. Collishaw S. Annual research review: secular trends in child and adolescent mental health. J Child Psychol Psychiatry. 2015;56(3):370–393. doi: 10.1111/jcpp.12372.

26. Olfson M, Druss BG, Marcus SC.. Trends in mental health care among children and adolescents. N Engl J Med. 2015;372(21):2029–2038. doi: 10.1056/NEJMsa1413512.

27. Panchal U, Salazar de Pablo G, Franco M, et al. The impact of COVID-19 lockdown on child and adolescent mental health: systematic review. Eur Child Adolesc Psychiatry. 2023;32(7):1151–1177. doi: 10.1007/s00787-021-01856-w.

5

28. Viner R, Russell S, Saulle R, et al. School closures during social lockdown and mental health, health behaviors, and well-being among children and adolescents during the first COVID-19 wave: a systematic review. JAMA Pediatr. 2022;176(4):400–409. doi: 10.1001/jamapediatrics.2021.5840.

29. Bendau A, Petzold MB, Pyrkosch L, et al. Associations between COVID-19 related media consumption and symptoms of anxiety, depression and COVID-19 related fear in the general population in Germany. Eur Arch Psychiatry Clin Neurosci. 2021;271(2):283–291. doi: 10.1007/s00406-020-01171-6.

30. McManus S, Bebbington P, Jenkins R, et al. Mental health and wellbeing in England: adult psychiatric morbidity survey 2014. Leeds: NHS Digital; 2016. https://assets.publishing.service.gov.uk/media/5a802e2fe5274a2e8ab4ea71/apms-2014-full-rpt.pdf

31. Silva SA, Silva SU, Ronca DB, et al. Common mental disorders prevalence in adolescents: a systematic review and meta-analyses. PLoS One. 2020;15(4):e0232007. doi: 10.1371/journal.pone.0232007.

32. Liddon L, Kingerlee R, Barry JA.. Gender differences in preferences for psychological treatment, coping strategies, and triggers to help-seeking. Br J Clin Psychol. 2018;57(1):42–58. doi: 10.1111/bjc.12147.

Supplementary files

eTable1. *Overview of the type of psychosocial problems (ICPC codes) as percentage of the total of psychosocial problems*

ICPC code	Description	% of total
P21	ADHD	11.73
P24	Specific learning problems	9.55
P74	Anxiety disorders	7.54
P03	Feeling depressed	6.78
P22	Other worries about child's behavior	5.97
P99	Other psychiatric problem (including autism spectrum)	5.9
P76	Depressive disorders	5.76
P01	Feeling anxious/nervous/stressed	5.37
P29	Other psychiatric symptoms/complains	4.22
P02	Crisis/transient stress reaction (including PTSD)	4.03
P06	Sleeping problems	2.53
P20	Problems with memory/concentration/orientation	2.04
R98	Hyperventilation	1.63
P19	Substance (eg, drugs) abuse	1.49
P80	Personality disorder	1.38
Z20	Relationship problems with parents/family	1.38
P23	Other worries about adolescent's behavior	1.35
P12	Enuresis	1.32
Z25	Problem due to violence (or sexual assault)	1.31
P04	Irritable/angry behavior	1.28
T06	Eating disorder	1.18
Z23	Loss/death of parents/family	1.12
P78	Emotional exhaustion	1.12
P85	Mental retardation	1.1
P11	Eating problem of child	0.95
P79	Other neurosis (including fobia and OCD)	0.88
Z21	Problem due to behavior (including substance abuse) of parents/family	0.85
P17	Tobacco abuse	0.81
P10	Stammering/stuttering/tics	0.75
Z29	Other social problem (including burnout)	0.71
Z16	Relationship problem with child (including maltreatment/sexual abuse of child)	0.71
P09	Concerns about sexual preferences (including gender dysphoria)	0.69
Z22	Problem due to disease of parent/family	0.66
P77	Suicide attempt (including suicid)	0.63
P98	Other/non-specific psychosis	0.60
Z12	Relationship problems with partner	0.50

*ICPC codes representing less than 0.5% of total are not shown. These codes together represent less <5% of total number of psychosocial ICPC codes.**These numbers represent all ICPC codes coded by GPs. On average 103.8 psychosocial ICPC codes were given per 100 consultations. Thus, approximately 1 in 40 consultation was coded with two or more psychosocial ICPC codes.

eTable 2. Selection procedure for Models

Variables	Outcomes: N: total number of psychosocial consultations N2: total number of non-psychosocial consultations Independent variables: Month: categorical variable with 12 levels for every month Trend: linear trend ranging for every month during the study period ranging from 1 (January 2016) to 72 (December 2021) Sex: factorial variable with 2 levels (female 0; male 1) Age category: factorial variable with 4 levels (0-6 years, 7-12 years, 13-17 years, 18-24 years) COVID-19 New Cases: this variable was derived using information from OurWorldinData.org (initiative Oxford University), which presents daily COVID-19 statistics for 219 countries. Per month we averaged the daily number of new COVID-19 infections per 1000 inhabitants. This variable was used to investigate the influence of severity of the pandemic (ie, the viral spread) School closure: this variable was derived using information from OurWorldinData.org (initiative Oxford University), which presents daily COVID-19 statistics for 219 countries. On OurWorldinData.org school closure is presented as variable with four levels (0 - no measures 1 - recommend closing or all schools open with alterations resulting in significant differences compared to non-COVID-19 operations 2 - require closing (only some levels or categories, eg just high school, or just public schools) 3 - require closing all levels). These were averaged per month and transformed to a scale from 0 to 1. 0 represents a complete month without restrictions, 1 represents a month with complete school closure. Offsets: Totals: For every month the number of person months (CYP<25 years) Totals_category: For every month the number of person months (CYP<25 years) per age and sex For the variables School closure and COVID-19 New Cases https://github.com/owid/COVID-19-data/tree/master/public/data
Model selection	For each model we started with a full model (see below for full model). We removed variables one-by-one, starting with removal of the least significant variable in the model. For every reduction we compared the reduced model with the non-reduced model using likelihood ratio test (LRT). When a variable LRT was significant (P value < 0.05) it was kept into the model, if not it was removed. This was continued until all remaining variables were significant. In case of model with interaction, we started reducing the model by removing the interactions.
Model 1	Model 1_Full <- glm.nb(N ~ Trend + Month + offset(log(Totals)), data = dfm) dfm: data from January 2016 to February 2020 All tested variables were significant predictors. Full model = Final model
Model 2	Model 2_Full <- glm.nb(N2 ~ Trend + Month + offset(log(Totals)), data = dfm) dfm: data from January 2016 to February 2020. All tested variables were significant predictors. Full model = Final model

Model 3   Model 3_Full <- glm.nb(N ~ Trend + Month + COVID-19 New Cases + School closure + offset(log(Totals)), data = dfm) dfm: data from January 2016 to December 2021.
All tested variables were significant predictors. Full model = Final model

Model 4   Model 4_Full <- glm.nb(N ~ Trend + Month + Age category + Sex + COVID-19 New Cases + School closure + (Age category: COVID-19 New Cases) + (Sex : COVID-19 New Cases) + (Age category : School closure) + (Sex : School closure) + offset(log(Totals_category)), data = dfm)   dfm: data from January 2016 to December 2021.

We first reduced the model by removing the interaction between Age category and COVID-19 New Cases. Secondly, we removed interaction between Sex and COVID-19 New Cases. Thirdly, we removed the interaction between Sex and School Closure. Fourthly, we tried to remove the interaction between Age category and School closure. However, this decreased the fit of the model significantly and this interaction remained in the model. Finally, we removed sex because this did not improve the fit.

Model 4_Final <- glm.nb(N ~ Trend + Month + Age category + Sex + COVID-19 New Cases + School closure + (Age category: School closure) + offset(Totals_category), data = dfm
We did a post-hoc analysis checking whether the COVID-19 indices estimates changed when adding Sex and (Sex: Age category) to the model. This did not affect the COVID-19 indices estimates

**Sensitivity analysis:**   Unique patients: We repeated the Final_models but used a different outcome. Instead of N (total number of consultations per month) we used N_unique (the total number unique patients per month, ie if a patient visited the GP two times in one month this was counted as 1)
Subgroup analysis: We repeated Model_1 in a) subgroup of only girls aged 13-17 and b) subgroup of only young women aged 18-24.

eTable 3. *Model 1–3 complete output*

Variables	Model 1: Number of psychosocial contacts based on data up to February 2020		Model 2: Number of non-psychosocial contact based on data up to February 2020		Model 3: Number of psychosocial contacts based on data up to December 2021 with the variables 'COVID-19 infection rate' and 'school closure'	
	Estimate of relative rate (RR) (95% CI)	P value	Estimate of relative rate (RR) (95% CI)	P value	Estimate of relative rate (RR) (95% CI)	P value
Trend (RR per subsequent month)	1.009 (1.008-1.011)	P < 0.001	1.004 (1.003-1.005)	P < 0.001	1.010 (1.008-1.011)	P < 0.001
February	0.942 (0.862-1.029)	P = 0.185	0.981 (0.922-1.044)	P = 0.55	0.948 (0.866-1.038)	P = 0.248
March	1.080 (0.983-1.029)	P = 0.107	1.058 (0.99-1.131)	P = 0.094	1.066 (0.974-1.166)	P = 0.163
April	0.932 (0.848-1.024)	P = 0.142	0.962 (0.901-1.028)	P = 0.257	0.902 (0.824-0.987)	P = 0.024
May	0.907 (0.826-0.997)	P = 0.043	0.984 (0.921-1.052)	P = 0.641	0.875 (0.800-0.958)	P = 0.004
June	0.949 (0.863-1.042)	P = 0.273	0.988 (0.925-1.056)	P = 0.72	0.966 (0.882-1.057)	P = 0.449
July	0.795 (0.723-0.874)	P < 0.001	0.865 (0.809-0.924)	P = <0.001	0.799 (0.729-0.875)	P < 0.001
August	0.710 (0.646-0.781)	P < 0.001	0.816 (0.764-0.872)	P = <0.001	0.687 (0.627-0.753)	P < 0.001
September	0.877 (0.798-0.963)	P = 0.006	0.932 (0.873-0.996)	P = 0.038	0.882 (0.805-0.967)	P = 0.007
October	0.930 (0.846-1.021)	P = 0.129	0.952 (0.891-1.017)	P = 0.143	0.907 (0.828-0.994)	P = 0.037
November	1.020 (0.928-1.120)	P = 0.684	0.987 (0.924-1.055)	P = 0.702	0.975 (0.888-1.071)	P = 0.604
December	0.864 (0.786-0.949)	P = 0.002	0.931 (0.872-0.995)	P = 0.036	0.878 (0.800-0.963)	P = 0.005
School closure (scale 0 to 1)	Not applicable	Not applicable	Not applicable	Not applicable	0.786 (0.706-0.875)	P < 0.001
New COVID-19 infections (number/1000 inhabitants)	Not applicable	Not applicable	Not applicable	Not applicable	1.010 (1.002-1.018)	P = 0.010

Model 1 <- glm.nb(n ~ trend + month + month + offset(log(patient months)), data = Psychosocial consultations, Jan 2016 – Feb 2020) Model 2 <- glm.nb(n ~ trend + month + offset(log(patient months)), data = Non- Psychosocial consultations, Jan 2016 – Feb 2020) Model 3 <- glm.nb(n ~ trend + month + School closure + New COVID-19 infections + offset(log(patient months)), data = Psychosocial consultations, Jan 2016 – Dec 2021)

eFigure 1a. *Observed consultation rates for psychosocial problems over time (Males)*
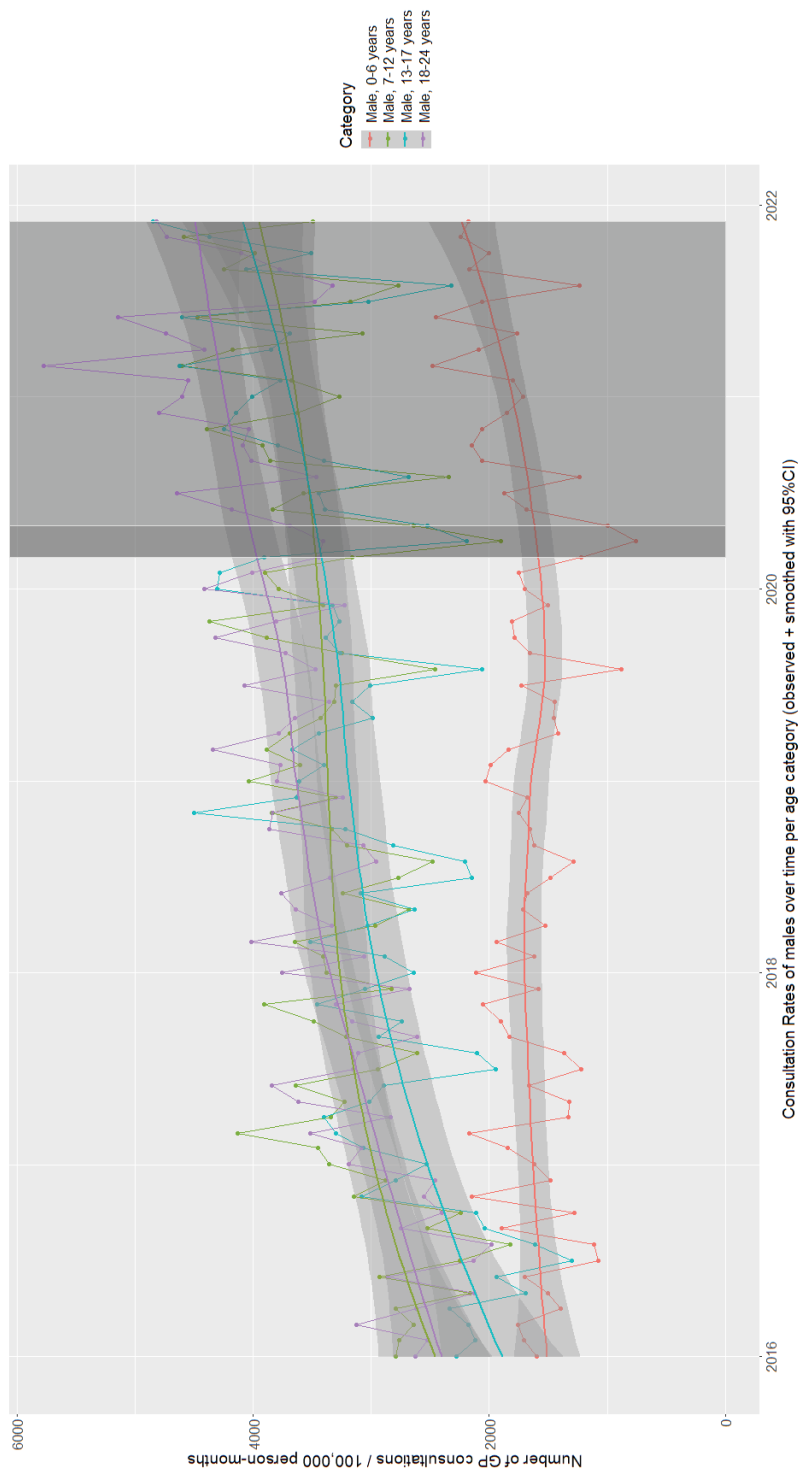
Monthly observed consultation rates per age group, including smoothed line. The shaded area indicates the COVID-19 pandemic, the dark shaded area covers the first COVID-19 wave.

eFigure 1b. *Observed consultation rates for psychosocial problems over time (Females)*
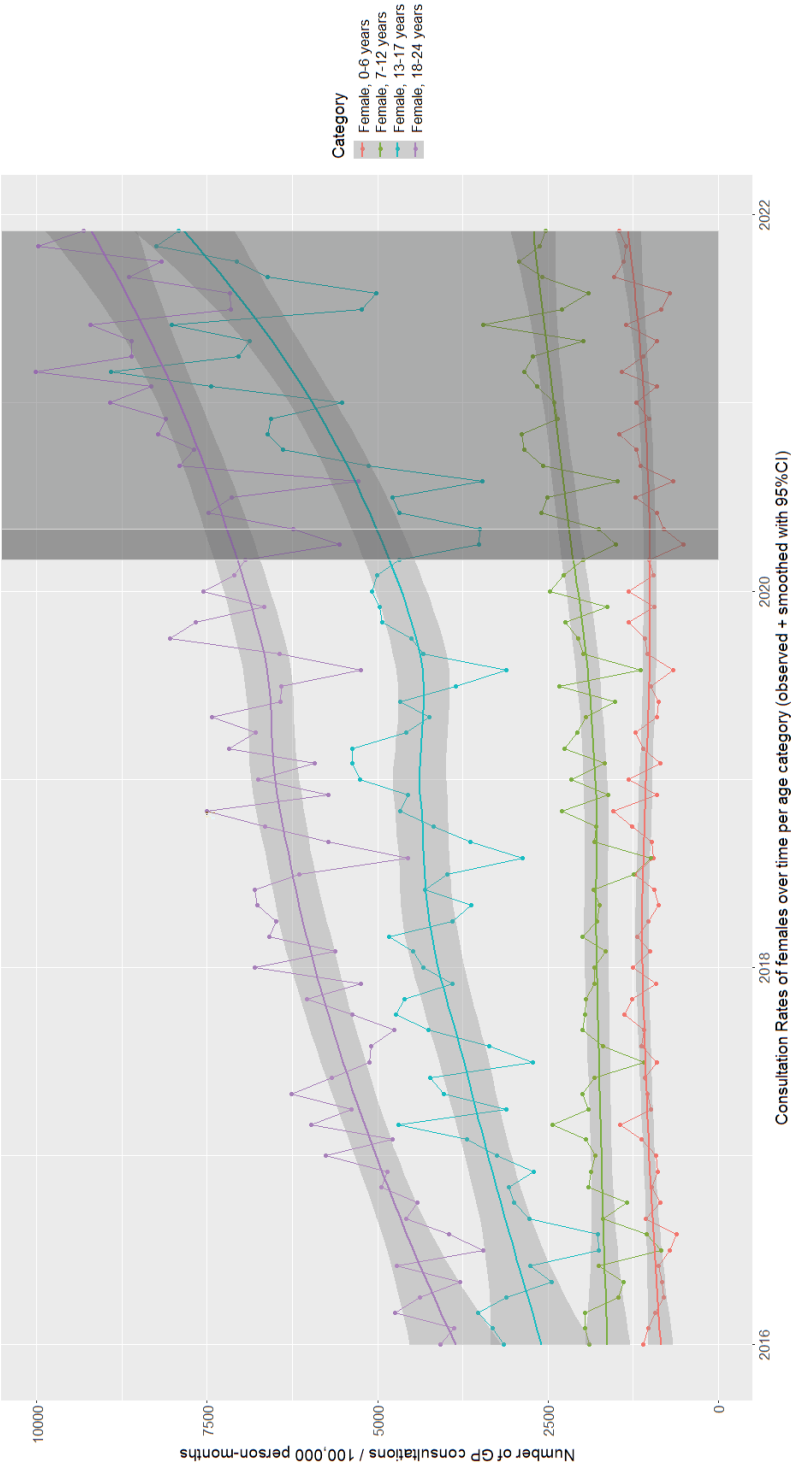
Monthly observed consultation rates per age group, including smoothed line. The shaded area indicates the COVID-19 pandemic, the dark shaded area covers the first COVID-19 wave.

eFigure 2. Monthly Consultation rates for non-psychosocial problems patients per age category and sex

GP Consultations for non-psychological problems
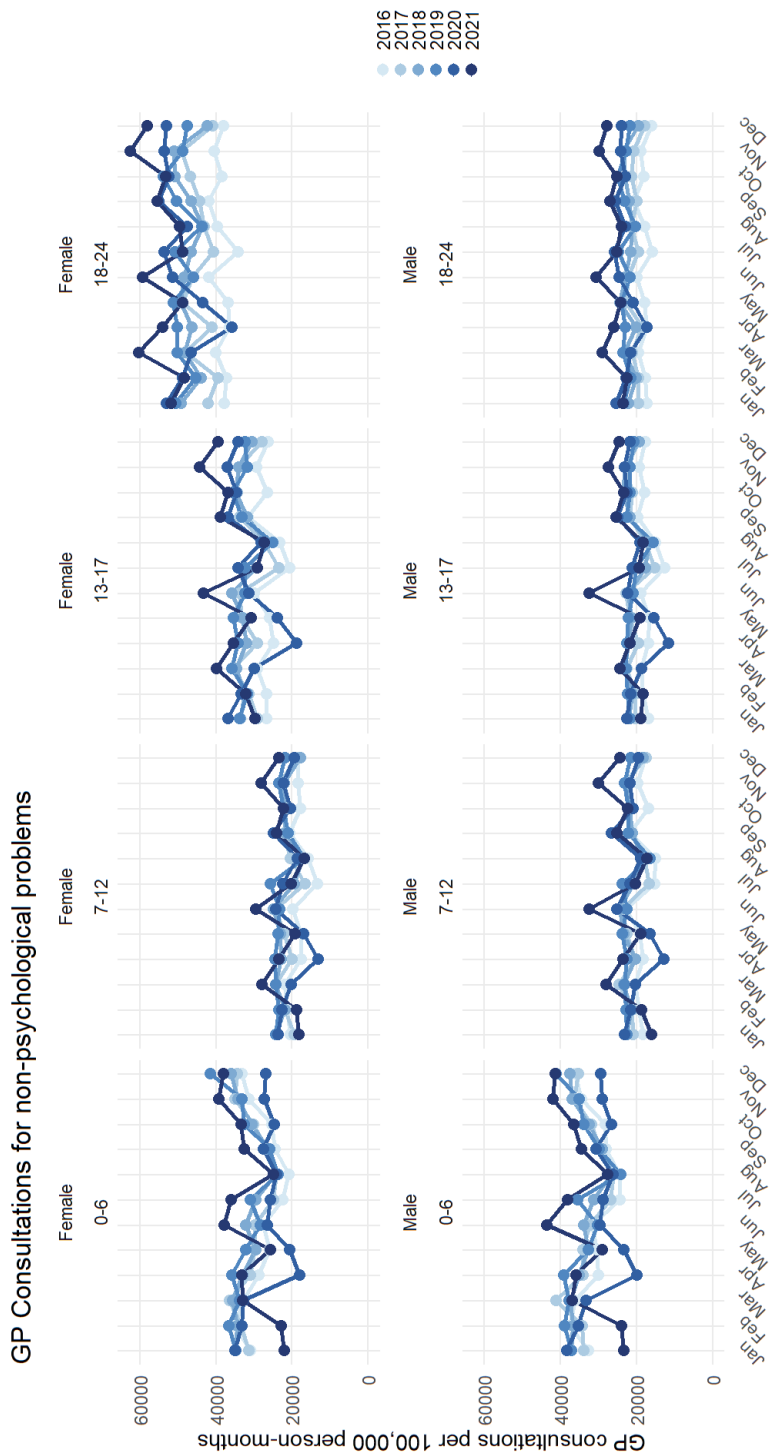
eTable 4. *Observed number of consultations for psychosocial problems, compared with expected numbers of consultations based on Model 1 and 3.*

Standardized for 100,000 children	Observed number of psychosocial consultations	Model 1: Expected number of psychosocial consultations based on data up to February 2020	Model 3: Expected number of psychosocial consultations based on data up to December 2021 with the variables 'COVID-19 infection rate' and 'school closure' set to 0*
First COVID-19 lockdown: March 2020 – May 2020	7382	10262 (95% CI 9459 -11134)	10162 (95% CI 9413-10972)
Complete COVID-19 period: March 2020 – December 2021	82941	87637 (95% CI 80398-94876)	88324 (95% CI 81485-95163)

In order to validate our estimates, we did a second approach to estimate consultation rates assuming the absence of the COVID-19 pandemic, by setting 'school-closure index' and 'COVID-19 infection rate' to 0. As can be seen from the table, this gave very comparable results.

eTable 5. *Regression table of Model 4, based on consultation rate per age-category and sex, including interactions*

Variable	Estimate of relative rate (RR) (95% CI)	P value
Time trend	1.009 (1.007-1.010)	p<0.001
February	0.957 (0.855-1.071)	p=0.446
March	1.067 (0.954-1.194)	p=0.257
April	0.884 (0.789-0.990)	p=0.033
May	0.85 (0.759-0.952)	p=0.005
June	0.962 (0.859-1.078)	p=0.505
July	0.793 (0.708-0.889)	p<0.001
August	0.669 (0.597-0.750)	p<0.001
September	0.902 (0.805-1.012)	p=0.078
October	0.912 (0.813-1.023)	p=0.115
November	0.987 (0.878-1.110)	p=0.826
December	0.873 (0.778-0.981)	p=0.022
Age 7-12	1.862 (1.725-2.010)	p<0.001
Age 13-17	2.513 (2.329-2.712)	p<0.001
Age 18-24	3.361 (3.116-3.626)	p<0.001
New COVID-19 infections	1.013 (1.003-1.023)	p=0.009
Interaction		
School closure in:		p<0.001[c]
Age 0-6	0.563 (0.459-0.692)	
Age 7-12	0.693 (0.565-0.848)	
Age 13-17	0.951 (0.777-1.163)	
Age 18-24	0.891 (0.729-1.089	

*Model 4 <- glm.nb(n ~ trend + month + age category + sex + school closure + COVID-19 infections + (age category : school closure) + offset(log(patient months)), data = Psychosocial consultations, Jan 2016 – Dec 2021)*

eFigure 3. *Monthly unique patients consulting general practice for psychosocial problems per age category and sex*

Unique patients per month / 100,000 person-months
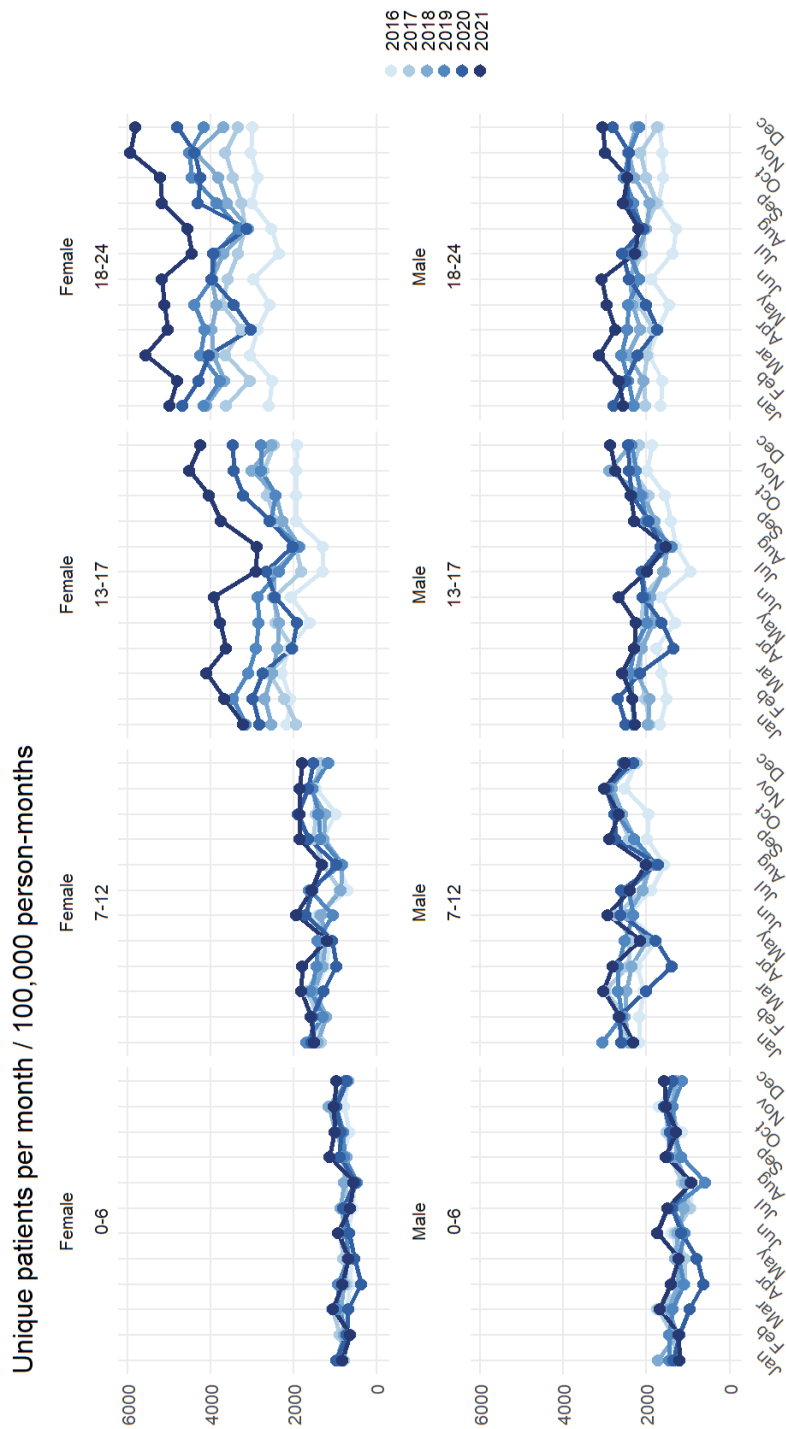
eFigure 4. *Observed monthly unique patients consulting general practice for psychosocial problems rates versus expected based on data until February 2020*
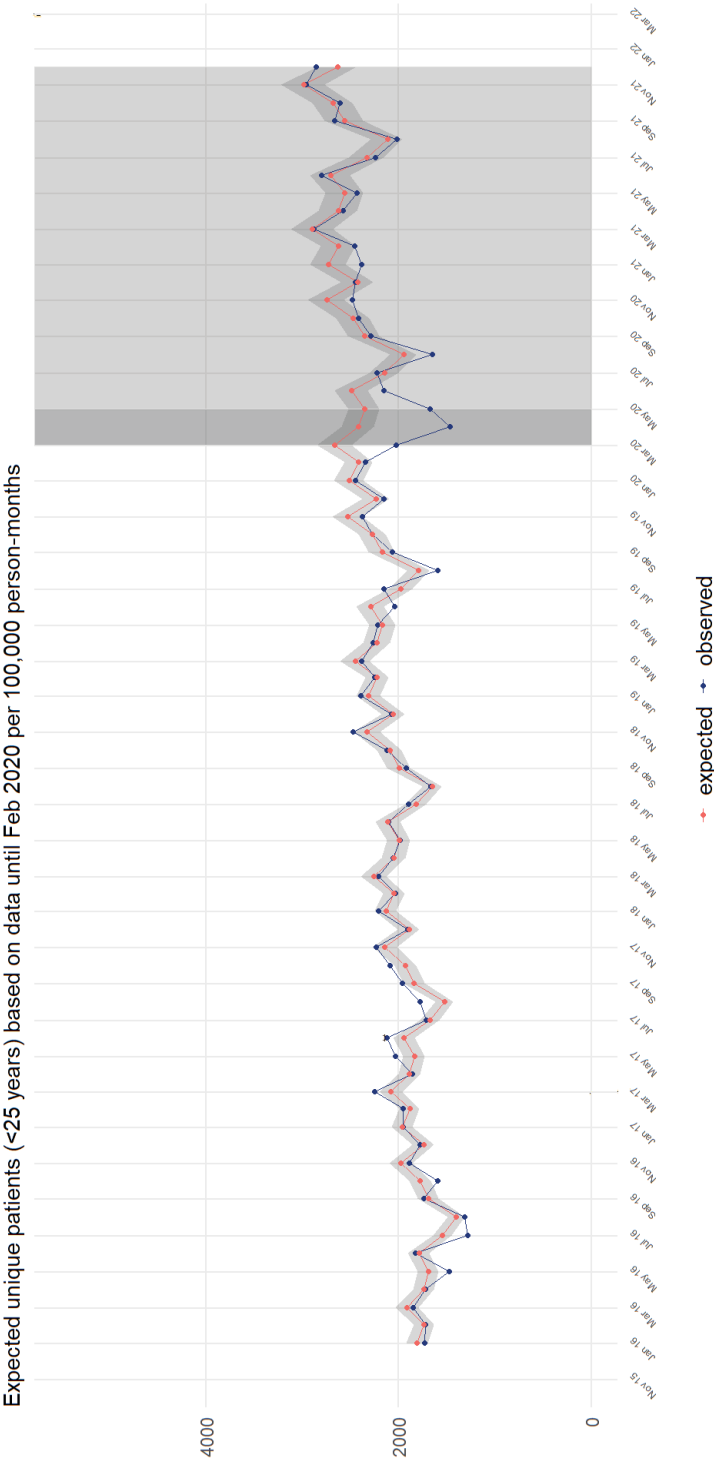
eFigure 5a. *Subgroup analysis girls aged 13–17. Observed monthly consultation rates versus expected rates based on data until February 2020*

Subanalysis: Expected vs. observed consultations girls aged 13-17. Expected numbers based data until Feb 2020

expected   observed

5
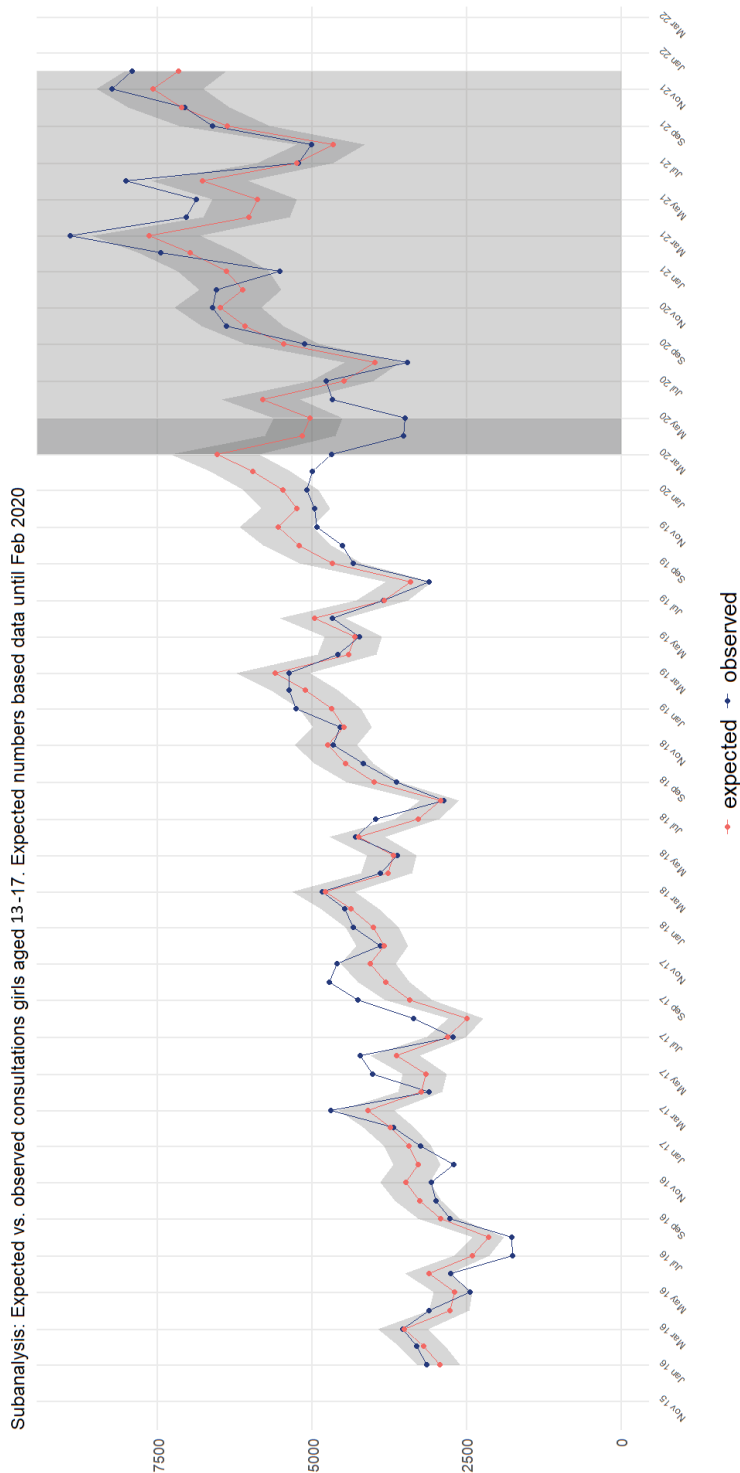
eFigure 5b. *Subgroup analysis young women aged 18–24, observed monthly consultation rates versus expected rates based on data until February 2020*

Subanalysis: Expected vs. observed consultation rates young women aged 18-24. Expected numbers based data until Feb 2020
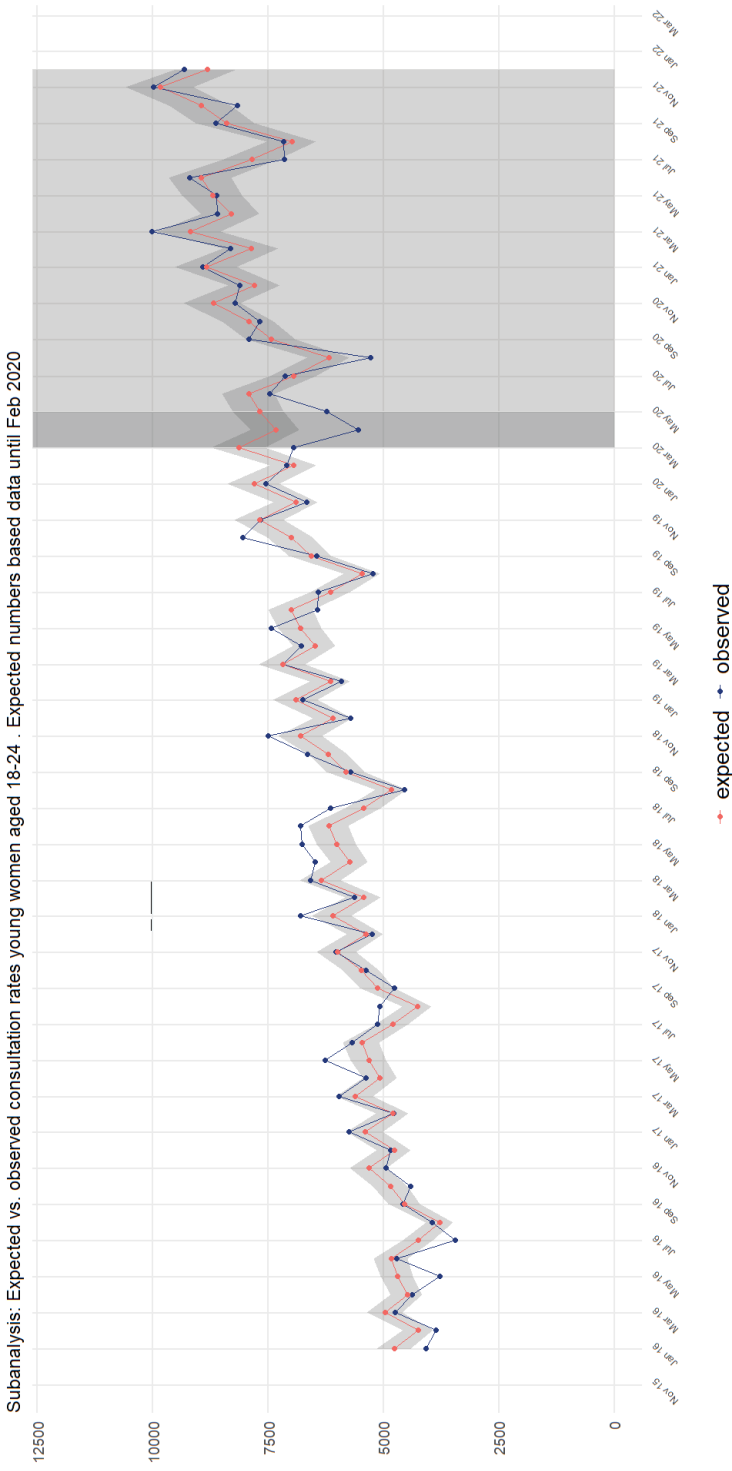
eTable 6. Sensitivity analysis unique patients

Variable	Model of monthly unique patients based on data up to February 2020		Model of monthly unique patients based on data up to December 2021 with COVID-19 indices	
	Estimate of relative rate (RR) (95% CI)	P Value	Estimate of relative rate (RR) (95% CI)	P Value
Trend (RR per subsequent month)	1.007 (1.006-1.008)	P < 0.001	1.007 (1.005-1.01)	P < 0.001
February	0.954 (0.885-1.028)	P = 0.214	0.962 (0.802-1.155)	P = 0.681
March	1.045 (0.965-1.13)	P = 0.28	1.034 (0.862-1.241)	P = 0.718
April	0.942 (0.87-1.019)	P = 0.137	0.91 (0.758-1.093)	P = 0.314
May	0.911 (0.842-0.986)	P = 0.022	0.876 (0.73-1.051)	P = 0.154
June	0.956 (0.884-1.035)	P = 0.270	0.962 (0.801-1.156)	P = 0.682
July	0.819 (0.757-0.887)	P = <0.001	0.815 (0.678-0.98)	P = 0.029
August	0.738 (0.682-0.8)	P = <0.001	0.714 (0.594-0.859)	P < 0.001
September	0.887 (0.819-0.96)	P = 0.003	0.895 (0.744-1.077)	P = 0.239
October	0.923 (0.853-0.999)	P = 0.048	0.903 (0.75-1.087)	P = 0.283
November	1.020 (0.943-1.104)	P = 0.622	0.967 (0.8-1.169)	P = 0.730
December	0.894 (0.826-0.968)	P = 0.006	0.9 (0.747-1.086)	P = 0.272
School Closure	Not applicable	Not applicable	0.728 (0.585-0.905)	P = 0.004
New COVID-19 infections (number /1000 inhabitants)	Not applicable	Not applicable	1.015 (0.999-1.031)	P = 0.072

Model <- glm.nb(n ~ trend + month + offset(log(patient months)), data = Unique patients, Jan 2016 – Feb 2020)

Model <- glm.nb(n ~ trend + month + School closure + New COVID-19 infections + offset(log(patient months)), data = Unique patients, Jan 2016 – Dec 2021)

5

eTable 7. Sensitivity analysis unique patients with interaction between age category using data up to December 2021

Variable	Relative rate (95% CI)	P value
Trend (RR per subsequent month)	1.006 (1.005-1.008)	P<0.001
February	0.959 (0.862-1.067)	P=0.443
March	1.035 (0.931-1.152)	P=0.522
April	0.897 (0.806-0.998)	P=0.046
May	0.859 (0.772-0.956)	P=0.005
June	0.959 (0.861-1.067)	P=0.443
July	0.815 (0.732-0.907)	P<0.001
August	0.703 (0.63-0.783)	P<0.001
September	0.908 (0.815-1.011)	P=0.079
October	0.908 (0.815-1.012)	P=0.082
November	0.977 (0.874-1.091)	P=0.677
December	0.894 (0.801-0.997)	P=0.044
Male gender	1.048 (1.003-1.094)	P=0.036
Age 7-12	1.773 (1.65-1.907)	P<0.001
Age 13-17	2.083 (1.937-2.239)	P<0.001
Age 18-24	2.733 (2.544-2.936)	P<0.001
New COVID-19 infections (number/1000 inhabitants)	1.016 (1.006-1.025)	P=0.001
School closure * Age 0-6 (Ref category)	0.55 (0.452-0.669)	P<0.001
School closure * Age 7-12 (compared to risk of Ref category)	1.183 (0.934-1.499)	
School closure * Age 13-17 (compared to risk of Ref category)	1.538 (1.215-1.948)	
School closure * Age 18-24 (compared to risk of Ref category)	1.577 (1.248-1.994)	

Model <- glm.nb(n ~ trend + month + sex + age category + COVID-19 infections + school closure + (school closure : age category) + offset(log(totals)) , data = Unique patients, Jan 2016 – Dec 2021)

eTable 8. Subgroup analysis, Observed number of consultations for psychosocial problems, compared with expected numbers of consultations based on data until February 2020

	Girls aged 13-17		Young women aged 18-24	
	Observed number of consultations	**Expected number of consultations (95% CI)**	**Observed number of consultations**	**Expected number of consultations (95% CI)**
First COVID-19 lockdown: March 2020 – May 2020	1007	1441 (1292-1608)	2319	2867 (2669-3080)
Complete COVID-19 period: March 2020 – December 2021	13089	12974 (11590-14358)	24160	24645 (22892-26398)

5

Chapter 6

Trends in mental health problems in children and young people in Dutch general practice: a population-based study

Lukas BM Koet*, Vincent R 't Hart*, Boris WV Schouten, Premysl Velek,
Patrick JE Bindels, Heike Gerger
*These two authors contributed equally to this work

Abstract

Purpose

In recent decades, the prevalence of mental health problems among children and young people (CYP) has increased. It is unclear whether this increase in prevalence has also led to changes in health-care utilization for these problems in general practice. We therefore investigated time trends in consultation and incidence rates for eight mental health problems in CYP in Dutch general practice.

Methods

We conducted a longitudinal population-based study using a GP-database (Rijnmond Primary Care Database) between 2016 and 2022. We extracted monthly data on mental health problems in CYP (0-24 years) in general practice. Using negative binomial models, we calculated trends for GP-registered incidence and consultation rates for different age and sex categories for the complete study period and for the period before the COVID-19 pandemic.

Results

Consultation rates of all eight mental health problems increased significantly over time. Additionally, incidence rates for attention deficit hyperactivity disorder and depressive problems in both sexes, and anxiety problems in females increased significantly. Although we observed a decrease in incidence and consultations in the first months of the COVID-19 pandemic, overall trends did not differ from pre-pandemic trends.

Conclusion

Our findings suggest an increasing workload for GPs for mental health problems in CYP. These observations imply the need for policymakers and GP-councils to develop new strategies which deal with these trends to ensure appropriate support and resources in the future.

Introduction

In recent decades, there has been a rise in prevalence of mental health problems among children and young people (CYP).[1-3] These problems are associated with significant short- and long-term negative effects including impaired quality of life, reduced workforce participation in later life and increased healthcare costs.[4-7] To prevent these negative impacts, early recognition and intervention is essential.[8] Unfortunately, mental health services have been under strain for years with long waiting-lists due to a shortage of resources and professionals.[9] There are indications that the COVID-19 pandemic has led to worsening of mental health in CYP with increased demand for mental healthcare.[10-12]

In the Netherlands, general practitioners (GPs) play a central role in primary care for CYP.[13] Patients seeking help for a mental health problem are either managed by their GP or are referred to specialized mental healthcare. GPs, however, have reported difficulties managing CYP due to a lack of time, knowledge, reimbursement, and long waiting lists for specialized care.[14] Simultaneously there are indications that GP consultation rates for mental health problems in CYP have increased in the past decade, potentially further amplified by the COVID-19 pandemic.[10, 11] In an earlier study we found that consultation rates in CYP for psychosocial problems increased steadily over time, with a similar trend before and during the pandemic.[15] In the present study, we investigated time-trends for eight mental health problems in CYP. We investigated the rates and trends of GP-registered incidence and GP consultations for these problems in different sex and age groups. Additionally, we explored whether these trends were influenced by the COVID-19 pandemic.

Methods

Data sources and study population

We performed a longitudinal population-based study of CYP (0-24 years) using Rijnmond Primary Care Database (RPCD) data from January 2016 to December 2022. The RPCD is a region-specific derivative of the Integrated Primary Care Information database covering the Rotterdam metropolitan area.[16] It contains pseudonymized medical data of general practice patients, including diagnostic codes, laboratory findings, prescriptions, referrals and specialists' letters. Dutch GPs use the International Classification for Primary Care (ICPC-1) to register diagnoses and reasons for consultation.[17] The RPCD database has extensive quality control measures.[16]

6

Outcomes

We investigated the occurrence of attention deficit hyperactivity disorder (ADHD), anxiety problems, eating disorders (i.e. anorexia nervosa and bulimia), behavioural problems, depressive problems, sleeping problems, substance abuse, and suicidality (i.e. suicidal ideations, attempts and suicide). These problems were selected because they are (relatively) common in general practice and have clearly defined ICPC-codes. Supplementary eTable 1 gives an overview of the ICPC-codes per mental health problem. We used two outcomes: First, for each mental health problem we calculated GP-registered incidence rates per month and per year, defined as the first time a GP entered a new diagnosis (i.e., ICPC-code) in the patient's record based on a consultation or on correspondence (e.g. specialist letters); second, we calculated consultation rates per problem. We defined consultations as any contact (in person, by phone, or online) with a relevant ICPC-code between a GP and a patient or GP and a specialist (including specialist letters) in which symptoms, diagnosis, or treatment were discussed.

To calculate monthly incidence rates, we divided the number of new diagnoses in a month (nominator) by the number of CYP registered in this month (denominator in person-months) for the investigated mental health problems. Once a patient had a mental health episode in their history, he/she was excluded from future incidence calculation for that specific mental health problem. For the calculation of consultation rates, we extracted all mental health contacts (nominator) and the number of registered CYP per month (denominator). Yearly rates were calculated by aggregating the monthly rates per year. We calculated incidence and consultation rates for the individual mental health problems for all included patients and for subgroups based on sex and four age-groups: young children (0–6 years), primary school children (7–12 years), adolescents (13–17 years), and young adults (18-24 years).

Data-analysis

Analyses were performed using R (version 4.3.1, MASS package).[18] To assess time-trends, we fitted negative binomial regression models to monthly counts of first diagnosis and to the monthly counts of consultations for each mental health problem for the complete study period (2016-2022). We tested for linear trends over time (number of months from start was fitted as a continuous variable) while adjusting for seasonal variation (e.g. reductions during summer holidays) by fitting a categorical month variable. The outcome

of interest was the linear trend, presented as relative rate (RR) per incremental month. We repeated analyses per sex and age group. We used autocorrelation-plots to detect possible autocorrelation. In case of autocorrelation, we corrected for this by including first-order lagged residuals.

Sensitivity analyses

We identified two potential effect modifiers, the COVID-19 pandemic period and a slight increase in CYP living in social deprivation areas from fall 2020 onwards. To assess influence of these two factors we conducted sensitivity analyses using the pre-pandemic period (until March 2020), in which the percentage of CYP living in social deprivation areas was stable. For this period, we fitted negative binomial regression models per mental health problem for the total sample. These were used to predict incidence and consultation rates during and after the pandemic. Firstly, we plotted the observed and expected incidence and consultation rates with their 95% confidence intervals (95% CI) (supplementary eFigure 1) per mental health problem and visually compared these for differences. Secondly, we calculated the expected number of new incidences and consultations for the COVID-19 period (March 2020-April 2022) by adding up the expected monthly rates with their 95% CI and compared these with the observed numbers. Thirdly, to assess changes in trends due to the pandemic, we compared the time trends for the complete study period (January 2016–December 2022) with pre-pandemic trends (January 2016–February 2020).

Ethics and data availability

The study was approved by the Governance Board of the RPCD (project-number 2020.012). Patient data was pseudonymized. Therefore, by Dutch law, no patient consent is required. We followed the RECORD guidelines.[19] Due to legal constraints, data is not publicly available, and access requires approval by the RPCD Governance Board.

Results

Cohort characteristics

The number of CYP in the RPCD increased from 60892 patients in January 2016 to 105103 in December 2022. In total, 49.2% was female and mean age was 12.6 (SD 6.1) years. The percentage of CYP living in socially deprived areas increased from 18.2% to

21.7% over time. Changes in cohort demographics can be explained by more practices joining the RPCD. Cohort demographics are presented in Table 1.

Table 1. Demographics

Year	Cohort size	Females	Mean age (SD)	Living in deprived area
2016	68599	49.2%	12.60 (7.09)	18.2%
2017	76644	49.1%	12.64 (7.09)	17.9%
2018	78424	49.0%	12.65 (7.09)	18.0%
2019	79287	48.9%	12.67 (7.08)	17.8%
2020	96044	49.0%	12.58 (7.04)	18.6%
2021	109754	49.0%	12.57 (7.03)	21.9%
2022	112845	49.0%	12.59 (7.03)	21.7%

Cohort size of children and young people (0–24 years) measured in July each year. Due to increasing number of participating practices in the Rijnmond Primary Care Database during study period, more patients were added to the dynamic cohort over time.

Incidence rates per year

The incidence rates per mental health problem for the years 2016 and 2022 are presented in Figure 1 and Table 2 (see supplementary eTable 2-3 for details per age and sex per year). Overall, highest incidences were found for anxiety problems, ADHD and depressive problems.

Table 2. Average incidence and consultations per year

	Incidence per 1000 person years		Consultations per 1000 person years	
	2016	**2022**	**2016**	**2022**
ADHD	4.15 (3.68-4.67)	5.42 (4.99-5.87)	41.33 (39.82-42.89)	55.88 (54.51-57.29)
Anxiety problems	9.76 (9.02-10.54)	10.30 (9.70-10.92)	42.48 (40.94-44.05)	70.01 (68.47-71.58)
Eating disorders	0.43 (0.29-0.61)	0.27 (0.18-0.38)	3.23 (2.82-3.96)	4.51 (4.13-4.93)
Behavioral problems	7.70 (7.05-8.40)	7.05 (6.56-7.57)	29.96 (28.67-31.29)	41.73 (40.54-42.94)
Depressive problems	5.38 (4.84-5.97)	6.57 (6.10-7.07)	37.16 (35.72-38.64)	60.71 (59.28-62.17)
Sleeping problems	4.12 (3.65-4.64)	3.91 (3.54-4.29)	9.79 (9.06-10.56)	11.31 (10.96-11.95)
Substance abuse	2.16 (1.82-2.54)	1.91 (1.66-2.18)	9.55 (8.83-10.31)	9.89 (9.31-10.49)
Suicidality	0.41 (0.26-0.61)	0.58 (0.44-0.74)	1.22 (0.96-1.53)	3.05 (2.73-3.39)

Average incidence and consultations per year (per 1000 person years) of investigated mental health problems with 95% confidence intervals.

Figure 1. Incidence of mental health problems
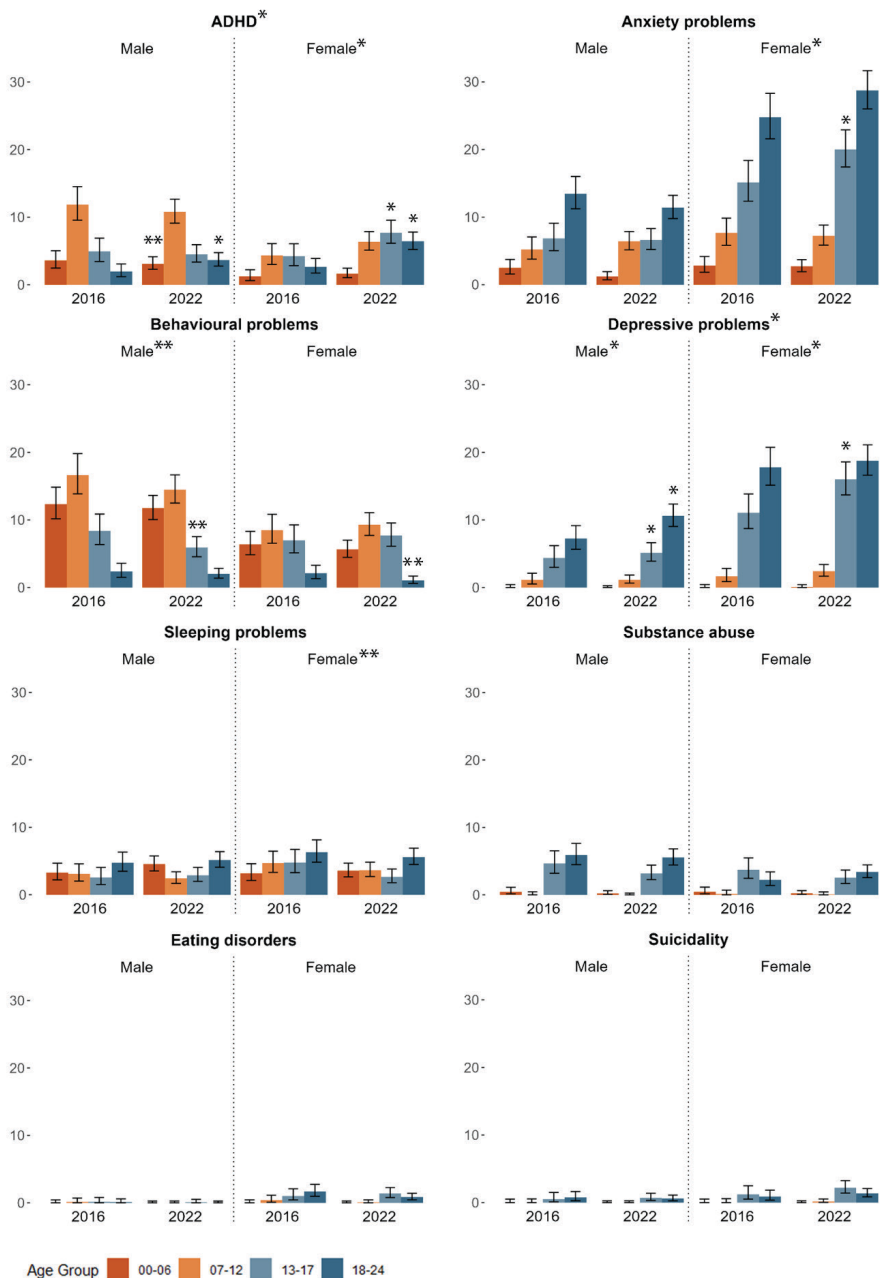
Incidence per sex and age group (in 1000 person years) in 2016 and 2022 with 95% confidence interval
**significant increasing (modelled) monthly trend over (sub)group ** significant decreasing (modelled) monthly trend over (sub)group*

Time-trends in incidence rates

Time-trends per mental health problem are presented in Table 3. Supplementary eTable 4 shows the results per age and sex category. No or too few incident cases for allowing subgroup analyses were seen in the following subgroups: eating disorders in male subgroup across all age categories and in females aged 0-12; depressive problems in both sexes aged 0-6; substance abuse and suicidality in both sexes aged 0-12 (see supplementary eTable 4). We detected no autocorrelation in any of the models.

Table 3. Time-trends in incidence and consultations

	Time-trends in incidence		Time-trends in consultations	
	Monthly relative rate	**p-value**	**Monthly relative rate**	**p-value**
ADHD	1.004 (1.002-1.006)	<0.001	1.005 (1.004-1.006)	<0.001
Anxiety problems	1.001 (1.000-1.002)	0.164	1.008 (1.007-1.009)	<0.001
Eating disorders	1.000 (0.994-1.005)	0.945	1.007 (1.005-1.010)	<0.001
Behavioral problems	0.999 (0.997-1.000)	0.106	1.005 (1.004-1.006)	<0.001
Depressive problems	1.003 (1.001-1.005)	0.004	1.008 (1.007-1.009)	<0.001
Sleeping problems	0.999 (0.997-1.000)	0.095	1.002 (1.001-1.004)	0.001
Substance abuse	0.999 (0.997-1.001)	0.400	1.002 (1.001-1.004)	0.007
Suicidality	1.004 (0.999-1.009)	0.122	1.013 (1.009-1.016)	<0.001

Time-trends in incidence and consultations for investigated mental health problems. Monthly trends in relative rate with 95% confidence interval per mental health category.

For ADHD, the monthly incidence rate increased significantly over time (RR = 1.004; 95% CI 1.002-1.006). The steepest trends were seen in adolescent girls aged 13-17 (RR = 1.012; 95% CI 1.007-1.018) and young women aged 18-24 (RR = 1.017; 95% CI 1.011-1.022). The monthly incidence rate of depressive problems increased significantly over time (RR = 1.003; 95% CI 1.001-1.005). This trend was most pronounced in children aged 13-17 (boys: RR = 1.005; 95% CI 1.000-1.009, girls: RR = 1.005; 95% CI 1.002-1.008). Anxiety problems had no significant trend in the total sample, but we observed a significantly increasing trend in females (RR = 1.002; 95% CI 1.001-1.004) which was mainly explained by the increasing trend in girls aged 13-17 (RR = 1.005; 95% CI 1.002-1.008). Sleeping problems showed a significantly negative trend among females (RR = 0.998; 95% CI 0.995-1.000; p = 0.028) as did behavioural problems among males (RR = 0.998; 95% CI 0.996-1.000; p=0.026). There were no significant trends in incidence for eating disorders (RR = 1.000; 95% CI 0.994-1.005), substance abuse (RR = 0.999; 95% CI 0.997-1.001) or suicidality (RR = 1.004 95% CI 0.999-1.009).

GP consultation rates

Yearly consultation rates in 2016 and 2022 are presented in Table 2. Highest consultation rates were found for anxiety problems, ADHD and depressive problems. Figure 2 shows monthly consultation rates from 2016 to 2022.

Figure 2. Monthly consultation rates over time
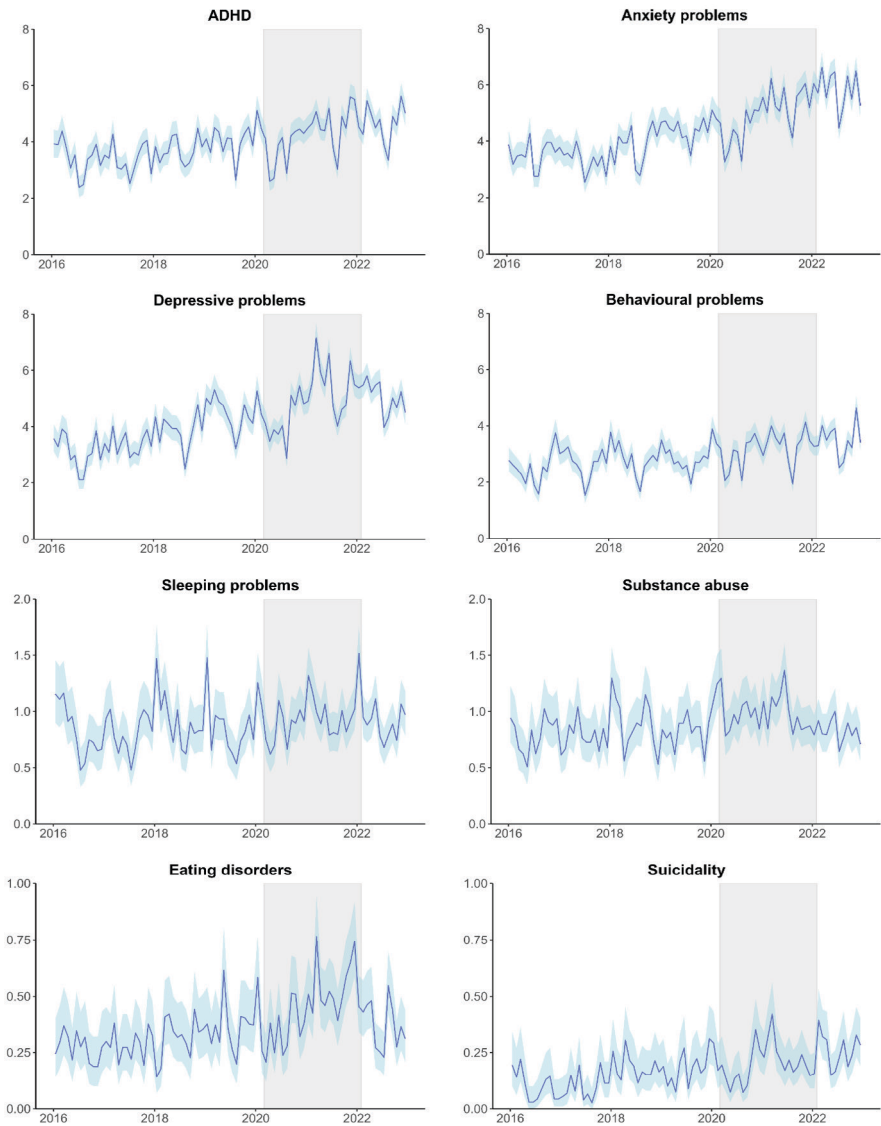
Monthly consultation rates over time (per 1000 person months). COVID-19 period (March 2020–April 2022) is marked in grey.

Time-trends in GP consultation rates

Overall consultation rates increased significantly for all mental health problems between 2016 and 2022 (Table 3). Supplementary eTable 5 shows the results per age and sex category. No or too few consultations for allowing subgroup analyses were seen for substance abuse, suicidality and eating disorders in both sexes aged 0-12 and for depressive disorders in both sexes aged 0-6. Although we detected autocorrelation in some models, correction for autocorrelation did not change our results (see supplementary eTable 6 for corrected estimates).

For anxiety problems the largest increasing trend was found in girls aged 13-17 (RR = 1.013; 95% CI 1.011-1.015). In ADHD monthly consultation rates showed a significantly increasing trend over time which was mainly explained by increases in consultations in adolescents and young adults of both sexes. The steepest trend was seen in young women aged 18-24 (RR = 1.013; 95% CI 1.011-1.015). Trends in depressive problems were significantly increasing and similar for males (RR = 1.008; 95% CI 1.007-1.010) and females (RR = 1.007; 95% CI 1.006-1.009). Suicidality-related consultations showed the strongest increasing trend over time (RR = 1.013; 95% CI 1.009-1.016) in the total sample. This should be interpreted with caution due to the low number of consultations (1.22 consultations/1000 person-years in 2022), as few extra consultations could affect the trend significantly. Consultation rates of eating disorders remained stable in males (RR = 1.000; 95% CI 0.989-1.011) and showed a significantly increasing trend in females (RR = 1.008; 95% CI 1.005-1.011). Contrarily, consultation rates for behavioural problems increased significantly for both males (RR = 1.004; 95% CI 1.003-1.005) and females (RR = 1.005; 95% CI 1.004-1.007). There was a significant increasing trend in sleeping problems particularly among young women (RR = 1.005; 95% CI 1.003-1.007). In contrast, while overall consultation rates related to substance abuse increased (RR = 1.002; 95% CI 1.001-1.004), there was a decrease in children aged 13-17 (boys: RR = 0.996; 95% CI 0.992-0.999; girls RR = 0.994; 95% CI 0.988-0.999).

Sensitivity analyses

In the first months of the pandemic (March-May 2020), incidence and consultation rates for most mental health problems were lower than expected. Hereafter, the rates returned to expected levels based on pre-pandemic trends (supplementary eFigure 1, eTables 7-8). In general, there were no or small differences between the observed trend before the pandemic and during the entire study period.

Sleeping problems incidence, however, showed a significant difference with an increasing trend pre-COVID and a stable trend in the entire study period (pre-COVID: RR = 1.006; 95% CI 1.003-1.009, entire study period: RR = 0.999; 95% CI 0.997-1.000). The observed cases were within the 95% CI of expected cases (expected cases: 1023; 95% CI 814-1286, observed cases: 878).

The increasing trend in incidence rate for depressive problems was more pronounced before the COVID-19 pandemic compared to the trend over the entire study period (pre-pandemic: RR = 1.006; 95% CI 1.003-1.009, entire study period: RR = 1.003; 95% CI 1.001-1.005). However, this did not result in significant differences between observed and expected incident cases (observed 1483; expected: 1700; 95% CI 1398-2067) during the pandemic period.

Increasing trends in consultation rates for suicidality problems seemed somewhat higher before the pandemic when compared with the entire study period (pre-pandemic: RR = 1.019 95% CI 1.011-1.028 entire study period: RR = 1.013 95% CI 1.009-1.016). The observed number of consultations, however, was still within the 95% CI (expected: 770; 95% CI 462-1283, observed: 565).

Discussion

Main findings

In this study we analysed trends in mental health problems in CYP within general practice between 2016 and 2022. The three most common mental health problems in our cohort were anxiety problems, ADHD and depressive problems. When looking at trends in GP-registered incidence over time, we found increasing trends in ADHD and depressive problems in both sexes. Incidence of anxiety problems only increased in females. Trends in GP consultation rates increased significantly for all investigated mental health problems. We observed relevant differences between age and sex categories for some mental health problems. Overall COVID-19 did not have a significant effect on observed trends over time: after an initial decrease during the first months of the pandemic, both incidence and consultation rates showed similar trends compared with those observed pre-pandemic. Overall, our findings showed a significant rise in the total number of consultations for all analyzed mental health problems, while incidence increased only in some problems and in particular subgroups of CYP.

6

What is already known on this topic

Our study aligns with previous reports indicating increasing trends in mental health problems among CYP.[1, 20, 21] During 2005-2008 increases in the prevalence of anxiety, depression, and alcohol abuse were reported in Dutch general practices.[1] Increasing trends (1995-2014) and high prevalence of mental health problems were also seen in other European countries with prevalence rates up to 15.5%.[20, 21] It has been suggested that one reason for these increasing trends might be greater awareness of mental health problems among professionals and patients.[22] For example, in recent years there is more information about sex-differences in the presentation of ADHD.[23, 24] This increased awareness among professionals may have led to improved recognition and increased incidence rates in females.

Depressive and anxiety disorders in CYP have seen increasing trends before 2020 in Europe, the USA and Asia.[25-28] Although several studies reported that the prevalence of depressive and anxiety symptoms increased during the COVID-19 pandemic, the exact impact of the pandemic on these problems is debated.[29, 30]

Several studies using primary care registry data reported higher numbers of mental health-related GP-consultations in CYP during the pandemic, compared with the period before the pandemic.[10, 11, 31, 32] Significant increases were mainly seen in consultations related to anxiety, mood and eating disorders.[10, 31, 32] Only a limited number of studies used longitudinal trends before and during the pandemic.[11, 31, 32]

What this study adds

In our study, consultation rates increased strongly across all mental health problems suggesting increased higher healthcare utilization in general practice. Our results suggest that the previously observed increases in consultation rates for mental health in primary care [10, 11, 15] seem to reflect increases in consultations for several types of mental health problems. As GP consultations for mental health problems in CYP are increasing over time, the role of GPs in the management of these problems may have become more important, accompanied by a higher workload for GPs.

Whereas earlier studies suggested that the COVID-19 pandemic led to increased consultations for mental health problems in CYP, the observed trends in our study existed before and continued throughout the pandemic. This steady increase over time

suggests that the COVID-19 pandemic had limited impact on help-seeking behaviour for mental health problems in our study population. Based on the steady increasing trends we speculate that GPs will continue to experience an increasing demand for mental healthcare for CYP in the coming years.

The main strength of this study is that it reports a comprehensive overview of trends in both incidence and consultations rates of mental health problems in CYP in general practice. Contrary to many other studies using cross-sectional samples, we used longitudinal data from seven consecutive years, covering the complete COVID-19 pandemic. Due to this longitudinal design, we were able to demonstrate existing upward trends while correcting for seasonality and taking possible effects of the pandemic into account.

Future studies should focus on investigating possible factors causing these increasing trends, whether it be increasing awareness, increasing help-seeking behaviour, waiting times for secondary care, transfer of care from specialized mental healthcare to general practice or actual increases in the occurrence of mental health problems in CYP. Additionally, we recommend that policymakers and medical councils proactively develop strategies to address these trends and ensure appropriate support and resources are available in primary care settings.

Limitations

First, the RPCD data only represent cases of mental health problems which are documented within the GP patient file. In the Netherlands GPs have a comprehensive patient file (which includes specialists' letters). The completeness of this file depends on other professionals providing information to the GP. GP-registered incidence may therefore underestimate the overall incidence. Second, due to the dynamic cohort design, the percentage of CYP living in deprived areas in our cohort increased slightly over time. This could in theory have influenced the observed trends in incidence and consultation rates. In our sensitivity analysis of the pre-pandemic trends, the percentage of CYP living in deprived areas was stable and the results in that study period did not differ significantly from our main results covering the entire study period. Moreover, previous research in Rotterdam reported similar help-seeking behaviour for mental health problems in children between neighbourhoods with different social economic status.[33] Therefore, we consider the risk that the observed slight change in demographics of the study population over time significantly influenced our findings to be small. Third, despite our

6

large dataset, the trends for rare problems (e.g. suicidality and eating disorders) should be interpreted with caution, as a minor increase in cases may affect the overall trend. Fourth, it is important to recognize that our study focused on trends and rates of mental health problems in general practice, which are dependent on the actual help-seeking behaviour of patients. Therefore, our results should be interpreted in conjunction with results from other study types (e.g. prevalence studies).

Conclusion

GPs in our cohort have seen a steadily increasing trend in consultation rates for all eight investigated mental health problems in CYP, which started well before the COVID-19 pandemic. Incidence increased for certain problems. The increased utilization of GP care for mental health issues indicates higher workload and an increasingly important role of Dutch GPs for these patients. Based on the consistent trend over the observed seven years we assume that the increasing trend in consultations will continue into the near future. This increasing demand for mental health care requires the development of new strategies by policy makers and GP-councils to ensure adequate support and resources for these problems in the future.

References

1. Zwaanswijk M, van Dijk CE, Verheij RA. Child and adolescent mental health care in Dutch general practice: time trend analyses. BMC Fam Pract. 2011;12:133. doi: https://doi.org/10.1186/1471-2296-12-133.

2. Elia J, Pajer K, Prasad R, Pumariega A, Maltenfort M, Utidjian L, et al. Electronic health records identify timely trends in childhood mental health conditions. Child Adolesc Psychiatry Ment Health. 2023;17(1):107. doi: https://doi.org/10.1186/s13034-023-00650-7.

3. Comeau J, Georgiades K, Duncan L, Wang L, Boyle MH, Afifi TO, et al. Changes in the Prevalence of Child and Youth Mental Disorders and Perceived Need for Professional Help between 1983 and 2014: Evidence from the Ontario Child Health Study. Can J Psychiat. 2019;64(4):256-64. doi: https://doi.org/10.1177/0706743719830035.

4. Agnafors S, Kjellström AN, Björk MP, Rusner M, Torgerson J. Health care utilization in children and adolescents with psychiatric disorders. Acta Psychiatr Scand. 2023;148(4):327-37. doi: https://doi.org/10.1111/acps.13590.

5. Larrañaga I, Ibarrondo O, Mar-Barrutia L, Soto-Gordoa M, Mar J. Excess healthcare costs of mental disorders in children, adolescents and young adults in the Basque population registry adjusted for socioeconomic status and sex. Cost Eff Resour Alloc. 2023;21(1):18. doi: https://doi.org/10.1186/s12962-023-00428-w.

6. King D, Gronholm PC, Knapp M, Hoffmann MS, Bonin EM, Brimblecombe N, et al. Effects of mental health status during adolescence on primary care costs in adulthood across three British cohorts. Soc Psychiatry Psychiatr Epidemiol. 2023. doi: https://doi.org/10.1007/s00127-023-02507-y.

7. Gibb SJ, Fergusson DM, Horwood LJ. Burden of psychiatric disorder in young adulthood and life outcomes at age 30. Br J Psychiatry. 2010;197(2):122-7. doi: https://doi.org/10.1192/bjp.bp.109.076570.

8. Mei C, Fitzsimons J, Allen N, Alvarez-Jimenez M, Amminger GP, Browne V, et al. Global research priorities for youth mental health. Early Interv Psychiatry. 2020;14(1):3-13. doi: https://doi.org/10.1111/eip.12878.

9. Hansen AS, Christoffersen CH, Telléus GK, Lauritsen MB. Referral patterns to outpatient child and adolescent mental health services and factors associated with referrals being rejected. A cross-sectional observational study. BMC Health Serv Res. 2021;21(1):1063. doi: https://doi.org/10.1186/s12913-021-07114-8.

10. Kuitunen I, Uimonen MM, Ponkilainen VT, Mattila VM. Primary care visits due to mental health problems and use of psychotropic medication during the COVID-19 pandemic in Finnish adolescents and young adults. Child Adolesc Psychiatry Ment Health. 2023;17(1):35. doi: https://doi.org/10.1186/s13034-023-00584-0.

11. Evensen M, Hart RK, Godoy AA, Hauge LJ, Lund IO, Knudsen AKS, et al. Impact of the COVID-19 pandemic on mental healthcare consultations among children and adolescents in Norway: a nationwide registry study. Eur Child Adolesc Psychiatry. 2023;32(6):1025-35. doi: https://doi.org/10.1007/s00787-022-02046-y.

12. Straub L, Bateman BT, Vine S, Huybrechts KF. Prevalence of Mental Health Diagnoses in Commercially Insured Children and Adolescents in the US Before and During the COVID-19 Pandemic. JAMA Netw Open. 2023;6(5):e2314415-e. doi: https://doi.org/10.1001/jamanetworkopen.2023.14415.

6

13. van Esso D, Del Torso S, Hadjipanayis A, Biver A, Jaeger-Roman E, Wettergren B, et al. Paediatric primary care in Europe: variation between countries. Arch Dis Child. 2010:95(10):791-5. doi: https://doi.org/10.1136/adc.2009.178459.

14. O'Brien D, Harvey K, Howse J, Reardon T, Creswell C. Barriers to managing child and adolescent mental health problems: a systematic review of primary care practitioners' perceptions. Br J Gen Pract. 2016;66(651):e693-707. doi: https://doi.org/10.3399%2Fbjgp16X687061.

15. Koet LBM, Velek P, de Schepper EIT, Bohnen AM, Bindels PJE, Gerger H. Children and young people's consultation rates for psychosocial problems between 2016 and 2021 in the Netherlands. Eur J Gen Pract. 2024 Jun 4;30(1):2357780. doi:10.1080/13814788.2024.2357780

16. de Ridder MAJ, de Wilde M, de Ben C, Leyba AR, Mosseveld BMT, Verhamme KMC, et al. Data Resource Profile: The Integrated Primary Care Information (IPCI) database, The Netherlands. Int J Epidemiol. 2022;51(6):e314-e23. doi: https://doi.org/10.1093/ije/dyac026.

17. Napel HT, van Boven K, Olagundoye OA, van der Haring E, Verbeke M, Härkönen M, et al. Improving Primary Health Care Data With ICPC-3: From a Medical to a Person-Centered Perspective. Ann Fam Med. 2022;20(4):358-61. doi: https://doi.org/10.1370/afm.2830.

18. Ripley B, Venables B, Bates DM, Hornik K, Gebhardt A, Firth D, et al. Package 'mass'. Cran r. 2013;538:113-20.

19. Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, et al. The REporting of studies Conducted using Observational Routinely-collected health Data (RECORD) Statement. Plos Med. 2015;12(10):e1001885. doi: https://doi.org/10.1371/journal.pmed.1001885.

20. Pitchforth J, Fahy K, Ford T, Wolpert M, Viner RM, Hargreaves DS. Mental health and well-being trends among children and young people in the UK, 1995-2014: analysis of repeated cross-sectional national health surveys. Psychol Med. 2019;49(8):1275-85. doi: https://doi.org/10.1017/S0033291718001757.

21. Sacco R, Camilleri N, Eberhardt J, Umla-Runge K, Newbury-Birch D. A systematic review and meta-analysis on the prevalence of mental disorders among children and adolescents in Europe. Eur Child Adolesc Psychiatry. 2022:1-18. doi: https://doi.org/10.1007/s00787-022-02131-2.

22. Collishaw S. Annual Research Review: Secular trends in child and adolescent mental health. Journal of Child Psychology and Psychiatry. 2015;56(3):370-93. doi: https://doi.org/10.1111/jcpp.12372.

23. Xu G, Strathearn L, Liu B, Yang B, Bao W. Twenty-Year Trends in Diagnosed Attention-Deficit/Hyperactivity Disorder Among US Children and Adolescents, 1997-2016. JAMA Netw Open. 2018;1(4):e181471. doi: https://doi.org/10.1001/jamanetworkopen.2018.1471.

24. Young S, Adamo N, Ásgeirsdóttir BB, Branney P, Beckett M, Colley W, et al. Females with ADHD: An expert consensus statement taking a lifespan approach providing guidance for the identification and treatment of attention-deficit/ hyperactivity disorder in girls and women. BMC Psychiatry. 2020;20(1):404. doi: https://doi.org/10.1186/s12888-020-02707-9.

25. Husky MM, Léon C, du Roscoät E, Vasiliadis H-M. Prevalence of past-year major depressive episode among young adults between 2005 and 2021: Results from four national representative surveys in France. J Affect Disord. 2023;342:192-200. doi: https://doi.org/10.1016/j.jad.2023.09.019.

26. Lu W, Keyes KM. Major depression with co-occurring suicidal thoughts, plans, and attempts: An increasing mental health crisis in US adolescents, 2011–2020. Psychiatry Res. 2023;327:115352. doi: https://doi.org/10.1016/j.psychres.2023.115352.

27. Kim H, Lee YJ, Jung SJ. Trends in Depressive Symptoms and Suicidality of South Korean Adolescents: Comparison of Expected and Observed Prevalence During the COVID-19 Pandemic. J Adolesc Health. 2023;73(1):79-87. doi: https://doi.org/10.1016/j.jadohealth.2023.02.014.

28. Duffy ME, Twenge JM, Joiner TE. Trends in Mood and Anxiety Symptoms and Suicide-Related Outcomes Among U.S. Undergraduates, 2007–2018: Evidence From Two National Surveys. J Adolesc Health. 2019;65(5):590-8. doi: https://doi.org/10.1016/j.jadohealth.2019.04.033.

29. Miao R, Liu C, Zhang J, Jin H. Impact of the COVID-19 pandemic on the mental health of children and adolescents: A systematic review and meta-analysis of longitudinal studies. J Affective Disord. 2023;340:914-22. doi: https://doi.org/10.1016/j.jad.2023.08.070.

30. Racine N, McArthur BA, Cooke JE, Eirich R, Zhu J, Madigan S. Global Prevalence of Depressive and Anxiety Symptoms in Children and Adolescents During COVID-19: A Meta-analysis. JAMA Pediatr. 2021;175(11):1142-50. doi: https://doi.org/10.1001/jamapediatrics.2021.2482.

31. Trafford AM, Carr MJ, Ashcroft DM, Chew-Graham CA, Cockcroft E, Cybulski L, et al. Temporal trends in eating disorder and self-harm incidence rates among adolescents and young adults in the UK in the 2 years since onset of the COVID-19 pandemic: a population-based study. Lancet Child Adolesc Health. 2023;7(8):544-54. doi: https://doi.org/10.1016/S2352-4642(23)00126-8.

32. Moin JS, Vigod SN, Plumptre L, Troke N, Asaria M, Papanicolas I, et al. Sex differences among children, adolescents and young adults for mental health service use within inpatient and outpatient settings, before and during the COVID-19 pandemic: a population-based study in Ontario, Canada. BMJ Open. 2023;13(11):e073616. doi: https://doi.org/10.1136/bmjopen-2023-073616.

33. Eijgermans DG, Boelens M, Groeniger JO, van der Zanden WH, Jansen PW, Raat H, et al. Role of neighbourhood social characteristics in children's use of mental health services between ages 9 and 13 years: a population-based cohort study in the Netherlands. BMJ Open. 2022;12(4):e057376. doi: https://doi.org/10.1136/bmjopen-2021-057376.

6

Supplementary files

eTable 1. International Classification of Primary Care (ICPC) codes

Problem category	ICPC code
ADHD	P21
Anxiety problems	P01, P74
Behavioural problems	P04, P22, P23
Depressive problems	P03, P76
Eating disorders (i.e. anorexia nervosa, boulemia)	T06
Sleeping problems	P06
Substance abuse	P15, P16, P17, P18, P19
Suicidality	P77

eTable 2. Males: incidence of mental health problems

Males: Incidence per Problem (cases/1000 person years with 95% confidence intervals) Categorized by year and age category (years)

year	sex	age group	ADHD	Anxiety problems	Eating disorders	Behavioral problems	Depressive problems	Sleeping problems	Substance abuse	Suicidality
2016	Male	00-06	3.58 (2.46-5.03)	2.49 (1.58-3.73)	0 (0-0.4)	12.33 (10.15-14.83)	0 (0-0.40)	3.27 (2.21-4.67)	0.43 (0.12-1.10)	0 (0-0.48)
2017	Male	00-06	4.54 (3.34-6.04)	1.93 (1.18-2.98)	0.12 (0-0.64)	10.88 (8.95-13.1)	0 (0-0.35)	5.15 (3.86-6.74)	0.38 (0.10-0.98)	0 (0-0.43)
2018	Male	00-06	3.96 (2.85-5.35)	1.03 (0.52-1.85)	0.22 (0.03-0.81)	11.21 (9.27-13.43)	0 (0-0.35)	4.56 (3.36-6.04)	0.56 (0.21-1.23)	0 (0-0.35)
2019	Male	00-06	2.77 (1.87-3.95)	1.56 (0.91-2.50)	0 (0-0.45)	11.72 (9.75-13.96)	0 (0-0.34)	3.44 (2.42-4.74)	0.46 (0.15-1.07)	0 (0-0.37)
2020	Male	00-06	2.97 (2.09-4.09)	1.52 (0.92-2.38)	0 (0-0.44)	8.88 (7.29-10.71)	0.16 (0.02-0.58)	3.88 (2.86-5.14)	0.24 (0.05-0.70)	0 (0-0.3)
2021	Male	00-06	2.36 (1.65-3.29)	1.48 (0.93-2.25)	0 (0-0.25)	10.62 (9.02-12.43)	0.27 (0.07-0.69)	4.35 (3.35-5.56)	0.4 (0.15-0.88)	0 (0-0.25)
2022	Male	00-06	3.09 (2.26-4.12)	1.21 (0.72-1.91)	0 (0-0.25)	11.73 (10.04-13.62)	0 (0-0.25)	4.54 (3.52-5.76)	0.2 (0.04-0.59)	0 (0-0.25)
2016	Male	07-12	11.85 (9.55-14.53)	5.22 (3.76-7.05)	0.12 (0-0.68)	16.63 (13.85-19.8)	1.1 (0.5-2.09)	3.09 (2-4.56)	0 (0-0.45)	0 (0-0.54)
2017	Male	07-12	10.62 (8.57-13.01)	4.96 (3.62-6.64)	0 (0-0.48)	18.61 (15.82-21.74)	2.39 (1.5-3.62)	2.86 (1.87-4.19)	0.11 (0-0.6)	0 (0-0.48)
2018	Male	07-12	9.71 (7.79-11.97)	5.01 (3.68-6.66)	0 (0-0.46)	15.32 (12.84-18.15)	1.47 (0.8-2.47)	4.04 (2.86-5.55)	0.1 (0-0.58)	0 (0-0.39)
2019	Male	07-12	10.96 (8.95-13.29)	5.55 (4.17-7.24)	0 (0-0.49)	15.59 (13.12-18.38)	0.91 (0.42-1.73)	2.88 (1.91-4.16)	0.5 (0.16-1.18)	0 (0-0.41)
2020	Male	07-12	8.99 (7.31-10.93)	4.62 (3.46-6.05)	0 (0-0.48)	15.98 (13.68-18.56)	1.12 (0.6-1.91)	3.32 (2.35-4.56)	0.09 (0-0.48)	0 (0-0.32)
2021	Male	07-12	11.64 (9.89-13.60)	3.59 (2.66-4.73)	0.07 (0-0.39)	14.82 (12.81-17.05)	0.99 (0.54-1.67)	2.02 (1.34-2.91)	0.07 (0-0.4)	0.14 (0.02-0.51)

year	sex	age group	ADHD	Anxiety problems	Eating disorders	Behavioral problems	Depressive problems	Sleeping problems	Substance abuse	Suicidality
2022	Male	07-12	10.79 (9.12-12.67)	6.4 (5.15-7.87)	0 (0-0.26)	14.47 (12.5-16.67)	1.12 (0.64-1.82)	2.42 (1.68-3.39)	0 (0-0.26)	0 (0-0.26)
2016	Male	13-17	4.93 (3.42-6.89)	6.84 (5.04-9.07)	0.14 (0-0.78)	8.37 (6.34-10.85)	4.36 (2.96-6.19)	2.55 (1.51-4.03)	4.64 (3.19-6.51)	0.51 (0.1-1.48)
2017	Male	13-17	4.42 (3.06-6.17)	6.5 (4.84-8.54)	0.15 (0-0.83)	6.73 (5.01-8.84)	3.51 (2.33-5.08)	3.16 (2.04-4.66)	4 (2.74-5.65)	0.45 (0.09-1.32)
2018	Male	13-17	4.44 (3.09-6.18)	8.45 (6.56-10.71)	0 (0-0.53)	8.53 (6.6-10.86)	5.74 (4.22-7.63)	3.19 (2.08-4.68)	2.43 (1.48-3.75)	0.36 (0.08-1.06)
2019	Male	13-17	3.72 (2.51-5.32)	6.31 (4.71-8.27)	0 (0-0.58)	6.61 (4.94-8.67)	7.17 (5.47-9.22)	2.39 (1.46-3.69)	3.42 (2.29-4.91)	0.77 (0.28-1.68)
2020	Male	13-17	4.12 (2.92-5.66)	6.92 (5.34-8.82)	0.47 (0.1-1.36)	6.01 (4.51-7.84)	5.97 (4.52-7.74)	2.73 (1.78-3.99)	3.62 (2.52-5.04)	0.52 (0.17-1.21)
2021	Male	13-17	5.41 (4.12-6.98)	5.67 (4.36-7.26)	0.35 (0.1-0.9)	6.48 (5.04-8.19)	7.01 (5.55-8.74)	2.75 (1.87-3.91)	3.6 (2.58-4.89)	0.7 (0.3-1.38)
2022	Male	13-17	4.50 (3.34-5.93)	6.61 (5.2-8.29)	0.09 (0-0.48)	5.90 (4.54-7.53)	5.13 (3.9-6.61)	2.87 (1.97-4.03)	3.18 (2.24-4.39)	0.69 (0.3-1.36)
2016	Male	18-24	1.96 (1.18-3.05)	13.46 (11.23-16.01)	0.1 (0-0.56)	2.38 (1.51-3.57)	7.25 (5.65-9.15)	4.73 (3.47-6.31)	5.89 (4.46-7.63)	0.75 (0.27-1.62)
2017	Male	18-24	1.88 (1.17-2.88)	9.73 (7.97-11.77)	0.21 (0.03-0.76)	2.98 (2.05-4.18)	9.4 (7.68-11.39)	3.67 (2.64-4.98)	5.49 (4.2-7.05)	0.11 (0-0.61)
2018	Male	18-24	2.87 (1.98-4.04)	9.81 (8.06-11.82)	0 (0-0.38)	3.25 (2.29-4.48)	10.9 (9.07-12.99)	5.65 (4.36-7.2)	5.94 (4.61-7.53)	0.61 (0.25-1.26)
2019	Male	18-24	2.82 (1.94-3.95)	13.12 (11.11-15.4)	0 (0-0.41)	2.93 (2.03-4.09)	10.85 (9.04-12.91)	5.36 (4.12-6.86)	5.29 (4.06-6.78)	0.56 (0.2-1.21)
2020	Male	18-24	3.35 (2.43-4.50)	11.36 (9.59-13.36)	0 (0-0.41)	2.61 (1.81-3.65)	9.2 (7.62-11)	5.23 (4.07-6.62)	4.78 (3.67-6.12)	0.53 (0.21-1.09)
2021	Male	18-24	3.89 (2.97-5.01)	10.63 (9.05-12.4)	0.06 (0-0.35)	2.42 (1.71-3.34)	11.04 (9.44-12.84)	4.97 (3.92-6.21)	5.94 (4.79-7.29)	0.52 (0.22-1.02)
2022	Male	18-24	3.65 (2.76-4.73)	11.4 (9.77-13.21)	0 (0-0.23)	2.00 (1.36-2.84)	10.59 (9.03-12.34)	5.14 (4.08-6.39)	5.53 (4.43-6.82)	0.57 (0.26-1.09)

eTable 3. *Females: incidence of mental health problems*

Females: Incidence per Problem (cases/1000 person years with 95% confidence intervals) Categorized by year and age category (years)

year	sex	age group	ADHD	Anxiety problems	Eating disorders	Behavioral problems	Depressive problems	Sleeping problems	Substance abuse	Suicidality
2016	Female	00–06	1.24 (0.62-2.22)	2.83 (1.83-4.17)	0 (0-0.41)	6.39 (4.83-8.30)	0 (0-0.42)	3.18 (2.12-4.60)	0.45 (0.12-1.15)	0 (0-0.5)
2017	Female	00–06	0.5 (0.16-1.18)	1.82 (1.08-2.88)	0 (0-0.45)	6.53 (5.03-8.34)	0 (0-0.37)	3.87 (2.74-5.31)	0.20 (0.02-0.73)	0 (0-0.45)
2018	Female	00–06	1.19 (0.62-2.08)	1.99 (1.22-3.08)	0 (0-0.44)	6.24 (4.78-8.00)	0.1 (0-0.55)	5.53 (4.16-7.19)	0.20 (0.02-0.72)	0 (0-0.37)
2019	Female	00–06	1.46 (0.82-2.41)	1.96 (1.19-3.02)	0 (0-0.48)	6.42 (4.95-8.18)	0 (0-0.36)	4.83 (3.58-6.39)	0.19 (0.02-0.7)	0 (0-0.39)
2020	Female	00–06	0.6 (0.24-1.23)	1.36 (0.78-2.22)	0 (0-0.47)	6.18 (4.84-7.79)	0.17 (0.02-0.61)	4.04 (2.97-5.37)	0.51 (0.19-1.11)	0 (0-0.31)
2021	Female	00–06	1 (0.54-1.67)	2.21 (1.5-3.14)	0 (0-0.26)	6.4 (5.14-7.87)	0 (0-0.26)	4.1 (3.1-5.31)	0.36 (0.12-0.83)	0 (0-0.26)
2022	Female	00–06	1.62 (1.03-2.43)	2.69 (1.9-3.69)	0 (0-0.26)	5.63 (4.45-7.01)	0.07 (0-0.39)	3.56 (2.64-4.69)	0.21 (0.04-0.62)	0 (0-0.26)
2016	Female	07–12	4.33 (3-6.06)	7.65 (5.83-9.84)	0.38 (0.08-1.1)	8.5 (6.56-10.83)	1.63 (0.87-2.79)	4.69 (3.3-6.46)	0.12 (0-0.7)	0 (0-0.56)
2017	Female	07–12	5.27 (3.86-7.03)	8.03 (6.26-10.15)	0.27 (0.03-0.97)	8.59 (6.73-10.8)	1.8 (1.03-2.93)	2.96 (1.94-4.34)	0.22 (0.03-0.81)	0.27 (0.03-0.98)
2018	Female	07–12	4.64 (3.34-6.27)	4.77 (3.45-6.42)	0.13 (0-0.72)	10.67 (8.63-13.06)	1.41 (0.75-2.41)	4.52 (3.24-6.13)	0.11 (0-0.6)	0.11 (0-0.6)
2019	Female	07–12	5.85 (4.4-7.61)	7.25 (5.63-9.19)	0 (0-0.51)	9.32 (7.44-11.52)	1.88 (1.11-2.97)	2.66 (1.72-3.92)	0 (0-0.38)	0 (0-0.42)
2020	Female	07–12	5.07 (3.83-6.58)	7.54 (6-9.35)	0.13 (0-0.75)	11.08 (9.18-13.26)	1.96 (1.23-2.97)	3.53 (2.51-4.83)	0 (0-0.33)	0.27 (0.06-0.78)
2021	Female	07–12	4.73 (3.64-6.06)	7.55 (6.14-9.18)	0.07 (0-0.41)	8.95 (7.4-10.73)	1.93 (1.26-2.83)	2.48 (1.71-3.49)	0.07 (0-0.41)	0.15 (0.02-0.53)

6

year	sex	age group	ADHD	Anxiety problems	Eating disorders	Behavioral problems	Depressive problems	Sleeping problems	Substance abuse	Suicidality
2022	Female	07-12	6.37 (5.1-7.87)	7.22 (5.85-8.8)	0.07 (0-0.41)	9.28 (7.71-11.08)	2.41 (1.66-3.39)	3.64 (2.69-4.81)	0.07 (0-0.41)	0.15 (0.02-0.53)
2016	Female	13-17	4.21 (2.82-6.05)	15.12 (12.33-18.36)	1 (0.4-2.06)	6.95 (5.11-9.25)	11.06 (8.71-13.84)	4.77 (3.28-6.7)	3.72 (2.43-5.45)	1.21 (0.49-2.49)
2017	Female	13-17	3.21 (2.08-4.74)	14.63 (12.05-17.61)	1.21 (0.52-2.38)	7.85 (5.99-10.1)	15.05 (12.45-18.04)	3.57 (2.37-5.16)	2.02 (1.15-3.28)	0.61 (0.17-1.56)
2018	Female	13-17	3.27 (2.14-4.79)	11.8 (9.51-14.47)	1.92 (1.02-3.29)	5.28 (3.79-7.17)	15.45 (12.83-18.45)	4.5 (3.15-6.23)	2.59 (1.61-3.97)	2.47 (1.51-3.82)
2019	Female	13-17	3.49 (2.32-5.05)	17.61 (14.8-20.81)	2.27 (1.24-3.81)	7.05 (5.31-9.17)	16.49 (13.79-19.57)	5.7 (4.18-7.61)	2.56 (1.59-3.92)	1.06 (0.46-2.1)
2020	Female	13-17	4.17 (2.95-5.73)	16.07 (13.54-18.93)	1.62 (0.78-2.98)	6.43 (4.87-8.33)	14.59 (12.21-17.3)	4.05 (2.85-5.58)	2.05 (1.23-3.19)	1.94 (1.15-3.06)
2021	Female	13-17	6.16 (4.76-7.83)	18.64 (16.12-21.45)	2.56 (1.7-3.7)	6.97 (5.46-8.76)	20.92 (18.26-23.86)	4.08 (2.97-5.48)	2.1 (1.33-3.15)	1.74 (1.05-2.71)
2022	Female	13-17	7.69 (6.13-9.53)	20.01 (17.4-22.91)	1.36 (0.76-2.24)	7.68 (6.1-9.55)	16 (13.69-18.58)	2.66 (1.78-3.82)	2.53 (1.68-3.66)	2.17 (1.39-3.23)
2016	Female	18-24	2.64 (1.71-3.89)	24.77 (21.57-28.3)	1.68 (0.96-2.73)	2.13 (1.3-3.29)	17.79 (15.15-20.75)	6.31 (4.81-8.14)	2.22 (1.37-3.39)	0.89 (0.36-1.83)
2017	Female	18-24	2.23 (1.43-3.32)	25.17 (22.14-28.5)	0.56 (0.18-1.3)	2.44 (1.6-3.58)	16.88 (14.46-19.58)	8.02 (6.41-9.92)	2.32 (1.5-3.43)	1.23 (0.62-2.21)
2018	Female	18-24	2 (1.25-3.02)	27.25 (24.12-30.68)	0.97 (0.44-1.84)	2.11 (1.34-3.17)	19.61 (17.02-22.48)	6.9 (5.43-8.65)	2.9 (1.98-4.09)	1.36 (0.76-2.24)
2019	Female	18-24	3.59 (2.58-4.87)	27.2 (24.12-30.57)	1.5 (0.8-2.56)	1.77 (1.08-2.74)	18.51 (16.04-21.26)	6.66 (5.24-8.35)	1.92 (1.2-2.9)	1.14 (0.59-1.99)
2020	Female	18-24	3.02 (2.15-4.12)	23.01 (20.36-25.9)	1.49 (0.8-2.55)	1.09 (0.6-1.83)	15.21 (13.11-17.56)	6.8 (5.45-8.39)	3.07 (2.19-4.18)	0.92 (0.48-1.61)
2021	Female	18-24	5.57 (4.45-6.89)	27.77 (25.09-30.65)	1.49 (0.94-2.23)	1.91 (1.28-2.75)	22.07 (19.73-24.63)	7.54 (6.22-9.05)	2.6 (1.86-3.54)	0.72 (0.36-1.28)
2022	Female	18-24	6.41 (5.21-7.80)	28.72 (26.00-31.64)	0.83 (0.44-1.41)	1.04 (0.60-1.69)	18.75 (16.60-21.11)	5.59 (4.47-6.91)	3.39 (2.54-4.44)	1.35 (0.83-2.06)

Trends in mental health problems

eTable 4. Monthly trends of incidence

Monthly trends in incidence per problem category

	ADHD Trend (95% CI)	ADHD P value	Anxiety problems Trend (95% CI)	Anxiety P value	Eating disorders Trend (95% CI)	Eating P value	Behavioural problems Trend (95% CI)	Behav. P value	Depressive problems Trend (95% CI)	Depr. P value	Sleeping problems Trend (95% CI)	Sleep P value	Substance abuse Trend (95% CI)	Subst. P value	Suicidality Trend (95% CI)	Suic. P value
Overall	1.004 (1.002-1.006)	<0.001	1.001 (1-1.002)	0.164	1.000 (0.994-1.005)*	0.945	0.999 (0.997-1.000)	0.106	1.003 (1.001-1.005)	0.004	0.999 (0.997-1.000)*	0.095	0.999 (0.997-1.001)*	0.400	1.004 (0.999-1.009)*	0.122
Male overall	1.001 (0.999-1.003)*	0.363	0.999 (0.997-1.001)	0.221	Too low number	0.363	0.998 (0.996-1.000)	0.026	1.003 (1.000-1.005)	0.04	1.000 (0.998-1.002)*	0.953	0.998 (0.995-1.001)*	0.192	1.004 (0.994-1.013)*	0.434
Female overall	1.01 (1.007-1.013)	<0.001	1.002 (1.001-1.004)	0.003	1.001 (0.995-1.006)*	0.824	0.999 (0.997-1.002)	0.645	1.003 (1.001-1.005)	0.01	0.998 (0.995-1.000)*	0.028	1.001 (0.997-1.005)*	0.740	1.004 (0.998-1.01)*	0.179
Male 0-6	0.994 (0.989-0.999)	0.016	0.992 (0.984-1.000)	0.061	Too low number**		0.999 (0.996-1.002)	0.494	Too low number**		1.001 (0.997-1.005)*	0.637	Too low number**		No cases	
Male 7-12	1.000 (0.997-1.003)	0.925	1.001 (0.996-1.005)*	0.797	Too low number**		0.998 (0.995-1.000)	0.062	0.993 (0.985-1.001)*	0.083	0.995 (0.989-1.000)*	0.068	Too low number**		Too low number**	
Male 13-17	1.001 (0.996-1.006)*	0.790	0.998 (0.994-1.002)*	0.365	Too low number**		0.996 (0.991-1.000)	0.047	1.005 (1.000-1.009)*	0.044	1.000 (0.994-1.006)*	0.906	0.997 (0.992-1.003)	0.295	1.006 (0.991-1.02)*	0.437
Male 18-24	1.010 (1.004-1.015)*	<0.001	0.999 (0.997-1.002)	0.696	Too low number**		0.996 (0.991-1.002)*	0.158	1.003 (1.000-1.006)	0.037	1.002 (0.998-1.006)*	0.364	0.999 (0.996-1.003)*	0.783	1.001 (0.989-1.014)*	0.823
Female 0-6	1.005 (0.996-1.014)*	0.275	1.001 (0.994-1.007)*	0.817	No cases		0.999 (0.995-1.002)*	0.469	Too low number**		0.999 (0.995-1.004)*	0.770	Too low number**		No cases	
Female 7-12	1.003 (0.999-1.007)*	0.147	1.000 (0.997-1.004)	0.811	Too low number**		1.001 (0.998-1.004)*	0.672	1.005 (0.998-1.012)*	0.141	0.996 (0.991-1.001)*	0.130	Too low number**		Too low number**	
Female 13-17	1.012 (1.007-1.018)*	<0.001	1.005 (1.002-1.008)	0.001	1.005 (0.997-1.014)	0.218	1.001 (0.997-1.005)	0.660	1.005 (1.002-1.008)	0.002	0.995 (0.99-1.000)*	0.074	0.996 (0.989-1.003)*	0.227	1.008 (1.000-1.017)*	0.056
Female 18-24	1.017 (1.011-1.022)	<0.001	1.002 (1.000-1.004)	0.139	0.999 (0.991-1.007)*	0.822	0.991 (0.984-0.998)*	0.007	1.002 (0.999-1.004)	0.165	0.998 (0.995-1.002)*	0.321	1.005 (1-1.01)*	0.075	1.000 (0.991-1.009)*	0.924

*Monthly trends in relative rate with 95% confidence interval. * there was no over dispersion (i.e. a Poisson distribution was used). ** unstable model due to low number of cases*

eTable 5. *Monthly trends of consultations*

Monthly trends in consultation rates per problem category

		ADHD		Anxiety problems		Eating disorders		Behavioral problems		Depressive problems		Sleeping problems		Substance abuse		Suicidality	
		Trend (95% CI)	P value	Trend (95% CI)	P value	Trend (95% CI)	P value	Trend (95% CI)	P value	Trend (95% CI)	P value	Trend (95% CI)	P value	Trend (95% CI)	P value	Trend (95% CI)	P value
Overall		1.005 (1.004-1.006)	<0.001	1.008 (1.007-1.009)	<0.001	1.007 (1.005-1.010)	<0.001	1.005 (1.004-1.006)	<0.001	1.008 (1.007-1.009)	<0.001	1.002 (1.001-1.004)	0.001	1.002 (1.001-1.004)	0.007	1.013 (1.009-1.016)	<0.001
Male overall		1.003 (1.002-1.004)	<0.001	1.005 (1.003-1.006)	<0.001	1.000 (0.989-1.011)	0.975	1.004 (1.003-1.005)	<0.001	1.008 (1.007-1.010)	<0.001	1.001 (0.999-1.002)	0.407	1.002 (1.000-1.004)	0.014	1.010 (1.003-1.018)	0.008
Female overall		1.008 (1.007-1.010)	<0.001	1.009 (1.008-1.010)	<0.001	1.008 (1.005-1.011)	<0.001	1.005 (1.004-1.007)	<0.001	1.007 (1.006-1.009)	<0.001	1.003 (1.002-1.005)	<0.001	1.002 (1.000-1.004)	0.080	1.014 (1.010-1.017)	<0.001
Male	0-6	0.994 (0.990-0.997)	<0.001	0.999 (0.991-1.006)	0.726	Too low number**		1.006 (1.003-1.008)	<0.001	Too low number**		1.003 (0.998-1.007)	0.219	Too low number**		No cases	
	7-12	1.000 (0.998-1.001)	0.538	1.005 (1.001-1.009)	0.006	Too low number**		1.005 (1.003-1.007)	<0.001	0.997 (0.992-1.003)	0.316	0.997 (0.993-1.002)	0.221	Too low number**		Too low number**	
	13-17	1.003 (1.001-1.004)	<0.001	1.004 (1.002-1.006)	<0.001	1.038 (1.020-1.056)	<0.001	1.002 (1.000-1.004)	0.022	1.015 (1.012-1.018)	<0.001	1.002 (0.998-1.007)	0.272	0.996 (0.992-0.999)	0.026	1.006 (0.995-1.018)	0.262
	18-24	1.009 (1.007-1.01)	<0.001	1.005 (1.004-1.007)	<0.001	0.965 (0.946-0.984)	<0.001	1.002 (1.000-1.004)	0.081	1.007 (1.005-1.009)	<0.001	1.001 (0.998-1.004)	0.497	1.004 (1.002-1.006)	<0.001	1.015 (1.004-1.025)	0.005
Female	0-6	0.997 (0.990-1.004)	0.380	1.008 (1.003-1.013)	0.001	no cases		1.003 (1.000-1.006)	0.038	Too low number**		1.003 (1.000-1.007)*	0.054	Too low number**		No cases	
	7-12	1.003 (1.001-1.005)	0.002	1.008 (1.006-1.011)	<0.001	Too low number**		1.008 (1.005-1.010)	<0.001	1.014 (1.010-1.018)	<0.001	1.004 (0.999-1.008)	0.085	Too low number**		Too low number**	
	13-17	1.009 (1.007-1.011)	<0.001	1.013 (1.011-1.015)	<0.001	1.017 (1.012-1.022)	<0.001	1.006 (1.004-1.008)	<0.001	1.009 (1.007-1.012)	<0.001	0.999 (0.995-1.003)	0.780	0.994 (0.988-0.999)	0.022	1.012 (1.006-1.018)	<0.001
	18-24	1.013 (1.011-1.015)	<0.001	1.008 (1.007-1.009)	<0.001	1.005 (1.002-1.007)	0.001	1.001 (0.998-1.004)	0.401	1.007 (1.005-1.008)	<0.001	1.005 (1.003-1.007)	<0.001	1.004 (1.001-1.006)	0.003	1.015 (1.011-1.020)	<0.001

*Monthly trends in relative rate with 95% confidence interval. * there was no over dispersion (i.e. a Poisson distribution was used. ** unstable model due to low number of cases*

eTable 6. Monthly trends of consultation rates, after correction for autocorrelation

Monthly trends in consultation rates per problem category

	ADHD Trend (95% CI)	P value	Anxiety problems Trend (95% CI)	P value	Eating disorders Trend (95% CI)	P value	Behavioral problems Trend (95% CI)	P value	Depressive problems Trend (95% CI)	P value	Sleeping problems Trend (95% CI)	P value	Substance abuse Trend (95% CI)	P value	Suicidality Trend (95% CI)	P value
Overall	No autocorrelation		1.008 (1.007-1.009)	<0.001	1.007 (1.005-1.010)	<0.001	No autocorrelation		1.008 (1.007-1.009)	<0.001	No autocorrelation		1.002 (1.001-1.004)	0.004	No autocorrelation	
Male overall	No autocorrelation		1.005 (1.003-1.006)	<0.001	0.998 (0.988-1.008)	0.687	No autocorrelation		No autocorrelation		No autocorrelation		1.002 (1.000-1.004)	0.012	No autocorrelation	
Female overall	No autocorrelation		1.009 (1.009-1.010)	<0.001	No autocorrelation		No autocorrelation		1.007 (1.006-1.008)	<0.001	No autocorrelation		1.002 (1.000-1.004)	0.068	No autocorrelation	
Male 0-6	No autocorrelation		No autocorrelation		Too low number		No autocorrelation		Too low number		No autocorrelation		Too low number		No cases	
Male 7-12	No autocorrelation		1.005 (1.002-1.008)	0.001	Too low number		No autocorrelation		0.998 (0.993-1.002)	0.321	No autocorrelation		Too low number		Too low number	
Male 13-17	1.003 (1.002-1.004)	<0.001	1.004 (1.002-1.006)	<0.001	1.034 (1.017-1.052)	<0.001	No autocorrelation		1.015 (1.012-1.018)	<0.001	1.003 (0.998-1.007)	0.204	No autocorrelation		No autocorrelation	
Male 18-24	No autocorrelation		1.005 (1.003-1.007)	<0.001	0.963 (0.944-0.980)	<0.001	No autocorrelation		1.007 (1.005-1.009)	<0.001	No autocorrelation		1.004 (1.002-1.006)	<0.001	No autocorrelation	
Female 0-6	No autocorrelation		No autocorrelation		no cases		No autocorrelation		Too low number		No autocorrelation		Too low number		No cases	
Female 7-12	No autocorrelation		1.008 (1.006-1.010)	<0.001	Too low number		No autocorrelation		No autocorrelation		No autocorrelation		Too low number		Too low number	
Female 13-17	1.009 (1.007-1.010)	<0.001	1.013 (1.012-1.015)	<0.001	1.017 (1.012-1.023)	<0.001	No autocorrelation		1.009 (1.008-1.011)	<0.001	1.000 (0.996-1.004)	0.780	No autocorrelation		No autocorrelation	
Female 18-24	1.013 (1.011-1.015)	<0.001	No autocorrelation		No autocorrelation		1.001 (0.998-1.003)	0.563	1.006 (1.005-1.007)	<0.001	1.005 (1.002-1.007)	<0.001	No autocorrelation		No autocorrelation	

The analyses that showed signed of auto-correlation were repeated with correction for autocorrelation and are highlighted in this table. The estimates for the corrected and non-corrected trends are (almost) identical.

6

eTable 7. Monthly trends of incidence, before March 2020 and for 2016–2022

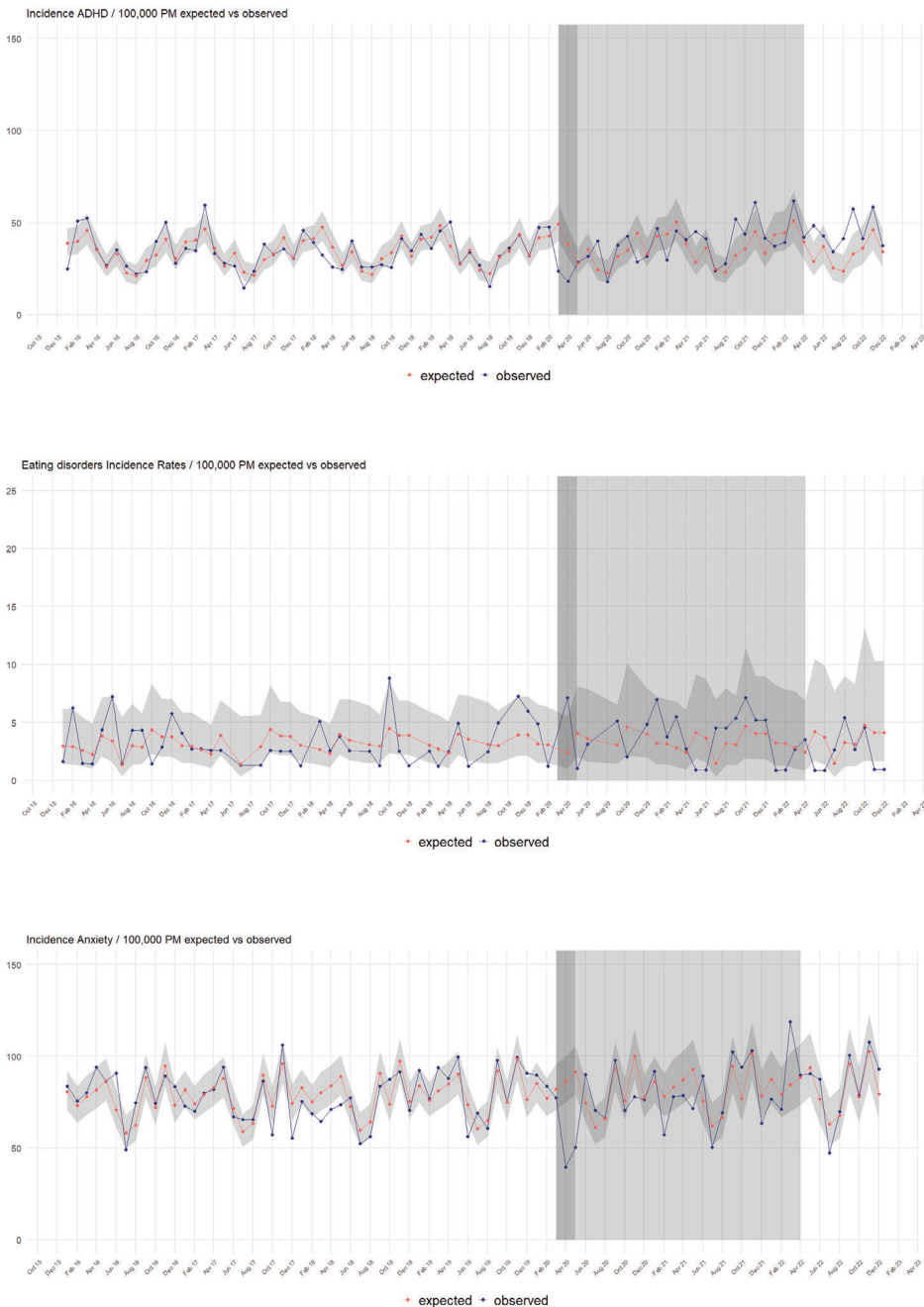Time trend analysis of impact of COVID-19 period on mental health problems incidence

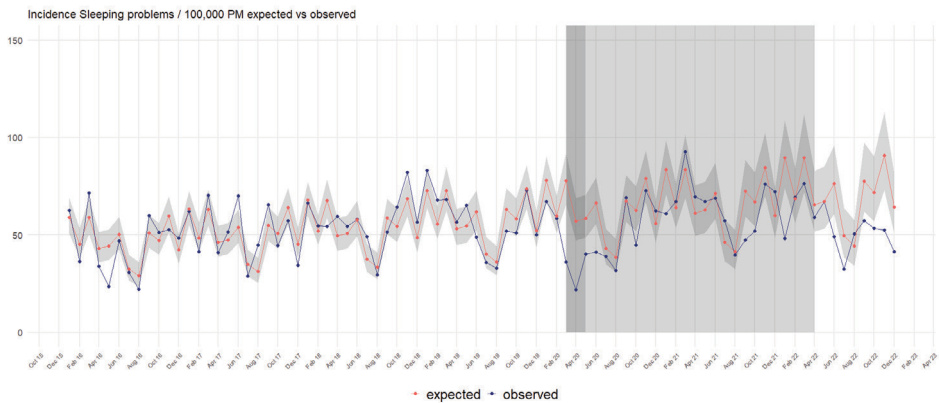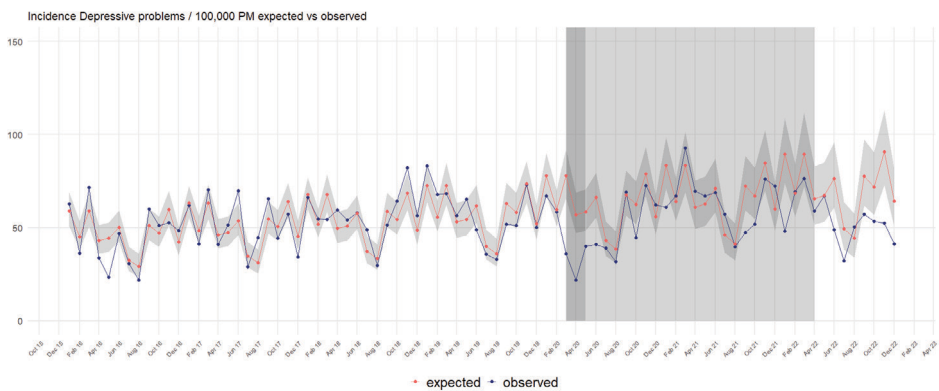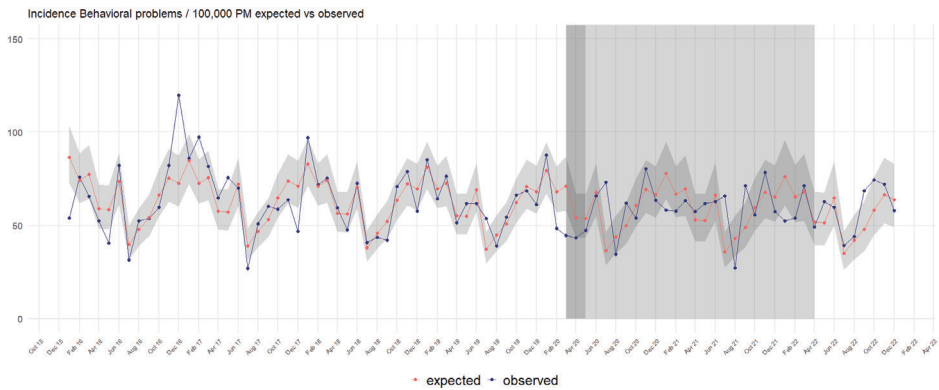|	Trend 2016-March 2020		Trend 2016-2022		COVID-19 period March-2020 until April-2022	
	trend (95% CI)	p	trend (95% CI)	p	Expected n (95% CI)	observed
ADHD	1.002 (0.998-1.005)	0.427	1.004 (1.002-1.006)	<0.001	939 (740-1194)	977
Anxiety problems	1.001 (0.999-1.004)	0.407	1.001 (1-1.002)	0.164	2068 (1763-2426)	1968
Eating disorders	1.001 (0.988-1.015)	0.860	1.000 (0.994-1.005)	0.945	78 (34-183)	86
Behavioral problems	0.998 (0.995-1.002)	0.336	0.999 (0.997-1.000)	0.106	1500 (1197-1879)	1480
Depressive problems	1.006 (1.003-1.009)	<0.001	1.003 (1.001-1.005)	0.004	1700 (1398-2067)	1483
Sleeping problems	1.006 (1.003-1.009)	<0.001	0.999 (0.997-1.000)	0.095	1023 (814-1286)	878
Substance abuse	0.996 (0.99-1.001)	0.130	0.999 (0.997-1.001)	0.400	351 (247-498)	401
Suicidality	1.005 (0.992-1.017)	0.461	1.004 (0.999-1.009)	0.122	115 (55-244)	107

eTable 8. Monthly trends of consultation rates (contacts), before March 2020 and for 2016–2022

Time trend analysis of impact of COVID-19 period on mental health problems consultation rates

	Trend 2016-March 2020		Trend 2016-2022		COVID-19 period March-2020 until April-2022	
	trend (95% CI)	p	trend (95% CI)	p	Expected n (95% CI)	observed
ADHD	1.005 (1.003-1.007)	<0.001	1.005 (1.004-1.006)	<0.001	11712 (10439-13140)	11367
Anxiety problems	1.007 (1.005-1.009)	<0.001	1.008 (1.007-1.009)	<0.001	13048 (11669-14589)	13370
Eating disorders	1.009 (1.005-1.014)	<0.001	1.007 (1.005-1.010)	<0.001	1171 (880-1559)	1207
Behavioral problems	1.003 (1.001-1.005)	<0.001	1.005 (1.004-1.006)	<0.001	8104 (7214-9105)	8482
Depressive problems	1.010 (1.008-1.012)	<0.001	1.008 (1.007-1.009)	<0.001	14268 (12999-15661)	13161
Sleeping problems	1.002 (0.999-1.004)	0.289	1.002 (1.001-1.004)	0.001	2375 (1991-2834)	2472
Substance abuse	1.003 (1.000-1.007)	0.086	1.002 (1.001-1.004)	0.007	2443 (1967-3035)	2524
Suicidality	1.019 (1.011-1.028)	<0.001	1.013 (1.009-1.016)	<0.001	770 (462-1283)	565

6

eFigure 1a. *Modelled monthly incidence rate vs observed incidence*

Incidence ADHD / 100,000 PM expected vs observed

Eating disorders Incidence Rates / 100,000 PM expected vs observed

Incidence Anxiety / 100,000 PM expected vs observed

Incidence Behavioral problems / 100,000 PM expected vs observed

expected • observed

Incidence Depressive problems / 100,000 PM expected vs observed

expected • observed

Incidence Sleeping problems / 100,000 PM expected vs observed

expected • observed

6

Incidence Substance abuse problems / 100,000 PM expected vs observed

expected   observed

Incidence Suicidality problems / 100,000 PM expected vs observed
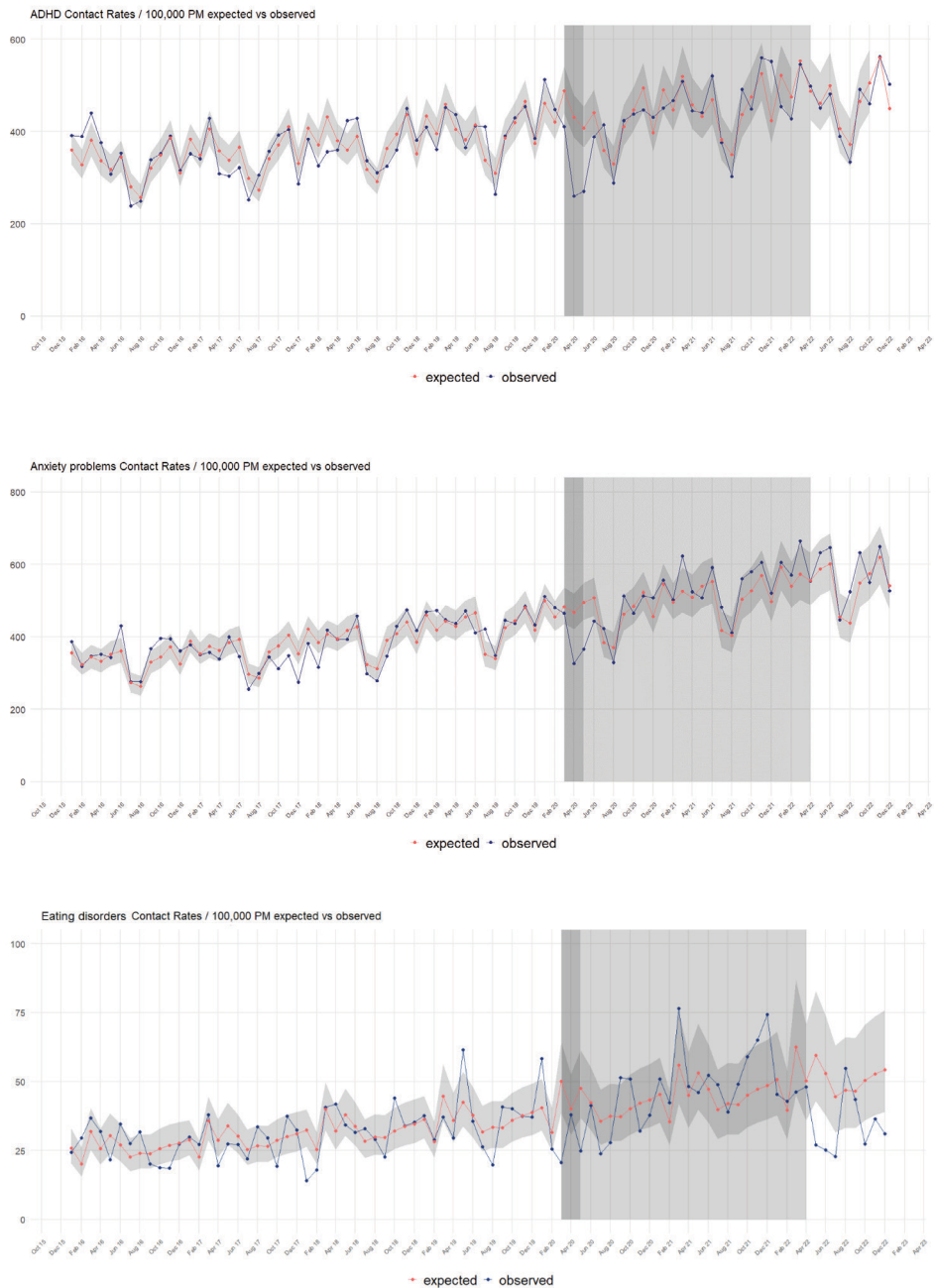
expected   observed

Expected monthly incidence based on pre pandemic trend vs observed incidence. Grey area represents COVID-19 pandemic with dark grey area representing the first lockdown measures in the Netherlands

eFigure 1b. *Modelled monthly consultation rate vs observed consultation rate*

ADHD Contact Rates / 100,000 PM expected vs observed

expected • observed

Anxiety problems Contact Rates / 100,000 PM expected vs observed

expected • observed

Eating disorders Contact Rates / 100,000 PM expected vs observed

expected • observed

Behavioral problems Contact Rates / 100,000 PM expected vs observed

expected · observed

Depressive problems Contact Rates / 100,000 PM expected vs observed

expected · observed

Sleeping problems Contact Rates / 100,000 PM expected vs observed

expected · observed

Substance abuse Contact Rates / 100,000 PM expected vs observed

expected ・ observed

Suicidality problems Contact Rates / 100,000 PM expected vs observed
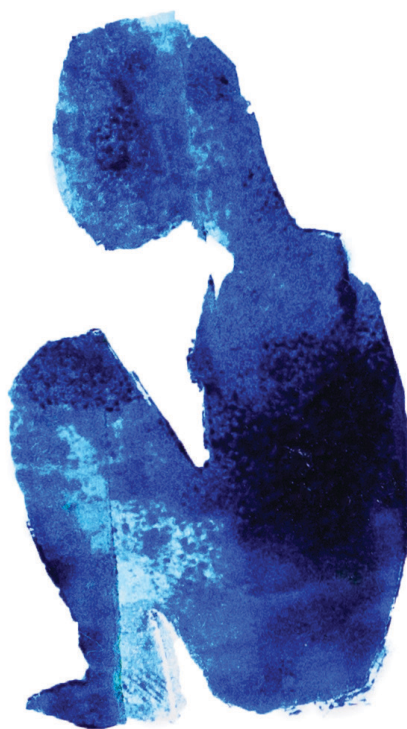
expected ・ observed

Expected monthly consultations (contacts) based on pre pandemic trend vs observed consultations (contacts). Grey area represents COVID-19 pandemic with dark grey area representing the first lockdown measures in the Netherlands

6

Chapter 7

Integrating youth mental health practice nurses into general practice: effects on outpatient mental health care utilization among children and adolescents

Lukas BM Koet, Sanne Verhoog, Özcan Erdem, Heike Gerger, Patrick JE Bindels, Evelien IT de Schepper, Wilma Jansen

Abstract

Integration of child mental health services in general practice may improve early detection and treatment and reduce strain on specialized services. In this study we investigated whether outpatient mental health care utilization and associated costs in children and adolescents were affected by the introduction of youth mental health practice nurses (YMHPNs) in general practice. We linked healthcare data of the Rijnmond Primary Care Database to municipal registry data on child outpatient mental health care expenditures between 2019 and 2022. Using mixed models, we assessed if the presence of a YMHPN in practices was associated with outpatient mental health care utilization. Our cohort consisted of 33,971 children aged 0–17 years registered in 38 general practices in Rotterdam, the Netherlands. 5.5% of these children attended outpatient mental health services between 2019 and 2022. The proportion of children utilizing outpatient mental health care and associated costs increased over time. After correction for practice demographics and trends over time, the presence of a YMHPN in a practice was associated with small non-significant reductions in the number of children receiving outpatient care (Rate Ratio = 0.99, 95% CI 0.92 to 1.06) and associated costs (-395.80 euros 95% CI -1431.27 to 639.67) compared with practices without YMHPN. Considering the study limitations, we cautiously concluded that the introduction of YMHPNs in general practice was not associated with significant changes in outpatient mental health care utilization one to four years after implementation. Future studies should elucidate the long-term impact and underlying changes in pathways to care due to the introduction of the YMHPN.

Introduction

Worldwide there has been an increasing demand for child mental health services in the last decades.[1, 2] However, mental health services often lack resources to handle this increasing demand resulting in long waiting-lists and rejection of referrals.[3] The limited access to mental health services can be especially problematic in cases where early detection and treatment of the problem could have prevented problems later in life.[4] In addition, there is evidence that referral of children with limited or no mental health impairment to child mental health care is at least partially responsible for the observed strain on these services.[2] To address the problems associated with restricted access to mental health care services and to relieve overburdened specialized services, it has been suggested to integrate mental health services into primary care.[5] Available evidence suggests that integrated care models may offer several benefits compared to usual care, including improved accessibility and better mental health outcomes.[6]

In the Netherlands, all health care for children below 18 years is reimbursed. Primary care for children and adolescents is delivered by general practitioners (GPs). All children and adolescents are registered at the practice of their local GP and typically only change practices when moving further away. Children and their caregivers can seek help for mental health problems from their GP, who can either provide basic treatment themselves or refer to specialized services if needed. However, many GPs feel they lack confidence and sufficient time to manage child mental health problems and often choose to refer rather than to manage these problems themselves.[7,8,9] In the Netherlands children and adolescents referred to mental health services are typically treated on an outpatient basis, mostly provided by large mental health institutions. GPs experience difficulties in the referral process (e.g., selecting the appropriate provider) and regularly see their referrals rejected.[7] In the Netherlands, there is no direct access to child mental health services. As such, children need a referral to access mental care, which can be provided by different health professionals including GPs, local support teams, and hospital pediatricians. In Rotterdam, GPs are responsible for most mental health care referrals.

Since 2015 a specialized position of 'youth mental health practice nurse' (YMHPN) has been introduced into general practice.[10] The GP can refer children to the YMHPN when they present with psychosocial problems. The aims of introducing the YMHPN are to improve early treatment of child mental health, improve quality of referrals, and to reduce unnecessary referrals to specialized mental health care by offering basic care.[10] YMHPNs

7

are professionals with experience in youth care and can have diverse backgrounds including psychiatric nursing, psychology, and social work. YMHPNs work within general practices and provide a variety of tasks, such as problem clarification, support for parenting, psycho-education, short-term basic treatment of mental health problems, and specific family interventions.[10] Furthermore, they assist GPs by providing information and advice, serve as liaisons with external parties such as schools, social support teams, and specialized mental health services, and refer children on behalf of the GP when specialized care is needed.[11] Usually, there is no waiting list for the YMHPN.[7, 12] Unlike GPs, YMHPNs are not licensed to prescribe medication. Although the number of initiatives to integrate mental health services into primary care is increasing worldwide,[6] the position of the YMHPN in the Netherlands is not directly comparable to other initiatives.

Also, in the Netherlands the number of children receiving mental care services has increased substantially in the last two decades, as well as the needed budgets.[13] It is unclear what effects the introduction on the YMHPNs has had on child mental health care utilization. On the one hand the introduction of YMHPNs may prevent unnecessary referrals and lead to more early treatment, which may prevent worsening of mental problems and reduce the need for more specialized care. On the other hand, the introduction of YMHPNs may reduce barriers to mental care, effectually leading to more children receiving mental health care, either in general practice or in a specialized setting. It is also possible for these effects to co-occur. To date, it remains unclear whether the introduction of YMHPNs in general practice leads to different outpatient mental care utilization among affected children.

In this study, we first investigated whether outpatient mental health care utilization changed over time. Secondly, we evaluated which child characteristics are associated with outpatient mental health care utilization. Thirdly, we investigated whether the introduction of YMHPNs into general practice is associated with changes in outpatient mental healthcare utilization and costs for outpatient mental healthcare.

Methods

Study design and population

We performed a retrospective population-based cohort study using GP medical records and municipal registry data of children and adolescents aged 0–17 years in Rotterdam between January 1st, 2019 and December 31st, 2022.

Setting

Rotterdam is the second-largest city of the Netherlands, with a population of 670,000. It has a large community of ethnic minorities and the highest percentage of children living in a low-income household of the Netherlands.[14] In 2019, after performing a pilot-project, the municipality of Rotterdam implemented the integration of child mental health services into primary care by introducing youth mental health practice nurses (YMHPNs) into several general practices (YMHPN-project).[15] In the practices participating in the project, YMHPNs work typically 1 to 2 days per week. All starting YMHPNs in Rotterdam are obliged to follow a 1-year post-graduate training and receive continued education. Salary costs of the YMHPNs are paid by the municipality. The number of general practices participating in the YMHPN-project has steadily increased. In 2019 approximately 20% of children in the municipality Rotterdam were registered in a practice with a YMHPN which increased to approximately 50% in 2022.

Data sources and data linkage

We linked data of our GP database (Rijnmond Primary Care Database) with municipal registry data on youth care expenses. Practices participating in the YMHPN-project also joined the Rijnmond Primary Care Database (RPCD) for evaluation purposes. The RPCD is a region-specific derivative of the Integrated Primary Care Information (IPCI) database, covering the Rotterdam metropolitan area.[16] It contains pseudonymized routinely collected medical data of general practice patients. The RPCD database has extensive quality control measures.[16] New practices joining the RPCD start providing data one year after joining the database (run-in period). The municipal registry data contains information on all youth care expenditures (e.g., outpatient and inpatient mental health services, foster care) of all children aged 0–17 living in Rotterdam from 2019 onwards. From age 18 onwards health care costs are reimbursed by health insurance, and therefore no information for adults was available.

We selected data on outpatient mental health care only because YMHPN typically refer their patients to outpatient care and the care delivered by YMHPN may theoretically substitute outpatient care delivered for non-complex mental problems.[11, 17] Outpatient mental health care was defined by any outpatient psychosocial care, one-on-one or in groups, delivered by any mental health institution or practice. The RPCD and municipal registry do not contain robust information on expenditures in general practice and

medication costs because these are covered by health insurances. General practice expenditures and medication costs related to child mental health problems are relatively low compared to costs for more complex care such as outpatient mental health care. For these reasons, we did not take these costs into consideration in our analyses. The municipality provided information regarding the specific general practices in which a YMHPN was employed, along with the corresponding start dates for each practice. General practices in Rotterdam participating in the RPCD were informed about the study goals and were asked to give consent for data linkage. Out of 47 participating practices, we received consent from 38 practices. Data linkage was performed by a trusted third party. The authors were not involved in the linkage process.

Data extraction

For every child we extracted from the municipal registry monthly data on whether a child received outpatient mental health care, and the associated monthly costs in euros. These costs are estimates of the expenditures based on the indicated care at start of the treatment. Cost estimates are based on price agreements between the municipality and the care providers. If the treatment plan changed during the treatment trajectory (e.g., prolonged or more intense treatment was needed), new estimates for the subsequent months were available. The estimated costs are assumed to be a good representation of actual costs. Additionally, we extracted from the RPCD monthly information on the child's age, sex, and social deprivation status. Social deprivation status is a summary score (deprived or non-deprived) calculated for every postal code using deprivation indicators (i.e., benefit recipients, residents with low income, surrounding address density and non-western foreigner) provided by the Dutch Healthcare Authority (NZA).[18]

Analysis

All analysis were performed in R (version 4.3.1; glmmtmb package).[19] We compared differences in outpatient healthcare utilization between boys and girls, and children living in deprived and non-deprived areas using student t-test and chi-square test. To assess the association between the presence of YMHPNs and outpatient mental health care utilization we used aggregated data per month per practice. We used aggregated data because we regard the introduction of the YMHPN as a practice level intervention. The effects of a YMHPN in a practice may be direct (e.g., consultations with the YMHPN take place) but also indirect (e.g., increased awareness in the practices of mental health

problems, GP consults the YMHPN for advice on treatment plan with no appointments between child and YMHPN taking place). We used mixed-effects models estimating the association between the presence of YMHPNs and the two outcomes of interest (1) the number of children receiving outpatient mental health care, and (2) the costs for outpatient mental health care per practice, while accounting for the correlation between monthly measurements of each practice. We used Poisson mixed-effects models for the number of children receiving care and linear mixed-effects models for the total costs for outpatient mental health care per practice. In the fixed-effects part we allowed for a linear effect of time (In months ranging from 0 in January 2019 to 47 in December 2022). We corrected for practice characteristics (i.e., number of children per practice, average age of children within practices, proportion of boys, and proportion of children living in deprived areas). In the Netherlands the number of referrals to child mental care decreased significantly in 2020 due to the COVID-19 pandemic.[20] Therefore, we included a dummy variable (March-December 2020) to adjust for possible confounding effects of the first year of the pandemic. In the random-effects structure we included random intercepts and random linear time per practice. Residual plots were used to validate the models' assumptions.

Sensitivity analyses

Since participation in the YMHPN-project was not random (i.e., practices could decide themselves whether to participate or not) participating practices may differ in terms of care utilization from non-participating practices regardless of the presence of a YMHPN. To assess possible confounding effects of unmeasured differences between participating and non-participating practices, we repeated the analyses using only practices that participated in the YMHPN-project. To assess possible confounding effects of a dynamic cohort (e.g., practices joining the cohort during the study period) we repeated the above analysis using only practices that provided at least three years of follow-up information.

Ethics and data availability

Under Dutch GDPR law, this study does not require ethical approval. The RPCD is a pseudonymised, opt-out database, stored confidentially on a local server of ErasmusMC. Patients of participating practices are informed by their GP about the participation of the practice, and that their information can be removed from the database on request. The Governance Board of the RPCD approved our study protocol (project-number

2020.013). We followed the RECORD guidelines for studies using routinely-collected health data.[21] Due to legal constraints, the data is not publicly available.
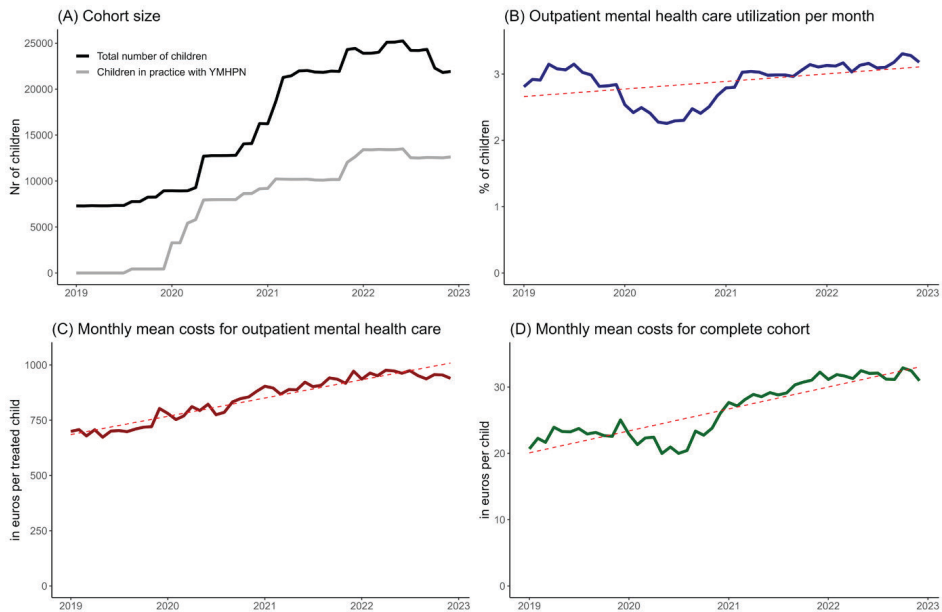
Results

Cohort characteristics

38 general practices with a total of 33,971 children contributed to our cohort. At the start of the study in January 2019, the cohort consisted of 9 practices with 7718 children. Over time the number of practices providing information to the RPCD database increased, which can partly be explained by practices joining the YMHPN-project during the study period. (see Table 1; Fig. 1). Children were on average 8.6 years old (SD 5.1) and 49.3% were girls. In January 2019 a total of 28.4% of children lived in a deprived area which increased to 43.2% by December 2022. Changes in cohort demographics are also explained by more practices providing data to the RPCD over time (see Table 1; Fig. 1).

Table 1. Cohort demographics over time

	Total cohort size[a]	Number of children in practice with YMHPN[b]	Mean age (SD)	% Male	% living in deprived area
2019-01-01	7298	0	8.6 (5.2)	50.3	28.4
2019-07-01	7335	0	8.6 (5.1)	50.2	28.6
2020-01-01	8943	3278	8.5 (5.1)	50.3	27.6
2020-07-01	12767	7983	8.5 (5.1)	50.6	40.5
2021-01-01	16232	9195	8.6 (5.1)	51.0	44.3
2021-07-01	21859	10111	8.6 (5.0)	50.8	40.8
2022-01-01	23898	13414	8.6 (5.1)	50.8	40.1
2022-07-01	24216	12536	8.6 (5.1)	50.5	42.5
2022-12-01	21927	12624	8.7 (5.0)	50.6	43.2

[a]The cohort size increased over time due to more practices joining the RPCD. One practice was closed during follow-up. 7 practices had not yet provided follow-up information for the last months of 2022 at time of data-linkage. [b]Over time more practice that employed a YMHPN joined the RPCD and some already participating practices started employing a YMHPN. One practice stopped employing a YMHPN during follow-up.

Figure 1. Changes in cohort size, mental health care utilization and costs over time

(A) Cohort size
(B) Outpatient mental health care utilization per month
(C) Monthly mean costs for outpatient mental health care
(D) Monthly mean costs for complete cohort

This graphs show monthly data on number of children in cohort, and monthly outpatient mental health care utilization. The dotted-line in figure b, c and d shows the simple regression line over time. The proportion of children in outpatient care was lower than expected in the first year of the COVID-19 pandemic. Consequently, average costs per child were also lower in the first year of the pandemic.

Practice characteristics

The number of children per practice ranged from 205 to 2150 children. The percentage of children living in socially deprived areas varied by practice, ranging from 1.8 to 91.4%. There were large differences in the mean of monthly outpatient mental health care utilization between practices ranging from 0.9 to 5.6% of children. Taking into account the number of children per practice, the average monthly costs of practices ranged from 9.33 to 41.38 euro per registered child. Twenty practices never employed a YMHPN in their practice during the study period. Nine practices started employing a YMHPN during the study period. Eight practices had a YMHPN during the complete study period. One practice had a YMHPN at the start of the study period but stopped with the project during follow-up. Trends over time in these outcomes seemed to vary per practice (see eFigure 1). Although utilization rates and mean costs tended to increase over time, patterns over time varied between practices. No uniform changes were seen either on outpatient health care utilization or on associated costs after a YMHPN started in a practice (eFigure 1).

Utilization and costs of outpatient mental health care

On average 5.5% of children attended outpatient mental health services during the study period (mean follow-up per child = 24.1 months). The monthly percentage of children attending these services increased from 2.8% in January 2019 to 3.2% by December 2022. However, during the year of the COVID-19 pandemic this rate dropped temporarily to a minimum of 2.3% in June 2020 (Fig. 1B). Monthly rates were higher for boys than for girls (average monthly rate 3.3% vs. 2.6%, p < 0.001). Monthly rates were lower for children living in a social deprived area than for those in non-deprived areas (average monthly rate 2.4% vs. 3.3%, p < 0.001).

The average monthly cost for outpatient mental health care increased from 699.23 euros in January 2019 to 939.47 euros per treated child by December 2022 (Fig. 1C). Averaged monthly cost across all children, including those who attended outpatient care and those who did not, increased from 23.66 euro per child in January 2019 to 34.25 euro per child by December 2022 (Fig. 1D). However, during the first year of the COVID-19 pandemic average costs temporarily decreased to 22.55 euros per child in May 2020. The average monthly cost for boys was higher than for girls (30.62 vs. 25.70 euros, p < 0.001). In girls, the cost for outpatient mental health care peaked at ages 14 to 17. For boys, mean cost increased until age eight, after which these remained stable (see Fig. 2). The average monthly cost was lower for children living in a socially deprived area than for children from non-deprived areas (25.77 vs. 30.06, p < 0.001). Figure 2 and eFigure 2 show mental health care utilization and associated costs per sex, age and deprived area.

Associations between the presence of YMHPNs and outpatient care utilization and associated costs

In the analysis assessing the association of the presence of a YMHPN in a practice and outpatient mental health care utilization, most practice demographics (i.e., number of children per practice, average age of children within practices, and proportion of children living in deprived areas) were relevant predictors of the number of children receiving outpatient care (Table 2). Trend over time was also a relevant predictor for care utilization, with utilization increasing over time. The first COVID-19 year (March-December 2020) was associated with a significant reduction in outpatient care utilization (Rate Ratio [RR] = 0.88, 95% CI 0.84–0.92). After adjustment for these confounders, the presence of a YMHPN was associated with a minimal non-significant reduction in number of children receiving outpatient care (RR = 0.99, 95% CI 0.92–1.06).

The modelled expected costs for an average practice of 678 children in January 2019 was 16,793 euros per month. In the analyses assessing the association of the presence of a YMHPN in a practice and costs for outpatient mental health care, most practice demographics (i.e., number of children per practice, average age of children within practices, and proportion of children living in deprived areas) and trend over time were relevant predictors for the total cost for outpatient care per practice (Table 3). The first COVID-19 year was associated with a reduction in monthly costs (-2333.39 euros 95% CI -2931.19 to -1735.60). After adjustment for these confounders, the presence of a YMHPN in a practice was associated with a small, non-significant reduction of costs for outpatient mental health care services of 395.80 euros (95% CI -1431.27 to 639.67) per month per practice.

Figure 2. Outpatient mental health care utilization per sex, age and deprivation status
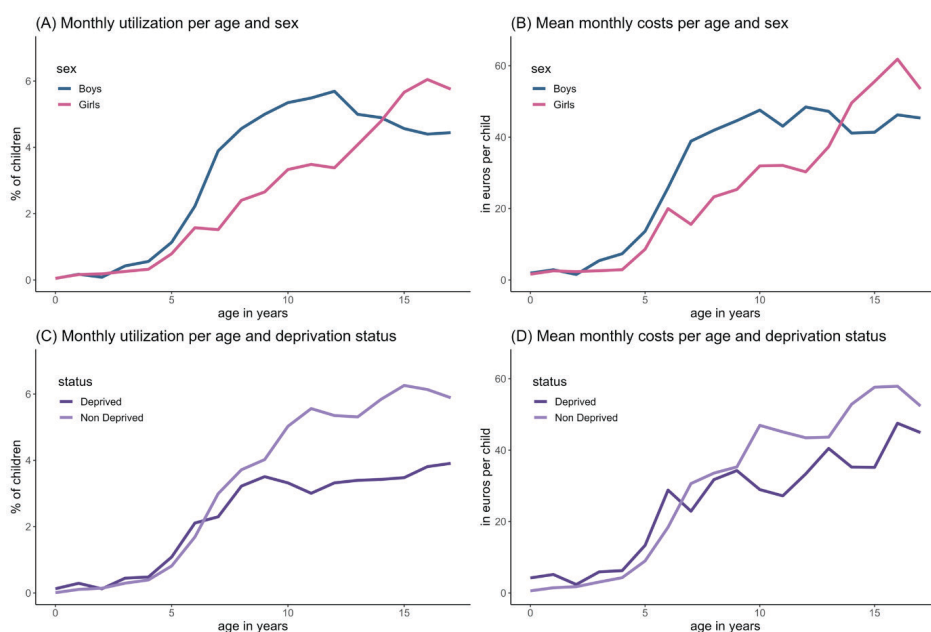

7

Table 2. Poisson mixed model results of monthly outpatient mental health care utilization per practice

Model 1. Modelled monthly rate of children receiving outpatient mental care per practice			
Predictors	**Rate Ratios**	**CI**	**p**
(Intercept)	0.022	0.02 – 0.03	<0.001
Yearly trend over time[a]	1.06	1.01 – 1.11	0.024
% Living in social deprived area[b,c]	0.99	0.99 – 0.99	<0.001
Mean age in years[c]	1.14	1.03 – 1.27	0.015
% Male[b,c]	1.00	0.98 – 1.03	0.855
YMHPN in practice	**0.99**	**0.92 – 1.06**	**0.695**
First COVID-19 year[d]	0.88	0.84 – 0.92	<0.001

[a]Modelled linear trend every year increase over time is associated with increasing number of children receiving outpatient care. [b]In percentage per practice, the shown estimate is the relative rate per percentage increase of the variable (eg 40 to 41% percentage of children living in deprived area) [c]These variables are centered on their grand-mean average (e.g., average number of children registered per practice) to facilitate interpretation. [d]Dummy variable to correct for the period of March 2020 to December 2020 in which a strong decrease in mental health care utilization was observed.

Table 3. Linear mixed model results of monthly costs for outpatient mental health care per practice

Model 2. Modelled costs for total outpatient mental care per practice			
Predictors	**Estimates**	**CI**	**p**
(Intercept)	16793.10	12922.76 – 20663.43	<0.001
Yearly trend over time[a]	1500.36	8.22 – 241.83	0.036
% Living in social deprived area[b,c]	-111.78	-165.91 – -57.64	<0.001
Mean age in years[c]	3412.38	1755.19 – 5069.58	<0.001
% Male[b,c]	-42.40	-354.51 – 269.72	0.790
YMHPN in practice	**-395.80**	**-1431.27 – 639.67**	**0.454**
Practice size (nr. of registered children)[c]	34.55	30.58 – 38.51	<0.001
First COVID-19 year[d]	-2333.39	-2931.19 – -1735.60	<0.001

[a]Modelled linear trend over time to allow for increasing costs for each year (e.g. inflation). [b]In percentage per practice, the shown estimate is the increase in costs per percentage increase of the variable (eg 40 to 41% percentage of children living in deprived area) [c]These variables are centered on the grand-mean average (e.g., average number of children registered per practice). [d]Dummy variable to correct for the period of March 2020 to December 2020.

Sensitivity analyses

We performed sensitivity analyses in two subsets of practices. Although the estimates on the association found in the sensitivity analyses differ slightly from the main analysis including all practices (see eTable 1–2), the overall conclusions are in line with the main analysis. In the first sensitivity analysis including only practices participating in the

YMHPN-project, the introduction of a YMHPN in a practice was associated with small non-significant reductions in the monthly number of children receiving care (RR = 0.94, 95% CI 0.87–1.02) and associated monthly costs (-575.86 euros, 95% CI -1787.18 to 635.46). In the second sensitivity analysis including only practices with at least 36 months follow-up, the presence of a YMHPN in a practice was also associated with small, non-significant reductions in the number of children receiving care (RR = 0.98, 95% CI 0.90–1.07), and associated costs (-960.13 euros, -2205.74 to 285.48).

Discussion

In our study we investigated whether the introduction of youth mental health practice nurses in general practice was associated with outpatient mental health services utilization and costs for outpatient healthcare in one to four years after implementation. Overall, outpatient health care utilization and associated costs increased steadily between 2019 and 2022. After adjustment for relevant confounders, including the COVID-19 pandemic, the presence of a YMHPN in a practice was associated with small, non-significant reductions of outpatient health care utilization and associated costs. Continued evaluation of the introduction of the YMHPN in general practice is needed to confirm the current findings and to assess whether longer-term effects differ from the shorter-term effects.

Worldwide utilization of mental health services has increased substantially among children and adolescents over the past decades.[1, 22, 23] Of the several types of care (e.g., inpatient, school-counselling), the increased utilization of outpatient mental health care is apparent.[24] In our study, we also saw a slow but steady increase in outpatient mental health care utilization in children and adolescents. Furthermore, we noticed a positive correlation between age and the percentage of children using outpatient mental health. Additionally, boys were more likely to receive care than girls. In contrast with our findings, previous research showed inconsistent associations between mental health service use and sex and age.[25] Although adolescent girls tend to experience more mental problems than adolescent boys,[26] we noticed that before the age of 15 health utilization in boys is higher than in girls suggesting unmet needs of girls in this age category. In our study on average 5.5% of children attended outpatient mental health services during the study period. Although this seems relatively low considering the high prevalence of child mental health problems, it is comparable to mental care utilization in other high-income countries.[27] It is also in line with regional registry data which show that approximately

7

7% of children up to 17 years in Rotterdam receive one or more forms of youth care including among others outpatient mental care, help for dyslexia, and developmental problems.[28]

Growing up in a socially deprived area has been shown to be an important risk factor for developing mental health problems and is associated with a lower well-being.[29] On the contrary, mental health care utilization is assumed to be lower among children and adolescents living in a socially deprived area than among children living in less deprived areas.[30] This is supported by our findings, where living in a deprived area was associated with less outpatient mental health service use and lower costs. This is worrisome and suggests that although children in socially deprived areas may suffer more from mental health problems, they are less likely to receive care for these issues. One of the goals of integrating mental health services into primary care is to improve accessibility of care for all children regardless of their background.[31] Future research should therefore investigate whether the availability of a YMHPN has differential effects on accessibility of mental health care for children with different socioeconomic, cultural and ethnic backgrounds.

In the past decades, several studies evaluated initiatives to integrate child mental health services into primary care. A meta-analysis of randomized clinical trials showed that integrated mental health care for children and adolescents was associated with improved health outcomes compared with usual care.[6] Additionally, integrated child mental care within primary care may have the potential to reduce disparities for vulnerable children (e.g., children from a minority or social-economically disadvantaged background).[31] To our knowledge only a limited number of studies evaluated cost effects of such initiatives, using relatively small samples.[32, 33] As far as we are aware, this is the first large-scale study investigating the associations between integrated child mental health care into general practice and the utilization of outpatient mental health care and associated costs. Earlier studies investigating the effects of integrating mental health professionals into general practice in adult populations showed various results, with no clear evidence on whether this form of integrated care changed specialized care utilization and costs.[34] Overall, we found that integrating YMHPNs within general practices did neither lead to short term changes in the number of children receiving outpatient mental health care nor to significant changes in associated costs. It is important to note that we could only investigate overall associations. We were not able to investigate whether the presence of YMHPNs had different effects for specific subgroups (e.g., whether the presence of a YMHPN was associated with specific mental health problems being more or less often

treated in outpatient care, or whether it was associated with less unnecessary referrals). Importantly, children registered in a practice with a YMHPN receiving outpatient mental care were not necessarily referred by the YMHPN. They could also be referred directly by their GP or other care providers. Importantly, large variation on both outcomes became apparent between practices which deserves further attention in future research.

YMHPNs can play an important role in lowering barriers to access services. Many barriers (e.g. limited access to mental services and fear of stigmatization) are shown to influence access to mental health services and gaps are still suspected between those who need care and those who receive care.[27, 35] In our study we did not have information on the number of children seen by YMHPNs, and as a result we do not know whether the introduction of the YMHPN led to more children being treated within general practice. However, the monthly rate of children receiving outpatient care did not change following the introduction of YMHPNs. Importantly, an earlier study showed that YMHPNs can successfully manage a substantial part of children without the need for additional referral to specialized care.[17]

One of the presumed benefits of integrating child mental health services into primary care is that it improves early detection and treatment.[6] Integrated care may prevent mental health problems from worsening and reduce long-term negative outcomes and associated costs for the affected individual and society.[4] Additionally, integrated care (e.g., YMHPNs) may reduce referrals for non-complex problems and prevent unnecessary medicalization. To determine whether YMHPNs can indeed prevent long-term negative outcomes, studies with longer follow-up periods are necessary. The current study focused on the effects within the first four years of the introduction of the YMHPN. Longer-term effects may differ from the observed shorter-term effects. Therefore, further research is needed to investigate whether the introduction of the YMHPN led to long-term changes in mental health care utilization (e.g., both in absolute rate of mental health services use and on type of service use). Such research should preferably encompass all levels of Dutch mental health care, as well as costs for medication, which will allow stronger and more specific inferences. Besides the prevention of long-term negative outcomes, there might be other effects of introducing the YMHPN into general practice that are not captured in this study and might confound the overall found association, such as an increased interest in children's mental health by the GP or a lower rejection rate of referrals to specialized mental health care. A study on the long-term effects could be extended with questionnaire data from GP practices, YMHPNs and children and their family members to investigate

7

other effects from the introduction of the YMHPN. This data could also be used to investigate differences between practices and YMHPNs. Moreover, with questionnaire data it is possible to collect information on patient characteristics (e.g., clinical condition) and investigate the effect for different subgroups or certain interactions.

Limitations

Our study has several limitations. First, it was not possible to investigate on the individual child level whether the introduction of the YMHPN led to changes in the number of children receiving help, because we did not have information on which children were seen by YMHPNs. As such, we were only able to investigate the overall effect of the availability of a YMHPN in a practice on outpatient care utilization. Nevertheless, we believe that this study offers valuable insights for practice and policy as this is the first study to evaluate the effect of the introduction of the YMHPN. Secondly, we had limited information on specific patient characteristics (e.g., no info on ethnic background of children or the clinical condition of the child). Therefore, we could not investigate differences between specific patient populations. Thirdly, we did not have information on costs for general practice care and medication. As such, we only assessed costs for outpatient mental care. We did not take into account the costs for the implementation of the YMHPN. Future research should address the cost-effectiveness of the YMHPN. Fourthly, participation in the YMHPN-project was not random and it is possible that participating practices differed from those that did not participate. For instance, during our study period the number of practices from deprived areas joining the RPCD and the YMHPN-project increased. However, by adjusting for living in a deprived area we minimalized this confounding effect. Fifthly, not all practices provided follow-up information for all months and in some practices that participated in the YMHPN-project only the period with a YMHPN was covered. We addressed the fourth and fifth limitation by conducting two sensitivity analyses in two subsets of practices (i.e., all practices that participated in the YMHPN-project and all practices with >3 years follow-up). These sensitivity analyses provided comparable results to our main analysis and thus strengthened our results. Lastly, our study period included the COVID-19 pandemic. Although we corrected for the effect of the COVID-19 pandemic in our models, it cannot be ruled out that some remaining confounding effects did affect our results.

Conclusion

To our knowledge, the current study is the first large scale research that investigated effects of integrated care, in our case the introduction of a YMHPN in Dutch general practice, on the use of specialized outpatient mental care and associated costs. Our findings indicate small but non-significant decreases of both outcomes across practices. Overall, we did not find significant associations between the presence of YMHPN and outpatient mental care and associated costs within the first four years in which the YMHPN-projects was implemented. We believe more research at both practice and individual patient level is needed to investigate longer-term effects of the introduction of the YMHPN and whether these effects vary for children with different socioeconomic, cultural and ethnic backgrounds in order to gain more insight into the importance of integrated mental care for children.

7

References

1.   Collishaw S. Annual research review: secular trends in child and adolescent mental health. J Child Psychol Psychiatry. 2015;56(3):370-93.

2.   Olfson M, Druss BG, Marcus SC. Trends in mental health care among children and adolescents. N Engl J Med. 2015;372(21):2029-38.

3.   Kieling C, Baker-Henningham H, Belfer M, Conti G, Ertem I, Omigbodun O, et al. Child and adolescent mental health worldwide: evidence for action. The Lancet. 2011;378(9801):1515-25.

4.   Uhlhaas PJ, Davey CG, Mehta UM, Shah J, Torous J, Allen NB, et al. Towards a youth mental health paradigm: a perspective and roadmap. Mol Psychiatry. 2023;28(8):3171-81. doi: 10.1038/s41380-023-02202-z.

5.   Wissow LS, van Ginneken N, Chandna J, Rahman A. Integrating Children's Mental Health into Primary Care. Pediat Clin N Am. 2016;63(1):97-113. doi: 10.1016/j.pcl.2015.08.005.

6.   Asarnow JR, Rozenman M, Wiblin J, Zeltzer L. Integrated medical-behavioral care compared with usual primary care for child and adolescent behavioral health: a meta-analysis. JAMA Pediatr. 2015;169(10):929-37.

7.   Koet LBM, Bennenbroek JJM, Bruggeman AYS, de Schepper EIT, Bohnen AM, Bindels PJE, Gerger H. GPs' and practice nurses' views on their management of paediatric anxiety problems: an interview study. BMC Prim Care. 2022;23(1):235.

8.   Koet LB, de Schepper EI, Bohnen AM, Bindels PJ, Gerger H. Anxiety problems in children and adolescents: a population-based cohort study on incidence and management in Dutch primary care. Br J Gen Pract. 2022;72(719):e405-e12.

9.   O'Brien D, Harvey K, Howse J, Reardon T, Creswell C. Barriers to managing child and adolescent mental health problems: a systematic review of primary care practitioners' perceptions. Br J Gen Pract. 2016;66(651):e693-707.

10.   Verhaak PFM, van Dijk M, Walstock D, Zwaanswijk M. A new approach to child mental healthcare within general practice. BMC Fam Pract. 2015;16(1):132. doi: 10.1186/s12875-015-0354-2.

11.   Zwaanswijk M, Geuijen P, Boelhouwer M, Spijk-de Jonge M, Serra M. Verwijspatronen bij praktijkondersteuners jeugd. Huisarts Wet. 2020;63(5):14-8.

12.   Spijk-de Jonge MJ BM, Geuijen P, Zwaanswijk M, Serra M. Jeugdhulp bij de huisarts. Onderzoek naar inzet en effect van de Praktijkondersteuner Jeugd. Assen: Accare Child Study Center; 2019.

13.   van Yperen T vdMA, Prakken J. The Growing Use of Youthcare; Interpretation and Strategy. [Het groeiend jeugdzorggebruik; Duiding en aanpak]. Utrecht2020.

14.   CBS: [Statistics on poverty in families] [Report in Dutch] https://www.nji.nl/cijfers/armoede-gezinnen#:~:text=In%20Rotterdam%2C%20Heerlen%2C%20Delfzijl%20en,procent%20van%20de%20minderjarige%20kinderen. (2022). Accessed 10-07-2023 2023.

15.   Gemeente Rotterdam. Tussenrapportage evaluatie inzet Praktijk ondersteuner Huisartsen Jeugd en Gezin in de Rotterdamse huisartspraktijken. 2021.

16.   de Ridder MAJ, de Wilde M, de Ben C, Leyba AR, Mosseveld BMT, Verhamme KMC, et al. Data Resource Profile: The Integrated Primary Care Information (IPCI) database, The Netherlands. Int J Epidemiol. 2022(51(6)):e314-e23. doi: 10.1093/ije/dyac026.

17. Koet LBM, Gerger H, Jansen W, Bindels PJE, de Schepper EIT. Evaluation of practice nurses' management of paediatric psychosocial problems in general practice. J Public Health (Oxf). 2024. doi: 10.1093/pubmed/fdae008.

18. Fonderson MS, Bindels PJE, Bohnen AM, de Schepper EIT. The role of area level social deprivation on childhood and adolescent consultation rate in primary care: a population based, cohort study. BMC Prim Care. 2022;23(1):1-10.

19. Brooks ME, Kristensen K, van Benthem KJ, Magnusson A, Berg CW, Nielsen A, et al. Modeling zero-inflated count data with glmmTMB. BioRxiv. 2017:132753.

20. [Analysis of the impact of the COVID-19 pandemic on mental health care][Report in Dutch]. Utrecht: The Dutch Healthcare Authority (NZa); 2021.

21. Benchimol EI, Smeeth L, Guttmann A, Harron K, Moher D, Petersen I, et al. The reporting of studies conducted using observational routinely-collected health data (RECORD) statement. PLoS Med. 2015;12(10):e1001885.

22. Olfson M, Blanco C, Wang S, Laje G, Correll CU. National trends in the mental health care of children, adolescents, and adults by office-based physicians. JAMA psychiatry. 2014;71(1):81-90.

23. Lempinen L, Luntamo T, Sourander A. Changes in mental health service use among 8-year-old children: a 24-year time-trend study. Eur Child Adolesc Psychiatry. 2019;28(4):521-30. doi: 10.1007/s00787-018-1218-9.

24. Mojtabai R, Olfson M. National Trends in Mental Health Care for US Adolescents. JAMA Psychiatry. 2020;77(7):703-14. doi: 10.1001/jamapsychiatry.2020.0279.

25. Eijgermans DGM, Fang Y, Jansen DEMC, Bramer WM, Raat H, Jansen W. Individual and contextual determinants of children's and adolescents' mental health care use: A systematic review. Child Youth Serv Rev. 2021;131:106288. doi: https://doi.org/10.1016/j.childyouth.2021.106288.

26. Yoon Y, Eisenstadt M, Lereya ST, Deighton J. Gender difference in the change of adolescents' mental health and subjective wellbeing trajectories. Eur Child Adolesc Psychiatry. 2023;32(9):1569-78.

27. Barican JL, Yung D, Schwartz C, Zheng Y, Georgiades K, Waddell C. Prevalence of childhood mental disorders in high-income countries: a systematic review and meta-analysis to inform policymaking. Evid Based Ment Health. 2022;25(1):36-44.

28. CBS: [Key figures on youth care][Report in Dutch]. https://opendata.cbs.nl/#/CBS/nl/dataset/85099NED/table (2024). Accessed 28-10-2024.

29. Visser K, Bolt G, Finkenauer C, Jonker M, Weinberg D, Stevens GWJM. Neighbourhood deprivation effects on young people's mental health and well-being: A systematic review of the literature. Soc Sci Med. 2021;270:113542. doi: https://doi.org/10.1016/j.socscimed.2020.113542.

30. Verhoog S, Eijgermans DGM, Fang Y, Bramer WM, Raat H, Jansen W. Contextual determinants associated with children's and adolescents' mental health care utilization: a systematic review. Eur Child Adolesc Psychiatry. 2022. doi: 10.1007/s00787-022-02077-5.

31. Arrojo MJ, Bromberg J, Walter HJ, Vernacchio L. Pediatric primary-care integrated behavioral health: a framework for reducing inequities in behavioral health care and outcomes for children. Pediatric Clinics. 2023;70(4):775-89.

7

32. Yu H, Kolko DJ, Torres E. Collaborative mental health care for pediatric behavior disorders in primary care: Does it reduce mental health care costs? Fam Syst Health. 2017;35(1):46.

33. Dopp A, Smith A, Dueweke A, Bridges A. Cost-Savings Analysis of Primary Care Behavioral Health in a Pediatric Setting: Implications for Provider Agencies and Training Programs. Clin Pract Pediatr Psychol. 2018;6:129-39. doi: 10.1037/cpp0000231.

34. Woods J-B, Greenfield G, Majeed A, Hayhoe B. Clinical effectiveness and cost effectiveness of individual mental health workers colocated within primary care practices: a systematic literature review. BMJ Open. 2020;10(12):e042052. doi: 10.1136/bmjopen-2020-042052.

35. Radez J, Reardon T, Creswell C, Lawrence PJ, Evdoka-Burton G, Waite P. Why do children and adolescents (not) seek and access professional help for their mental health problems? A systematic review of quantitative and qualitative studies. Eur Child Adolesc Psychiatry. 2021;30(2):183-211. doi: 10.1007/s00787-019-01469-4.

Supplementary files

***eFigure 1.** Trends of health care utilization and associated costs per practice over time*

(A) Outpatient mental health care utilization per practice

(B) Costs for outpatient mental health care averaged for practice size
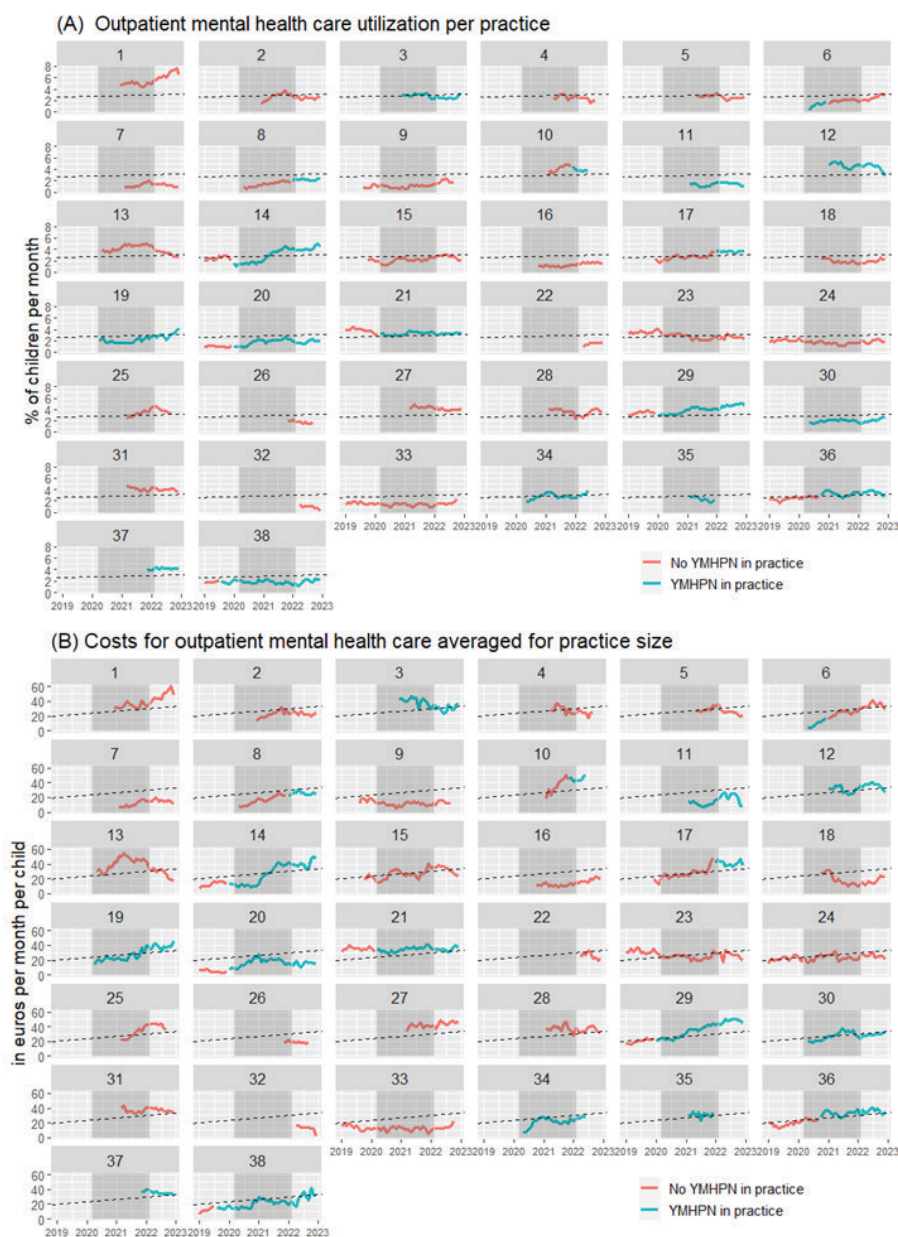
eFigure 1 shows the trends per practice in (a) the monthly percentage of children receiving outpatient mental and (b) average monthly costs for outpatient per registered patient per practice. The dotted-line shows the simple regression for the complete cohort over time. Not all practice provided follow-up data for the complete study period. The color depicts whether a YMHPN was working in the practice. The shaded area shows the COVID-19 pandemic in the Netherlands.

eFigure 2. Monthly outpatient mental care utilization per age and social deprivation status over time

(A) Monthly care utilization per sex

(B) Monthly mean costs per sex

(C) Monthly utilization per deprivation status

(D) Monthly mean costs per deprivation status
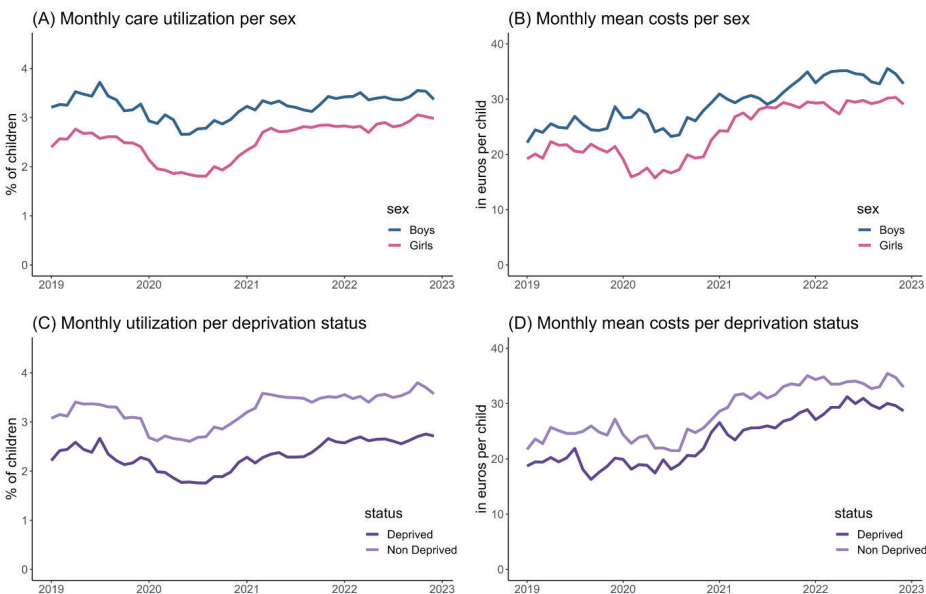
eTable 1. Sensitivity analyses for modelled monthly rate of children receiving outpatient mental care per practice

Predictors	Model 1. Modelled monthly rate of children receiving outpatient mental care per practice using complete cohort			Sensitivity analysis 1: Model 1 in subset of practices that all take part in the YMHPN-project			Sensitivity analysis 2: Model 1 in subset of practices that provide minimal 36 months of follow-up data		
	Incidence Rate Ratios	CI	p	Incidence Rate Ratios	CI	p	Incidence Rate Ratios	CI	p
(Intercept)	0.02	0.02 to 0.03	<0.001	0.02	0.02 to 0.03	<0.001	0.02	0.02 to 0.03	<0.001
Monthly trend over time[a]	1.00	1.00 to 1.01	0.024	1.01	1.00 to 1.02	<0.001	1.01	1.00 to 1.01	0.012
% Living in social deprived area[b,c]	0.99	0.99 to 0.99	<0.001	0.99	0.99 to 1.00	<0.001	0.99	0.98 to 1.00	0.011
Mean age in years[c]	1.14	1.03 to 1.27	0.015	1.16	0.99 to 1.36	0.065	1.24	1.02 to 1.50	0.034
% Male [b,c]	1.00	0.98 to 1.03	0.855	1.00	0.97 to 1.03	0.862	1.01	0.97 to 1.05	0.583
YMHPN in practice	0.99	0.92 to 1.06	0.695	0.94	0.87 to 1.02	0.123	0.98	0.90 to 1.07	0.641
First COVID-19 wave [d]	0.88	0.84 to 0.92	<0.001	0.89	0.84 to 0.95	<0.001	0.89	0.84 to 0.94	<0.001

The estimates are adjusted for practice size by using the log of the number of children per practice as offset variable. [a]Modelled linear trend over time (range 0–47) every month increase over time is associated with increase in expected costs. [b]In percentage per practice, the shown estimate is the increase in costs per percentage increase of the variable (eg 40 to 41% percentage of children living in deprived area). [c]These variables are centered on the grand mean average (eg, average percentage of children living in social deprived area). [d]Dummy variable to correct for the period of March 2020 to December 2020 during which a strong decrease in mental health care utilization was observed.

7

eTable 2. Sensitivity analyses for modelled average monthly costs for outpatient mental health care per practice

Predictors	Model 2. Modelled monthly costs for outpatient mental care per practice using complete cohort			Sensitivity analysis 3: Model 2 in subset of practices that all take part in the YMHPN project			Sensitivity analysis 4: Model 2 in subset of practices that provide minimal 36 months of follow-up data		
	Estimates	CI	p	Estimates	CI	p	Estimates	CI	p
(Intercept)	16790.19	12946.46 to 20633.91	<0.001	19395.94	12827.74 to 25964.14	<0.001	15736.84	10417.34 to 21056.34	<0.001
Monthly trend over time[a]	125.03	8.22 to 241.83	0.036	239.49	42.42 to 436.57	0.017	240.79	13.37 to 468.20	0.038
% Living in social deprived area[b,c]	-111.78	-165.91 to -57.64	<0.001	-78.21	-151.82 to -4.61	0.037	-52.91	-132.80 to 26.99	0.194
Mean age in years[c]	3412.38	1755.19 to 5069.58	<0.001	4264.55	1536.53 to 6992.56	0.002	3431.90	1286.88 to 5576.93	0.002
% Male [b,c]	-42.40	-354.51 to 269.72	0.790	-232.43	-698.54 to 233.67	0.328	296.13	-135.73 to 727.99	0.179
YMHPN in practice	**-395.80**	**-1431.27 to 639.67**	**0.454**	**-575.86**	**-1787.18 to 635.46**	**0.351**	**-960.13**	**-2205.74 to 285.48**	**0.131**
Number of registered children in practice[c]	34.55	30.58 to 38.51	<0.001	34.48	30.21 to 38.74	<0.001	35.25	31.47 to 39.03	<0.001
First COVID-19 wave [d]	-2333.39	-2931.19 to -1735.60	<0.001	-2753.31	-3630.85 to -1875.77	<0.001	-1803.15	-2511.27 to -1095.04	<0.001

[a]Modelled linear trend over time (range 0–47) every month increase over time is associated with increase in expected costs. [b]In percentage per practice, the shown estimate is the increase in costs per percentage increase of the variable (eg 40 to 41% percentage of children living in deprived area) [c]These variables are centered on the grand mean average (eg, average number of children registered per practice). [d]Dummy variable to correct for the period of March 2020 to December 2020 during which a strong decrease in mental health care utilization was observed.

7

Chapter 8

A network meta-analysis on the effectiveness and acceptability of physical exercise interventions on attention deficit hyperactivity disorder symptoms in children and adolescents

Lukas BM Koet, Selina Tuerk, Ann-Kathrin Korfmacher-Koopmann, Eveline Molendijk, Kirsten de Oude, Patrick JE Bindels, Heike Gerger

Abstract

Physical exercise may have positive effects on ADHD-related problems. We conducted a network meta-analysis (NMA) to examine the effectiveness of different types of physical exercise interventions on reducing ADHD symptoms and improving executive functions in children and adolescents with ADHD. Randomized controlled trials were identified in EMBASE, Medline, Web of Science, Cochrane, PsychINFO, CINAHL, and previous reviews. Two independent reviewers performed screening, data extraction and risk-of-bias (RoB) assessments. We conducted random-effects NMAs based on a frequentist framework to establish the comparative effectiveness between different types of physical exercise and any other comparator including pharmacotherapy. Our primary outcome was parent-rated ADHD symptoms, secondary outcomes were teacher-rated ADHD symptoms, executive functions and treatment acceptability. We included 35 trials. The analyses showed that several types of physical exercise interventions were effective in either reducing ADHD core symptoms or improving executive functions in children and adolescents with ADHD. However, the included trials had high RoB and the analyses showed large heterogeneity complicating the interpretability of our results. Treatment acceptability did not differ significantly between the comparators. Our main conclusion is that more high-quality trials with larger sample sizes are needed to allow definite conclusions on the effectiveness of exercise interventions in reducing ADHD-related problems.

Introduction

Attention-deficit/hyperactivity disorder (ADHD) is one of the most common neurobehavioral disorders in childhood and adolescence.[1, 2] It is characterized by developmentally-inappropriate inattention and/or hyperactivity-impulsivity that occur in more than one setting.[3] Estimates of the worldwide prevalence of ADHD in childhood and adolescence range between 5 to 8 percent.[4-6] Boys are approximately twice as likely to be diagnosed with ADHD as girls.[2, 6] ADHD can negatively affect the academic achievement, quality of life, and social interactions of children and adolescents,[2] and is associated with long-term adverse outcomes, such as failure to complete high school, substance abuse, accidental injuries and delinquent behavior.[7-9] Symptoms of ADHD peak in childhood and typically continue through adolescence into adulthood.[2] As children become older, inattentive symptoms tend to be more persistent than hyperactive-impulsive symptoms.[10] The considerable impact on children with ADHD themselves but also on their social environment, comorbidities with additional mental and physical health impairments, and the need for long-term treatment, make ADHD a relevant public health problem, which creates considerable societal costs and defines a need for successful treatment.[11]

Treatment for ADHD helps at least partially to reduce symptoms and to mitigate related adverse outcomes.[12] Both pharmacological and psychological treatments are available and effective in reducing symptoms of ADHD in childhood and adolescence.[13] Current treatment guidelines recommend pharmacotherapy and behavioral treatments for school-aged children and adolescents.[2]

Among the available pharmacological options, stimulants (e.g., methylphenidate) are preferred because these are most effective.[2] However, many children experience side effects from stimulants including appetite loss, headaches, or sleep disturbances.[2] A substantial part of children discontinue pharmacotherapy with estimates ranging between 13.2% to 64%.[14, 15] Several factors are associated with low treatment adherence of which side effects and no perceived benefits from medication are most commonly reported.[15] In addition, there are parental concerns about potentially negative long-term effects of ADHD medication.[16] Long-term negative effects of pharmacotherapy are scarcely researched and remain controversial,[17, 18] but there are indications that long-term is associated with an increased risk of cardiovascular disease.[19]

Besides medication as treatment, clinical guidelines recommend psychological interventions as firs- or second-line treatment option for children and adolescents with ADHD.[2, 20] Treatments such as cognitive-behavioral therapy (CBT), behavioral parent training, or classroom-based treatments are regularly applied in clinical practice.[21] Behavioral treatments are especially recommended for preschool aged children as first-line treatment, and for mild to moderate ADHD symptoms.[2, 20] Psychological treatments contribute significantly to short-term improvements in ADHD symptoms, however, availability of psychological treatments is mostly limited with long waiting-lists for specialized mental health care.[13, 22]

A variety of additional interventions have been investigated in children with ADHD, including for instance antidepressants, neurofeedback, dietary changes, and physical exercise interventions which are, however, not (yet) among the recommendations in most clinical guidelines.[23] The diversity of ADHD with regards to the associated problem areas and symptoms requires interventions with a broad range of beneficial effects. In addition, in order to compete with medication's proven beneficial effects, an alternative treatment approach for ADHD should come along with few or no adverse effects and should result in sustainable effects that remain after the intervention is terminated.[24] In this sense physical exercise seems like a promising intervention for ADHD, as it has the potential to fulfill all three outlined requirements.[24, 25]

Physical exercise is often experienced as enjoyable by children and has additional health-related benefits (e.g., improve fitness, reduce overweight).[26-28] Several mechanisms of action have been suggested by which physical exercise can improve cognitive function and mental health of children with ADHD. These mechanisms may include (a) neuropsychological mechanisms (e.g., physical exercise could positively affect structural and functional composition of the brain), (b) psychosocial mechanisms (e.g., physical exercise may lead to improved task self-efficacy with increasing confidence in one's ability to perform activities) and (c) behavioral mechanisms (e.g., physical exercise can improve sleep quality, which positively affects psychological outcomes, such as cognitive functions).[29]

A wide variety of physical exercise interventions have been used in studies investigating potential effects on ADHD symptoms and executive function in children with ADHD. The investigated exercise interventions include among others table-tennis, running, hippotherapy, mind body exercises, and aerobic exercises.[30-32] A recently published

umbrella review summarized several meta-analyses on the effectiveness of acute and chronic physical exercise on ADHD symptoms and executive function in children with ADHD.[33] Overall, most meta-analyses showed positive effects of physical exercise on ADHD-related problems, but substantial differences in estimates of effectiveness between these meta-analyses became apparent.[33] Given the large variety of exercise interventions used in the available studies traditional pairwise meta-analysis which focus on the comparison between two interventions is not the optimal analysis strategy to summarize the available evidence .

Network meta-analysis (NMA) is a powerful tool to compare three or more interventions and control interventions simultaneously in a single analysis when summarizing the available evidence.[34] NMAs are particularly of high value in fields where different interventions exist (e.g., different types of physical exercise interventions), and if only few randomized controlled trials (RCTs) are available for each possible combination of treatments and comparators. To our knowledge, three NMAs have investigated the effectiveness of physical exercise in children with ADHD.[35-37] These NMAs, however, have substantial methodological limitations and did not thoroughly evaluate the credibility of their results, nor did they address the acceptability of the investigated interventions. Of these three NMAs, one was retracted due to suspicion of data manipulation.[37]

In the present network meta-analysis we aimed to critically evaluate the effects of any type of physical exercise interventions in children and adolescents with ADHD. Our primary outcome was the comparative effectiveness of exercise interventions as compared with any other comparator on parent-rated ADHD symptoms in children and adolescents. Our secondary outcomes were teacher-rated ADHD symptoms, executive function and the acceptability of physical exercise interventions.

Methods

We prospectively registered this systematic review in the International Prospective Register of Systematic Reviews database (PROSPERO) on July 27th 2023 (reg. no. CRD42023446795). This report follows the PRISMA network meta-analysis extension.[38] We used the risk-of-bias 2 (RoB 2) tool to assess risk of bias in individual studies and the Confidence In Network Meta-Analysis (CINeMA) approach to assess the credibility of the NMA results.[39, 40]

Eligibility criteria

We included randomized controlled trials (including cluster-randomized trials and crossover trials) which met the following criteria: (i) study participants were children or adolescents (i.e., 18 years or younger); (ii) study participants had either a clinical diagnosis of ADHD or scored above the clinical cut-off value of a validated ADHD rating scale (e.g., Conners' Rating Scale) [41]; (iii) at least one of the investigated interventions consisted of any type of physical exercise; (iv) the trial reported post-intervention outcomes on either ADHD core symptoms on a validated ADHD rating scale or objective assessment of executive function; (v) the study was published in a peer-reviewed journal. Studies which investigated a population at-risk of ADHD (e.g., not all participants were diagnosed with ADHD) were only included if more than 80% of participants had a clinical diagnosis of ADHD or scored above the clinical cut-off value of a validated ADHD rating scale and if the studies met all other inclusion criteria. Studies meeting the above criteria that included both children with and without ADHD were included only if separate outcomes for affected and non-affected children were described. We excluded trials if they concerned (i) specific disease populations with co-morbid ADHD (e.g., children with cerebral palsy and comorbid ADHD) or (ii) experiments investigating short-term effects of a single bout of exercise within one experimental session. We set no restrictions on language of publication, study duration (e.g., number of weeks), session duration, intensity (e.g., vigorous exercise), frequency (e.g., two weekly), setting (e.g., indoor), social context (e.g., group exercises), or level of supervision of physical exercise.

Study selection

We performed a systematic computerized search of the following databases from inception to search date (June 1st, 2023): Medline All, Embase, Web of Science Core Collection, Cochrane Central Register of Controlled Trials, CINAHL and PsycINFO. The search was conducted by a biomedical information specialist at our academic hospital (Erasmus MC) and a senior researcher (HG). The information specialist automatically removed duplicate records (see supplementary file 1 for the complete search strategy and number of hits per searched database).[42] The complete de-duplicated search was loaded in EndNote (version 20.3) and screened using a standardized method.[43] Titles and abstracts were screened regarding the presence of exclusion criteria in double (LK screened all titles, AK/SB both screened half of titles) and classified as 'exclusion' or 'possibly relevant'. A study was only excluded if an exclusion criterion clearly applied, all other 'possibly

relevant' studies were included for full-text screening. As a second approach to detect relevant studies, all systematic reviews on the effect of non-pharmacological treatments of ADHD retrieved by the database search were manually screened (LK).[23, 35, 36, 44-53] If these systematic reviews included studies on physical exercise that were not detected by our search algorithm, these were considered as 'possibly relevant' and included for full text screening. In case no full text was available, we contacted the first author via e-mail or involved our medical library. As a second stage, all full texts were screened by two independent reviewers (LK screened all full texts, AK/SB both screened half). Discrepancies were discussed with a senior researcher (HG). Studies published in other languages than English were read together with co-researchers fluent in this language in order to check eligibility for inclusion.

Data extraction

All data extraction was done by two independent reviewers (LK/EM) using standardized extraction forms (Microsoft Forms, office 365) based on the templates provided by the Cochrane Collaboration.[54] We extracted data on the study population (e.g., sex, age, medication status, etc.), the intervention (e.g., type of intervention, control group, duration, frequency, supervised or unsupervised, etc.), and general study information (author, publication year). We obtained the number of participants in each group before and after the intervention as well as means and standard deviations of pre-test and post-test scores for ADHD core symptoms or the executive function tests as well as treatment dropouts. If studies used figures to present data we used WebPlotDigitizer (version 4.6) to extract means and standard deviations, this was needed in two studies.[55-57]

Outcomes

For ADHD symptoms, we extracted who assessed them (i.e., parent, teacher, child, clinician). The number of studies using ADHD symptoms rated by the child itself or clinicians was too small to allow separate analyses. All studies that reported child-rated or clinician-rated outcomes also reported parent or teacher-rated outcomes. In order to reduce heterogeneity between assessment methods, we only extracted parent-rated and teacher-rated outcomes.

For executive function, if several tests were conducted and reported in one study on executive function (e.g., Stroop test and Go-no-Go task), we extracted only information

of the most commonly encountered test, independent of the type of execution function tested (see supplementary file 2 for details on the hierarchy of outcome measures which we developed before data extraction and which we used in our data extraction).

Acceptability of the interventions was operationalized as study dropout for any reason after randomization until end of the intervention. For this, we extracted the number of drop outs for each treatment arm. If no drop-out rates were reported, we calculated the difference between the number of patients at the beginning of treatment and at the end of treatment. Supplementary file 2 shows details on the extracted outcomes per study.

Strategy for data synthesis

We categorized the different exercise interventions in accordance with the descriptions provided by the study authors as follows: aerobic exercises, balance training, exergaming, mind body exercise, combination intervention. Non-exercise comparators included: education on behavior control group, no intervention control group, neurofeedback, pharmacotherapy, semi-active control group, and waiting-list control group (see supplementary files 2 for detailed descriptions of the intervention and comparator categories).

We calculated network meta-analyses within a frequentist framework analysis in R (version 4.2.1), using the 'netmeta' package.[58] The outcomes of interest (parent-rated ADHD symptoms, teacher-rated ADHD symptoms, executive function, drop-out) were analyzed separately. We used post-intervention outcomes for the network meta-analyses. We did not perform meta-analyses for long term effects (i.e., outcomes that were assessed at a long-term follow up and not directly after the intervention ended) because only three studies reported outcomes at a time point of more than one month follow-up (ranging 1-6 months after ending of the intervention).[59-61] We tested for significant baseline differences between comparators.

Effect sizes were pooled according to a random-effects model accounting for dependencies between comparisons in the case of multi-arm trials.[62] Random-effects pairwise standardized mean differences (SMD) expressed in Cohen's d for ADHD symptoms and executive function, and odds ratios (OR) for dropout were calculated together with their 95% confidence intervals based on the available comparisons between the different exercise categories and the comparators. SMDs were interpreted as small (0.2-0.5), moderate (0.5-0.8), or large (>0.8).[63] We quantified heterogeneity across analyzed studies with I^2

and tau-squared (τ^2). We used the restricted maximum-likelihood (REML) estimator for estimation of τ^2. I^2 values on the order of 25%, 50%, and 75% were considered as low, moderate and high respectively.[64] For our NMAs we assumed a common estimate for the heterogeneity variance across the different comparisons and that any patient that met all inclusion criteria was likely, in principle, to be randomized to any of the interventions in the network. We addressed the assumption of transitivity by assessing whether the distribution of potential moderators (e.g., frequency and intensity of the intervention, study population, concurrent pharmacotherapy, and outcome assessments) was similar across comparisons.[65] We used local, as well as global methods to detect inconsistency.[39]

Sensitivity analyses

In our study protocol we described possible subgroup and sensitivity analyses based on clinical and methodological aspects of the included studies (e.g., differences in study duration, availability of follow-up measures, supervision/unsupervised studies, methodological quality, indirectness rating). Due to the limited number of included studies and observed reporting issues, we could not perform most pre-planned sensitivity analyses. Only one sensitivity analysis excluding studies with high indirectness could be performed. However, heterogeneity remained very large in this sensitivity analysis and did not improve the interpretability of the results. Further, we noticed that some studies reported very large treatment effect sizes (e.g., Cohens d of 4.8 and 5.6),[66, 67] contributing to the observed large between-study heterogeneity. Therefore, we decided to perform post-hoc, exploratory sensitivity analyses excluding studies reporting very large effect sizes based on the following reasoning: In the treatment of ADHD, large effects of methylphenidate are well-established with SMDs on ADHD symptoms ranging from 0.78 to 0.82 depending on the rater (i.e., parent, clinician or teacher).[68] Based on these effects, for both ADHD symptoms and executive function, we defined effect sizes larger than twice the SMD of methylphenidate (i.e. a Cohen's d of more than 1.64) as likely to be inflated and included only studies with effect sizes of 1.64 SMD or lower in an exploratory sensitivity analysis.

Risk of Bias (RoB) assessment and Confidence In Network Meta-Analyses (CINeMA)

We used the Cochrane risk-of-bias 2 tool (RoB2) to assess RoB for each included study.[40] We scored RoB separately for ADHD core symptoms and executive function. Two

authors (LK/KO) assessed all studies independently with the RoB2 excel tool provided by the Cochrane Collaboration.[69] Then, we evaluated the credibility of our NMA using the online application of the CINeMA approach.[39, 70] Following the GRADE framework confidence in the results from the NMA is rated in domains: (i) within-study bias (using the results from our previous RoB2 assessments), (ii) reporting bias, (iii) indirectness (using individual ratings of indirectness based on the GRADE approach), (iv) imprecision, (v) heterogeneity, and (vi) incoherence leading to a graded confidence in the NMA results (i.e., very low, low, moderate, or high).[71] For each domain with some concerns the level was downgraded by one level and for major concerns by two levels.[70] In case of no consensus, a final decision was made with a senior researcher (HG). See supplementary file 3 for more information on the CINeMA and RoB scoring process. We used comparison-adjusted funnel plots to assess possible publication bias.[58]

Results

A total of 35 RCTs with 1,590 participants met our inclusion criteria (see Figure 1 for the flowchart for study inclusion).[30-32, 50, 56, 57, 60, 61, 66, 67, 72-96] Of these studies, a total of 21 studies reported ADHD symptom outcomes and 26 studies reported executive function outcomes. The studies were published between 1984 and 2023 in four different languages: 29 in English, 4 in Chinese, 1 in Persian, and 1 in German. We included five three-arm studies. The most frequent comparators were aerobic exercise (28 RCTs), followed by no intervention control group (14 RCTs), waiting list control group (6 RCTs), exergaming (4 RCTs), combination intervention (4 RCTs), mind body exercise (4 RCTs), education on behavioral control group (3 RCTs), neurofeedback (3 RCTs), semi-active control intervention (3 RCTs), and balance training (1 RCT; see Figure 2). Mean sample size was n = 45.4 (SD 23.5) and ranged from 16 to 112 study participants. Of the 35 included studies, 32 included only children clinically diagnosed with ADHD. Two studies included children who scored above a clinical cut-off on a validated ADHD questionnaire.[73, 79] One study included children with both clinically diagnosed and subthreshold ADHD (with >80% of participants with clinical diagnosed ADHD).[95] Duration of the intervention ranged from 3 to 78 weeks, but most commonly lasted 10 to 12 weeks (14 RCTs) or 6 to 8 weeks (12 RCTs). The studies were conducted in 12 different countries: Iran (8 RCTs), China (6 RCTs), South-Korea (5 RCTs), Germany (4 RCTs), the USA (3 RCTs), Switzerland (2 RCTs), Tunesia (2 RCTs), Taiwan (2 RCTs), Brazil (1 RCTs) , the Netherlands (1 RCTs), Turkey (1 RCTs), Saudi-Arabia

(1 RCTs), and Spain (1 RCTs) . Of the included studies, two studies were performed in two countries simultaneously (China/USA, Germany/Switzerland). Supplementary file 4 gives a detailed overview of relevant characteristics of the included studies.

Figure 1. PRISMA flowchart for study selection
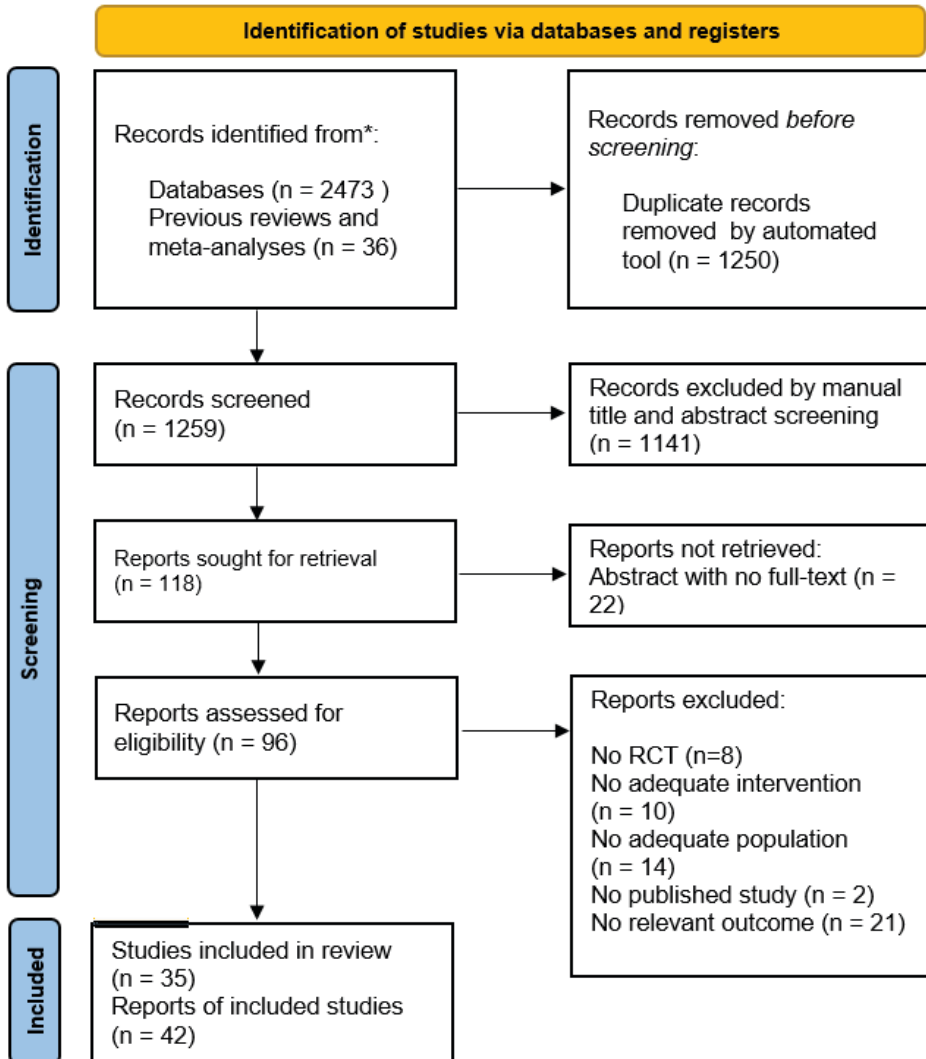
Medline ALL, Embase, Web of Science Core Collection, Cochrane Central Register of Controlled Trials, CINAHL, PsycINFO

Figure 2. Network of eligible comparisons for parent- and teacher-rated ADHD symptoms, executive function and dropout

A. Parent-rated ADHD symptoms

B. Teacher-rated ADHD symptoms

C. Executive Functions

D. Dropout
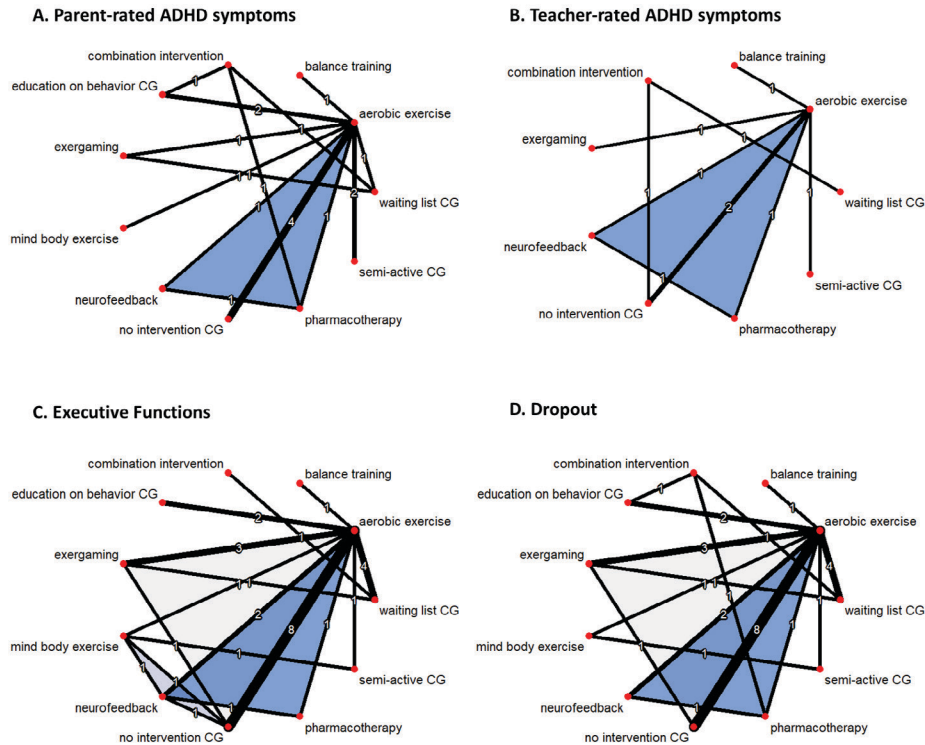
* Network graphs showing the evidence network for the four different outcomes, network graphs for sensitivity analyses are not shown. Presented numbers represent the number of direct comparisons between two interventions categories. Studies with three different comparators (multi-arm studies) are shown by shaded areas.

ADHD core symptoms: parents' assessment

In total 17 studies reporting parent-rated ADHD symptoms (n = 793 children, pairwise comparisons k = 19) could be included into the network.[30-32, 56, 60, 61, 66, 67, 72, 79, 80, 82, 84, 88, 89, 95, 96] Overall, baseline differences were non-significant and tended to be small (supplementary file 5). Balance training, however, showed non-significantly higher values at baseline compared with no intervention control group (moderate SMD 0.56 95% CI -0.24 to 1.37). Post-intervention outcomes across these 17 studies showed significant superiority of almost all comparisons over the no intervention control group. Effects sizes compared with no intervention control group were very large for all comparisons (SMD > 1.4) with broad confidence intervals (see Figure 3). Very large heterogeneity (τ^2 1.98, I^2 93.6%; 95% CI 89.9% to 95.9%) and significant inconsistency (p = 0.002) were observed. Aerobic exercises,

combination interventions, exergaming, mind body exercises, pharmacotherapy and waiting-list control group were significantly more effective than no intervention control group. Balance training, neurofeedback, education on behavior control group and semi-active control group were not significantly better than no intervention control group. A relative small number of direct comparisons was available (see Table 1). There were no significant differences between the different exercise interventions (Table 1). A significant difference was found between two control group categories (no intervention CG and waiting list CG).

Figure 3. Forest plots showing the effects of different types of interventions of the main analyses (red) and the exploratory sensitivity analyses (black) on parent- and teacher-rated ADHD symptoms, executive function and dropout
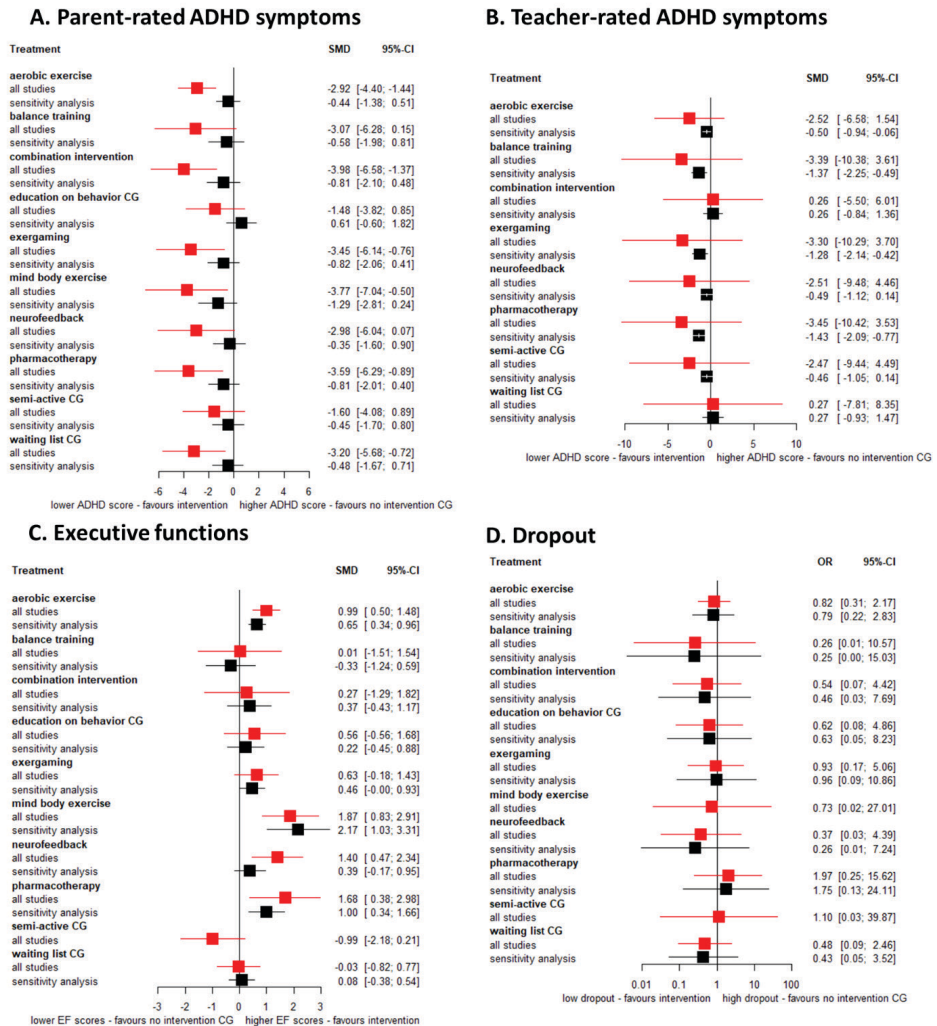
After exclusion of five studies with very large treatment effects (i.e., SMD > 1.64), [66, 67, 82, 84, 88] our post-hoc exploratory sensitivity analysis of the 12 remaining studies with 583 children (number of pairwise comparisons k = 14) did not show significant baseline differences.[30-32, 56, 60, 61, 72, 79, 80, 89, 95, 96] Post-intervention assessments for all comparators did not differ significantly from the no intervention control group. The sensitivity analysis had much less heterogeneity (τ^2 0.13, I^2 54.2%; 95% CI 0.0-84.8.0) and there was no significant inconsistency (p = 0.06). Figure 3 shows the estimates of the overall and the sensitivity analysis. Effect sizes and corresponding confidence intervals were much smaller in the sensitivity analysis (Table 2). There were no significant differences in effectivity between the different comparators, with the exception of 'education on behavior control group' which performed significantly less well in reducing symptoms than other comparators.

ADHD core symptoms: teachers' assessment

In total 8 studies reporting on teacher-rated ADHD symptoms (n = 451 children; pairwise comparisons k = 10) could be included into the network.[60, 61, 66, 79, 81, 90, 95, 96] Overall, baseline differences were non-significant between no intervention control group and the comparators in the network (supplementary file 5). Balance training, however, showed non-significantly lower values at baseline compared with no intervention control group (moderate SMD -0.55 95% CI -1.77 to 0.68). Post-intervention outcomes across these 8 studies did not significantly favor any comparator over the no intervention control group. Effects sizes were large with broad confidence intervals (see Figure 3). Very large heterogeneity was observed (τ^2 8.30, I^2 96.8% with 95% CI 91.6% to 98.8%) and inconsistency could not be assessed. The estimates between comparators had very large confidence intervals and no significant differences between the comparators (Table 3).

For our post-hoc sensitivity analysis, we excluded studies with an unlikely treatment effect (n = 1).[66] Across the 7 remaining studies (children n = 421, comparisons k = 9), [60, 61, 79, 81, 90, 95, 96] aerobic exercise, balance training, exergaming and pharmacotherapy performed significantly better than the no intervention control group. Between-study heterogeneity could not be quantified because there was only one study per comparison. Comparative effectiveness of all included interventions are shown in Table 4. In this sensitivity analysis pharmacotherapy was significantly superior in reducing ADHD core symptoms than most comparators (Table 4).

Table 1. League table of parent-rated ADHD symptoms – post intervention

	aerobic exercise	balance training	combination intervention	education on behavior CG	exergaming	mind body exercise	neurofeedback	no intervention CG	Pharmaco-therapy	semi-active CG	waiting list CG
aerobic exercise		0.15 [-2.71; 3.00]	1.06 [-1.09; 3.20]	-1.44 [-3.24; 0.37]	0.53 [-1.71; 2.78]	0.85 [-2.07; 3.77]	0.06 [-2.61; 2.73]	-2.92 [-4.40; -1.44]	0.67 [-1.59; 2.93]	-1.32 [-3.31; 0.67]	0.28 [-1.71; 2.27]
balance training	0.15 [-2.71; 3.00]		0.91 [-2.66; 4.48]	-1.59 [-4.96; 1.79]	0.39 [-3.25; 4.02]	0.70 [-3.38; 4.78]	-0.09 [-4.00; 3.82]	-3.07 [-6.28; 0.15]	0.52 [-3.12; 4.16]	-1.47 [-4.95; 2.01]	0.13 [-3.35; 3.61]
combination intervention	-1.05 [-3.08; 0.98]	.		-3.30 [-6.22; -0.38]	-0.52 [-3.30; 2.26]	-0.21 [-3.83; 3.41]	-0.99 [-4.07; 2.08]	**-3.98 [-6.58; -1.37]**	-0.39 [-2.66; 1.89]	-2.38 [-5.31; 0.55]	-0.77 [-2.97; 1.42]
education on behavior CG	0.64 [-2.22; 3.50]	.	**-2.49 [-4.70; -0.29]**		1.97 [-0.80; 4.74]	2.29 [-1.15; 5.72]	1.50 [-1.61; 4.61]	-1.48 [-3.82; 0.85]	2.11 [-0.52; 4.73]	0.11 [-2.58; 2.80]	1.72 [-0.73; 4.17]
exergaming	0.85 [-2.07; 3.77]	.	0.64 [-2.22; 3.50]	.		0.32 [-3.37; 4.00]	-0.47 [-3.89; 2.95]	**-3.45 [-6.14; -0.76]**	0.14 [-2.90; 3.17]	-1.86 [-4.86; 1.14]	-0.25 [-2.48; 1.98]
mind body exercise	0.03 [-2.77; 2.82]	.	.	.	.		-0.79 [-4.74; 3.17]	**-3.77 [-7.04; -0.50]**	-0.18 [-3.87; 3.51]	-2.17 [-5.71; 1.36]	-0.57 [-4.10; 2.97]
neurofeedback	.	.	.	.	.	0.57 [-2.23; 3.37]		-2.98 [-6.04; 0.07]	0.61 [-2.07; 3.28]	-1.39 [-4.72; 1.95]	0.22 [-2.97; 3.41]
no intervention CG	-2.92 [-4.40; -1.44]	.	.	.	.	.	.		**3.59 [0.89; 6.29]**	1.60 [-0.89; 4.08]	**3.20 [0.72; 5.68]**
Pharmaco-therapy	0.59 [-2.20; 3.39]	-0.31 [-3.16; 2.54]	.	.	.	.	.	.		-1.99 [-5.00; 1.02]	-0.39 [-3.07; 2.30]
semi-active CG	-1.32 [-3.31; 0.67]	.	.	.	.	.	.	.	.		1.61 [-1.21; 4.42]
waiting list CG	-0.51 [-3.36; 2.34]	-0.11 [-2.91; 2.68]	-0.15 [-2.96; 2.67]	.	.	.	.	.	.	.	

*League table is a square matrix showing all pairwise comparisons in a network meta-analysis. Network estimates from network meta-analysis object are shown in the upper triangle and the direct treatment estimates, if available, from pairwise comparisons in the lower triangle. A lower score is preferable (i.e., negative treatment estimate indicates superiority).

8

Table 2. League table of parent-rated ADHD symptoms – post intervention – post hoc sensitivity analysis

aerobic exercise	0.15 [-0.87; 1.17]	.	**-1.05** [**-1.80; -0.29**]	0.64 [-0.39; 1.66]	0.85 [-0.34; 2.04]	0.03 [-0.82; 0.87]	-0.44 [-1.38; 0.51]	0.59 [-0.26; 1.45]	0.01 [-0.81; 0.84]	-0.51 [-1.51; 0.50]
0.15 [-0.87; 1.17]	**balance training**	.	.	.	.	.	.	.	.	.
0.37 [-0.50; 1.25]	0.22 [-1.12; 1.57]	**combination intervention**	.	.	.	.	.	.	.	.
-1.05 [**-1.80; -0.29**]	-1.19 [-2.46; 0.07]	**-1.42** [**-2.57; -0.27**]	**education on behavior CG**	.	.	.	.	-0.31 [-1.31; 0.69]	.	-0.11 [-0.95; 0.73]
0.39 [-0.40; 1.18]	0.24 [-1.05; 1.53]	0.01 [-0.97; 1.00]	**1.43** [**0.34; 2.52**]	**exergaming**	.	.	.	.	.	.
0.85 [-0.34; 2.04]	0.70 [-0.87; 2.27]	0.48 [-1.00; 1.95]	**1.89** [**0.49; 3.30**]	0.46 [-0.97; 1.89]	**mind body exercise**	.	.	.	.	.
-0.09 [-0.91; 0.74]	-0.23 [-1.55; 1.08]	-0.46 [-1.52; 0.60]	0.96 [-0.15; 2.07]	-0.47 [-1.57; 0.63]	-0.94 [-2.38; 0.51]	**neuro-feedback**	.	0.57 [-0.28; 1.42]	.	.
-0.44 [-1.38; 0.51]	-0.58 [-1.98; 0.81]	-0.81 [-2.10; 0.48]	0.61 [-0.60; 1.82]	-0.82 [-2.06; 0.41]	-1.29 [-2.81; 0.24]	-0.35 [-1.60; 0.90]	**no intervention CG**	.	.	.
0.37 [-0.38; 1.12]	0.22 [-1.04; 1.49]	-0.00 [-0.83; 0.82]	**1.42** [**0.36; 2.47**]	-0.02 [-1.02; 0.99]	-0.48 [-1.88; 0.93]	0.46 [-0.37; 1.28]	0.81 [-0.40; 2.01]	**pharmaco-therapy**	.	.
0.01 [-0.81; 0.84]	-0.13 [-1.45; 1.18]	-0.36 [-1.56; 0.84]	1.06 [-0.05; 2.17]	-0.37 [-1.51; 0.77]	-0.83 [-2.28; 0.61]	0.10 [-1.06; 1.26]	0.45 [-0.80; 1.70]	-0.36 [-1.47; 0.76]	**semi-active CG**	.
0.04 [-0.68; 0.76]	-0.11 [-1.36; 1.14]	-0.33 [-1.07; 0.41]	**1.09** [**0.05; 2.13**]	-0.34 [-1.09; 0.40]	-0.81 [-2.20; 0.58]	0.13 [-0.89; 1.15]	0.48 [-0.71; 1.67]	-0.33 [-1.20; 0.55]	0.03 [-1.06; 1.12]	**waiting list CG**

*League table is a square matrix showing all pairwise comparisons in a network meta-analysis. Network estimates from network meta-analysis object are shown in the upper triangle and the direct treatment estimates, if available, from pairwise comparisons in the upper triangle. A lower score is preferable (i.e., negative treatment estimate indicates superiority).

Table 3. League table of teacher-rated ADHD symptoms – post intervention

	aerobic exercise	balance training	combination intervention	exergaming	neurofeedback	no intervention CG	pharmacotherapy	semi-active CG	waiting list CG
aerobic exercise		0.87 [-4.83; 6.57]	.	0.78 [-4.92; 6.47]	-0.01 [-5.68; 5.66]	-2.52 [-6.58; 1.54]	0.93 [-4.74; 6.60]	-0.04 [-5.71; 5.62]	.
	0.87 [-4.83; 6.57]	**balance training**	-3.65 [-12.70; 5.41]	.	.	.	.	.	.
	-2.78 [-9.82; 4.26]	-3.65 [-12.70; 5.41]	**combination intervention**	3.55 [-5.50; 12.61]	2.77 [-6.27; 11.81]	0.26 [-5.50; 6.01]	.	.	-0.01 [-5.68; 5.66]
	0.78 [-4.92; 6.47]	-0.09 [-8.15; 7.97]	3.55 [-5.50; 12.61]	**exergaming**	-0.79 [-8.82; 7.25]	-3.30 [-10.29; 3.70]	.	.	.
	-0.01 [-5.68; 5.66]	-0.88 [-8.92; 7.16]	2.77 [-6.27; 11.81]	-0.79 [-8.82; 7.25]	**neurofeedback**	-2.51 [-9.48; 4.46]	0.94 [-4.73; 6.61]	.	.
	-2.52 [-6.58; 1.54]	-3.39 [-10.38; 3.61]	0.26 [-5.50; 6.01]	-3.30 [-10.29; 3.70]	-2.51 [-9.48; 4.46]	**no intervention CG**	3.45 [-3.53; 10.42]	2.47 [-4.49; 9.44]	.
	0.93 [-4.74; 6.60]	0.06 [-7.98; 8.10]	3.71 [-5.34; 12.75]	0.15 [-7.89; 8.19]	0.94 [-4.73; 6.61]	3.45 [-3.53; 10.42]	**pharmacotherapy**	-0.97 [-8.99; 7.04]	.
	-0.04 [-5.71; 5.62]	-0.91 [-8.95; 7.12]	2.73 [-6.30; 11.77]	-0.82 [-8.85; 7.21]	-0.03 [-8.05; 7.98]	2.47 [-4.49; 9.44]	-0.97 [-8.99; 7.04]	**semi-active CG**	-2.74 [-13.41; 7.93]
	-2.79 [-11.83; 6.25]	-3.65 [-14.34; 7.03]	-0.01 [-5.68; 5.66]	-3.56 [-14.25; 7.12]	-2.78 [-13.45; 7.89]	-0.27 [-8.35; 7.81]	-3.71 [-14.38; 6.96]	-2.74 [-13.41; 7.93]	**waiting list CG**

*League table is a square matrix showing all pairwise comparisons in a network meta-analysis. Network estimates from network meta-analysis object are shown in the lower triangle and the direct treatment estimates, if available, from pairwise comparisons in the upper triangle. A lower score is preferable (i.e., negative treatment estimate indicates superiority).

8

Table 4. League table of teacher-rated ADHD symptoms – post intervention – post-hoc sensitivity analysis

aerobic exercise	**0.87** **[0.11; 1.63]**	·	**0.78** **[0.03; 1.52]**	-0.01 [-0.47; 0.45]	**-0.50** **[-0.94;-0.06]**	**0.93** **[0.44; 1.42]**	-0.04 [-0.45; 0.36]	-0.01 [-0.50; 0.48]
0.87 **[0.11; 1.63]**	**balance training**	·	·	·	·	·	·	·
-0.76 [-1.94; 0.42]	**-1.63** **[-3.03; -0.22]**	**combination intervention**	·	·	0.26 [-0.84; 1.36]	·	·	·
0.78 **[0.03; 1.52]**	-0.09 [-1.16; 0.97]	**1.54** **[0.14; 2.93]**	**exergaming**	·	·	·	·	·
-0.01 [-0.47; 0.45]	-0.88 [-1.77; 0.01]	0.75 [-0.52; 2.02]	-0.79 [-1.66; 0.08]	**neurofeedback**	·	**0.94** **[0.46; 1.42]**	·	·
-0.50 **[-0.94;-0.06]**	**-1.37** **[-2.25; -0.49]**	0.26 [-0.84; 1.36]	**-1.28** **[-2.14; -0.42]**	-0.49 [-1.12; 0.14]	**no intervention CG**	·	·	·
0.93 **[0.44; 1.42]**	0.06 [-0.85; 0.97]	**1.69** **[0.41; 2.97]**	0.15 [-0.74; 1.04]	**0.94** **[0.46; 1.42]**	**1.43** **[0.77; 2.09]**	**pharmacotherapy**	·	·
-0.04 [-0.45; 0.36]	**-0.91** **[-1.78; -0.05]**	0.72 [-0.53; 1.97]	-0.82 [-1.67; 0.02]	-0.03 [-0.64; 0.58]	0.46 [-0.14; 1.05]	**-0.97** **[-1.61;-0.33]**	**semi-active CG**	·
-0.77 [-2.05; 0.51]	**-1.64** **[-3.13; -0.15]**	-0.01 [-0.50; 0.48]	**-1.55** **[-3.02;-0.07]**	-0.76 [-2.12; 0.60]	-0.27 [-1.47; 0.93]	**-1.70** **[-3.07;-0.33]**	-0.72 [-2.07; 0.62]	**waiting list CG**

League table is a square matrix showing all pairwise comparisons in a network meta-analysis. Network estimates from network meta-analysis object are shown in the lower triangle and the direct treatment estimates, if available, from pairwise comparisons in the upper triangle. A lower score is preferable (i.e., negative treatment estimate indicates superiority).

Table 5. League table of executive functions – post intervention

aerobic exercise	balance training	combination intervention	education on behavior CG	exergaming	mind body exercise	neuro-feedback	no intervention CG	pharmacotherapy	semi-active CG	waiting list CG
aerobic exercise	0.98 [-0.47; 2.42]	0.43 [-0.58; 1.44]	0.30 [-0.52; 1.12]	-1.52 [-3.12; 0.08]	0.28 [-0.67; 1.22]	·	**0.87 [0.35; 1.38]**	-0.39 [-1.70; 0.93]	**1.96 [0.60; 3.31]**	**1.04 [0.35; 1.74]**
0.98 [-0.47; 2.42]	**balance training**	·	·	·	·	·	·	·	·	·
0.73 [-0.75; 2.20]	-0.25 [-2.32; 1.82]	**combination intervention**	·	·	·	·	·	·	·	0.29 [-1.04; 1.63]
0.43 [-0.58; 1.44]	-0.55 [-2.31; 1.22]	-0.30 [-2.09; 1.49]	**education on behavior CG**	·	·	·	·	·	·	·
0.36 [-0.33; 1.06]	-0.61 [-2.22; 0.99]	-0.36 [-1.93; 1.21]	-0.07 [-1.29; 1.16]	**exergaming**	·	-1.08 [-2.73; 0.56]	0.46 [-0.95; 1.86]	·	·	0.57 [-0.78; 1.91]
-0.88 [-1.85; 0.09]	**-1.86 [-3.60; -0.12]**	-1.61 [-3.38; 0.16]	-1.31 [-2.71; 0.09]	**-1.25 [-2.43; -0.06]**	**mind body exercise**	0.47 [-0.66; 1.60]	**2.76 [0.95; 4.57]**	·	2.89 [1.31; 4.46]	·
-0.41 [-1.24; 0.42]	-1.39 [-3.06; 0.28]	-1.14 [-2.83; 0.56]	-0.84 [-2.15; 0.46]	-0.78 [-1.85; 0.30]	0.47 [-0.66; 1.60]	**neuro-feedback**	**3.84 [1.86; 5.83]**	-0.57 [-1.89; 0.74]	·	·
0.99 [0.50; 1.48]	0.01 [-1.51; 1.54]	0.27 [-1.29; 1.82]	0.56 [-0.56; 1.68]	0.63 [-0.18; 1.43]	**1.87 [0.83; 2.91]**	**1.40 [0.47; 2.34]**	**no intervention CG**	·	·	·
-0.69 [-1.90; 0.52]	-1.67 [-3.55; 0.22]	-1.42 [-3.33; 0.50]	-1.12 [-2.70; 0.46]	-1.05 [-2.45; 0.34]	0.19 [-1.30; 1.69]	-0.28 [-1.49; 0.93]	**-1.68 [-2.98; -0.38]**	**pharmacotherapy**	·	·
1.98 [0.87; 3.09]	1.00 [-0.82; 2.82]	1.25 [-0.60; 3.10]	**1.55 [0.05; 3.05]**	**1.61 [0.31; 2.92]**	**2.86 [1.69; 4.03]**	**2.39 [1.06; 3.72]**	0.99 [-0.21; 2.18]	**2.67 [1.05; 4.29]**	**semi-active CG**	·
1.02 [0.38; 1.65]	0.04 [-1.54; 1.62]	0.29 [-1.04; 1.63]	0.59 [-0.61; 1.78]	0.65 [-0.17; 1.48]	**1.90 [0.74; 3.06]**	**1.43 [0.39; 2.48]**	0.03 [-0.77; 0.82]	**1.71 [0.34; 3.08]**	-0.96 [-2.24; 0.32]	**waiting list CG**

*League table is a square matrix showing all pairwise comparisons in a network meta-analysis. Network estimates from network meta-analysis object are shown in the lower triangle and the direct treatment estimates, if available, from pairwise comparisons in the upper triangle. A higher score is preferable (i.e., a positive treatment estimate indicates superiority).

8

Table 6. League table of executive functions – post intervention – post hoc sensitivity analysis

aerobic exercise	**0.98** [**0.12; 1.84**]	·	·	0.30 [-0.17; 0.77]	**-1.52** [**-2.62; -0.42**]	0.26 [-0.20; 0.73]	**0.66** [**0.35; 0.98**]	-0.39 [-1.01; 0.23]	**0.51** [**0.13; 0.89**]
0.98 [**0.12; 1.84**]	balance training	·	·	·	·	·	·	·	·
0.28 [-0.47; 1.02]	-0.70 [-1.84; 0.44]	combination intervention	·	·	·	·	·	·	0.29 [-0.37; 0.95]
0.43 [-0.16; 1.02]	-0.55 [-1.59; 0.50]	0.15 [-0.80; 1.10]	education on behavior CG	·	·	·	·	·	·
0.19 [-0.20; 0.57]	-0.79 [-1.73; 0.15]	-0.09 [-0.89; 0.70]	-0.25 [-0.95; 0.46]	exergaming	·	·	0.46 [-0.34; 1.25]	·	0.57 [-0.11; 1.25]
-1.52 [**-2.62; -0.42**]	**-2.49** [**-3.89; -1.10**]	-1.80 [-3.12; -0.47]	**-1.95** [**-3.19; -0.70**]	**-1.70** [**-2.87; -0.54**]	mind body exercise	·	·	·	·
0.26 [-0.20; 0.73]	-0.71 [-1.69; 0.26]	-0.02 [-0.89; 0.86]	-0.17 [-0.92; 0.58]	0.08 [-0.53; 0.69]	**1.78** [**0.59; 2.97**]	neurofeedback	·	-0.57 [-1.19; 0.04]	·
0.65 [**0.34; 0.96**]	-0.33 [-1.24; 0.59]	0.37 [-0.43; 1.17]	0.22 [-0.45; 0.88]	0.46 [0.00; 0.93]	**2.17** [**1.03; 3.31**]	0.39 [-0.17; 0.95]	no intervention CG	·	·
-0.35 [-0.93; 0.23]	**-1.33** [**-2.37; -0.29**]	-0.63 [-1.57; 0.32]	-0.78 [-1.61; 0.05]	-0.53 [-1.24; 0.17]	1.17 [-0.08; 2.41]	**-0.61** [**-1.19; -0.03**]	**-1.00** [**-1.66; -0.34**]	pharmacotherapy	·
0.57 [0.22; 0.92]	-0.41 [-1.33; 0.52]	0.29 [-0.37; 0.95]	0.14 [-0.54; 0.82]	0.39 [-0.06; 0.83]	2.09 [0.94; 3.24]	0.31 [-0.27; 0.89]	-0.08 [-0.54; 0.38]	**0.92** [**0.24; 1.60**]	waiting list CG

*League table is a square matrix showing all pairwise comparisons in a network meta-analysis. Network estimates from network meta-analysis object are shown in the lower triangle and the direct treatment estimates, if available, from pairwise comparisons in the upper triangle (i.e., a positive treatment estimate indicates superiority).

Executive function

In total 25 studies reporting executive function as outcome (children n = 1014, pairwise comparisons k = 31) were included into the network.[31, 56, 57, 60, 61, 67, 72-76, 78, 80, 82, 83, 85-87, 89, 91, 93-97] Overall, baseline differences were non-significant between no intervention control group and the comparators in the network (supplementary file 5). Balance training, however, showed significantly lower values at baseline compared with no intervention control group (SMD -0.68 95% CI -1.56 to 0.18). Across the 25 included studies several comparisons were significantly better than no intervention control group including mind body exercise, pharmacotherapy, neurofeedback, and aerobic exercise. The confidence intervals were broad, and large heterogeneity (τ^2 0.39, I^2 74.7%; 95% CI 60.4 to 83.8%) and significant inconsistency (p = 0.004) were observed. There were no significant differences between the types of exercise interventions (Table 5) and only mind body exercise performed significantly better than exergaming.

For our post-hoc exploratory sensitivity analysis we excluded five studies with an unlikely treatment effect (i.e., SMD > 1.64).[31, 73, 74, 82, 93] Across the 20 remaining studies (children n = 823, comparisons k = 24), aerobic exercises, mind body exercise and pharmacotherapy were significantly favorable compared with no intervention.[56, 57, 60, 61, 67, 72, 73, 75, 76, 78, 80, 83, 85-87, 89, 91, 94-97] Exergaming was almost significantly better than no intervention control group (Table 6). Small heterogeneity (τ^2 0.04, I^2 24.9%; 95% CI 0.0 to 60.2%) and no inconsistency (p = 0.81) was observed. Mind body exercise tended to be better in improving executive functions than other exercise interventions (Table 6).

Dropout

In total 28 studies (children n = 1239) provided information on dropout. Overall 105 children (8.4%) dropped out across all studies and all comparators. Only a limited number of studies reported the precise reasons for dropout. Adverse events were only reported in studies in which pharmacotherapy was part of the investigated interventions.

Of these 28 studies with information on dropout, 26 studies with n = 1181 children (pairwise comparisons k = 30) were included in the NMA when using continuity correction for arms without dropout.[30-32, 56, 57, 60, 61, 67, 72, 73, 75, 76, 78, 80, 82-84, 86-89, 91, 94-97] There were no significant differences in dropouts between the different interventions as compared to the no intervention control group (see Figure 3). Heterogeneity was limited (τ^2 0.56; I^2 5.1%; 95% CI 0.0 to 51.6%) and there was no significant inconsistency (p = 0.91).

When compared with no intervention control group ORs ranged between OR 0.26; 95% CI 0.01 to 10.57 for balance training and OR 1.97; 95% CI 0.25 to 15.62 for pharmacotherapy (see Figure 3).

In our sensitivity analysis we excluded all studies without dropouts (double zero events studies), 16 studies (807 children, pairwise comparisons k = 18) remained in the network analysis.[30, 32, 56, 57, 60, 72, 75, 76, 78, 80, 84, 91, 94-97] Also in this analysis, there were no significant differences in dropout between the different comparators and no intervention control group (Figure 3). Heterogeneity was moderate (τ^2 1.17; I^2 51.4% 95% CI 0.1 to 76.4%) and there was no significant inconsistency (p = 0.31).

Risk of bias and credibility of network meta-analysis

For the outcome ADHD symptoms, RoB was "high" for 90.4% and "some concerns" for 9.6% of studies. Primarily the domain "measurement of the outcome" was often high risk because blinding was not possible for exercise interventions, raising concerns for most studies that the assessment of the outcome was influenced by the knowledge about the intervention. For the outcome executive function, RoB was "high" for 50.0%, "some concerns" for 38.5% and "low" for 11.5% of included RCTS (supplementary file 6). Many studies used a per protocol analysis or had substantial missing assessments at post-intervention in at-least one of the study arms raising concerns for both study outcomes. Comparison-adjusted funnel plots showed some outliers (supplementary file 7), and as such we considered there were 'some concerns' regarding publication bias. Overall, CINeMA revealed a very low confidence in practically all NMA results (supplementary file 6).

Discussion

The present review has synthesized evidence from 42 articles on 35 trials that investigated the effectiveness of a broad range of physical exercise interventions on ADHD symptoms and executive functions in children and adolescents with ADHD. In these trials exercise interventions included among others swimming, aerobic exercises and mind-body exercises. Comparators included among ohters pharmacotherapy, neurofeedback, art sessions, waiting list and no treatment controls. None of the included trials used an established psychological interventions (e.g. cognitive-behavioral treatment) as comparator, neither were combinations of pharmacological and psychological treatments used as comparators. Combinations of pharmacological and psychological interventions, however, are widely used in clinical practice.

The results of our NMA indicate that several physical exercise interventions may be effective in either reducing symptoms of parent-rated ADHD or improving executive functions in children and adolescents with ADHD. The results are not consistent across sensitivity analyses and differed per outcome domain. The NMAs showed very large between-study heterogeneity which suggests the presence of systematic effect modifiers between studies. Also, for some analyses we found differences between direct and indirect estimates (supplementary file 5). Unfortunately, due to the low number of studies per comparison we were unable to conduct several initially intended subgroup and sensitivity analyses which might have helped to gain insight in sources of between-study heterogeneity.

Assessments of the credibility of our NMAs revealed that the evidence was of very low certainty for both outcomes ADHD symptoms and executive functions. Importantly, our attempts to explore sources of heterogeneity resulted in sensitivity analyses with low heterogeneity and non-significant inconsistency in our exploratory sensitivity analyses. Although, of course, in these analyses a number of studies was not included, we believe the results based on a more homogeneous set of studies allow relevant conclusions.

With regards to the acceptability of the interventions, we found that 1 in 10 participants dropped out during the study period. According to our NMA, treatment acceptability did not differ significantly between the different interventions, which suggests that exercise interventions were similarly acceptable to the participants as were other ADHD treatments, including pharmacotherapy.

Comparison with previous studies

In the last two decades the interest for physical exercise interventions for children and adolescents with ADHD has increased, and from 2015 onwards several meta-analyses have been published to investigate the effectiveness of such interventions. However, previous meta-analyses often showed conflicting results as well as substantial methodological limitations.[33, 35-37, 45-49, 52] In order to summarize the evidence an umbrella review of meta-analyses was performed.[33] According to this umbrella review, it is highly suggestive that exercise interventions are effective in reducing symptoms of inattention (Hedge's g = 0.92, 95% CI: 0.44–1.39, 95%), and in improving executive functions (inhibitory control; Hedge's g = 0.82, 95% CI: 0.52–1.13; and cognitive flexibility (g = 0.52, 95% CI: 0.32–0.72).[33]

Given the large variety of researched exercise interventions traditional pairwise meta-analysis is not the optimal analysis to summarize the available evidence, hence the choice for a network meta-analysis in the present study. To our knowledge two, non-retracted, network meta-analyses on the effectiveness of physical exercise in children with ADHD are currently available, but these NMAs show substantial methodological limitations.[35, 36] The NMA by Zhu et al. included RCTs, quasi-RCT and self-controlled studies.[35] The authors concluded that different types of physical exercise are effective in improving executive functions with exergaming being the least and open-skill activities the most effective. On closer examination, however, open-skill activities was the least effective exercise category in reducing symptoms of ADHD, which is in contrast with the authors conclusion. Zhu et al describe in their method section that sensitivity analyses were performed (e.g, evaluating only RCTs), but these sensitivity analyses are not presented, increasing the risk of reporting biases. Contrary to Zhu et al, Li et al. aimed to include only RCTs in their NMA.[36] Two non-randomized studies were included in their NMA nevertheless.[98, 99] Li et al. present their results using 'mean differences' as effect size indicators, which is inadequate because of the use of different questionnaires and scales for outcome assessment.[100] In this circumstance it is necessary to standardize the results of the studies to a uniform scale before they can be combined meta-analytically, resulting in effect sizes based on 'standardized mean differences' (SMD).

The main differences between our NMA and the two previously published NMAs is that we (i) only included RCTs reporting post-intervention outcomes (ii) excluded experiments investigating short-term effects of a single bout of exercise within one session and (iii) categorized the different types of control group into individual nodes (e.g., waiting-list, no intervention, semi-active intervention). We are convinced that these choices make our results more reliable and valid but also more meaningful for implementation in practice when compared with the two previously published NMAs. When comparing our NMA with the results of an earlier NMA on the effectiveness of pharmacotherapy, we noticed the effectiveness of pharmacotherapy compared with control group interventions in our main analysis was much larger than previously described.[68] Interestingly, the results of our exploratory sensitivity analyses were very comparable with effect size described in the previous study.

From earlies studies it is known that parent-teacher agreement on ADHD symptom ratings is limited.[101] However, in the NMA assessing the effectiveness of different pharmacotherapies similar effect sizes were found for parent and teacher-rated

outcomes.[68] In our study, we noticed clear differences between parent and teacher-rated outcomes, but these can also be explained by the limited number of studies with teacher-rated outcomes.

Exploring sources of between-study heterogeneity

In our initial analyses we found large between-study heterogeneity, which means that differences in effect sizes between studies investigating the same type of intervention were larger than expected by chance alone. This large between-study heterogeneity reflects the inconsistencies in findings reported by previous meta-analyses.

To assess the assumption of transitivity, which may contribute to between-study heterogeneity, we qualitatively compared the included studies for potential effect-modifiers (e.g., year of publication, country, medication status, study population age and sex). In many studies methodological details of study conduct are not reported, which made it difficult to assess such effect-modifiers. For example, information on concurrent pharmacological treatment during the intervention period were often not (clearly) reported. In general most included studies used populations with a similar age (i.e., most children were aged between 8-12 year). Additionally, the majority of included studies included both boys and girls, usually with more boys than girls, which is expected based on the differences in prevalence of ADHD between the sexes.[2] The trial duration showed a wide range, but the large majority of trials lasted between 6 to 12 weeks. As such these study characteristics did not provide a clear explanation for the observed between-study heterogeneity.

Further, we investigated whether individual studies particularly contributed to the occurrence of between-study heterogeneity by the identification of outlier studies. We identified a few studies that reported very large effect sizes. We defined a cut-off for very large effect size (SMD > 1.64) based on the double SMD of different types of pharmacotherapy in children and adolescents with ADHD in a previous network meta-analysis.[68] While we are aware about the arbitrary nature of this approach, we decided to use it nevertheless in an exploratory sensitivity analysis with the goal to check the robustness of our main results by comparing these with results based on a subset of studies with more homogeneous results. In total 9 studies were excluded from the sensitivity analyses using this cut-off value.[31, 66, 67, 73, 74, 82, 84, 88, 93] One excluded RCT was performed in the USA and published in 1984.[73] It was performed several decades earlier than all

other studies, lasted only three weeks, and investigated one weekly muscle relaxation and contraction training. It was the only study that used the Matching Familiar Figures Test to measure executive functioning. The usefulness of this test in children with ADHD has not been conclusively established.[102] The other excluded RCTs were performed in China (2 RCTs), Iran (3 RCTs), Taiwan (1 RCT), and Tunisia (2 RCTs), and were all published after 2013. The study populations of these outliers had similar age when compared with the remaining studies, but relatively often consisted only out of boys or only girls.[31, 66, 84, 93] The excluded studies used comparable exercise interventions and outcome measures as the other included studies. Among the examined study characteristics we did not find clear reasons that could explain the observed very large effect sizes. Interestingly, almost all excluded studies were performed in North-Africa and Asia. Therefore, it cannot be excluded that the cultural context may play a modifying role in the effectiveness of physical exercise interventions.[103] At the same time, studies performed in some countries are probably more prone to study and reporting bias.[104] For example, in the past Chinese researchers often mislabeled their trial as randomized while it was in fact non-randomized.[105]

Limitations

The most important limitation of our analyses was the large between-study heterogeneity for all outcomes and the high RoB, specifically related to the assessment of ADHD symptoms. These limitations hamper strong conclusions from our results, which is also reflected by the CINeMA rating which was 'very low' for almost all comparators. We speculate that the observed heterogeneity and high RoB are partly related as high RoB may have led to over- or underestimation of the treatment effects leading to more heterogeneous findings.[106] Another important limitation is that we could not perform most pre-planned sensitivity analyses due to reporting issues (e.g., poor reporting when describing the interventions' content such as supervision status and intensity) and limited number of studies (e.g., too few studies had low risk of bias to allow for a sensitivity analysis). Another limitation of our NMA is that we could not investigate the long-term effects of the interventions because most studies only reported direct post-intervention outcomes. A final important limitation was the power of our network meta-analyses including a limited number of trials that were relatively small in size (i.e., 17 studies with a total of 793 participants for 19 pairwise comparisons were included for parent-rated ADHD symptoms network meta-analysis). Many of the comparisons between categories

were based on indirect evidence rather than direct evidence (see supplementary file 6), as such more studies with larger study populations per study would have been preferable. We consider the risk that we missed relevant studies as limited because we identified studies by both systematic database screening and screening of previously published systematic reviews and meta-analysis. However, we only included peer-reviewed studies which led to the exclusion of one possible relevant thesis study, which was not published in a peer-review journal.[107]

Strengths

This study also has several strengths. We made a large effort to include all available evidence by setting no language limits which led to the inclusion of studies published in English, as well as Chinese, German and Persian. Secondly, we were conservative in our RoB ratings and identified relevant problems in the conduct of the included studies which may serve as guide to improve future research in this field. Third, we differentiated between different types of physical exercise interventions (in contrast to lumping them together in a broad 'exercise' node) and between comparators in separate nodes. Most of the previously performed (network) meta-analyses on this topic did, for instance, not differentiate between different types of control groups (i.e., lumping together semi-active control with waiting list and no treatment controls), likely affecting the validity of their results and conclusions. Finally, we included studies from 12 different countries from different parts of the world with diverse cultural backgrounds. We previously discussed the risk of this approach to contribute to increase between-study heterogeneity, however, the broad inclusion also increases confidence in the generalizability of our findings across different populations and reduces the risk of selection bias during study inclusion.

Future directions for research

Our RoB and CINeMA assessments identified relevant problems in the conduct and reporting in the included studies. Some of these problems seem difficult to avoid, for instance parents or the children themselves cannot be blinded to the intervention received. Many identified problems, however, would not have been necessary if the researchers had adhered to research guidelines. For example, most of the studies in this NMA, including recently published studies, did not describe the randomization process clearly, raising concerns about the allocation procedure. To increase the credibility of the results of this research field, researchers should conduct and report future studies in-line

8

with the research standards and reporting guidelines (e.g., by following the CONSORT guidelines).[108] For instance, details about methods, outcomes and sensitivity analyses (e.g., a per-protocol analysis which is performed as addition to the intention-to-treat analysis is the main manuscript) may be reported as additional supplementary files.

To date there is no standard exercise training or program available for children and adolescents with ADHD. The exercise interventions investigated in our NMAs included a broad variety of exercise interventions and future research might focus on investigating differential treatment effects, for instance whether different types of exercise may benefit particular children more than others, the potentially moderating effects of culture, or the impact of the intensity of exercise interventions on the effectiveness of these interventions.

To our knowledge, no study so far compared physical exercise intervention with psychological treatment, which are advices by international guidelines.[2, 20] Therefore, new studies should ideally compare physical exercise interventions with psychological treatment and pharmacotherapy and a no intervention/waitlist control group.

Conclusions

In conclusion, this NMA shows that several categories of physical exercise interventions may be effective in either reducing symptoms of ADHD or improving executive functions in children and adolescents with ADHD. However, the certainty of the evidence is very low due to high risk of bias of the included studies and the heterogeneous findings across studies. Our exploration of potential sources of between-study variation in effect sizes did not offer a clear explanation for the unexpectedly very large effect sizes observed in several studies. As many of the studies, which we excluded in the exploratory sensitivity analyses, were conducted in Asian and North-African countries cultural differences but also deviating methodological standards of conducting and reporting research results might play a role. We conclude that high-quality studies using larger study samples are needed to allow definite conclusions on the effects of physical exercise interventions in children and adolescents with ADHD. For clinicians, it seems important to inform patients and their caregivers of the potential benefits of exercise on ADHD-related problems. Since there is currently insufficient evidence that particular types of exercise are more effective than others, it seems sensible to consider patient preferences and recommend physical exercises that are interesting, enjoyable and feasible for the specific child to ensure optimal adherence and compliance.

References

1. Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA. Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry. 2015;56(3):345-65.

2. Wolraich ML, Hagan JF, Jr., Allan C, Chan E, Davison D, Earls M, et al. Clinical Practice Guideline for the Diagnosis, Evaluation, and Treatment of Attention-Deficit/Hyperactivity Disorder in Children and Adolescents. Pediatrics. 2019;144(4).

3. American Psychiatric A, American Psychiatric A. DSM 5. American Psychiatric Association. 2013;70.

4. Thomas R, Sanders S, Doust J, Beller E, Glasziou P. Prevalence of attention-deficit/hyperactivity disorder: a systematic review and meta-analysis. Pediatrics. 2015;135(4):e994-e1001.

5. Polanczyk GV, Willcutt EG, Salum GA, Kieling C, Rohde LA. ADHD prevalence estimates across three decades: an updated systematic review and meta-regression analysis. Int J Epidemiol. 2014;43(2):434-42.

6. Ayano G, Demelash S, Gizachew Y, Tsegay L, Alati R. The global prevalence of attention deficit hyperactivity disorder in children and adolescents: An umbrella review of meta-analyses. J Affect Disord. 2023;339:860-6.

7. Wilens TE, Martelon M, Joshi G, Bateman C, Fried R, Petty C, Biederman J. Does ADHD predict substance-use disorders? A 10-year follow-up study of young adults with ADHD. J Am Acad Child Adolesc Psychiatry. 2011;50(6):543-53.

8. Pingault JB, Tremblay RE, Vitaro F, Carbonneau R, Genolini C, Falissard B, Côté SM. Childhood trajectories of inattention and hyperactivity and prediction of educational attainment in early adulthood: a 16-year longitudinal population-based study. Am J Psychiatry. 2011;168(11):1164-70.

9. Erskine HE, Norman RE, Ferrari AJ, Chan GC, Copeland WE, Whiteford HA, Scott JG. Long-Term Outcomes of Attention-Deficit/Hyperactivity Disorder and Conduct Disorder: A Systematic Review and Meta-Analysis. J Am Acad Child Adolesc Psychiatry. 2016;55(10):841-50.

10. Holbrook JR, Cuffe SP, Cai B, Visser SN, Forthofer MS, Bottai M, et al. Persistence of Parent-Reported ADHD Symptoms From Childhood Through Adolescence in a Community Sample. J Atten Disord. 2016;20(1):11-20.

11. Hakkaart-van Roijen L, Zwirs BWC, Bouwmans C, Tan SS, Schulpen TWJ, Vlasveld L, Buitelaar JK. Societal costs and quality of life of children suffering from attention deficient hyperactivity disorder (ADHD). Eur Child Adolesc Psychiatry. 2007;16(5):316-26.

12. Faraone SV, Banaschewski T, Coghill D, Zheng Y, Biederman J, Bellgrove MA, et al. The World Federation of ADHD International Consensus Statement: 208 Evidence-based conclusions about the disorder. Neurosci Biobehav Rev. 2021;128:789-818.

13. Türk S, Korfmacher A-K, Gerger H, van der Oord S, Christiansen H. Interventions for ADHD in childhood and adolescence: A systematic umbrella review and meta-meta-analysis. Clin Psychol Rev. 2023;102:102271.

14. Adler LD, Nierenberg AA. Review of Medication Adherence in Children and Adults with ADHD. Postgrad Med. 2010;122(1):184-91.

15. Kamimura-Nishimura KI, Brinkman WB, Froehlich TE. Strategies for improving ADHD medication adherence. Curr Psychiatr. 2019;18(8):25-38.

16. Schatz NK, Fabiano GA, Cunningham CE, dosReis S, Waschbusch DA, Jerome S, et al. Systematic Review of Patients' and Parents' Preferences for ADHD Treatment Options and Processes of Care. Patient. 2015;8(6):483-97.

17. Storebø OJ, Krogh HB, Ramstad E, Moreira-Maia CR, Holmskov M, Skoog M, et al. Methylphenidate for attention-deficit/hyperactivity disorder in children and adolescents: Cochrane systematic review with meta-analyses and trial sequential analyses of randomised clinical trials. BMJ. 2015;351.

18. Clavenna A, Bonati M. Safety of medicines used for ADHD in children: a review of published prospective clinical trials. Arch Dis Child. 2014;99(9):866-72.

19. Zhang L, Li L, Andell P, Garcia-Argibay M, Quinn PD, D'Onofrio BM, et al. Attention-Deficit/Hyperactivity Disorder Medications and Long-Term Risk of Cardiovascular Diseases. JAMA Psychiatry. 2024;81(2):178-87.

20. Attention deficit hyperactivity disorder: diagnosis and management. London: National Institute for Health and Care Excellence (NICE); 2018.

21. Sonuga-Barke EJ, Brandeis D, Cortese S, Daley D, Ferrin M, Holtmann M, et al. Nonpharmacological interventions for ADHD: systematic review and meta-analyses of randomized controlled trials of dietary and psychological treatments. Am J Psychiatry. 2013;170(3):275-89.

22. Young S, Asherson P, Lloyd T, Absoud M, Arif M, Cortese S, et al. Failure of healthcare provision for attention-deficit/hyperactivity disorder in the United Kingdom: a consensus statement. Front Psychiatry. 2021;12:649399.

23. Catalá-López F, Hutton B, Núñez-Beltrán A, Page MJ, Ridao M, Macías Saint-Gerons D, et al. The pharmacological and non-pharmacological treatment of attention deficit hyperactivity disorder in children and adolescents: A systematic review with network meta-analyses of randomised trials. PLoS One. 2017;12(7):e0180355.

24. Halperin JM, Healey DM. The influences of environmental enrichment, cognitive enhancement, and physical exercise on brain development: can we alter the developmental trajectory of ADHD? Neurosci Biobehav Rev. 2011;35(3):621-34.

25. Archer T, Kostrzewa RM. Physical exercise alleviates ADHD symptoms: regional deficits and development trajectory. Neurotox Res. 2012;21(2):195-209.

26. Byrne NM, Hills AP. The importance of physical activity in the growth and development of children. Children, Obesity and Exercise: Routledge; 2007. p. 62-72.

27. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. Int J Behav Nutr Phys Act. 2010;7(1):40.

28. Tannehill D, MacPhail A, Walsh J, Woods C. What young people say about physical activity: the Children's Sport Participation and Physical Activity (CSPPA) study. Sport Educ Soc. 2015;20(4):442-62.

29. Lubans D, Richards J, Hillman C, Faulkner G, Beauchamp M, Nilsson M, et al. Physical activity for cognitive and mental health in youth: a systematic review of mechanisms. Pediatrics. 2016;138(3).

30. Oh Y, Joung YS, Jang B, Yoo JH, Song J, Kim J, et al. Efficacy of Hippotherapy Versus Pharmacotherapy in Attention-Deficit/Hyperactivity Disorder: A Randomized Clinical Trial. J Altern Complement Med. 2018;24(5):463-71.

31. Pan CY, Chu CH, Tsai CL, Lo SY, Cheng YW, Liu YJ. A racket-sport intervention improves behavioral and cognitive performance in children with attention-deficit/hyperactivity disorder. Res Dev Disabil. 2016;57:1-10.

32. Soori R, Goodarzvand F, Akbarnejad A, Effatpanah M, Ramezankhani A, Teixeira AL, Ghram A. Effect of high-intensity interval training on clinical and laboratory parameters of adolescents with attention deficit hyperactivity disorder. Sci Sports. 2020;35(4):207-15.

33. Dastamooz S, Sadeghi-Bahmani D, Farahani MHD, Wong SHS, Yam JCS, Tham CCY, Sit CHP. The efficacy of physical exercise interventions on mental health, cognitive function, and ADHD symptoms in children and adolescents with ADHD: an umbrella review. eClinicalMedicine. 2023;62:102137.

34. Mills EJ, Thorlund K, Ioannidis JP. Demystifying trial networks and network meta-analysis. BMJ. 2013;346:f2914.

35. Zhu F, Zhu X, Bi X, Kuang D, Liu B, Zhou J, et al. Comparative effectiveness of various physical exercise interventions on executive functions and related symptoms in children and adolescents with attention deficit hyperactivity disorder: A systematic review and network meta-analysis. Front Public Health. 2023;11:1133727.

36. Li D, Wang D, Cui W, Yan J, Zang W, Li C. Effects of different physical activity interventions on children with attention-deficit/hyperactivity disorder: A network meta-analysis of randomized controlled trials. Front Neurosci. 2023;17:1139263.

37. Complexity. Retracted: Comparative Efficacy and Acceptability of Nonpharmacotherapy in the Treatment of Inattention for ADHD: A Network Meta-Analysis. Complexity. 2023;2023:9762653.

38. Hutton B, Salanti G, Caldwell DM, Chaimani A, Schmid CH, Cameron C, et al. The PRISMA extension statement for reporting of systematic reviews incorporating network meta-analyses of health care interventions: checklist and explanations. Ann Intern Med. 2015;162(11):777-84.

39. Nikolakopoulou A, Higgins JPT, Papakonstantinou T, Chaimani A, Del Giovane C, Egger M, Salanti G. CINeMA: an approach for assessing confidence in the results of a network meta-analysis. PLoS Med. 2020;17(4):e1003082.

40. Higgins JPT, Savović J, Page MJ, Elbers RG, Sterne JAC. Assessing risk of bias in a randomized trial. Cochrane handbook for systematic reviews of interventions. 2019:205-28.

41. Conners CK. Conners third edition (Conners 3). Los Angeles, CA: Western Psychological Services. 2008.

42. Bramer WM, Giustini D, de Jonge GB, Holland L, Bekhuis T. De-duplication of database search results for systematic reviews in EndNote. J Med Libr Assoc. 2016;104(3):240-3.

43. Bramer WM, Milic J, Mast F. Reviewing retrieved references for inclusion in systematic reviews using EndNote. J Med Libr Assoc. 2017;105(1):84-7.

44. Zhang Z, Chang X, Zhang W, Yang S, Zhao G. The effect of meditation-based mind-body interventions on symptoms and executive function in people with ADHD: a meta-analysis of randomized controlled trials. J Atten Disord. 2023;27(6):583-97.

8

45. Huang H, Jin Z, He C, Guo S, Zhang Y, Quan M. Chronic Exercise for Core Symptoms and Executive Functions in ADHD: A Meta-analysis. Pediatrics. 2023;151(1).

46. Sun W, Yu M, Zhou X. Effects of physical exercise on attention deficit and other major symptoms in children with ADHD: A meta-analysis. Psychiatry Res. 2022;311:114509.

47. Seiffer B, Hautzinger M, Ulrich R, Wolf S. The Efficacy of Physical Activity for Children with Attention Deficit Hyperactivity Disorder: A Meta-Analysis of Randomized Controlled Trials. J Atten Disord. 2022;26(5):656-73.

48. Bustamante EE, Balbim GM, Ramer JD, Santiago-Rodríguez ME, DuBois DL, Brunskill A, Mehta TG. Diverse multi-week physical activity programs reduce ADHD symptoms: A systematic review and meta-analysis. Psychol Sport Exerc. 2022;63:102268.

49. Xie Y, Gao X, Song Y, Zhu X, Chen M, Yang L, Ren Y. Effectiveness of Physical Activity Intervention on ADHD Symptoms: A Systematic Review and Meta-Analysis. Front Psychiatry. 2021;12.

50. Liang X, Li R, Wong SHS, Sum RKW, Sit CHP. The impact of exercise interventions concerning executive functions of children and adolescents with attention-deficit/hyperactive disorder: a systematic review and meta-analysis. Int J Behav Nutr Phys Act. 2021;18(1):68.

51. Lambez B, Harwood-Gross A, Golumbic EZ, Rassovsky Y. Non-pharmacological interventions for cognitive difficulties in ADHD: A systematic review and meta-analysis. J Psychiatr Res. 2020;120:40-55.

52. Cerrillo-Urbina AJ, García-Hermoso A, Sánchez-López M, Pardo-Guijarro MJ, Santos Gómez JL, Martínez-Vizcaíno V. The effects of physical exercise in children with attention deficit hyperactivity disorder: A systematic review and meta-analysis of randomized control trials. Child Care Health Dev. 2015;41(6):779-88.

53. Vancampfort D, Firth J, Schuch FB, Rosenbaum S, Probst M, Ward PB, et al. Dropout from physical activity interventions in children and adolescents with attention deficit hyperactivity disorder: A systematic review and meta-analysis. Ment Health Phys Act. 2016;11:46-52.

54. Higgins JPT TJ, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). Cochrane Handbook for Systematic Reviews of Interventions version 6.4 (updated August 2023). Cochrane; 2023. Available from www.training.cochrane.org/handbook

55. Rohatgi A. WebPlotDigitizer: web based tool to extract data from plots, images, and maps. automeris. io. URL: https://automeris io/WebPlotDigitizer/citation html [accessed 2023-07-11]. 2023.

56. Kang KD, Choi JW, Kang SG, Han DH. Sports therapy for attention, cognitions and sociality. Int J Sports Med. 2011;32(12):953-9.

57. Ziereis S, Jansen P. Effects of physical activity on executive function and motor performance in children with ADHD. Res Dev Disabil. 2015;38:181-91.

58. Balduzzi S, Rücker G, Nikolakopoulou A, Papakonstantinou T, Salanti G, Efthimiou O, Schwarzer G. netmeta: An R package for network meta-analysis using frequentist methods. J Stat Softw. 2023;106:1-40.

59. Gelade K, Janssen TWP, Bink M, Twisk JWR, van Mourik R, Maras A, Oosterlaan J. A 6-month follow-up of an RCT on behavioral and neurocognitive effects of neurofeedback in children with ADHD. Eur Child Adolesc Psychiatry. 2018;27(5):581-93.

60. Nejati V. Balance-based Attentive Rehabilitation of Attention Networks (BARAN) improves executive functions and ameliorates behavioral symptoms in children with ADHD. Complement Ther Med. 2021;60:102759.

61. Nejati V, Derakhshan Z. The effect of physical activity with and without cognitive demand on the improvement of executive functions and behavioral symptoms in children with ADHD. Expert Rev Neurotherapeutics. 2021;21(5):607-14.

62. Rücker G, Schwarzer G. Reduce dimension or reduce weights? Comparing two approaches to multi-arm studies in network meta-analysis. Stat Med. 2014;33(25):4353-69.

63. Cohen J. Statistical power analysis for the behavioral sciences: Routledge; 2013.

64. Borenstein M HL, Higgins JPT, Rothstein HR. Identifying and Quantifying Heterogeneity. Introduction to Meta-Analysis. 2009. p. 107-25.

65. Chaimani A, Caldwell DM, Li T, Higgins JPT, Salanti G. Undertaking network meta-analyses. Cochrane Handbook for Systematic Reviews of Interventions. 2019. p. 285-320.

66. Bahram ME, Assarian F, Atoof F, Taghadosi M, Akkasheh N, Akkasheh G. Effect of a 12-week interval running program on female primary school students with ADHD. J Kashan Univ Med Sci Feyz. 2014;18(2):151-8.

67. Hattabi S, Bouallegue M, Ben Yahya H, Bouden A. Rehabilitation of ADHD children by sport intervention: a Tunisian experience. Tunis Med. 2019;97(7):874-81.

68. Cortese S, Adamo N, Del Giovane C, Mohr-Jensen C, Hayes AJ, Carucci S, et al. Comparative efficacy and tolerability of medications for attention-deficit hyperactivity disorder in children, adolescents, and adults: a systematic review and network meta-analysis. Lancet Psychiatry. 2018;5(9):727-38.

69. Risk-of-bias.info. An Excel tool to implement RoB 2 2021 [Available from: https://www.riskofbias.info/welcome/rob-2-0-tool/current-version-of-rob-2

70. Papakonstantinou T, Nikolakopoulou A, Higgins JPT, Egger M, Salanti G. CINeMA: Software for semiautomated assessment of the confidence in the results of network meta-analysis. Campbell Syst Revi. 2020;16(1):e1080.

71. Schünemann HJ, Higgins JPT, Vist GE, Glasziou P, Akl EA, Skoetz N, et al. Completing 'Summary of findings' tables and grading the certainty of the evidence. Cochrane Handbook for systematic reviews of interventions. 2019:375-402.

72. Benzing V, Schmidt M. The effect of exergaming on executive functions in children with ADHD: A randomized clinical trial. Scand J Med Sci Sports. 2019;29(8):1243-53.

73. Porter SS, Omizo MM. The effects of group relaxation training/large muscle exercise, and parental involvement on attention to task, impulsivity, and locus of control among hyperactive boys. Except Child. 1984;31(1):54-64.

74. Kadri A, Slimani M, Bragazzi NL, Tod D, Azaiez F. Effect of Taekwondo Practice on Cognitive Function in Adolescents with Attention Deficit Hyperactivity Disorder. Int J Environ Res Public Health. 2019;16(2):204.

75. Lee SK, Song J, Park JH. Effects of combination exercises on electroencephalography and frontal lobe executive function measures in children with ADHD: a pilot study. Biomed Res. 2017;2017:S455-S60.

8

76. Silva LAD, Doyenart R, Henrique Salvan P, Rodrigues W, Felipe Lopes J, Gomes K, et al. Swimming training improves mental health parameters, cognition and motor coordination in children with Attention Deficit Hyperactivity Disorder. Int J Environ Health Res. 2020;30(5):584-92.

77. Mesler CF, Holmberg HC, Sperlich B. Multimodal Therapy Involving High-Intensity Interval Training Improves the Physical Fitness, Motor Skills, Social Behavior, and Quality of Life of Boys With ADHD: A Randomized Controlled Study. J Atten Disord. 2018;22(8):806-12.

78. Memarmoghaddam M, Torbati HT, Sohrabi M, Mashhadi A, Kashi A. Effects of a selected exercise program on executive function of children with attention deficit hyperactivity disorder. J Med Life. 2016;9(4):373-9.

79. Hoza B, Smith AL, Shoulberg EK, Linnea KS, Dorsch TE, Blazo JA, et al. A randomized trial examining the effects of aerobic physical activity on attention-deficit/hyperactivity disorder symptoms in young children. J Abnorm Child Psychol. 2015;43(4):655-67.

80. Choi JW, Han DH, Kang KD, Jung HY, Renshaw PF. Aerobic exercise and attention deficit hyperactivity disorder: brain research. Med Sci Sports Exerc. 2015;47(1):33-9.

81. Ahmed GM, Mohamed S. Effect of Regular Aerobic Exercises on Behavioral, Cognitive and Psychological Response in Patients with Attention Deficit-Hyperactivity Disorder. Life Sci J. 2011;8.

82. Chen X LG, Li M, Wang Q, Su M. [Effect of aerobic exercise on core symptoms and executive function in children with attention deficit hyperactivity disorder (in Chinese)]. Chinese Journal of Rehabilitation Theory and Practice. 2022;28(6):704-9.

83. Song T LY, Liu J, Li X, Yin T, Wang F, Lu S, Chen M, Ren Y. [Effects of Football Exercise on Executive Function of Boys with Attention Deficit Hyperactivity Disorder] (in Chinese). Chinese Journal of Sports Medicine. 2022.

84. Sabzi AH, Dana A, Salehian MH, Shaygan Yekta H. The Effect of Water Treadmill Exercise on Children with Attention Deficit Hyperactivity Disorder. Int J Pediatr. 2021;9(6):13671-81.

85. Liu Y, Yang N. [An experimental study on the effects of directed motor practice on cognitive ability in children with ADHD] (in Chinese). Chin J Spec Educ 2018(11):39–44.

86. Ghadamgahi Sani N, Akbarfahimi M, Akbari S, Alizadeh Zarei M, Taghizadeh G. Neurofeedback Training Versus Perceptual-motor Exercises Interventions in Visual Attention for Children With Attention-Deficit/Hyperactivity Disorder: A Randomized Controlled Trial. Basic Clin Neurosci. 2022;13(2):215-24.

87. Chang SH, Shie JJ, Yu NY. Enhancing Executive Functions and Handwriting with a Concentrative Coordination Exercise in Children with ADHD: A Randomized Clinical Trial. Percept Mot Skills. 2022;129(4):1014-35.

88. Xu X, Sun Y, Zhou F, Yang J, Jin S. [Analysis of the effect of psychomotor therapy combined with behavioral therapy on children with attention-deficit-hyperactivity-disorder aged 4 to 6] (in Chinese) Chinese Pediatrics of Integrated Traditional and Western Medicine. 2021;13(5):388-91.

89. Haffner J, Roos J, Goldstein N, Parzer P, Resch F. [The effectiveness of body-oriented methods of therapy in the treatment of attention-deficit hyperactivity disorder (ADHD): results of a controlled pilot study] (in German). Z Kinder Jugendpsychiatr Psychother. 2006;34(1):37-47.

90. García-Gómez A, Rodríguez-Jiménez M, Guerrero-Barona E, Rubio-Jiménez JC, García-Peña I, Moreno-Manso JM. Benefits of an experimental program of equestrian therapy for children with ADHD. Res Dev Disabil. 2016;59:176-85.

91. Ji H, Wu S, Won J, Weng S, Lee S, Seo S, Park JJ. The Effects of Exergaming on Attention in Children With Attention Deficit/Hyperactivity Disorder: Randomized Controlled Trial. JMIR Serious Games. 2023;11:e40438.

92. Durgut E, Orengul AC, Algun ZC. Comparison of the effects of treadmill and vibration training in children with attention deficit hyperactivity disorder: A randomized controlled trial. NeuroRehabilitation. 2020;47(2):121-31.

93. Rezaei M, Kamarzard TS, Razavi MN. The Effects of Neurofeedback, Yoga Interventions on Memory and Cognitive Activity in Children with Attention Deficit/Hyperactivity Disorder: A Randomized Controlled Trial. Ann Appl Sport Sci. 2018;6(4):17-27.

94. Ludyga S, Mucke M, Leuenberger R, Bruggisser F, Puhse U, Gerber M, et al. Behavioral and neurocognitive effects of judo training on working memory capacity in children with ADHD: A randomized controlled trial. Neuroimage. 2022;36:103156.

95. Smith SD, Vitulano LA, Katsovich L, Li S, Moore C, Li F, et al. A Randomized Controlled Trial of an Integrated Brain, Body, and Social Intervention for Children With ADHD. J Atten Disord. 2020;24(5):780-94.

96. Gelade K, Janssen TW, Bink M, van Mourik R, Maras A, Oosterlaan J. Behavioral Effects of Neurofeedback Compared to Stimulants and Physical Activity in Attention-Deficit/Hyperactivity Disorder: A Randomized Controlled Trial. J Clin Psychiatry. 2016;77(10):e1270-e7.

97. Liang X, Qiu H, Wang P, Sit CHP. The impacts of a combined exercise on executive function in children with ADHD: A randomized controlled trial. Scand J Med Sci Sports. 2022;32(8):1297-312.

98. Gohr Månsson A, Elmose M, Mejldal A, Dalsgaard S, Roessler KK. The effects of practicing target-shooting sport on the severity of inattentive, hyperactive, and impulsive symptoms in children: a non-randomised controlled open-label study in Denmark. Nord J Psychiatry. 2019;73(4-5):233-43.

99. Milligan K, Sibalis A, McKeough T, Lackner C, Schmidt LA, Pun C, Segalowitz SJ. Impact of Mindfulness Martial Arts Training on Neural and Behavioral Indices of Attention in Youth with Learning Disabilities and Co-occurring Mental Health Challenges. Mindfulness. 2019;10(10):2152-64.

100. Higgins JPT, Li T, Deeks JJ. Choosing effect measures and computing estimates of effect. Cochrane handbook for systematic reviews of interventions. 2019:143-76.

101. Narad ME, Garner AA, Peugh JL, Tamm L, Antonini TN, Kingery KM, et al. Parent–teacher agreement on ADHD symptoms across development. Psychol Assess. 2015;27(1):239.

102. Inoue K, Nadaoka T, Oiji A, Morioka Y, Totsuka S, Kanbayashi Y, Hukui T. Clinical Evaluation of Attention-Deficit Hyperactivity Disorder by Objective Quantitative Measures. Child Psychiatry Hum Dev. 1998;28(3):179-88.

103. Cuijpers P, Karyotaki E, Reijnders M, Purgato M, Barbui C. Psychotherapies for depression in low- and middle-income countries: a meta-analysis. World Psychiatry. 2018;17(1):90-101.

8

104. Panagiotou O, Contopoulos-Ioannidis D, Ioannidis J. Comparative effect sizes in randomised trials from less developed and more developed countries: meta-epidemiological assessment. BMJ. 2013;346:f707.

105. Wu T, Li Y, Bian Z, Liu G, Moher D. Randomized trials published in some Chinese journals: how many are randomized? Trials. 2009;10(1):46.

106. Savović J, Turner RM, Mawdsley D, Jones HE, Beynon R, Higgins JPT, Sterne JAC. Association Between Risk-of-Bias Assessments and Results of Randomized Trials in Cochrane Reviews: The ROBES Meta-Epidemiologic Study. Am J Epidemiol. 2017;187(5):1113-22.

107. Felmet MB. The effects of karate training on the levels of attention and impulsivity of children with attention deficit/hyperactivity disorder. United States -- Ohio: The University of Toledo; 1998.

108. Butcher NJ, Monsour A, Mew EJ, Chan AW, Moher D, Mayo-Wilson E, et al. Guidelines for Reporting Outcomes in Trial Reports: The CONSORT-Outcomes 2022 Extension. JAMA. 2022;328(22):2252-64.

Supplementary files

This network meta-analysis was conducted in accordance with the Confidence in Network Meta-Analyses (CINeMA) methodology. This approach necessitates a comprehensive account of the selected studies, assessment of bias risks, extracted data, and statistical analyses, among other elements. Consequently, the supplementary files for this chapter are extensive. To ensure the thesis remains concise and clear, only the most essential supplementary files are included below.

Supplementary file 2d. *Categorization of network nodes.*

After inclusion of the studies we categorized these based on the performed activities. We used the below broad descriptions to categorize the interventions.

| Type of physical exercise	Description	Examples of interventions included in this review
Aerobic exercises	Physical activities (either one type or multiple type) that use the body's large muscle groups, often rhythmic and repetitive. Aerobic exercises increases the heart rate and increase oxygen use.	mixed exercise program, running, table tennis, swimming.
Balance training	Training that challenges aspects of the balance systems, involving the efficient transfer of body weight.	Balance training with concurrent cognitive tasks
Exergaming	Interventions involving structured, physical exercises delivered via video-games and/or virtual reality applications	Nintendo Wii table tennis
Mind-body exercise	Interventions primarily addressing the mind and body	Yoga, relaxation/muscle training
Combination intervention	Interventions that involved physical exercise as well as other treatment components	Hippotherapy
Non-exercise intervention	**Description**	**Examples of interventions included in this review**
Education on behavior control group	Control group consisting out of education for affected children on symptoms of ADHD and how to deal with them	Education on ADHD in group sessions by health professionals
No intervention control group	Control group that did not receive any intervention	n.a.
Neurofeedback	Neurofeedback is a training in self-control of brain functions to subjects by measuring brain waves and providing a feedback signal.	n.a.
Pharmacotherapy	Pharmacotherapy with medication approved for ADHD	Methylphenidate
Semi-active control group	Control group that was offered activities that have no (or are unlikely to have) therapeutic effects on ADHD symptoms	cartoon watching, Sedentary art session
Waiting-list control group	Control group that got offered the investigated intervention after an initial wait-period	n.a.

Supplementary file 6a. ROB2 score for each study on ADHD core symptoms

Reference	Outcome	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall Bias
Ahmed et al. 2011	Core	Some concerns	High	High	High	Some concerns	High
Bahram et al. 2014	Core	Some concerns	High	High	High	Some concerns	High
Benzing et al. 2019	Core	Low	Low	High	High	Low	High
Chen et al. 2022	Core	Some concerns	High	High	High	Some concerns	High
Choi et al. 2015	Core	Some concerns	High	High	High	Some concerns	High
Durgut et al. 2020	Core	Low	Low	Low	High	Low	High
Garcia Gomez et al. 2016	Core	Some concerns	High	High	High	Some concerns	High
Gelade et al. 2016	Core	Low	Low	Low	Some concerns	Low	Some concerns
Haffner et al. 2006	Core	Some concerns	Low	Low	Some concerns	Some concerns	Some concerns
Hattabi et al. 2019	Core	Some concerns	Low	Low	High	High	High
Hoza et al. 2015	Core	High	Low	Some concerns	Some concerns	Some concerns	High
Kang et al. 2011	Core	Some concerns	High	High	High	Some concerns	High
Messler et al. 2018	Core	Some concerns	Low	Some concerns	High	Some concerns	High
Nejati 2021	Core	Some concerns	Low	Low	High	Some concerns	High
Nejati et al. 2021	Core	Low	Low	Low	High	Low	High
Oh et al. 2018	Core	Some concerns	Some concerns	High	Some concerns	Low	High
Pan et al. 2016	Core	Some concerns	Low	Low	High	Low	High
Sabzi et al. 2021	Core	Low	High	High	High	Some concerns	High
Smith et al. 2016	Core	Low	Some concerns	High	High	Low	High
Soori et al. 2020	Core	Some concerns	Some concerns	High	High	Some concerns	High
Xu et al. 2021	Core	Some concerns	High	Low	High	Some concerns	High

Supplementary file 6b. *ROB2 score for each study on executive functions*

Reference	Outcome	Randomization process	Deviations from intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall Bias
Benzing et al. 2019	EF	Low	Low	High	Low	Low	High
Chang et al. 2022	EF	Some concerns	Low	Low	Low	Some concerns	Some concerns
Chen et al. 2022	EF	Some concerns	High	High	Low	Some concerns	High
Choi et al. 2015	EF	Some concerns	High	High	Low	Some concerns	High
Da Silva et al. 2020	EF	Some concerns	High	High	Low	Some concerns	High
Durgut et al. 2020	EF	Low	Low	Low	Low	Low	Low
Gelade et al. 2016	EF	Low	Low	Low	Low	Low	Low
Ghadamagahi et al. 2022	EF	High	Some concerns	Some concerns	Low	Low	Some concerns
Haffner et al. 2006	EF	Some concerns	Low	Low	Low	Some concerns	Some concerns
Hattabi et al. 2019	EF	Some concerns	Low	Low	Low	High	High
Ji et al. 2023	EF	Some concerns	High	High	Low	Some concerns	High
Kadri et al. 2019	EF	High	High	High	Low	Some concerns	High
Kang et al. 2011	EF	Some concerns	High	High	Low	Some concerns	High
Lee et al. 2017	EF	Some concerns	Low	High	Low	Some concerns	High
Liang et al. 2022	EF	Some concerns	Low	Low	Low	Some concerns	Some concerns
Ludyga et al. 2022	EF	Low	Low	Low	Low	Some concerns	Some concerns
Memarmoghaddam et al. 2016	EF	Some concerns	Some concerns	High	Low	High	High
Nejati 2021	EF	Some concerns	Low	Low	Low	Some concerns	Some concerns
Nejati et al. 2021	EF	Low	Low	Low	Low	Low	Low
Pan et al. 2016	EF	Some concerns	Low	Low	Some concerns	Some concerns	Some concerns
Porter et al. 1984	EF	Some concerns	Some concerns	Low	Low	Some concerns	Some concerns
Rezaei et al. 2018	EF	Some concerns	Low	Low	Low	Some concerns	Some concerns
Smith et al. 2016	EF	Low	Some concerns	High	Low	Low	High
Song et al. 2022	EF	Some concerns	Some concerns	Low	Low	Some concerns	Some concerns
Yang et al. 2018	EF	Some concerns	High	High	Low	Some concerns	High
Ziereis et al. 2015	EF	Some concerns	High	High	Low	Some concerns	High

8

Chapter 9
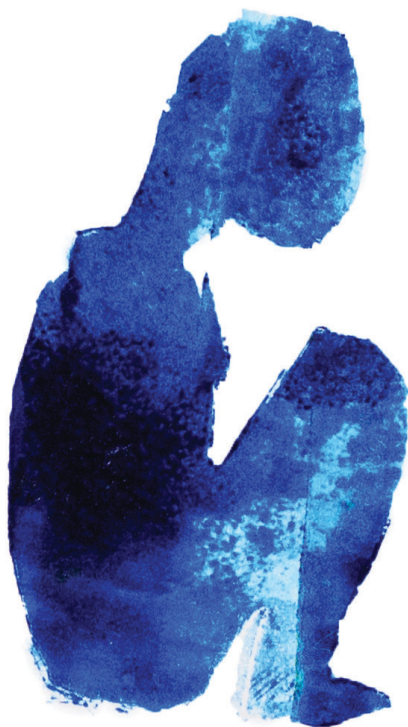
General Discussion

General Discussion

Mental health problems are common in childhood and adolescence. Despite this, relatively few studies have explored child mental health in the context of general practice. This PhD research aims to fill this gap by providing new insights into the topic. The thesis examines the epidemiology of child mental health problems in general practice, assesses how GPs currently manage these problems, and investigates the effects of the recently introduced youth mental health practice nurse (YMHPN). Additionally, we explore whether physical exercise can help reduce ADHD-related problems in children and adolescents.

Main findings

In **Chapter 2**, a cohort study using readily available general practice data from the Rijnmond Primary Care Database (RPCD), we found that the incidence of anxiety problems in children (<18 years) was 5.4 per 1,000 person-years (PY) (95% CI 5.0 - 5.7). There were large differences in incidences between age and sex categories ranging from 1.8 (95% CI 1.4 -2.3) per 1000 PY in boys aged 0 to 6 years to 14.0 (95% CI 12.6 - 15.6) per 1000 PY in girls aged 13 to 17 years. We studied the medical records of 381 children presenting to their GP with an initial anxiety problem in depth. Of these children, almost 60% were referred to mental health care services in the first year after presentation. While the majority of these children did not receive pharmacological treatment, a small percentage of children got at least one prescription of benzodiazepine (1 in 18 children), beta-blocker (1 in 11 children), or SSRI (1 in 100 children) in the year after presentation.

Chapter 3 presents an interview study examining how general practitioners (GPs) and youth mental health practitioners (YMHPNs) manage pediatric anxiety problems. Both GPs and YMHPNs aim to understand the underlying causes of these problems and address the needs of affected children and their families. GPs typically refer children for further care, preferably to their YMHPN. In turn, YMHPNs frequently conduct follow-up consultations with these children, employing a range of therapeutic techniques during these sessions. GPs expressed satisfaction with their collaboration with YMHPNs. However, both groups face significant challenges in managing pediatric anxiety problems, the most notable being long waiting lists for specialized mental health services.

Chapter 4 evaluates the care provided by youth mental health practitioners (YMHPNs) through an analysis of RPCD medical records for 375 children who underwent treatment sessions with a YMHPN between 2017 and 2021. Most of these children were adolescents (57.3% aged 13–17) and predominantly female (59.2% compared to 40.8% male). Treatment trajectories were relatively brief, with a median of four consultations (IQR 2–7). YMHPNs addressed a broad range of psychosocial problems, successfully resolving the problem without need for additional treatment in approximately 25% of cases. Drop-out rates were low, with only 1 in 8 children discontinuing treatment, reflecting strong adherence. However, 52.0% of children were referred to external mental health services within a year.

Chapter 5 presents the observed and modeled trends in GP consultations for mental health problems in young people (<25 years) between 2016 and 2021. Overall consultation rates increased strongly almost doubling over six years. This increase was steady over time, albeit with a temporary reduction in the first 3 to 4 months of the COVID-19 pandemic. In our models, a higher COVID-19 infection rate was associated with a slight increase in the observed consultation rates for psychosocial problems. School closure was associated with a reduction in the observed consultation rates.

Chapter 6 builds on the findings from **Chapter 5** by examining the consultation and incidence rates of eight specific mental health problems between 2016 and 2022. Consultation rates for all eight mental health problems increased significantly over time. The incidence rates of attention deficit hyperactivity disorder (ADHD) and depressive disorders rose significantly in both sexes, while the incidence of anxiety problems increased only in females. Although we observed a decrease in incidence and consultations in the first months of the COVID-19 pandemic, the trends observed between 2016 and 2022 did not differ from pre-pandemic trends.

Chapter 7 presents, to our knowledge, the first study into the effects of the introduction of YMHPNs in general practice on outpatient mental health care utilization. In this study, outpatient mental health care utilization increased among children and adolescents living in Rotterdam between 2019 and 2022. Boys and children living in non-deprived areas more often attended outpatient mental health care than girls and children living in deprived areas respectively. After correction for practice demographics and trends over time, the presence of a YMHPN in a practice was associated with small non-significant reductions in the number of children receiving outpatient care and associated costs compared with practices without YMHPN.

9

In **Chapter 8** the results of a network meta-analysis (NMA) on the effectiveness of different types of physical exercise interventions in reducing ADHD symptoms and improving executive functions in children and adolescents with ADHD are presented. The NMA shows that several categories of physical exercise interventions are effective in either reducing symptoms of ADHD or improving executive functions in children and adolescents with ADHD. However, the included trials had a high risk of bias and the analyses showed large heterogeneity. Following the CINeMA guidelines, the certainty of evidence was graded as very low.

Discussion of the principal findings in the context of prior knowledge

Epidemiology of child mental health problems

Mental health problems are common in childhood and adolescence.[1] In fact, a large meta-analysis estimated that one in seven children and adolescents at a given point in time meets diagnostic criteria for one or more mental health disorders.[2] According to this meta-analysis of 41 primary studies, anxiety disorders are most common among children followed subsequently by behavioral disorders, ADHD, and depressive disorder. Importantly, between-study heterogeneity was very large ($I^2 > 99\%$) indicating large differences in prevalence estimates between studies.[2, 3] This meta-analysis included prevalence studies that used samples of the overall population and have limited value for general practice.[4, 5]

Studies on the incidence and prevalence of recorded child mental health problems in general practice are limited. Therefore, we studied in **Chapter 2**, **5** and **6** the epidemiology of child mental health problems in Dutch general practice. We investigated consultation and incidence rates for common mental health problems in children, adolescents, and young adults. We explored differences between age categories and sex and investigated whether these problems increase over time. We focused on anxiety problems in children and adolescent up to 18 years in **Chapter 2** and calculated consultation and incidence rates for eight specific mental health problems, with clearly defined ICPC codes in children, adolescents, and young adults (≤24 years) in **Chapter 5** and **6**.

The mental health problems with the highest incidence (**Chapter 6**) were anxiety problems (10.3 95% CI 9.7-10.9 per 1000 PY), behavioral problems (7.1 95% CI 6.6-7.6 per 1000 PY), depressive problems (6.6 95% CI 6.1-7.1 per 1000 PY), and ADHD (5.4 95% CI 5.0-5.9 per 1000 PY) in 2022.[6] Overall, the observed frequencies of mental

health problems were largely in line with the findings of the above-described meta-analysis. In our study, however, depressive problems were relatively more common which may be explained by the inclusion of young adults in the study population. Depressive problems are known to have a relatively late age of onset compared to other mental health problems, as such the inclusion of young adults may explain the relatively high incidence of depressive problems in our study.[7]

In terms of workload in general practice, we found that the most common reasons for consultations in 2022 were anxiety problems (70.0 95% CI 68.5-71.6 consultations per 1000 PY), depressive problems (60.7 95% CI 59.3-62.2 consultations per 1000 PY) and ADHD (55.9 95% CI 54.5-57.3 consultations per 1000 PY) and behavioral problems (41.7 95% CI 40.5-42.9 per 1000 PY).

Overall, mental health problems are quite common among children and young people. This becomes evident when comparing incidence rates for mental health problems with those of common physical conditions such as asthma (6.7 per 1,000 person-years in children aged 5–18) and rarer diseases like type 1 diabetes (0.3 per 1,000 person-years in children aged ≤19 years).[6, 8] Notably, while a GP guideline for managing asthma in children has been in place since 1998, the first guideline for psychological conditions in children (e.g., ADHD guideline) was only introduced in 2014. It is especially concerning that, despite being the most common mental health problem among children and adolescents, there is still no GP guideline for anxiety problems. Given the high incidence rates, it seems crucial to prioritize the development of GP guidelines for the recognition and treatment of mental health problems in children and adolescents.

Age of onset of mental health problems

A significant portion of mental health problems are persistent or tend to recur later in life after initial improvement. Previous research indicates that approximately 50% of lifetime mental health disorders emerge by age 14, and 75% by age 24.[9] A large-scale meta-analysis of epidemiological studies estimated the peak age of onset of common problems such as anxiety disorders, ADHD, depressive disorders, and less common problems including anorexia nervosa.[10] According to this meta-analysis, anxiety disorders typically have the earliest onset (peak age = 5.5 years), followed by ADHD (peak age = 9.5 years), eating disorders (peak age = 15.5 years), and depressive disorders (peak age = 19.5 years). A recent cross-national analysis of 32 WHO surveys in 29 countries also assessed the age

of onset for various mental health problems, yielding largely similar findings.[11] This last study also examined sex differences, revealing that while the incidence of mental health disorders differs between boys and girls, the peak age of onset is similar for both sexes.

When examining the peak incidence rate of ADHD in the RPCD, an interesting trend emerged between 2016 and 2022 (**Chapter 6**). In 2016, the clinical incidence rate for ADHD was highest among children aged 7 to 12 years for both boys and girls. For boys, the incidence rates across different age categories remained relatively stable throughout the study period. However, for girls, an increase in ADHD incidence rates was observed across all age categories. Furthermore, a gradual shift was noted, with ADHD diagnoses occurring at later ages over time. In 2022 the highest incidence rate was seen in girls aged 13-17 followed by young women aged 18-24. Recent developments may help explain the findings above. In recent years, researchers and patient associations have focused more on sex differences in ADHD between males and females. This increased awareness has likely led to more women seeking help for ADHD-related symptoms, as well as better recognition of these symptoms by healthcare providers.[12, 13]

Interestingly, the peak incidences of anxiety problems in the RPCD (**Chapter 6**) differ significantly from the estimated age of onset reported in the meta-analyses mentioned earlier.[10, 11, 14] In our study, the incidence of recorded anxiety was highest in both boys and girls between the ages of 18 and 24, which is about 10 years later than the estimated peak onset age reported in the literature. This discrepancy highlights an important methodological difference between the meta-analyses and our study. The meta-analyses usually rely on retrospective questionnaires or diagnostic interviews, meaning the mental health problems may not have been known to healthcare providers at the time. In contrast, our study used GP-recorded data on mental health problems, indicating that the child and/or their caregivers actively sought help for a mental health-related problem, and the healthcare professional identified the problem.

The roughly 10-year difference suggests a significant delay in the diagnosis of anxiety problems in our study population. Previous research supports this idea, showing that individuals, particularly children and young people, face considerable barriers in seeking help for mental health problems.[15] Even among those who eventually seek treatment, a delay of several years is commonly observed before a diagnosis is made and treatment is initiated, particularly for anxiety problems.[16] While treatment delays are also noted for depressive problems and eating problems,[16, 17] the peak age for recorded cases of

these problems in the RPCD study was similar to the findings in the meta-analyses. This suggests that delays in seeking help were less pronounced for depressive and eating problems in our study population.

Perhaps conditions such as depression and eating disorders are more readily identified in children by parents and health professionals compared to anxiety disorders, resulting in quicker diagnoses. A possible explanation may be that anxiety problems typically arise at a younger age than depression and eating disorders making it more difficult to adequately recognize this problems. Reducing delays in diagnosis and treatment is crucial, given the significant negative impacts mental health problems can have on children's daily lives and development, especially because mental health problems are persistent or tend to recur later in life. The data suggests that the greatest benefit could come from earlier diagnosis of anxiety disorders.

Are child mental health problems increasingly common?

This PhD thesis highlights a significant rise in general practice consultations for mental health problems among children and young people between 2016 and 2021 (**Chapters 5** and **6**). General practice consultations increased much more for mental health problems than for other health problems. Additionally, incidence rates of ADHD, anxiety disorders, and depression appeared to increase over time. These findings indicate that the utilization of mental health care services among young people has grown within general practice in the Rotterdam region. However, this rise in healthcare use does not necessarily imply that mental health problems are becoming more prevalent among young people.

Looking at the relevant scientific literature a similar trend is recognizable, with the number of children and adolescents diagnosed and treated for mental health problems increasing significantly in the past decades.[18-20] The question remains, however, whether there is an actual increase in mental health problems among young people or whether there are alternative explanations such as improved recognition of these problems or increased openness to seek help for these problems. Previous research estimates that less than half of children with relevant mental health symptoms are adequately recognized.[21] Theoretically, therefore, the observed increase in healthcare use and diagnosed children with mental health problems may reflect more awareness among minors, their caregivers, and healthcare professionals (i.e., increased recognition).[22] Also, it may be that views on mental problems have changed over time. Problems that were previously considered

9

nonmedical problems are increasingly often being defined and treated as disorders (medicalization) with diagnostic criteria for mental disorders becoming broader over time.[23, 24] In addition, the observed increase in healthcare use for mental health problems may be a result of several factors at play at the same time (e.g., increased awareness, increased openness about mental health problems, actual increase in prevalence over time).

According to recent literature, the percentage of children with a registered mental health problem and the rate of children attending mental health services is increasing faster than population-based prevalence estimates based on cross-cohort comparisons with equivalent methodology.[25] In our studies (**Chapters 5** and **6**) we also observed a strong increasing trend in mental health problems among children, adolescents, and young adults in general practice, with consultation rates for mental health-related problems almost doubling over six years. Consultation rates showed the largest increase in adolescent girls. These increases in consultation rates indicate that the involvement of GPs in the management of these problems has become more common.

There are strong indications that the actual prevalence of child mental health problems has increased in many countries over time.[22] This seems to be especially the case for anxiety problems and depressive symptoms, most significantly among adolescent girls.[26-28] However, even when representative population samples are compared with valid and identical screening methods it is important to consider whether the changes over time reflect actual changes in mental health or whether for instance changes in diagnostic criteria may be the reason for apparent increases in incidence of certain mental disorders. Nevertheless, there are several arguments supporting a real deterioration of mental health in children and adolescents.[25] Firstly, studies with different methodologies and informant samples (e.g., self-rated, parent-rated) show similar trends. Secondly, if the increase in mental health problems represents a general increased openness about mental health problems, one would expect all mental health problems to become more prevalent. However, there are clear differences in trends between the several types of mental health problems (e.g., strong increases in affective problems and few changes in behavioral problems). According to this differential finding a general shift in openness regarding reporting mental health symptoms as the main cause for the observed increases in mental health problems seems less likely. Therefore, the increase in observed mental health problems among children and adolescents demands attention. What is the reason for the observed increase? And what can be done to reverse this trend? Future research

should address societal factors that may explain the observed increase and whether these can be changed to positively influence the mental health of young people.

Influence of the COVID-19 pandemic

Immediately after the global spread of the virus in March 2020, many countries imposed strict measures including lockdowns, social distancing, and school closures.[29] Consequently, education for school-going children and young people stopped completely or switched to online learning limiting their contact with peers. In the Netherlands, several measures aiming to prevent the spread of COVID-19 were in place, albeit to a varying extent, between March 2020 and May 2022. The pandemic and the imposed measures to prevent viral spread had a major impact on young people's daily lives. This impact had potential negative effects on both, children's mental health and the accessibility of mental health care.

In this PhD thesis, we therefore investigated the influence of the COVID-19 pandemic on primary care utilization in young people aged 0-24 years taking into account a general trend over time (**Chapters 5** and **6**). Interestingly, a steady almost linear monthly increase over time was observed between 2016 and 2021. Although consultations were initially decreased during the first COVID-19 wave, rates returned to expected rates based on the pre-pandemic trend, and no additional increase during the pandemic was observed. A similar pattern was seen for consultation and incidence rates of specific mental health problems (**Chapter 6**). For all mental health problems, there was a temporary reduction in the number of consultations in the first months of the pandemic. Overall, trends before the COVID-19 pandemic (January 2016 to February 2020) were similar to trends in the complete study period (January 2016 to December 2020). These two studies suggest that the COVID-19 pandemic did not lead to significant changes in GP care utilization for mental health problems in young people in the region of Rotterdam. A similar trend in healthcare utilization was seen in outpatient mental health care among children aged 0-17 in Rotterdam (**Chapter 7**).

Consistent with our findings, numerous studies have documented a decline in the utilization of care for child mental health problems during the initial months of the COVID-19 pandemic.[30] However, the extent to which child mental healthcare utilization changed throughout the pandemic remains controversial. In contrast, there is strong evidence suggesting that healthcare utilization for eating disorders increased among adolescents

during this period.[31] This rise in care utilization was particularly notable among girls and was observed across various types of care, including emergency department visits, inpatient admissions, and outpatient services. As for mental health care utilization in primary care settings, studies present conflicting results, though most indicate that the pandemic was associated with an overall increase in care utilization.[32-36] Many of these studies only cover short periods, making it challenging to determine whether these changes are specifically linked to the pandemic or represent a broader, pre-existing trend. For instance, one Finnish study reported a rapid increase in primary care consultations among adolescents and young adults (ages 15-24) for mental health problems (i.e., the majority of the consultations were due to neurotic, stress-related and somatoform disorders) from 2019 to 2021, suggesting that the COVID-19 pandemic increased the demand for primary mental health services.[32] However, this study did not account for the potential confounding effect of a general upward trend over a longer period of time.

Although most studies suggest an increase in healthcare utilization for children's mental health problems during the COVID-19 pandemic, there is no consensus on whether these increases can be attributed directly to the pandemic. In our studies which covered a longer pre-pandemic period in addition to the period with COVID-19 related restrictions, we did not find indications that the COVID-19 related measures were the reason for increases in GP consultations for mental health problems in children and adolescents. To draw more accurate conclusions about the impact of the pandemic, it is therefore of pivotal importance for future research to adequately account for co-occurring time trends.

Integrated mental care within general practice: the role of the YMHPN

The important role of primary care providers, such as GPs, in managing children's mental health, as well as the need for integrated healthcare services, has long been recognized.[37,38] In 2009, a consensus of experts highlighted that primary care services—particularly general practice—are well-suited to assess, diagnose, and manage child and adolescent mental health problems, emphasizing the need for integrated care across health care settings and professions.[39] A recent systematic review and meta-analysis evaluated whether integrated care models for child mental health, when compared to usual care, improved outcomes.[40] A total of 31 RCTs were included and an overall beneficial effect of integrated care was found over usual care on behavioral health outcomes (Cohen's d = 0.32; 95% CI, 0.21-0.44)

In this thesis, we assess the newly introduced Youth Mental Health Practice Nurse (YMHPN) model of integrated care in Dutch general practice. Aside from the studies presented in **Chapters 3, 4,** and **7** of this thesis, only three peer-reviewed studies on the YMHPN have been published.[41-43]

The first study examined an integrated care intervention in Dutch general practice, where participating GPs were financially supported to conduct extended youth consultations and collaborate with YMHPNs.[43] Additionally, GPs and YMHPNs had access to mental health specialists. This intervention was compared to usual care practices. Results showed that more emotional and behavioral problems were identified in the intervention practices, although the intervention did not reduce referrals to child mental health services. However, referrals shifted from specialized to less specialized providers. Importantly, the intervention in this study had several components (e.g., YMHPN in practice, the possibility for GPs to consult a psychiatrist) and the observed changes are not necessarily a consequence of the presence of YMHPN in general practices. Nevertheless, the results were generally positive, with improved recognition of mental health problems in children and adolescents.

A second study surveyed GPs and YMHPNs and conducted semi-structured interviews with 5 YMHPNs and two expert stakeholders.[41, 44] It found that while GPs and YMHPNs were generally positive about their collaborative management of child mental health, cooperation was hindered by time constraints and limited opportunities for case discussions.

The third study focused on referral patterns of 47 YMHPNs across the Netherlands between 2016 and 2019.[42] YMHPNs recorded standardized data on each child's characteristics and treatment trajectory. The study found that boys predominantly sought help for behavioral problems, while girls more often presented with emotional problems, such as anxiety and mood disorders. Over half of the children seen by YMHPNs were eventually referred to external care providers, with boys being more likely to be referred to specialized services than girls.

Our study findings largely align with previous research. In our interview study, both GPs and YMHPNs expressed satisfaction with their collaborative approach to managing pediatric anxiety (**Chapter 3**). However, in contrast to earlier studies, the primary barriers identified in our research were related to cooperation with external mental health providers. Both YMHPNs and GPs reported difficulties in consulting with specialized professionals, such as psychiatrists, and in referring children to specialized services.

9

We complemented our interviews with an online survey, which allowed us to explore a broader range of topics. Data saturation was reached, and our sample included a diverse group of participants from both urban and rural areas, serving children with varying socio-economic backgrounds. A limitation of our study was the absence of interviews with the affected children and their caregivers. Future research should incorporate their perspectives to align the care provided by GPs and YMHPNs with the needs of the children and families they serve.

We evaluated care delivered and referral patterns by YMHPNs (**Chapter 4**). We found that just over half of the children seen by YMHPNs were eventually referred for further treatment, which is consistent with findings from earlier studies.[42] We also analyzed dropout rates and discovered that approximately 1 in 8 children dropped out of the treatment trajectory with the YMHPN. Dropout is a common issue in child mental health services and can be influenced by various factors.[45] Many children with mental health challenges come from disadvantaged families, who often have limited access to mental health services.[46] These families are also more likely to experience stigma and face practical barriers, such as transportation or financial difficulties, which can contribute to higher dropout rates.[46] However, the dropout rate in our study is relatively low compared to those reported in other research, suggesting that the YMHPN model may be more effective in keeping children engaged in care.[47]

Previous studies have not been able to assess whether the introduction of YMHPNs led to changes in the use of specialized mental health care. However, by linking RPCD and municipal data, we were able to investigate the impact of YMHPNs on outpatient mental health care utilization and associated costs (**Chapter 7**). Our study revealed that children living in socially deprived areas visited outpatient mental health services less frequently than those in non-deprived areas. This finding aligns with previous research showing that socially disadvantaged families have less access to mental health care.[46] In terms of our primary research question, we found no significant associations between the presence of YMHPNs in a practice and the use of outpatient mental health care or associated costs. This suggests that, at present, there is no evidence that the introduction of YMHPNs in general practice has reduced the burden on specialized mental health services—one of the intended outcomes. However, it is plausible that YMHPNs have made mental health care more accessible for children, as a substantial proportion of cases were managed within general practice rather than being referred to specialized services (**Chapter 4**).

This PhD research has provided valuable insights into the effects of introducing YMHPNs into a field that is currently facing numerous challenges. It is important to note that the introduction of the YMHPN in the Netherlands is a relatively new development, and its full implications and potential are not yet clear. This underscores the need for ongoing evaluation through follow-up research to assess the longer-term effects of the YMHPN model and whether these effects vary across children from different socioeconomic, cultural, and ethnic backgrounds.

Physical exercise as a treatment for mental health problems

In an ideal world, every child with mental health challenges would have access to evidence-based care. However, given the significant strain on mental health services, it is currently unrealistic for these systems to meet the needs of all children experiencing such problems. Additionally, providing comprehensive services to every affected child would lead to substantial increases in the already high economic costs of child mental health care. As a result, exploring alternative treatment options for children with mental health problems is crucial. These alternatives should ideally be effective, safe, accessible, and low-cost. Additionally, such alternative treatments should preferably not require specialized mental-health trained health care providers, to avoid further overloading of mental health services. One promising option is physical exercise,[48] which has been described as a "miracle cure" due to its numerous physical and mental health benefits.[49] For instance, higher levels of physical activity—regardless of intensity—are strongly linked to a reduced risk of premature mortality.[50] While exercise interventions are well-established as effective treatments for various mental health conditions in clinical and pre-clinical adult populations, research on their effects in children and adolescents remains relatively limited.[50]

A recent umbrella meta-analysis summarizes the several available meta-analyses into the effects of physical activity on ADHD-related symptoms in children with ADHD.[51] This umbrella review strongly suggests that exercise intervention may reduce symptoms of inattention and improve executive functions including cognitive flexibility and inhibitory control.

In a network meta-analysis (NMA) reported in **Chapter 8**, we delve further into this topic and explore whether different categories of exercise have differential effects. In contrast to conventional pairwise meta-analyses, network meta-analysis is an elaborate

9

analytic strategy in which three or more interventions are compared simultaneously in one analysis by combining both direct and indirect evidence across a network of interventions.[52] This technique offers several advantages compared with conventional meta-analyses but has more methodological challenges.[52] NMA gives estimates of the relative effect of all comparisons in the network and often yields more precise estimates than a single direct or indirect estimate. Most included trials in our NMA investigated an aerobic exercise intervention, next to other exercise interventions including balance training, exergaming, and mind-body exercises.

This network meta-analysis showed that several categories of physical exercise were effective in either reducing symptoms of ADHD or improving executive functions in children and adolescents with ADHD. According to our NMA aerobic exercises currently have the most evidence supporting their effectiveness. However, our NMA had several limitations, most importantly the large between-study heterogeneity for all outcomes of interest and the high risk of bias for the included trials. Consequently, the confidence in the evidence should be considered 'very low' for most comparators. To address the substantial heterogeneity in the studies, we took a pragmatic approach by excluding those studies with likely inflated treatment effects. After excluding these studies, the network meta-analysis (NMA) did not reveal significant differences between the treatment modalities. Another limitation of our analysis was its low statistical power, which resulted from the relatively small number of trials included and the small sample sizes within each trial. Based on these findings, we conclude that more high-quality studies with larger sample sizes are needed to draw more reliable conclusions.

Considerations regarding the Rijnmond Primary Care Database

Most of the studies presented in this thesis (**Chapters 2**, **4**, **5**, **6** and **7**) used data from the RPCD, a regional general practice database of electronic health care records. It is therefore important to consider aspects of the RPCD and to what extent these are relevant for interpretation of our results.

Use of primary care databases, such as the RPCD, has several strengths.[53] These databases make it possible to investigate a wide range of health problems in large study populations with a long follow-up for relatively low costs. Primary care data such as the RPCD reflect real-world clinical practice, which makes the findings representative and applicable to everyday healthcare settings.

However, there are several limitations to using primary care databases. The electronic health records (EHRs) that these databases rely on are primarily designed for patient management, not for research purposes. In the Netherlands, primary care is efficient and focused on specific goals, so only information relevant to patient care is recorded. As a result, the usefulness of primary care data depends on the variety of clinical variables included, and some important factors, such as lifestyle and socioeconomic status, may not be consistently documented.

Additionally, there are concerns about data completeness. For example, individuals who avoid care may not seek help for their health problems, leading to an underreporting of certain conditions. The quality of the data also depends on how health care providers code information, and misclassification of diagnoses is possible, which could introduce bias. These issues—incorrect or missing information—make it harder to establish reliable statistical associations between risk factors and health outcomes.

Because of these limitations, epidemiological cohort studies that involve cross-time comparisons, symptom screening, or interview-based assessments are likely more effective for examining the links between risk factors and health outcomes. These studies are typically more accurate in estimating disease prevalence and tracking trends in prevalence over time.

The RPCD was founded in 2018. At first, only a minority of general practices in the metropolitan area of Rotterdam participated. However, over time the number of participating practices has increased. At the time of writing this thesis more than half of the population of Rotterdam was registered in participating practices, located in the various neighborhoods of Rotterdam including socially deprived and non-deprived areas. The RPCD contains both symptom and diagnosis codes, textual information entered by the GP, and summary information. This can give more detailed information about the background, severity and certainty of problems and enables validation of coded information. The RPCD includes only information concerning secondary care or hospitalization available through correspondence with the GP. For reasons of confidentiality, the RPCD does not contain information on race or ethnicity nor does it contain information on whether the patient address was located in a socially deprived area. The RPCD is an opt-out database meaning that patients registered in a participating practice are automatically included in the database. RPCD practices have the obligation to inform their patients about the possibility to opt-out. Also in the RPCD, there is risk for misclassification.

9

To what extent the described risks of bias may have affected our results is unclear. In **Chapter 2** we were able to manually check medical records of children with diagnostic codes for anxiety problems, and we noticed almost no misclassification.

Future directions for research

To date, many research gaps remain in the field of child mental health problems within GP settings. Based on the research efforts and results of this thesis, we hereafter list suggestions for future research. Firstly, we make general suggestions for child mental health research. Secondly, we list suggestions for research on child mental health in the context of Dutch general practice, and specifically related to the shared management of these problems by GPs and YMHPNs.

The most apparent concern that requires further attention is the increasing prevalence of child mental health problems, alongside a corresponding surge in mental health care utilization among children. Addressing these issues necessitates more research to improve prevention and effective treatment strategies. To achieve this, it is essential to deepen our understanding of the causal factors underlying the development of child mental health problems. Currently, most identified risk and protective factors are based on associative evidence, with causal relationships often unproven. Here our findings add relevant information by showing that the increased health care utilization for mental health problems was not to be attributed to the COVID-19 pandemic but that an increasing trend began well before the pandemic and continued throughout the entire study period (**Chapters 5** and **6**). Therefore, continued research into the causal pathways influencing the development and progression of mental health problems is crucial.

Given the urgent need for preventive interventions, one could argue for developing measures targeting associational risk factors where a causal relationship appears plausible. For instance, numerous studies have found that high screen time and social media use among children and adolescents are associated with lower mental health outcomes.[54] While causality has not yet been established, implementing preventive interventions seems fitting to reduce screen time, as the potential benefits outweigh the risks of inaction.

Considering the treatment of child mental health problems, we suggest that future research should further explore alternative treatment modalities that do not rely on traditional mental health services involving specialized mental health care professionals. Such alternative interventions could include interventions to improve supportive social

networks and stimulate lifestyle changes such a dietary changes and physical activity. In our NMA (**Chapter 8**), aerobic exercises had the largest body of evidence to support its effectivity among the identified and analyzed physical activity interventions. Therefore, we cautiously suggest that future studies should focus on developing interventions that incorporate aerobic exercises. Such interventions offer other health benefits (e.g., improve fitness, reduce overweight). In our NMA, several studies used an intervention that seems unlikely to work in daily practice (e.g., daily group exercises over 1 hour of exercise). Therefore, future studies should also consider the feasibility of the intervention so that it is also likely to be implemented in a real life setting. It became apparent in our NMA that previous trials had high risk of bias and did not live up to current research standards. Hence, future studies into the effectiveness of exercise interventions on mental health problems should strive for larger study population and adhere to the highest research standards.

In this thesis it became once again apparent that GPs experience difficulties in the recognition and management of child mental health problems. GPs reported openly about these perceived difficulties in the interview study (**Chapter 3**). This was confirmed by our analysis of medical records (**Chapter 2**) which showed room for improvement in their management. Future research should firstly investigate barriers experienced in the recognition of child mental health problems and secondly address these barriers for example by investigating whether education aimed at GPs can improve their recognition of these problems. Previously, prediction models have been developed to aid GPs in the recognition of child mental health problems.[55, 56] These prediction models are currently insufficiently discriminatory because they cannot clearly distinguish children with mental health problems from those without these problems. However, we believe that continued research aimed at improving these predictive models could lead to better tools that can be beneficial in daily practice. Such improvements might include, among other innovations, linking child records with those of their parents or incorporating natural language processing into the models to extract information from free-text entries in medical records.

This thesis provides much-needed new insights into the effects of the introduction of YMHPN in the general practice setting. Although the number of Dutch general practices employing a YMHPN is steadily increasing, scientific research on the YMHPN lags behind this development. Therefore, future research into this topic is needed. Firstly, this research should focus on how YMHPNs are currently trained (e.g., quality of the

training, standardization of the training) and to what extent their treatment approaches are adequate (e.g., evidence-based, appropriate to the problem). Secondly, it seems important to investigate further the facilitators and barriers experienced by GPs and YMHPNs in their shared management. This information can be used to streamline their workflow. Thirdly, more insight into the effectiveness of the care delivered by YMHPNs is needed. Structured evaluation of the care delivered can provide understanding on how effective their management is and to what extent the needs of children and their caregivers are addressed. This can be achieved by including evaluation as a regular part treatment trajectory with the YMHPN. It could be considered, for example, to let children and caregivers fill in validated questionnaires (e.g., the Strengths and Difficulties Questionnaire) before treatment, after ending their treatment trajectory with the YMHPN, and at one-year follow-up, regardless of whether they were referred or not. Thirdly, it seems important to assess whether the introduction of the YMHPN led to changes in care utilization for child mental health problems in either general practice or outpatient mental health care, both on the short and long-term. It is for example possible that the introduction of the YMHPN led to more early treatment and as such prevented progression to more severe problems needing specialized care. We suggest that future research should assess whether the introduction of the YMHPN was associated with an change in number of children managed in general practice, as well as the percentage that is subsequently referred. Here, attention should be given to the background of the managed children to see if socially disadvantaged children are more likely to receive mental health care after the introduction of the YMHPN. This could be achieved by linking registry data of general practice (e.g., the RPCD), secondary mental health services, and Statistics Netherlands (*Dutch: Centraal Bureau voor Statistiek*). To this end, it is also important to further improve the quality of RPCD data so that a proper distinction can be made between care delivered by general practitioner and YMHPNs. Future research should preferably encompass all levels of mental health care (i.e., care delivered in primary care and secondary care), and include costs for all levels as well as medication. Additionally, such evaluations should be continued over time to capture long-term changes in mental health care utilization (e.g., both in absolute rate of mental health services use and on type of service use).

Other implications

For GPs and GP association

Child mental health problems have become increasingly common over time. At the same time, mental health services have only limited resources. Consequently, GPs are increasingly more often consulted for these problems which is established in this thesis. This increased demand should be a reason for concern and a call for action. It raises questions like "What are the responsibilities of the GP in the identification of child mental health problems?", "What are the limits of primary mental care for children, and what problems should be managed in other more specialized settings?", "Is it justified to ask GPs to take on additional tasks (i.e., management of child mental health problems), considering the many challenges GPs are already facing?"

Stakeholders (GPs, mental health specialists, local government responsible) will likely differ in opinion to what extent Dutch GPs should bear the responsibility for the identification and management of child mental health problems. GPs will also differ in their views on this issue depending on their personal factors (e.g., personal interest in mental health problems, previous work experience) and practice factors (e.g., busy practice, old patient population).

In addition to the above-mentioned issues, it is important to note that the Dutch GP association (*Landelijke Huisartsen Vereniging*) has published its viewpoints on the role of GPs in the care for child mental health problems.[57] According to the association, GPs should offer basic GP care to children and the primary role of the GP should be that of a gatekeeper. Additionally, the GP should have knowledge of the family, clarify the reason for help, and decide the follow-up course. According to this viewpoint, additional mental health care in general practice, for example delivered by the YMHPN, are for many GP practices neither feasible nor desirable. This current position statement leaves much open to the interpretation of the reader. For example, what should be considered basic GP care for child mental health problems? It seems relevant for GPs and the GP association to discuss the role of the GP in the management of child mental health problems and to delineate together what should be considered GP care in this particular context. Taking into account the current capacity and efficiency problems in mental health services and social support teams, it is likely that more and more children and young people will seek help for a mental health problems in general practice. Delineation of GP care may help to prevent that GPs will be overloaded with patients for whom most GPs have neither sufficient training nor time.

At present, there is only one Dutch guideline for child mental health problems, specifically on the management of ADHD.[58] Therefore, it seems necessary to develop evidence-based tools (e.g., e-learnings and guidelines) to help GPs and YMHPNs. Taking the viewpoint of the Dutch GP association into account, the first priority of such tools should be to assist GPs in correctly identifying child mental health problems. This could for example be achieved by developing e-learnings that give information on clinical presentation of common child mental health problems, and on screening methods (e.g., the strength and difficulties questionnaire).[59] A second goal should be to develop evidence-based treatment guidelines for common child mental health problems (e.g., short interventions based on cognitive behavioral therapy) for GPs and YMHPNs that are motivated to provide more extensive care.

Vocational GP training

The motto of the vocational GP training Rotterdam is '*specialist in veelzijdigheid*', meaning that GPs should learn to be a jack of all trades. In contrast to this goal, the GP vocational training offers only very limited training on child mental health problems. This seems unjustified taking into account the high prevalence of child mental health problems. We suggest that child mental health problems should get a more prominent role in the vocational GP training. Here it seems particularly important to offer training on the recognition of these complaints and to give more insight into when additional (specialized) help is indicated.

Local and national policymakers

Child mental health problems have long-term negative effects, including high direct and indirect costs for the affected individuals, their environments, and society as a whole.[60] Therefore, it seems advisable for the Dutch government to invest generously in preventive measures to address the rising prevalence of child mental health problems. Previous research suggesting that such measures are also cost-effective provides additional motivation for action.[61] Concurrently, it is crucial to continue evaluating current policies. Presently, many Dutch municipalities are actively promoting the deployment of YMHPNs in general practice, which requires significant financial investment. However, evaluations of this policy appear to be infrequent. We recommend that policymakers allocate a consistent portion of the budget for scientific evaluations when implementing policies.

References

1. Kieling C, Baker-Henningham H, Belfer M, Conti G, Ertem I, Omigbodun O, et al. Child and adolescent mental health worldwide: evidence for action. Lancet. 2011;378(9801):1515-25.

2. Polanczyk GV, Salum GA, Sugaya LS, Caye A, Rohde LA. Annual research review: a meta-analysis of the worldwide prevalence of mental disorders in children and adolescents. J Child Psychol Psychiatry. 2015;56(3):345-65.

3. Erskine HE, Baxter AJ, Patton G, Moffitt TE, Patel V, Whiteford HA, Scott JG. The global coverage of prevalence data for mental disorders in children and adolescents. Epidemiol Psychiatr Sci. 2017;26(4):395-402.

4. Thygesen LC, Ersbøll AK. When the entire population is the sample: strengths and limitations in register-based epidemiology. Eur J Epidemiol. 2014;29(8):551-8.

5. Lawrenson R, Williams T, Farmer R. Clinical information for research; the use of general practice databases. J Public Health Med. 1999:299-304.

6. Engelkes M, Janssens HM, de Ridder MA, de Jongste JC, Sturkenboom MC, Verhamme KM. Time trends in the incidence, prevalence and age at diagnosis of asthma in children. Pediatr Allergy Immunol. 2015;26(4):367-74.

7. Ormel J, Raven D, van Oort F, Hartman CA, Reijneveld SA, Veenstra R, et al. Mental health in Dutch adolescents: a TRAILS report on prevalence, severity, age of onset, continuity and co-morbidity of DSM disorders. Psychol Med. 2015;45(2):345-60.

8. Fazeli Farsani S, Souverein PC, van der Vorst MM, Knibbe CA, Herings RM, de Boer A, Mantel-Teeuwisse AK. Increasing trends in the incidence and prevalence rates of type 1 diabetes among children and adolescents in the Netherlands. Pediatr Diabetes. 2016;17(1):44-52.

9. Kessler RC, Berglund P, Demler O, Jin R, Merikangas KR, Walters EE. Lifetime prevalence and age-of-onset distributions of DSM-IV disorders in the National Comorbidity Survey Replication. Arch Gen Psychiatry. 2005;62(6):593-602.

10. Solmi M, Radua J, Olivola M, Croce E, Soardo L, Salazar de Pablo G, et al. Age at onset of mental disorders worldwide: large-scale meta-analysis of 192 epidemiological studies. Mol Psychiatry. 2022;27(1):281-95.

11. McGrath JJ, Al-Hamzawi A, Alonso J, Altwaijri Y, Andrade LH, Bromet EJ, et al. Age of onset and cumulative risk of mental disorders: a cross-national analysis of population surveys from 29 countries. Lancet Psychiatry. 2023;10(9):668-81.

12. Xu G, Strathearn L, Liu B, Yang B, Bao W. Twenty-Year Trends in Diagnosed Attention-Deficit/Hyperactivity Disorder Among US Children and Adolescents, 1997-2016. JAMA Netw Open. 2018;1(4):e181471.

13. Young S, Adamo N, Ásgeirsdóttir BB, Branney P, Beckett M, Colley W, et al. Females with ADHD: An expert consensus statement taking a lifespan approach providing guidance for the identification and treatment of attention-deficit/ hyperactivity disorder in girls and women. BMC Psychiatry. 2020;20(1):404.

14. McGrath J, Al-Hamzawi A, Alonso J, Altwaijri Y, Andrade LH, Bromet E, et al. Age of onset and cumulative risk of mental disorders: a cross-national analysis of population surveys from 29 countries. Lancet Psychiatry. 2023;10.

9

15. Radez J, Reardon T, Creswell C, Lawrence PJ, Evdoka-Burton G, Waite P. Why do children and adolescents (not) seek and access professional help for their mental health problems? A systematic review of quantitative and qualitative studies. Eur Child Adolesc Psychiatry. 2021;30(2):183-211.

16. Wang PS, Berglund P, Olfson M, Pincus HA, Wells KB, Kessler RC. Failure and delay in initial treatment contact after first onset of mental disorders in the National Comorbidity Survey Replication. Arch Gen Psychiatry. 2005;62(6):603-13.

17. Hamilton A, Mitchison D, Basten C, Byrne S, Goldstein M, Hay P, et al. Understanding treatment delay: Perceived barriers preventing treatment-seeking for eating disorders. Aust N Z J Psychiatry. 2022;56(3):248-59.

18. Olfson M, Druss BG, Marcus SC. Trends in mental health care among children and adolescents. N Engl J Med. 2015;372(21):2029-38.

19. Dalsgaard S, Nielsen HS, Simonsen M. Five-fold increase in national prevalence rates of attention-deficit/hyperactivity disorder medications for children and adolescents with autism spectrum disorder, attention-deficit/hyperactivity disorder, and other psychiatric disorders: a Danish register-based study. J Clinic Psychopharmacol. 2013;39(1).

20. Mojtabai R, Olfson M. National Trends in Mental Health Care for US Adolescents. JAMA Psychiatry. 2020;77(7):703-14.

21. Barican JL, Yung D, Schwartz C, Zheng Y, Georgiades K, Waddell C. Prevalence of childhood mental disorders in high-income countries: a systematic review and meta-analysis to inform policymaking. Evid Based Ment Health. 2022;25(1):36-44.

22. Collishaw S, Sellers R. Trends in child and adolescent mental health prevalence, outcomes, and inequalities. Mental health and illness of children and adolescents. 2020:63-73.

23. Rutter M. Research Review: Child psychiatric diagnosis and classification: concepts, findings, challenges and potential. J Child Psychol Psychiatry. 2011;52(6):647-60.

24. Dowrick C, Frances A. Medicalising unhappiness: new classification of depression risks more patients being put on drug treatment from which they will not benefit. BMJ. 2013;347:f7140.

25. Collishaw S. Annual research review: secular trends in child and adolescent mental health. J Child Psychol Psychiatry. 2015;56(3):370-93.

26. Blomqvist I, Henje Blom E, Hägglöf B, Hammarström A. Increase of internalized mental health symptoms among adolescents during the last three decades. Eur J Public Health. 2019;29(5):925-31.

27. Sawyer MG, Reece CE, Sawyer ACP, Johnson SE, Lawrence D. Has the Prevalence of Child and Adolescent Mental Disorders in Australia Changed Between 1998 and 2013 to 2014? J Am Acad Child Adolesc Psychiatry. 2018;57(5):343-50 e5.

28. Sadler K, Vizard T, Ford T, Goodman A, Goodman R, McManus S. Mental health of children and young people in England, 2017: trends and characteristics. 2018.

29. Panchal U, Salazar de Pablo G, Franco M, Moreno C, Parellada M, Arango C, Fusar-Poli P. The impact of COVID-19 lockdown on child and adolescent mental health: systematic review. Eur Child Adolesc Psychiatry. 2021.

30. Wan Mohd Yunus WMA, Kauhanen L, Sourander A, Brown JSL, Peltonen K, Mishina K, et al. Registered psychiatric service use, self-harm and suicides of children and young people aged 0–24 before and during the COVID-19 pandemic: a systematic review. Child Adolesc Psychiatry Ment Health. 2022;16(1):1-13.

31. Madigan S, Vaillancourt T, Dimitropoulos G, Premji S, Kahlert SM, Zumwalt K, et al. A Systematic Review and Meta-Analysis: Child and Adolescent Healthcare Utilization for Eating Disorders During the COVID-19 Pandemic. J Am Acad Child Adolesc Psychiatry. 2024.

32. Kuitunen I, Uimonen MM, Ponkilainen VT, Mattila VM. Primary care visits due to mental health problems and use of psychotropic medication during the COVID-19 pandemic in Finnish adolescents and young adults. Child Adolesc Psychiatry Ment Health. 2023;17(1):35.

33. Evensen M, Hart RK, Godøy AA, Hauge LJ, Lund IO, Knudsen AKS, et al. Impact of the COVID-19 pandemic on mental healthcare consultations among children and adolescents in Norway: a nationwide registry study. Eur Child Adolesc Psychiatry. 2023;32(6):1025-35.

34. Burrell TD, Sheu YS, Kim S, Mohadikar K, Ortiz N, Jonas C, Horberg MA. COVID-19 and Adolescent Outpatient Mental Health Service Utilization. Acad Pediatr. 2024;24(1):68-77.

35. Hong G, Less J, Masoudian B, Cruz A, Sifuentes S, Vue J, et al. Trends in Pediatric Primary Care Visits During the COVID-19 Pandemic: Opportunity to Address Adolescent Behavioral Health Through Telemedicine. Fam Med. 2023 Oct;55(9):620-624. doi: 10.22454/FamMed.2023.755040.

36. Daneshmand R, Acharya S, Zelek B, Cotterill M, Wood B. Changes in Children and Youth's Mental Health Presentations during COVID-19: A Study of Primary Care Practices in Northern Ontario, Canada. Int J Environ Res Public Health. 2023;20(16):6588.

37. Burns BJ, Costello EJ, Angold A, Tweed D, Stangl D, Farmer EM, Erkanli A. Children's mental health service use across service sectors. Health Aff (Millwood). 1995;14(3):147-59.

38. Kelleher K, Long N. Barriers and new directions in mental health services research in the primary care setting. J Clin Child Psychol. 1994;23(2):133-2.

39. Vallance AK, Kramer T, Churchill D, Garralda ME. Managing child and adolescent mental health problems in primary care: taking the leap from knowledge to practice. Prim Health Care Res Dev. 2011;12(4):301-9.

40. Asarnow JR, Rozenman M, Wiblin J, Zeltzer L. Integrated medical-behavioral care compared with usual primary care for child and adolescent behavioral health: a meta-analysis. JAMA Pediatr. 2015;169(10):929-37.

41. Jonker T, Remmelts H, Huyghen A-M, van der Woude G, Knot-Dickscheit J. Ervaringen en perspectief van de POH-Jeugd. Huisarts Wet. 2020;63(10):33-7.

42. Zwaanswijk M, Geuijen P, Boelhouwer M, Spijk-de Jonge M, Serra M. Verwijspatronen bij praktijkondersteuners jeugd. Huisarts Wet. 2020;63(5):14-8.

43. Verhaak PFM, van Dijk M, Walstock D, Zwaanswijk M. A new approach to child mental healthcare within general practice. BMC Fam Pract. 2015;16(1):132.

44. Jonker T J K-DJ, Huyghen A. De praktijkondersteuner huisarts-jeugd: een verkennende studie. Rijksuniversiteit Groningen, afdeling Orthopedagogiek. 2017:51.

9

45. Johnson E, Mellor D, Brann P. Factors Associated with Dropout and Diagnosis in Child and Adolescent Mental Health Services. Aust N Z J Psychiatry. 2009;43(5):431-7.

46. Barnett P, Oshinowo I, Cooper C, Taylor C, Smith S, Pilling S. The association between social class and the impact of treatment for mental health problems: a systematic review and narrative synthesis. Soc Psychiatry Psychiatr Epidemiol. 2023;58(4):581-603.

47. de Haan AM, Boon AE, de Jong JTVM, Hoeve M, Vermeiren RRJM. A meta-analytic review on treatment dropout in child and adolescent outpatient mental health care. Clin Psychol Review. 2013;33(5):698-711.

48. Smith PJ, Merwin RM. The Role of Exercise in Management of Mental Health Disorders: An Integrative Review. Annu Rev Med. 2021;72(Volume 72, 2021):45-62.

49. Godlee F. The miracle cure. BMJ. 2019;366:l5605.

50. Ekelund U, Tarp J, Steene-Johannessen J, Hansen BH, Jefferis B, Fagerland MW, et al. Dose-response associations between accelerometry measured physical activity and sedentary time and all cause mortality: systematic review and harmonised meta-analysis. BMJ. 2019;366:l4570.

51. Dastamooz S, Sadeghi-Bahmani D, Farahani MHD, Wong SHS, Yam JCS, Tham CCY, Sit CHP. The efficacy of physical exercise interventions on mental health, cognitive function, and ADHD symptoms in children and adolescents with ADHD: an umbrella review. eClinicalMedicine. 2023;62:102137.

52. Mills EJ, Thorlund K, Ioannidis JP. Demystifying trial networks and network meta-analysis. BMJ. 2013;346:f2914.

53. Verheij RA, Curcin V, Delaney BC, McGilchrist MM. Possible Sources of Bias in Primary Care Electronic Health Record Data Use and Reuse. J Med Internet Res. 2018;20(5):e185.

54. Santos RMS, Mendes CG, Sen Bressani GY, de Alcantara Ventura S, de Almeida Nogueira YJ, de Miranda DM, Romano-Silva MA. The associations between screen time and mental health in adolescents: a systematic review. BMC Psychol. 2023;11(1):127.

55. Koning NR, Büchner FL, van den Berg AW, Choi SY, Leeuwenburgh NA, Paijmans IJM, et al. The Usefulness of Electronic Health Records From Preventive Youth Healthcare in the Recognition of Child Mental Health Problems. Front Public Health. 2021;9:655.

56. Koning NR, Buchner FL, Vermeiren R, Crone MR, Numans ME. Identification of children at risk for mental health problems in primary care-Development of a prediction model with routine health care data. EClinicalMedicine. 2019;15:89-97.

57. LHV. Jeugd: LHV; 2024 [Available from: https://www.lhv.nl/thema/huisarts-patient/jeugd/.

58. Stijntjes F, Hassink-Franke L, Kruishoop A, Beeres MPJ, Eekhof H, Van Manen S. NHG-Standaard ADHD bij kinderen. Huisarts Wet. 2014;57(11):584-94.

59. Goodman R. The Strengths and Difficulties Questionnaire: a research note. J Child Psychol Psychiatry. 1997;38(5):581-6.

60. Smith JP, Smith GC. Long-term economic costs of psychological problems during childhood. Soc Sci Med. 2010;71(1):110-5.

61. Le LK-D, Esturas AC, Mihalopoulos C, Chiotelis O, Bucholc J, Chatterton ML, Engel L. Cost-effectiveness evidence of mental health prevention and promotion interventions: A systematic review of economic evaluations. PLoS Med. 2021;18(5):e1003606.

9

Appendices

Summary

Mental health problems are significant disturbances in cognition, emotion regulation, or behavior. Severe and lasting mental health problems are classified as mental health disorders. These disorders are common in children and adolescents, affecting approximately one in seven. The most prevalent disorders are anxiety disorders (6.5%), disruptive behavioral disorders (5.7%), attention-deficit disorders (3.4%), and depressive disorders (2.6%). Known risk factors include genetic predisposition and environmental influences. Childhood mental health problems can profoundly impact daily functioning (e.g., academic performance and social interactions) and quality of life. They also disrupt healthy development and can have long-term negative consequences.

General Practitioners (GPs) play a central role in the Dutch healthcare system and are theoretically well-positioned to recognize mental health problems in children and adolescents early on. However, in practice, it can be challenging for GPs to identify and manage these problems.

Research on child mental health within general practice is still limited. Therefore, the first aim of this thesis is to explore the epidemiology of child mental health problems in general practice and how GPs currently manage these issues. The second aim is to evaluate the impact of the recently introduced Youth Mental Health Practice Nurse (YMHPN) on the management of child mental health problems in general practice. The third objective is to assess potential opportunities and innovations to support GPs and YMHPNs in managing child mental health problems.

The primary data source for this thesis is the Rijnmond Primary Care Database (RPCD). The RPCD contains pseudonymized electronic medical records from participating general practices, including GP notes, diagnostic codes (ICPC codes), referrals, laboratory findings, GP prescriptions, and specialists' letters. At the time of writing, the RPCD included data from over 600,000 GP patients, covering approximately one-third of the Rijnmond region's population.

Chapter 1 provides an overview of the thesis topic, discusses key research aspects, and concludes with the aims and outline of the thesis.

Chapter 2 presents a cohort study investigating the incidence of recorded pediatric anxiety problems in general practice and how GPs manage children and adolescents with these problems. This population-based study utilized data from the Rijnmond Primary

Care Database (RPCD), covering 51,212 children (aged 0–17 years) from January 1, 2012, to December 31, 2018.

The study found that the incidence of anxiety problems in children was 5.4 per 1,000 person-years (PY) (95% CI: 5.0 - 5.7). There were significant differences in incidence rates across age and sex categories, ranging from 1.8 per 1,000 PY (95% CI: 1.4 - 2.3) in boys aged 0 to 6 years to 14.0 per 1,000 PY (95% CI: 12.6 - 15.6) in girls aged 13 to 17 years.

We examined the medical records of 381 children who presented to their GP with an initial anxiety problem in detail. Of these children, 59.3% were referred to mental health care services within the first year after presentation, and 26.5% had a treatment trajectory with a Youth Mental Health Practice Nurse (YMHPN) within general practice. While most children with anxiety problems did not receive pharmacological treatment, a small percentage were prescribed benzodiazepines (1 in 18 children), beta-blockers (1 in 11 children), or SSRIs (1 in 100 children) within the year following their initial presentation.

The study concludes that anxiety problems are frequently recorded in children and adolescents, particularly among adolescent girls. Most children presenting to their GP with anxiety problems are either referred to external mental health services or managed by a YMHPN within general practice.

Chapter 3 presents an interview study that explores the perspectives of General Practitioners (GPs) and Youth Mental Health Practice Nurses (YMHPNs) on their management of pediatric anxiety problems. The study involved 13 GPs and 13 YMHPNs from the greater Rotterdam area. The interviews were transcribed and categorized into various topics.

In managing pediatric anxiety, both GPs and practice nurses aim to understand the specific cases and needs of the affected children and their parents. GPs rarely conduct follow-ups themselves, often referring the child to their practice nurse. Practice nurses frequently initiate follow-up consultations and employ a range of therapeutic techniques, including elements of cognitive behavioral therapy. In more severe cases, they refer the child to external mental healthcare services.

GPs expressed satisfaction with their collaboration with practice nurses. However, both GPs and practice nurses face significant challenges in managing pediatric anxiety,

A

with long waiting lists for external mental health care being a major issue. Improving cooperation with external mental healthcare providers was identified as a key facilitator.

Chapter 4 presents a study evaluating the care delivered by Youth Mental Health Practice Nurses (YMHPNs) to children and adolescents who consulted their general practice for psychosocial problems. The study utilized medical records from the Rijnmond Primary Care Database (RPCD) of 21,717 children aged 0–17 years, registered in practices employing a YMHPN. The characteristics of children consulting a YMHPN, the types of problems, the care provided, and referrals were assessed using quantitative content analysis.

We analyzed the medical records of 375 children who received treatment sessions with a YMHPN between 2017 and 2021. Most of these children were adolescents (57.3% aged 13–17) and predominantly female (59.2% compared to 40.8% male). Treatment trajectories were relatively brief, with a median of four consultations (IQR 2–7). YMHPNs addressed a wide range of psychosocial problems, successfully resolving the reason for consultation without the need for additional treatment in approximately 25% of cases. Drop-out rates were low, with only 1 in 8 children discontinuing treatment, reflecting strong adherence. However, 52.0% of children were referred to external mental health services within a year. In the remaining 12.3% of cases, the treatment trajectory was stopped because the child was already attending specialized services, the treatment was still ongoing, or the medical record was inconclusive.

The study concludes that YMHPNs are able to successfully managed a substantial portion of children with psychosocial problems without the need for referral. Nevertheless, most children were eventually referred for additional care.

Chapter 5 presents a population-based cohort study examining trends in GP consultation rates for psychosocial problems and the impact of the COVID-19 pandemic on these trends. The study used data from the Rijnmond Primary Care Database (RPCD) for children and young people (0-24 years) living in the Rotterdam metropolitan area between 2016 and 2021. Monthly consultation rates for psychosocial problems were calculated, stratified by age group and sex. Negative binomial models were used to estimate the influence of the COVID-19 pandemic on the observed consultation rates.

Monthly consultation rates increased from 2,443 to 4,542 consultations per 100,000 patient months over the six years. This trend (RR 1.009, 95% CI 1.008–1.011) began

well before the COVID-19 pandemic. The consultation rates of adolescent girls and young women increased the most significantly. Between March and May 2020, there was a temporary reduction in consultation rates, after which they returned to expected levels. COVID-19 infection rates and school closures showed small but significant associations with consultation rates for psychosocial problems, but did not affect the overall trend. Although consultation rates for psychosocial problems increased, this increment was stable over the entire study period.

The study concludes that the observed increasing trend in consultation rates for children and young people over time was not significantly affected by the COVID-19 pandemic.

The study presented in **Chapter 6** builds on the findings from **Chapter 5** by examining the trends in consultation and incidence rates for eight mental health problems in children and young people. These problems include anxiety problems, ADHD, behavioral problems, depressive problems, eating disorders, sleeping problems, substance abuse, and suicidality. We extracted monthly data from the Rijnmond Primary Care Database (RPCD) for children and young people (0-24 years) between 2016 and 2022.

Using negative binomial models, we calculated trends for GP-registered incidence and consultation rates across different age and sex categories for the entire study period and the period before the COVID-19 pandemic. Consultation rates for all eight mental health problems increased significantly over time. Additionally, incidence rates for ADHD and depressive problems in both sexes, and anxiety problems in females, increased significantly. Although there was a decrease in incidence and consultations in the first months of the COVID-19 pandemic, overall trends did not differ from pre-pandemic trends.

In conclusion, this study suggests an increasing workload for GPs in managing mental health problems in children and young people. These findings highlight the need for policymakers and GP councils to develop new strategies to address these trends and ensure appropriate support and resources in the future.

Chapter 7 presents, to our knowledge, the first study examining the effects of introducing Youth Mental Health Practice Nurses (YMHPNs) in general practice on outpatient mental health care utilization. To achieve this, healthcare data from the Rijnmond Primary Care Database was linked to municipal registry data on child outpatient mental health care expenditures in Rotterdam between 2019 and 2022.

A

Using mixed models, we assessed whether the presence of a YMHPN in practices was associated with outpatient mental health care utilization. Our cohort consisted of 33,971 children aged 0–17 years registered in 38 general practices in Rotterdam. Of these children, 5.5% attended outpatient mental health services between 2019 and 2022. The proportion of children utilizing outpatient mental health care and the associated costs increased over time.

After adjusting for practice demographics and trends over time, the presence of a YMHPN in a practice was associated with small, non-significant reductions in the number of children receiving outpatient care (Rate Ratio = 0.99, 95% CI 0.92 to 1.06) and associated costs (-395.80 euros, 95% CI -1431.27 to 639.67) compared to practices without a YMHPN. Considering the study's limitations, we cautiously concluded that the introduction of YMHPNs in general practice was not associated with significant changes in outpatient mental health care utilization one to four years after implementation. However, the long-term impact of the introduction of the YMHPN, as well as potential changes in care pathways remain unclear.

Physical exercise has been linked to positive effects on ADHD-related problems. **Chapter 8** investigates these effects through a network meta-analysis (NMA) that examined the effectiveness of different types of physical exercise interventions in reducing ADHD symptoms and improving executive functions in children and adolescents with ADHD. Randomized controlled trials were identified in EMBASE, Medline, Web of Science, Cochrane, PsychINFO, CINAHL, and previous reviews. We conducted random-effects NMAs based on a frequentist framework to establish the comparative effectiveness between different types of physical exercise and other comparators, including pharmacotherapy.

Our primary outcome was parent-rated ADHD symptoms, while secondary outcomes included teacher-rated ADHD symptoms, executive functions, and treatment acceptability. We included 35 trials in our analysis. The results showed that several types of physical exercise interventions were effective in either reducing ADHD symptoms or improving executive functions in children and adolescents with ADHD. However, the included trials had a high risk of bias, and the analyses showed large heterogeneity, complicating the interpretability of our results. Treatment acceptability did not differ significantly between the comparators.

Our main conclusion is that more high-quality trials with larger sample sizes are needed to draw definitive conclusions on the effectiveness of exercise interventions in reducing ADHD-related problems.

Chapter 9 presents the main findings of this PhD thesis and provides a general discussion of these findings in the context of existing knowledge. The discussion covers several key topics including the epidemiology and age of onset of mental health problems, the influence of the COVID-19 pandemic on mental health, the impact of the recently introduced Young Mental Health Practitioners Network (YMHPN) on general practice, and the role of physical exercise as a treatment for ADHD. Additionally, the chapter outlines the strengths and limitations of using primary care databases. Finally, it offers implications and suggestions for future research and practice.

A

Nederlandse Samenvatting

Psychische problemen bij kinderen en de Nederlandse huisartspraktijk

Bij psychische problemen zijn er verstoringen in het denken, emoties of gedrag. Wanneer deze problemen ernstig en langdurig zijn, worden ze geclassificeerd als psychische stoornissen. Dergelijke stoornissen komen vaak voor: naar schatting heeft wereldwijd 1 op de 7 kinderen een psychische stoornis. De meest voorkomende psychische stoornissen in deze leeftijdsgroepen zijn angststoornissen (geschatte prevalentie 6,5%), gedragsstoornissen (5,7%), aandachtstekortstoornissen (3,4%) en depressieve stoornissen (2,6%). Psychische problemen in de kindertijd kunnen een aanzienlijke impact hebben op het dagelijks functioneren, schoolprestaties, sociale relaties en de kwaliteit van leven. Ze kunnen bovendien een gezonde ontwikkeling in de weg zitten en zodoende langdurige negatieve gevolgen hebben.

In het Nederlandse zorgsysteem is een hoofdrol weggelegd voor de huisarts. Gezinnen hebben doorgaans een gezamenlijke huisarts en daardoor is de huisarts vaak op de hoogte van de gezinssituatie. Dit maakt dat huisartsen in theorie goed gepositioneerd zijn om psychische problemen bij kinderen vroegtijdig te signaleren. In de dagelijkse praktijk blijkt het echter lastiger voor hen om dit type problemen te herkennen en begeleiden.

In de afgelopen 25 jaar hebben er veel ontwikkelingen plaatsgevonden in de organisatie van de huisartszorg, waarbij huisartspraktijken steeds vaker praktijkondersteuners inzetten. Dit begon met de praktijkondersteuner somatiek (POH-S) en later de praktijkondersteuner geestelijke gezondheid (POH-GGZ). In 2016 had het overgrote deel van de huisartspraktijken al één of meerdere praktijkondersteuners in dienst. Sinds enkele jaren wordt in verschillende delen van Nederland een nieuwe type praktijkondersteuner ingezet: de praktijkondersteuner jeugd en gezin (POH-Jeugd). De POH-Jeugd helpt huisartsen bij het signaleren en begeleiden van psychosociale problemen bij kinderen en adolescenten. De gemeente Rotterdam stimuleert de inzet van POH-Jeugd met het doel om passende hulpverlening aan kinderen tot 18 jaar met psychosociale problematiek te organiseren. De uitrol van de inzet van de POH-Jeugd vond gefaseerd plaats, met name in de periode 2019-2022.

Doelstellingen van dit proefschrift

Tot nu toe is er relatief weinig onderzoek gedaan naar psychische problemen bij kinderen binnen de huisartsenpraktijk. Dit proefschrift richt zich daarom op drie hoofdvragen.

Het eerste doel is het in kaart brengen van de epidemiologie van psychische problemen bij kinderen in de huisartsenpraktijk, en hoe huisartsen handelen bij deze problemen. Het tweede doel is het evalueren van de impact van de recent geïntroduceerde POH-Jeugd op de aanpak van psychische problemen binnen de huisartsenpraktijk. Het derde doel is het verkennen van kansen en innovaties die huisartsen en POH-Jeugd kunnen ondersteunen bij het signaleren en behandelen van psychische problemen bij kinderen.

Rijnmond Gezond Database

De belangrijkste gegevensbron voor dit onderzoek is de Rijnmond Gezond Database. Deze database bevat gepseudonimiseerde elektronische patiëntendossiers van deelnemende huisartsenpraktijken. De gegevens omvatten onder andere notities van huisartsen, diagnostische codes (ICPC-codes), verwijzingen, laboratoriumuitslagen, medicatievoorschriften en brieven van specialisten. Op moment van schrijven bevatte deze database informatie van meer dan 600.000 patiënten, wat neerkomt op ongeveer een derde van de bevolking in de regio Rijnmond.

Overzicht van de hoofdstukken van dit proefschrift

Hoofdstuk 1 is een inleidend hoofdstuk en geeft een beknopt overzicht van psychische problemen bij kinderen. Daarnaast bespreekt het de doelstellingen van het proefschrift.

Hoofdstuk 2 bespreekt een cohortstudie welke gebruik maakte van gegevens uit de Rijnmond Gezond Database. Deze studie bestaat uit een kwantitatieve analyse waarbij de incidentie van angstproblemen bij kinderen in de huisartsenpraktijk wordt onderzocht. Daarnaast is er een kwalitatieve analyse waarbij het handelen van huisartsen bij een kind met een angstprobleem wordt geëvalueerd. Er werd voor deze studie gebruikt gemaakt van de gegevens van 51.212 kinderen van 0 tot 17 jaar in de periode 2012-2018.

De incidentie van geregistreerde angstproblemen was 5,4 kinderen per 1.000 persoonsjaren. Er waren duidelijke verschillen tussen leeftijds- en geslachtsgroepen. Zo lag de incidentie het laagst bij jongens van 0 tot 6 jaar (1,8 per 1.000 persoonsjaren) en het hoogst bij meisjes van 13 tot 17 jaar (14,0 per 1.000 persoonsjaren).

Voor de kwalitatieve analyse zijn de medische dossiers van 381 kinderen bestudeerd die zich voor het eerst met een angstprobleem bij de huisarts meldden. 59,3% van deze kinderen werd binnen één jaar na presentatie doorverwezen voor psychische

A

hulpverlening. In totaal werd 26,5% van de kinderen begeleid door de POH-Jeugd binnen de huisartsenpraktijk. Een klein deel van de kinderen kreeg medicatie voorgeschreven. In het jaar na presentatie kreeg 1 op de 18 van de kinderen een benzodiazepine, 1 op de 11 een bètablokker en 1 op de 100 een selectieve serotonine heropname remmer (SSRI). De conclusie van de studie is dat angstproblemen frequent voorkomen bij kinderen, en dan met name bij adolescente meisjes. De meeste kinderen waarbij een angstprobleem wordt vastgesteld, worden doorverwezen naar psychische hulpverlening buiten de huisartspraktijk of krijgen ondersteuning bij de POH-Jeugd binnen de huisartspraktijk.

Hoofdstuk 3 beschrijft een interviewstudie naar de ervaringen en perspectieven van huisartsen en POH-Jeugd over hun aanpak van angstproblemen bij kinderen. In totaal zijn dertien huisartsen en dertien POH-Jeugd uit de regio Rotterdam geïnterviewd. Alle interviews zijn volledig getranscribeerd en vervolgens gecategoriseerd in thema's.

Zowel huisartsen als praktijkondersteuners proberen in de begeleiding van angstproblemen aan te sluiten bij de situatie en behoeften van het kind en hun ouders. Huisartsen voeren meestal geen follow-up gesprekken, maar verwijzen het kind vaak door naar de praktijkondersteuner. Praktijkondersteuners hebben doorgaans meerdere consulten met kind en/of ouders. Ze passen hierbij verschillende therapeutische technieken toe. Zij gebruiken bijvoorbeeld elementen uit de cognitieve gedragstherapie. In ernstigere gevallen verwijzen praktijkondersteuners kinderen door naar psychische hulpverlening buiten de huisartspraktijk.

Huisartsen zijn tevreden over hun samenwerking met de POH-Jeugd. Zowel huisartsen als praktijkondersteuners signaleren belangrijke knelpunten in de begeleiding van kinderen met angstproblemen. Vooral de lange wachttijden voor psychische hulpverlening buiten de huisartspraktijk wordt als een grote belemmering ervaren. Uit de interviews komt naar voren hopen dat het van essentieel belang is om de samenwerking tussen de huisartspraktijk en GGZ-zorgaanbieders te verbeteren.

Hoofdstuk 4 beschrijft een studie waarin de door POH-Jeugd geleverde zorg aan kinderen en adolescenten wordt geëvalueerd. Voor dit onderzoek zijn medische gegevens uit de Rijnmond Gezond Database gebruikt van 21.717 kinderen tot en met 17 jaar die stonden ingeschreven bij een huisartsenpraktijk met een POH-Jeugd. Er is geanalyseerd welke kenmerken de kinderen hadden die begeleiding kregen van een POH-Jeugd en voor welke type problemen deze begeleiding plaatsvond. Daarnaast is de geleverde zorg door praktijkondersteuners en de verwijzingen naar hulpverlening buiten de huisartspraktijk geclassificeerd.

In totaal zijn de dossiers van 375 kinderen geanalyseerd die tussen 2017 en 2021 begeleiding kregen van een POH-Jeugd. De meeste kinderen waren adolescenten (57,3% tussen de 13 en 17 jaar) en de meerderheid was vrouw (59,2% meisjes). De behandeltrajecten waren over het algemeen kort, met een mediaan van vier consulten. De POH-Jeugd bood begeleiding bij uiteenlopende psychosociale problemen. In ongeveer 25% van de trajecten bleek deze begeleiding voldoende om het probleem naar tevredenheid op te lossen. Het uitvalspercentage was relatief laag: slechts 13,3% van de kinderen stopte voortijdig met het traject. Daarentegen werd 52,0% van de kinderen doorverwezen voor aanvullende psychische hulp buiten de huisartsenpraktijk. De resultaten laten zien dat de POH-Jeugd in staat is om een aanzienlijk deel van de kinderen met psychosociale problemen effectief te helpen, al is bij de meerderheid alsnog verdere hulp nodig.

Wereldwijd is het zorggebruik voor psychische problemen de afgelopen decennia sterk toegenomen. Sommige studies suggereren dat de COVID-19-pandemie deze stijging heeft versneld. In **Hoofdstuk 5** wordt onderzocht of een vergelijkbare toename zichtbaar is in het zorggebruik voor psychosociale problemen onder jongeren binnen de Nederlandse huisartspraktijk, en in hoeverre de COVID-19-pandemie daarop van invloed was. Het hoofdstuk beschrijft een cohortstudie naar trends in maandelijkse consulten voor psychosociale problemen, gebaseerd op gegevens uit de Rijnmond Gezond Database.

De analyse omvatte kinderen en jongvolwassenen (0–24 jaar) uit de regio Rotterdam in de periode 2016–2021. Het aantal consulten per maand werd berekend per leeftijdsgroep en geslacht. Met negatieve binomiale modellen werd de ontwikkeling over tijd en de impact van COVID-19 onderzocht. In zes jaar tijd steeg het aantal maandelijkse consulten van 2.443 naar 4.542 per 100.000 patiëntmaanden. Deze stijging (RR 1,009; 95% BI 1,008-1,011) begon al ruim vóór de pandemie, en was het sterkst bij adolescente meisjes en jonge vrouwen. Tijdens de eerste COVID-19 golf (maart–mei 2020) was er een tijdelijke daling van het aantal consulten, waarna het aantal consulten weer het verwachte niveau bereikte. In de modellen waren hoge COVID-19 besmettingscijfers geassocieerd met meer consulten per maand, en schoolsluitingen met minder consulten per maand. Alhoewel deze associaties significant waren, was deze invloed zeer gering en veranderde de algehele trend niet. De studie concludeert dat het zorggebruik voor psychosociale problemen onder jongeren in de regio Rijnmond sterk is toegenomen, onafhankelijk van de COVID-19-pandemie.

A

Uit het onderzoek in Hoofdstuk 5 was het echter nog onduidelijk om welke specifieke problematiek toenam. **Hoofdstuk 6** onderzoekt daarom trends in het aantal huisartsconsulten en de incidentie van acht specifieke psychische problemen bij kinderen en jongvolwassenen.

De volgende problemen zijn geanalyseerd: angstproblemen, ADHD, gedragsproblemen, depressieve problemen, eetstoornissen, slaapproblemen, middelenmisbruik en suïcidale klachten. Hiervoor zijn maandelijkse gegevens (2016-2022) gebruikt uit de Rijnmond Gezond Database van kinderen en jongvolwassenen (0-24 jaar). De analyses, uitgesplitst naar leeftijd en geslacht, zijn uitgevoerd met negatieve binomiale modellen. Er is gekeken naar trends over de gehele periode én specifiek naar de periode vóór de COVID-19 pandemie.

Voor alle acht psychische problemen werd een duidelijke stijging gezien in het aantal maandelijkse consulten. Daarnaast nam de incidentie van ADHD en depressieve klachten toe bij zowel jongens als meisjes. Ook de incidentie van angstklachten nam toe bij meisjes. In de incidentie van de overige problemen werd geen significante toename gezien.

Tijdens de eerste maanden van de COVID-19-pandemie was er een tijdelijke daling van het aantal consulten en de incidentie cijfers, maar de trends in de gehele studieperiode weken nauwelijks af van die van voor de COVID-19-pandemie. De studie concludeert dat er sprake is van een structurele toename in zorggebruik voor uiteenlopende psychische problemen onder jongeren in de huisartspraktijk. Deze bevindingen benadrukken het belang van gericht beleid van huisartsenorganisaties en beleidsmakers om passende zorg voor deze doelgroep ook in de toekomst te kunnen waarborgen.

Hoofdstuk 7 presenteert een studie die de effecten onderzoekt van de inzet van POH-Jeugd in huisartsenpraktijken op het gebruik van ambulante psychische hulpverlening buiten de huisartspraktijk. Voor dit onderzoek zijn gegevens uit de Rijnmond Gezond Database gekoppeld aan de gemeentelijke registratie van uitgaven aan ambulante psychische hulpverlening buiten de huisartspraktijk in Rotterdam tussen 2019 en 2022. Met behulp van mixed-modellen is onderzocht in hoeverre de aanwezigheid van een POH-Jeugd in een huisartsenpraktijk samenhangt met het gebruik van deze hulpverlening.

De studiepopulatie bestond uit 33.971 kinderen van 0 tot 17 jaar, ingeschreven bij 38 huisartsenpraktijken in Rotterdam. Van deze kinderen maakte 5,5% gebruik van ambulante psychische hulpverlening buiten de huisartspraktijk tussen 2019 en 2022. Zowel het maandelijkse percentage van kinderen dat gebruik maakte van deze zorg, als de bijbehorende kosten namen tijdens de studieperiode toe. De aanwezigheid van een POH-Jeugd in een huisartspraktijk bleek geassocieerd te zijn met een kleine, niet-significante vermindering van het aantal kinderen in een praktijk dat ambulante psychische hulpverlening ontving vergeleken met praktijken zonder POH-Jeugd. Ook de kosten voor ambulante hulpverlening zijn niet-significant verschillend tussen praktijken met en zonder POH-Jeugd.

Het onderzoek had verschillende beperkingen, waardoor belangrijk is de resultaten met enige terughoudendheid te interpreteren. Op basis van de huidige gegevens kan voorzichtig geconcludeerd worden dat de inzet van de POH-Jeugd in de eerste vier jaar niet heeft geleid tot significante veranderingen in het gebruik van psychische hulpverlening buiten de huisartspraktijk. De langetermijneffecten, evenals de impact op specifieke groepen, zoals kinderen uit gezinnen met een lage sociaaleconomische status, blijven vooralsnog onduidelijk.

Er zijn aanwijzingen dat lichamelijke activiteit en sport een positief effect kunnen hebben op ADHD-gerelateerde klachten. **Hoofdstuk 8** onderzoekt daarom de effectiviteit van verschillende soorten bewegingsinterventies bij kinderen en adolescenten met ADHD, middels een netwerk meta-analyse. Hierbij is gekeken in hoeverre deze interventies, zoals aerobe training en actieve videogames, ADHD-symptomen verminderen en de executieve functies verbeteren (de cognitieve processen die helpen gedrag te reguleren en doelen te behalen).

Voor dit onderzoek werd een uitgebreide literatuursearch uitgevoerd in wetenschappelijke databases. Op basis hiervan werden 35 gerandomiseerde, gecontroleerde studies geselecteerd die bewegingsinterventies bij kinderen en adolescenten met ADHD onderzochten. De netwerkmeta-analyse vergeleek de effectiviteit van de verschillende interventies onderling én ten opzichte van andere behandelingen, waaronder medicatie.

De primaire uitkomstmaat was de door ouders beoordeelde ernst van de ADHD-symptomen. Secundaire uitkomstmaten waren 1) de door leerkrachten beoordeelde ernst van de ADHD-symptomen, 2) verbetering van executieve functies, en 3) de

A

aanvaardbaarheid van de interventies, uitgedrukt in het uitvalspercentage per interventie. De resultaten laten zien dat diverse bewegingsinterventies effectief kunnen zijn in het verminderen van ADHD-symptomen en/of het verbeteren van executieve functies. De aanvaardbaarheid verschilde niet significant tussen de interventies. Wel hebben veel van de geïncludeerde studies een hoog risico op bias en is er sprake van grote heterogeniteit in uitkomsten tussen de onderzoeken, wat de interpretatie van de resultaten bemoeilijkt.

Alhoewel de geïncludeerde studies erop wijzen dat bewegingsinterventies ADHD gerelateerde klachten kunnen verminderen, is het op basis van de huidige literatuur nog niet mogelijk om definitieve conclusies te trekken. Een belangrijke gevolgtrekking uit dit onderzoek is dan ook dat meer hoogwaardige studies met grotere steekproeven nodig zijn om de effectiviteit van bewegingsinterventies bij ADHD beter te kunnen vaststellen.

In het afsluitende **Hoofdstuk 9** worden de belangrijkste bevindingen van dit proefschrift besproken. De conclusies worden geplaatst in de context van bestaande literatuur. Ook worden de sterke en zwakke punten van het gebruik van huisartsendatabases besproken. Tot slot schetst het hoofdstuk verdere implicaties voor de praktijk, en worden aanbevelingen gedaan voor vervolgonderzoek.

A

Dankwoord

'Velen handen maken licht werk' volgens mijn oma. Gelukkig geldt dit ook in enige mate voor het schrijven van een proefschrift. Daarom is het passend om hier kort bij stil te staan, en hen te bedanken die mij zo goed hebben geholpen.

Heike Gerger

In jou had ik een zeer betrokken en betrouwbare copromotor. Je nam het stokje halverwege mijn eerste onderzoeksjaar over van Adela. Dit was de eerste keer dat je een promotieonderzoek superviseerde, maar dat deed niks af aan de begeleiding. Ik ben je dankbaar dat je speciaal voor mijn onderzoekstraject verbonden wilde blijven aan het Erasmus MC ondanks dat je in Maastricht woont, voor Nederlandse standaard toch relatief ver. De communicatie was altijd een leuke variëteit omdat we Engels afwisselden met Nederlands en Duits als we even niet op de juiste woorden konden komen.

Patrick Bindels

Het was vanaf het begin duidelijk dat je een zeer ervaren promotor bent. Ondanks het feit dat je als afdelingshoofd met honderd en één dingen bezighield, wilde je altijd meedenken en kreeg ik snel antwoord op mijn vragen. Ik ben blij dat je ook na je emiraat betrokken wilde blijven bij mijn promotie-traject.

Evelien de Schepper en Arthur Bohnen

Evelien, door omstandigheden kon je helaas niet tot het einde van mijn promotietraject betrokken blijven bij ons onderzoek. Desondanks wil ik je bedanken voor je hulp. Het was fijn om met je te kunnen sparren over onderzoek en niet-onderzoek gerelateerde vragen. Arthur, ik waardeer je doortastende opmerkingen tijdens onze overleggen. Daarnaast ben je (mede door je altijd op voorraad leuke praktijkverhalen) een inspirerend voorbeeld hoe je als huisarts de praktijk en wetenschap uitstekend kan combineren.

Aan de overige co-auteurs en datamanagers die meewerkten aan dit promotieonderzoek Premysl Velek, Vincent 't Hart, Sanne Verhoog, Wilma Jansen, Selina Berg, Ann-Kathrin Korfmacher, Eveline Molendijk, Jessie Bennebroek, Annouk Bruggeman, Kirsten de Oude, Boris Schouten, Davy Maas, Laura Struik, Özcan Erdem en Angeline Bosman. Zonder jullie was het huidige boekje niet mogelijk geweest. Ik wil jullie bedanken voor de prettige samenwerking, jullie ideeën en suggesties.

Aan de collega's van de 19^e verdieping

Hoog in het Erasmus MC hadden we samen ruimzicht, als het helder was kon je zo waar Den Haag goed zien liggen. Het was fijn om bij jullie te kunnen uitpuffen tijdens de koffie als het schrijven even tegenviel.

Aan de paranimfen

Khoshal. In het weekend kwam het wel eens voor dat ik met enige tegenzin naar het Erasmus ging voor een analyse of schrijfwerk. Het was dan een enorme meevaller als ik er achter kwam dat jij daar ook was (voor oplettende persoon af te leiden aan een thermoscan groene thee in de keuken)! Een van de hoogtepunt van mijn promotie periode was zonder twijfel het WONCA-congres met aansluitende korte vakantie in Londen met jou en Wisal.

Wei. Toen we samenwoonden in Rotterdam deed je een MD/PhD traject. Het gebeurde wel eens dat je 's avonds nog snel naar het Erasmus fietste om er de overleving van een celkolonie te waarborgen. Ik wist dus een beetje wat ik kon verwachten toen ik de huisartsopleiding met promotieonderzoek ging combineren. Gelukkig hoefde ik tijdens mijn onderzoek geen kankercellen te kweken, ik betwijfel of ze het hadden overleefd. Ik ben blij met de goede vriendschap die je me geeft.

Aan mijn opleiders

Arie en Karen, dank voor jullie goede en leerzame begeleiding. Jullie flexibiliteit en de ruimte die ik kreeg om waar nodig tijd vrij te maken voor het onderzoek, heb ik als erg prettig ervaren.

Aan mijn vrienden

Ik voel me gezegend met jullie. Bedankt voor jullie interesse, het (inhoudelijk) meedenken, de zeer welkome afleiding en relativerende steun in de afgelopen 6 jaar! Bijzondere dank aan Jantine voor het ontwerpen van de kleurrijke omslag van dit boekje.

Aan mijn familie

Je hoeft je niet te verdiepen in psychische klachten bij kinderen om te weten hoe bepalend de familie waarin je opgroeit is. Ik heb het ongelooflijk goed getroffen met jullie, daar ben ik dankbaar voor.

Aan mijn vriendin

Lieve Elo, uiteraard ben jij het beste wat ik heb overgehouden aan mijn promotieonderzoek! Ik dank je voor de liefde en steun die je me geeft.

A

Appendices

Curiculum vitae

Lukas Koet werd geboren op 19 oktober 1991 in Amsterdam. Na het behalen van zijn gymnasiumdiploma aan het Murmellius Gymnasium in Alkmaar, verhuisde hij in 2009 naar Groningen om geneeskunde te studeren. Na het afronden van zijn bachelor werkte hij een half jaar in Cardiff bij NHS Wales als begeleider in de geestelijke gezondheidszorg. Tijdens zijn master liep Lukas coschappen in Groningen en Oldenburg (Duitsland). Hij sloot zijn studie af bij de afdeling Kindergeneeskunde van het Isala Ziekenhuis in Zwolle. In 2016 verhuisde hij naar Rotterdam, waar hij als basisarts werkte op de afdelingen Hematologie (Daniël den Hoedkliniek), Interne Geneeskunde en Neurologie (Ikazia Ziekenhuis). In 2019 startte hij met het AIOTHO-traject aan het Erasmus MC, waarin hij de huisartsopleiding combineerde met onderzoek naar psychische klachten bij kinderen. Als onderdeel van dit traject volgde hij ook de master *Clinical Epidemiology*, die hij in 2021 succesvol afrondde. Naast zijn werkzaamheden binnen het AIOTHO-traject verzorgt Lukas jaarlijks gastcolleges neurologie aan de masteropleiding *Physician Assistant* van de Hogeschool Rotterdam. Ook schrijft hij regelmatig nieuwsberichten voor *Huisarts en Wetenschap*. Het eerste en derde jaar van zijn huisartsopleiding volgde hij respectievelijk bij Arie Sneep in Dongen en Karen Overbeeke in Blijdorp. Na het afronden van zijn opleiding gaat Lukas aan de slag als huisarts in Rotterdam. In zijn vrije tijd maakt en beluistert hij graag muziek; hij speelt klarinet en piano. Lukas woont samen met zijn vriendin Elodie in Delfshaven, Rotterdam.

A

PhD Portfolio

Erasmus MC Department: General Practice

PhD period: August 2019 - February 2025

Promotor: Prof. dr. P.J.E. Bindels

Co-promotor: Dr. H. Gerger

	Year	Workload (ECTS)
Courses/Training		
Master of Science in Clinical Epidemiology, NIHES, Rotterdam	2019-2021	70
Good Clinical Practice; re-registration	2020	0.3
Scientific Integrity	2023	0.3
Topics in Meta-analysis, NIHES summer course, Rotterdam	2023	
Good Clinical Practice; re-registration	2023	0.3
Professional education		
Vocational training for general practitioner, Erasmus MC, Rotterdam	2020-2025	
Oral presentations		
WONCA conference, London, 1 presentation	2022	1
WONCA conference, Brussel, 1 presentation	2023	1
NHG Wetenschapsdag, Groningen, 1 presentation	2023	1
Kennisatelier "POH Jeugd & Gezin", Municipality Rotterdam, 2 presentations	2024	
PsyHag, netwerk kaderhuisartsen GGZ, wintersymposium, 1 presentation	2024	
Poster presentations		
WONCA conference, Amsterdam, 1 poster	2021	1
Participation (inter)national conferences/meetings		
IOH-platform meeting, Maastricht	2022	0.3
Aiothodag, Groningen	2023	0.3

	Year	Workload (ECTS)
Teaching		
Clinical reasoning for bachelor and master students	2019-2020	1
Scientific meetings for GP trainees, Erasmus MC	2019-2024	1
Supervising student sessions 'Critical Reading'	2019-2024	1
Teaching 'Topics in neurology', Master Physician Assistant, Hogeschool Rotterdam	2019-	
Supervising master students with master thesis, 2 students	2021	2
Supervising GP trainee with scientific internship, 1 GP trainee	2023-2024	2
Organisation		
Organisation of Buddy system for new junior researchers of GP department	2021-2025	
Panel member Scientific requests, GP vocational training, ErasmusMC	2019-2025	
Other		
Writer of scientific news items for 'Huisarts en Wetenschap'	2022-	

A

Appendices

List of publications

This thesis

Lukas BM Koet, Evelien IT de Schepper, Arthur M Bohnen, Patrick JE Bindels, Heike Gerger. Anxiety problems in children and adolescents: a population-based cohort study on incidence and management in Dutch primary care. British Journal of General Practice 2022; 72 (719): e405-e412.

Lukas BM Koet, Jessie JM Bennenbroek, Annouk YS Bruggeman, Evelien IT de Schepper, Arthur M Bohnen, Patrick JE Bindels, Heike Gerger. GPs' and practice nurses' views on their management of paediatric anxiety problems: an interview study. BMC Primary Care 2022; 23 (235).

Lukas BM Koet, Heike Gerger, Wilma Jansen, Patrick JE Bindels, Evelien IT de Schepper. Evaluation of practice nurses' management of paediatric psychosocial problems in general practice. Journal of Public Health 2024; 46 (2): e261–e268.

Lukas BM Koet, Premysl Velek, Patrick JE Bindels, Arthur M Bohnen, Evelien IT de Schepper, Heike Gerger. Children and young people's consultation rates for psychosocial problems between 2016 and 2021 in the Netherlands. European Journal of General Practice 2024;30 (1).

Lukas BM Koet, Sanne Verhoog, Özcan Erdem, Heike Gerger, Patrick JE Bindels, Evelien IT de Schepper, Wilma Jansen. Integrating youth mental health practice nurses into general practice: effects on outpatient mental health care utilization among children and adolescents. European Child & Adolescent Psychiatry 2024; 1-10

Other

Lukas BM Koet, Paul LP Brand. Increase in atopic sensitization rate among Dutch children with symptoms of allergic disease between 1994 and 2014. Pediatric Allergy and Immunology 2018; 29 (1): 78-83.

A