

Department of General Practice and Primary Health Care
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ROUTINE GENERAL HEALTH CHECKS BY SCHOOL PHYSICIANS IN PRIMARY SCHOOLS: NEEDS AND BENEFITS

Kirsi Nikander

ACADEMIC DISSERTATION

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SUPERVISORS

Docent Silja Kosola
Pediatric Research Center
New Children's Hospital, Helsinki University Hospital and University of Helsinki
Helsinki, Finland

MD, PhD Elina Hermanson
Pikkujätö Medical Center for Children and Youth
Helsinki, Finland

Professor Minna Kaila
Visiting scholar, Faculty of Medicine, University of Helsinki
Helsinki, Finland

REVIEWERS

Docent Kaija Appelqvist-Schmidlechner
Finnish Institute for Health and Welfare

Professor Marjo Renko
University of Eastern Finland

OPPONENT

Professor Päivi Rautava
University of Turku

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LIST OF ORIGINAL PUBLICATIONS

- I. Nikander K, Kosola S, Kaila M, Hermanson E. Who benefit from school doctors' health checks: a prospective study of a screening method. *BMC Health Serv Res.* 2018;18:501. doi: 10.1186/s12913-018-3295-3.
- II. Nikander K, Hermanson E, Vahlberg T, Kaila M, Sannisto T, Kosola S. Associations between study questionnaire-assessed need and school doctor-evaluated benefit of routine health checks: an observational study. *BMC Pediatr.* 2021;21:346. doi: 10.1186/s12887-021-02810-0.
- III. Nikander K, Kosola S, Vahlberg T, Kaila M, Hermanson E. Associating school doctor interventions with the benefit of the health check: an observational study. *BMJ Paediatrics Open* 2022;6:e001394. doi:10.1136/bmjpo-2021-001394.
- IV. Nikander K, Hermanson E, Vahlberg T, Kaila M, Kosola S. Parent, teacher, and nurse concerns and school doctor actions: an observational study of general health checks. *BMJ Open* 2022; 12:e064699. doi:10.1136/bmjopen-2022-064699.

The publications are referred to in the text by their roman numerals.

ABBREVIATIONS

ADHD	Attention-deficit hyperactivity disorder
AkaTK	Academic Health Centre of the University of Helsinki
Avohilmo	Perusterveydenhuollon avohoidon ilmoitus (Register of Primary Health Care Visits)
CI	Confidence interval
HR-PRO	Health-related patient-reported outcome
IQR	Interquartile range
OR	Odds ratio
PREM	Patient-reported experience measure
SDQ	Strengths and Difficulties Questionnaire
THL	Terveyden ja hyvinvoinnin laitos (Finnish Institute for Health and Welfare)
Valvira	Sosiaali- ja terveystalalan lupa- ja valvontavirasto (The National Supervisory authority for Welfare and Health)
WHO	World Health Organisation

ABSTRACT

School health services reach the majority of children in over one hundred countries and provide a unique opportunity to reduce children's health risks with a holistic bio-psycho-social approach. The Finnish law mandates school physicians to examine all children in grades 1, 5, and 8 in addition to annual health checks performed by school nurses. Evidence regarding the benefits or harms of this system is needed. No structured method to screen children for school physician health checks exists.

The objective of this thesis was to evaluate the benefits and harms of school physician routine health checks in primary school grades one and five (at ages seven and eleven years) and to explore whether school physician expertise could be targeted to those children that parents, teachers, or school nurses are concerned about.

This prospective, multicentre observational study was conducted in 21 Finnish primary schools in four urban municipalities in Southern Finland between August 2017 and August 2018 (Study protocol, Study I). The target population consisted of 1341 randomly recruited children from grades one and five, aged seven and eleven years, respectively. Exclusion criteria comprised children mainly studying in special education groups and the need of an interpreter. After the school nurse routine health check parents, teachers, and school nurses filled study questionnaires that assessed their concerns regarding each child. We assessed the need for a health check by the physician based on the respondents' concerns using predetermined criteria. Physicians, blinded to the questionnaire responses, routinely examined all children accompanied by parents. After the health check physicians reported all their actions that were categorised into six groups: instructions and/or significant discussions, prescriptions, laboratory tests and/or medical imaging, scheduling of follow-up appointments, referrals to other professionals and referrals to specialised care. Physicians assessed the benefit or harm of the appointment according to predetermined criteria. Actions that the school nurse could have overtaken or actions with no significant harm as consequence of unhandled situation were regarded as only a little benefit and in the final analysis as no benefit. Parents and children evaluated their subjective perceptions of the benefit or harm of the health check without predetermined criteria. We compared the concerns of parents, teachers, and school nurses (quite a lot or a great deal of concern by at least one respondent) to the school physician actions (Study IV). Second,

we compared the need for a physician's appointment to the benefit gained from it (quite a lot or a great deal of benefit) according to the physicians (Study II). Third, we compared the school physician actions to the benefit gained from the health check according to the physicians and parents (Study III). We used multilevel logistic regression in all comparisons.

In total, 1013 children (75.5%) including 506 first graders and 507 fifth graders and their parents, 14 physicians, 31 nurses, and 105 teachers participated in the study. At least one respondent (parent, teacher, or nurse) had one concern about 47.5% of children. The top three concerns included growth/and or physical symptoms (22.7%), emotions (16.2%), and concentration (15.1%). Altogether, 20-25% of the children had no need for a school physician health check based on all respondent questionnaires.

Physicians evaluated 40.6%, parents 83.4%, and children 60.3% of the health checks as being beneficial. Respondents rarely assessed harm. Few children had physical findings that require a physician's expertise to be identified.

All concerns were associated with some type of school physician action (ORs 1.66-4.27, $p \leq 0.05$). Nearly all concerns were associated with referrals to other professionals (ORs 1.80-4.52, $p \leq 0.01$); emotions had the strongest association (OR 4.52; 95% CI 3.00-6.80, $p < 0.0001$). The children with need for a health check more often benefitted from it (evaluated by the physician) than those with no need for one (OR 3.53; 95% CI 2.41-5.17). Scheduled follow-up appointments, referrals to other professionals and referrals to specialised care were only associated with physician-estimated benefit.

Physicians considered that in 60% of the health checks the acquired benefit was scarce. The need for a school physician health check is an important predictor of school-physician assessed benefit of the health check. Health checks by school physicians may result in referrals of children to other professionals especially for children's psychosocial problems. Parents especially valued immediate help and testing from the physician compared with scheduled follow-up or referrals to other professionals. These findings support allocating school physician resources according to the concerns of parents, teachers, and school nurses. Especially psychosocial concerns may require a multidisciplinary evaluation of the most suitable treatment method. Targeting school physician health checks would release time for the treatment of identified problems.

TIIVISTELMÄ

Kouluterveydenhuolto tavoittaa suurimman osan lapsista yli sadassa maassa ja tarjoaa ainutlaatuisen mahdollisuuden vähentää lasten terveystarpeita kokonaisvaltaisella biopsykososiaalisella lähestymistavalla. Suomen laki velvoittaa koululääkärit tarkastamaan kaikki oppilaat peruskoulun vuosiluokilla 1,5 ja 8 vuosittaisen kouluterveydenhoitajan tarkastuksen lisäksi. Tarvitsemme tutkimustietoa tämän järjestelmän hyödyistä ja haitoista. Toimivaksi todettua strukturoitua menetelmää seuloa oppilaita lääkärintarkastukseen ei ole olemassa.

Väitöstutkimuksen tavoitteena oli arvioida alakouluikäisten määrääikaisten lääkärintarkastusten hyötyjä ja haittaa vuosiluokilla yksi ja viisi ja tutkia voitaisiinko koululääkäriin arvio kohdentaa niihin lapsiin, joista vanhemmilla, opettajilla tai kouluterveydenhoitajilla on huolta.

Tämä prospektiivinen havainnoiva tutkimus toteutettiin 21:ssä suomalaisessa peruskoulussa neljällä paikkakunnalla (Helsinki, Tampere, Kirkkonummi ja Kerava) lukuvuotena 2017-2018 (Tutkimusprotokolla, Study I). Tutkimusotokseen valittiin satunnaisotoksella 1341 lasta vuosiluokilta yksi ja viisi (seitsemän ja yhdentoista vuoden ikä vastaavasti). Poissulkukriteerejä olivat opiskelu erityisluokalla ja tulkin tarve. Kouluterveydenhoitajan tarkastuksen jälkeen vanhemmat, opettajat ja kouluterveydenhoitajat täyttivät kyselylomakkeet liittyen heidän huoliinsa kustakin lapsesta. Me arvioimme lääkärintarkastuksen tarvetta liittyen vastaajien huoliin ennalta määrättyjen kriteereiden mukaan. Lääkärit tekivät tarkastuksensa normaalin käytännön mukaisesti sokkona kyselylomakkeille. Lääkärintarkastuksen jälkeen lääkärit raportoivat kaikki toimenpiteensä, jotka luokiteltiin kuuteen luokkaan: hoito-ohjeet ja/tai merkittävät keskustelut, reseptit, laboratoriokokeet ja/tai lääketieteelliset kuvantamistutkimukset, kouluterveydenhuollon lisäkäynnit, läheteet tai suositukset hakeutua toisille ammattilaisille ja läheteet erikoissairaanhoidon. Lääkärit arvioivat lääkärintarkastuksen hyötyä tai haittaa ennalta annettujen kriteereiden mukaan. Toimenpiteet, jotka kouluterveydenhoitaja olisi pystynyt hoitamaan tai joiden hoitamatta jättämisestä ei olisi seurannut merkittävää haittaa, luokiteltiin kategoriaan vain vähän hyötyä ja lopullisessa analyysissä kategoriaan ei hyötyä. Vanhemmat ja lapset arvioivat lääkärintarkastuksen hyötyä tai haittaa omasta näkökulmastaan ilman ennalta määrättyjä kriteereitä. Me vertasimme vanhempien, opettajien ja kouluterveydenhoitajien huolia (melko paljon tai hyvin paljon huolta vähintään yhden vastaajan arvioimana)

lääkäreiden toimenpiteisiin (Study IV). Seuraavaksi vertasimme lääkärintarkastuksen tarvetta siitä saatuun hyötyyn (melko paljon tai hyvin paljon hyötyä) lääkäreiden näkökulmasta (Study II). Kolmanneksi vertasimme lääkäreiden toimenpiteitä lääkärintarkastuksesta saatuun hyötyyn lääkäreiden ja vanhempien näkökulmasta (Study III). Käytimme monitasoista logistista regressiota kaikissa vertailuissa.

Tutkimukseen osallistuivat yhteensä 1013 lasta (75.5%) mukaan lukien 506 ensimmäisen luokan ja 507 viidennen luokan oppilasta ja heidän vanhempansa, 14 koululääkärää, 105 opettajaa ja 31 kouluterveydenhoitajaa. Ainakin yhdellä vastaajista (vanhemmat, opettajat ja kouluterveydenhoitajat) oli jokin huoli noin 47.5%:sta lapsista. Kolme suurinta huolta olivat kasvu/ja tai fyysinen oire (22.7%), tunne-elämä (16.2%) ja keskittyminen (15.1%). Yhteensä 20-25%:lla lapsista ei ollut tarvetta lääkärintarkastukselle huomioiden kaikkien vastaajien kyselylomakkeet.

Lääkärit arvioivat 40.6%, vanhemmat 83.4% ja lapset 60.3% lääkärintarkastuksista hyödyllisiksi. Haittaa lääkärintarkastuksista arvioitiin syntyvän harvoin. Harvalla lapsella oli fyysisiä löydöksiä, jotka vaativat lääkärin ammattitaitoa niiden tunnistamiseksi.

Kaikki huoliluokat olivat yhteydessä johonkin lääkärin toimenpiteeseen (ORs 1.66-4.27, $p \leq 0.05$). Lähes kaikki huoliluokat olivat yhteydessä lähetteisiin tai suositukseen hakeutua toisille ammattilaisille. Vahvin yhteys oli tunnetiloja koskevilla huolilla (OR 4.52; 95% CI 3.00-6.80, $p < 0.0001$). Ne lapset, joilla oli tarve lääkärintarkastukselle, hyötyivät siitä useammin kuin ne lapset, joilla tarvetta ei ollut (OR 3.53; 95% CI 2.41-5.17, $p < 0.0001$). Suunnitellut kouluterveydenhuollon lisäkäynnit ja lähetteet ja/tai suositukset hakeutua toiselle ammattilaiselle ja erikoissairaanhoidon olivat yhteydessä vain lääkärin arvioimaan hyötyyn.

Lääkärit arvioivat, että noin 60 %:ssa tarkastuksista saavutettu hyöty oli vähäistä. Lääkärintarkastuksen tarve ennustaa hyvin koululääkärin arvioimaa lääkärintarkastuksen hyötyä. Lääkärintarkastukset voivat johtaa lähetteisiin muille ammattilaisille erityisesti lasten psykososiaalisissa ongelmissa. Vanhemmat arvostivat erityisesti välitöntä apua ja ohjelmoituja tutkimuksia verrattuna lisäkäynteihin tai lähetteisiin muille ammattilaisille. Nämä löydökset tukevat lääkärintarkastusten kohdentamista vanhempien, opettajien ja terveydenhoitajien huolten perusteella. Erityisesti psykososiaalisissa huolissa voisi olla hyötyä moniammatillisesta arviosta sopivimman hoitomenetelmän löytämiseksi. Kohdentamalla lääkärintarkastukset aikaa vapautuisi todettujen ongelmien hoitoon.

THESIS AT A GLANCE

Pilot study 2015-2016: Helsinki, one physician, 3 schools and nurses, 15 teachers, 132 children and their parents (90% of those approached participated).

Multicentre study 2017-2018: 4 Finnish municipalities (Helsinki, Tampere, Kirkkonummi, Kerava), 14 school physicians, 21 schools, 105 teachers, and 31 school nurses. Exclusion criteria: Children predominantly studying in special education groups and whose parents needed an interpreter. Random sample of children from primary school grades 1 and 5 (ages 7 and 11 years). 1013 children (75.5% of those approached participated): 506 first graders and 507 fifth graders and their parents.

Research questions and answers:

1. What concerns do parents, teachers and nurses have before the school physician health check?

Overall, parents, teachers, and nurses were concerned about 47.5% of children. Parents were concerned about almost one third, teachers about one fifth, and nurses about one fourth of all children. The top three concerns included growth/and or physical symptoms (23%), emotions (16%), and concentration (15%).

2. What is the need for school physician health check?

Altogether, 20-25% of the children had no need for a school physician health check.

3. What actions do school physicians undertake in routine health checks?

Physicians carried out actions in 78% of the health checks. The actions comprised: instructions and/or significant discussions (60%), scheduled follow-up appointments (17%), referrals to other professionals within schools or community services (13%), prescriptions (10%), laboratory tests and/or medical imaging (9%), and referrals to specialised care (5%). Few children had physical findings that require a physician's expertise to be identified.

4. What is the benefit or harm of the school physician health check according to predetermined criteria used by school physicians and the patient-reported experience measures of parents and children?

Physicians evaluated 40.6% of the health checks as being beneficial. Thus, from their point of view, 59.4 % of the health checks were of little or no benefit. Parents reported 83.4%, and children 60.3% of the health checks as being beneficial. Respondents seldom reported harm.

5. How are parent, teacher, and nurse concerns associated with school physician actions?

All concerns were associated with at least one school physician action. Nearly all concerns were associated with referrals to other professionals within schools or community services; emotions had the strongest association. In addition, several psychosocial concerns were associated with referrals to specialised care.

6. How is study-questionnaire-assessed need associated with school physician-evaluated benefit of routine health checks?

The need for a health check was associated with physician-evaluated benefit of the health check.

7. How are school physician actions associated with the benefit of the health check?

Both physicians and parents more often estimated the appointments with instructions and/or significant discussions, prescriptions and laboratory tests and/or medical imaging beneficial than the appointments without these actions. Only physicians more often estimated the appointments with scheduled follow-up appointments, referrals to other professionals and referrals to specialised care beneficial than the appointments without these actions.

1. INTRODUCTION

The organisation of school health services varies in over 100 countries (1–6). School health services provide an excellent opportunity to prevent, detect, and treat precursors to future disorders in close collaboration with the educational sector. This may improve both health and education outcomes and be cost beneficial (7–14). Actions that influence the home, communities and schools are required (15). In 2016, the Lancet commission on adolescent health and wellbeing highlighted that the most effective actions for adolescent health and wellbeing are intersectoral and multicomponent (16). Large-scale investments in the health and education of adolescents have the potential to generate high economic and social returns (17).

The WHO (World Health Organisation) guideline on school health services recommends policy makers and programme developers to consider three steps in setting intervention priorities: first, a needs assessment to identify which conditions have the greatest impact on children’s health and development as a whole, second, a landscape analysis to clarify what is already being done related to school health services and by whom, and third, a priority setting to identify which conditions to target in and which set of interventions to employ (18).

The five most common organisational challenges prominent in school health services literature in high income countries include human resources, coordination, quality of care, financing, and community support (3). Many areas such as mental health services, injury, and violence prevention interventions would require more time in routine work (3). Michaud et al suggest that school health services should adjust to the changing health priorities of children and extend their activities beyond screening to a more holistic multiprofessional model (6). They also suggest the implementation of psychosocial preventive interventions.

The Finnish healthcare system is legally regulated and based on public health care services (19–23). Public funding accounts for 75% of all health expenses (24). The services are free of charge for children under 18 years. The preventive care at Well Child Clinics of health centres offers at least 15 routine health checks by the nurse and 5 health checks by the physician for children aged 0-6 years (25). School nurses perform annual health checks of children and adolescents at ages 7-15 years. In grades 1, 5, and 8 (at ages 7, 11, and 14 years) the health checks are extensive, including both a school nurse and a school

physician. The aims of the extensive health checks include strengthening the well-being and health of the family, recognising special needs, providing timely support, and increasing health equality. The educational and health care sectors should arrange both school-level and individual meetings regarding students' well-being (23).

The treatment of children's acute illnesses and long-term diseases is mainly provided at public health centres. However, some municipalities provide medication controls for diseases such as non-complicated cases of attention-deficit/hyperactivity disorder (ADHD) in school health services where collaboration with teachers is easier than in health centres. This challenges the time remaining for health checks especially when the child's well-being changes and multidisciplinary collaboration with several organisations is needed. The school physician assesses the need for specialised treatment and, if necessary, refers the child to specialised medical care. Specialised medical care, with charge is usually provided at hospital clinics or hospitals. The most demanding treatment is provided in the five University hospitals.

Private health care services, partly subsidised with public funds complement municipal services. They provide both primary health care and some specialised medical care. However, the private services are expensive. A questionnaire survey from 2013-2014 describes the use of supplementary private health insurances to cover the costs of private services (26). About 23% of adults and half of Finnish children have a supplementary health insurance. The main factor for choosing the insurance was faster access to health care. Purchasing the insurance was increased with rising household income, higher level of education and excellent or good health status. The insurance seems to have no effect on children's utilisation of public services, but a significant increase on the utilisation of private services. This reinforces inequalities in access to care.

The Finnish law influences the use of professionals' expertise in schools. The National Institute for Health and Welfare follows and the National Supervisory authority for Welfare and Health (Valvira) and the Regional State Administrative Agencies monitor the implementation of obligatory health checks (27). According to the Finnish Institute for Health and Welfare (THL) Registry of Primary Health Care Visits (Avohilmo), most school physician assessments at ages 7-15 years are implemented as obligatory health checks in grades 1, 5 and 8 (28). School physicians seldom evaluate the well-being of children in other grades. Furthermore, school physicians rarely have time to attend multidisciplinary meetings (29,30). Both school nurses and physicians have insufficient time for the treatment of recognised problems which is in

contradiction with the principles of screening and obligation of providing timely help. Children's mild and moderate mental health symptoms and disorders are not alleviated at a sufficiently early stage (30–32). Despite actions of school health care professionals, obesity increases and obese children remain obese (33). In 2001, the Finnish organisations Duodecim and the Academia of Finland organised a consensus meeting on school children's health. The professionals recommended scientific research on the effectiveness of school health care actions on children's health and estimating the unintended effects of school health care actions. Scientific evidence regarding the quality of the Finnish school health care services is scarce. In 2015, Valvira proposed dismantling the norms and increasing the service organiser discretion in ways of implementing the services to achieve the targets, as well as the development of methods to identify risk groups to target the services (34).

The overall aim of this thesis was to assess the benefits or harms of school physician routine health checks in Finnish public primary school grades one and five (at ages seven and eleven years) and to explore whether school physician expertise could be targeted to those children that parents, teachers, or school nurses are concerned about.

2. REVIEW OF THE LITERATURE

2.1 The definition and organisation of school health services

According to WHO, school health services are defined as health services provided by a health professional to students registered in primary or secondary education, either within school premises or in a health service outside the school (18). Children's health needs and the structure and functioning of the whole health system are unique in each country. Globally, over one hundred countries have developed school health services that vary in governance, organisation, content, comprehensiveness, and financing (1–4,14,6). The most common type of services in high income countries include vaccination, screening, health education/promotion, counselling, referrals, medication provision/treatment, and support for chronic conditions (3).

Baltag et al have described five organisational models of school health services in the WHO European region: dedicated school-based, dedicated community-based, integrated with primary care, mixed school-based, and mixed community-based (1). Placing school health professionals to work within schools either permanently or at least part time seems to offer greater potential for desired outcomes such as effectiveness, equity, responsiveness, and efficiency than other models.

The American Medical Association recommends that health services in schools must be supervised by a physician and that a physician should be accessible to provide care on a regular basis (2). The American Academy of Pediatrics describes several possible roles for school doctors such as physical exams, consultation, and programmatic leadership (2).

A recent observational study of 30 European countries showed that about half of the countries had national policies or regulations and kept updated information on the health status of pupils. About half of the countries provided services both on school premises and externally (6). Only three countries offered a yearly health check with a health professional. Thirteen countries offered between 3 and 9 contacts between the ages 6 and 19 years. In 18 countries extra contacts could be organised if needed. The screening procedures differed considerably across countries. Most countries screened for growth abnormalities, obesity, vision and hearing defects. Several countries assessed speech, coordination

and psychomotor development. A number of countries included heart and lung auscultation and assessment of neurological status. However, some countries included also screening of limited evidence-based effectiveness such as blood pressure, cholesterol, thyroid gland, proteinuria, and scoliosis. Most countries provided health education and promotion activities in areas such as sexual health, substance use, and nutrition. Half of the countries offered pre-referral related to injuries or emergencies.

The WHO describes health promotion as “the process of enabling people to increase control over, and to improve, their health (35). It moves beyond a focus on individual behaviour towards a wide range of social and environmental interventions.” The recent observational study of 30 European countries showed that twenty countries had policies related to the WHO standards of health-promoting schools (6). The standards include aspects such as a healthy and safe physical and social–emotional school environment, the school curriculum supporting student health and well-being, and the school collaborating within the local community for health-promoting schools (36). Many countries suffered from a shortage of school health professionals and their training, insufficient involvement of families and teachers in health promotion programmes, and insufficient funding. The epidemiological change from somatic diseases to lifestyle problems requires more attention to psychosocial preventive interventions and less attention to screening (6).

Prevention of diseases can be divided into three levels (15,37). Primary prevention inhibits the onset of diseases. Secondary prevention aims to detect the disease early and prevent the disease from developing further. Tertiary prevention moderates the disease impact on health and functioning. Precursors to diseases can be categorised into four groups: 1) childhood environmental exposures, 2) health-related behaviour, 3) risk states, and 4) fully developed disorders. In children, prevention in the first group includes prevention of adverse environmental exposures such as poverty, parental depression, inconsistent/unsupportive parenting, harsh discipline, and exposure to parental substance use. Prevention in the second group includes ensuring positive health-related behaviour such as daily physical activity and healthy nutritional intake. Prevention in the third group includes prevention of risk states such as early identification and treatment of overweight/obesity and health problems associated with low subjective well-being. Prevention in the fourth group includes improving access to health services for identification and treatment of diseases. Each of these precursors to diseases can be influenced by one or more levels of prevention.

2.2 School health services in Finland

In Finland, school health care has a history from 1880's when poverty, undernourishment, and fatal infectious diseases were common (38). The aim was to provide all children a healthy growth and development. Nowadays school health care is legally regulated (20–23). Since 1972, primary health care has been responsible for preventive health care. In 1994-2000 school physician appointments per thousand 7–18-year-olds decreased (39). The present school health care system has been strengthened by the Health Care Act from 2010 and the Government decree from 2011. The Ministry of Social Affairs and Health and the Finnish Institute for Health and Welfare have provided guidelines and instructions on implementing the health checks and a guide for structured recording of the information (40–42).

School health services include (21):

- 1) promotion of the health and safety of the school environment and the well-being of the school community, and monitoring of this every three years;
- 2) monitoring and promoting the growth and development of pupils and their health and well-being annually;
- 3) supporting parents and guardians in the upbringing of their child;
- 4) oral health care of the pupil, including oral health checks at least three times in nine years and according to individual needs;
- 5) early identification of the pupil's need for special support and providing the needed support including support for the self-care of a pupil with a long-term illness, in cooperation with the needed school professionals, and referral for further examinations and treatment if necessary;
- 6) special examinations necessary to establish the pupil's state of health

Table 1 summarises the division of labour in school health services in primary school grades 1-6. School nurses especially trained in health promotion and preventive care are mandated to perform annual health checks of children and adolescents at ages 7-15 years. At ages 7, 11, and 14 years the health checks must be extensive, including both the school nurse and the school physician. The parents are invited to the extensive health checks and the discussion topics are required to include the well-being of the whole family. With the written consent of the parent or guardian, the health check includes the teacher's assessment of the child's learning, development, and well-being in school. Physicians complement the background information collected by the school nurse, the somatic and psychiatric status of the child in appropriate individual extent, and as needed propose diagnostic tests, make referrals to specialised

care and write prescriptions. The recommended time for the extensive health check by the school nurse is at least one hour and by the school physician 30 minutes but individual needs should be considered (41).

The health checks aim for 1) strengthening the resources, health and well-being of the child and the whole family, 2) early identification of needs for support, 3) ensuring timely provision and organisation of support, and 4) preventing marginalisation and enhancing health equity (41).

The Student Welfare Act from 2013 instructs the educational and health care sectors (teachers, psychologists, school social workers, school nurses, and the school physicians) to arrange both school-level and individual meetings regarding student well-being (23).

Table 1 Division of labour in school health services in primary school grades 1-6 in Finland^a; modified from the original table 1 of Study I.

Tasks	School nurse	School physician
Extensive health examinations in grades 1 and 5	x	x
Collection of background information for the extensive health examinations	x	
Well Child Clinic (pregnancy and birth, biopsychosocial development)		
THL ^b questionnaire by parent (1st and 5th grade), child (5th grade) and teacher (some schools)		
Statements from the student welfare group		
Evaluation: growth, vision, hearing, blood pressure, posture	x	
Complementation of background information		x
Evaluation of growth, somatic, psychiatric and neurologic status		x
Diagnostics and differential diagnostics		x
Vaccinations	x	
Referrals to physiotherapist, speech therapist, nutritionist	x	x
Referrals to secondary care		x
Guidance to or contact of specialized workers/other units	x	x
Teacher/special education teacher/school psychologist/school social worker		
Health centre		
Family guidance centre/Social worker/Home service		
Child welfare		
Referrals to laboratory tests	x	x
Referrals to medical imaging		x
Annual health checks (the general wellbeing, growth, eating, exercise and sleeping habits, friendships and hobbies)	x	
Prescriptions		x
Health education and support	x	x
Evaluation of special needs in all grades	x	x
Control visits	x	x
Participation in student welfare groups ^c	x	x

^aLocal variations may exist

^bTHL=The Finnish Institute for Health and Welfare

^cEvaluate and develop the well-being of school community and students (permanent members: school principal, special education teacher, school psychologist, school social worker, school nurse)

One of the problems of the current Finnish legislation is that school health services in primary schools is regarded preventive and does not include the treatment of diseases in contrast to school health services in upper levels of education. However, the border between secondary and tertiary prevention and treatment of diseases may be difficult to distinguish and cause differences between municipalities in providing actions related to health checks. The continuity of care may be disrupted if the child and family are referred to the health centre to another physician to examine and treat the problem further. This may be a problem if the school physician mainly works in school health services.

The Ministry of Social Affairs and Health recommends to arrange one school nurse per 600 and one physician per 2100 primary school children (43). In 2017, 88% of municipalities achieved the goal for school nurses but only 8% for physicians. The realised median was 3900 children per school physician (44). No specialist degree is required for school physicians. However, since 2002 physicians have had a possibility to acquire a special qualification for working in Well child clinics and school health care (45). Well child clinics, also known as child health clinics, assess the physical, mental and social condition of children under school age. The basic education required for the special qualification is a specialist degree in general medicine, paediatrics, child neurology, or child psychiatry.

2.2 School-aged children's health: mortality, morbidity, and major health concerns

The mortality of children aged 5-14 years has reduced markedly in the WHO European region over the past 26 years (46). Self-harm of children aged 10-14 years was one of the top five causes of death in many countries including Finland.

In Finland, the top three causes of death of children aged 5-14 years in 2016 included: 1) road injuries, 2) congenital birth defects, and 3) brain and nervous system cancer (46). The mortality of children aged 5-14 years decreased between 1990 and 2020 (47). Death from accidents or violence decreased. The suicides of children remained the same. In 1990, there were about 651 718 children aged 5-14 years in Finland and 131 children from that age group died; 68 children died from diseases and 63 children from accidents or violence. In 2020, the number of children aged 5-14 years had decreased to about 613 869 children and 35 children from that age group died; 23 children died from diseases

and 12 children from accidents or violence. Four children committed suicide in 1990 and 2020. Mortality is lower among children of highly educated and high income parents than among children whose parents have low education and income levels (48). The mortality of highly educated and better income parents' children is smaller than the mortality of less educated and lower income parents' children (48).

The total disease burden among children and adolescents reduced between 1990 and 2015 (49). However, the lowest socio-demographic index countries had a greater global mortality burden in 2015 than in 1990. The global disease burden from infectious, neonatal, maternal, and nutrition-associated causes reduced with an increase of noncommunicable diseases and injuries. In 2013, the leading causes of morbidity and mortality for young people aged 10-14 years were injuries, mental health disorders, and sexual and reproductive health problems (50). In 2019, the top three causes of disability-adjusted life-years in adolescents aged 10–24 years included road injuries, headache disorders and self-harm (51).

The major health concerns of children and adolescents in Europe are childhood obesity and adolescent mental health problems (52). Overweight and obesity have increased from 1975 to 2016 in most countries (53). In 2016, the prevalence of obesity was more than 30% for both sexes in Nauru, the Cook Islands, and Palau, and about 20% or more in some countries in Polynesia and Micronesia, the Middle East and north Africa, the Caribbean, and the USA. In Finland, in 2021, 29% of 2-16-year-old boys and 19% of girls were overweight or obese (54). Between 2014 and 2021 overweight including obesity increased 4% for boys and 3% for girls. Several comorbidities are associated with childhood obesity such as mental health problems and increased cardiovascular risk factors (55).

Concern regarding the physical activity behaviour of children and young people is increasing. LIITU is a population-level trend study that explores the movement and sedentary behaviour of children and young people aged 7-15 years in Finland. In 2018, about one third met the physical activity recommendation of one hour every day (56). Movement decreased and sitting increased with age. Children and young people found less meaning in physical activity in 2018 than four years earlier. The number of obstacles related to exercise increased with age. The most common barriers included the lack of training options for interesting sports, the lack of exercise places close to home, as well as exercise expensiveness.

Since 1996, The School Health Promotion study has been carried out nationwide every second year in Finland (57). The data are collected by anonymous and voluntary classroom-administered questionnaires. The topics of the questionnaires include living conditions, schoolwork, health, health-related behaviour, and school health services. The aim of the study is to strengthen the planning and evaluation of health promotion activities at school, municipal and national levels. In 2021, 104 082 children in primary school grades 4 and 5 participated in the study. The participation rate was 83%. Most of the children reported that they were satisfied with their lives. Three-fourth of the children reported that they enjoyed going to school. Girls reported moderate or severe anxiety in 30% of cases and boys in 8% of cases. About 13% of girls and 9% of boys felt their state of health was average or poor. About 8% of children reported bullying weekly. About 17% of boys and 11% of girls had experienced physical threat at least once in the past year. About 5% of girls and 3% of boys felt often lonely.

The prevalence of clinically elevated depression and anxiety symptoms in children and adolescents have doubled during the COVID19-pandemic compared with rates prior to the pandemic (58). In 2021, 1 in 4 youth globally had depression symptoms, while 1 in 5 had anxiety symptoms. The prevalence of child and adolescent mental health problems during COVID-19 pandemic is high in most reviews (59). In Finland, referrals to child psychiatry (children aged 0-12 years) have increased already before the pandemic and up to 140% between 2011 and 2020 (60). In spring 2021, young people's anxiety and depression symptoms increased significantly compared to the pre-epidemic measurement for both girls and boys in Finland (61).

2.3 Screening for school-aged children's health problems

Screening tests can be used in health checks to identify conditions that require either further examinations and follow-up or the organisation of treatment.

According to Wilson and Jungner, the path to early disease detection and treatment is bringing to treatment those with previously undetected disease and, avoiding harm to those persons not in need of treatment (62). The principles of screening include the following:

1. The condition sought should be an important health problem.
2. There should be an accepted treatment for patients with recognised disease.
3. Facilities for diagnosis and treatment should be available.
4. There should be a recognisable latent or early symptomatic stage.
5. There should be a suitable test or examination.
6. The test should be acceptable to the population.
7. The natural history of the condition, including development from latent to declared disease, should be adequately understood.
8. There should be an agreed policy on whom to treat as patients.
9. The cost of case-finding (including diagnosis and treatment of patients diagnosed) should be economically balanced in relation to possible expenditure on medical care as a whole.
10. Case-finding should be a continuing process and not a “once and for all” project.

In Finland, since 2003, the working group organised by the Ministry of Social Affairs and Health has evaluated existing and newscreening programs according to these criteria and additional criteria provided by the Danish Council of Ethics (63). These additional criteria take into account the sensitivity and specificity of the test, false positive or negative test results, stigmatisation, psychological and ethical aspects, the organisation of screening, and the effectiveness of screening.

A very sensitive test detects all the persons with the disease but gives also false positive test results. The specificity of a test describes the ability of the test to detect cases without the disease. The first test of a screening program is sensitive and detects part of the population to follow-up examinations. The second test is specific, often more expensive to use, and the harms of the test may be greater. The appropriate balance between the sensitivity and specificity of the test is based on the benefits of early detection, diagnosis, and treatment, the risks of following examinations, the availability of resources, and the harms of false positive or negative test results.

Effective screening detects the problem earlier than without screening and there is a real increase in survival without disease (64). Ineffective screening detects the problem earlier than without screening but has no effect on the time of survival without disease (Figure 1).

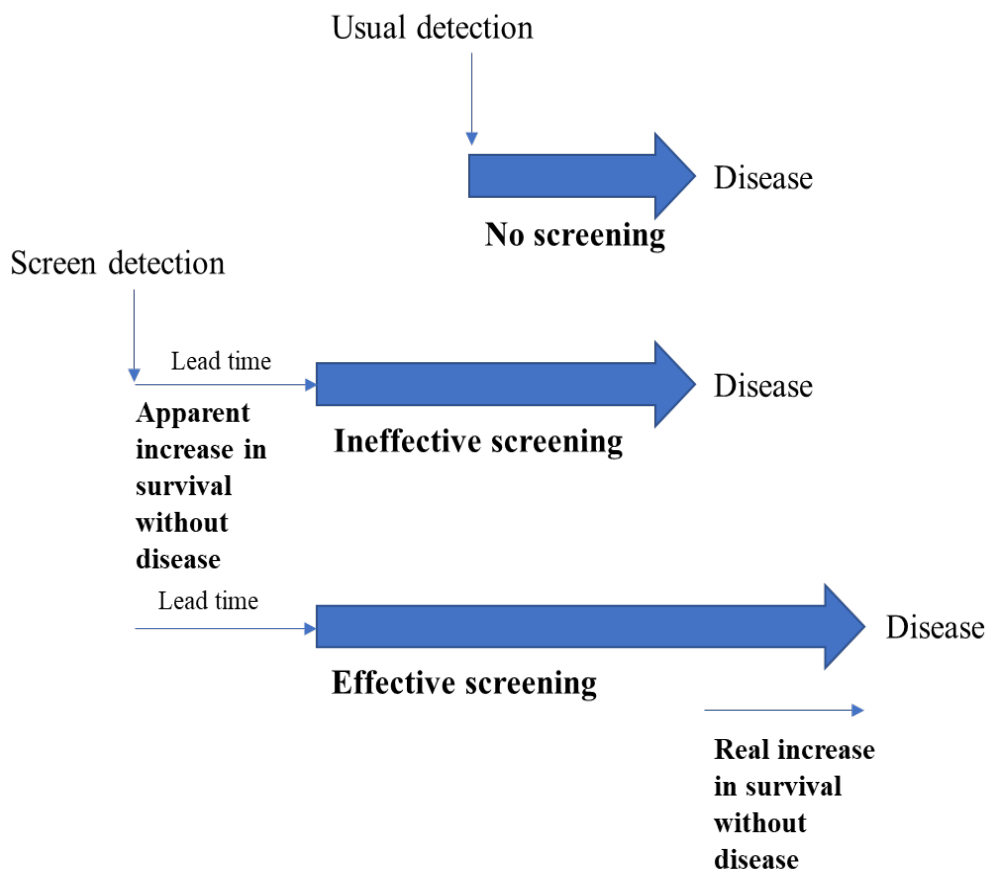


Figure 1 Effective vs ineffective screening; modified from the original figure by Straus et al (64).

Since 2011, Finland has had screening legislation (65). If the municipality organizes a screening that is not included in the national screening program, it must assess what requirements the screening has on the health care system and how the screening affects it. The assessment includes an examination of the prevalence and treatment of the disease, screening methods, effectiveness of screening, organisation and total costs, as well as ethical issues related to screening.

Evidence supporting many preventive care recommendations is weak (66). A systematic review in the United Kingdom showed insufficient evidence to evaluate the effectiveness of either the routine or selective school entry medical examination (67). A German study found that selection criteria such as low or medium social status, missed last paediatric routine check-up and migration background could differentiate children for whom school entry examination

should include a health check by a physician (68). However, a recent systematic review of universal preschool developmental assessments found that especially the Ages and Stages Questionnaire performed well in identifying children with later educational difficulties (69).

According to a review published in 2000, yearly physical examinations had no value in revealing serious abnormalities in adolescents (70). The evidence base of screening for adolescent idiopathic scoliosis and hypertension in children and adolescents is unclear (71–73). A systematic evidence review for the U.S. Preventive Services Task Force showed no direct evidence for benefits or harms of childhood lipid screening or treatment on outcomes in adulthood (74). The recommendations for screening for acquired undescended testes vary (75–77).

In the Netherlands, overweight, visual disorders, and psychosocial problems were detected similarly when physicians' assistants performed preventive child health care assessments instead of all children being assessed by a nurse (at age 10/11 years) or a physician (at age 5/6 years) (78). This triage approach increased additional preventive child health care assessments and assessments on request for children on demand from other age groups (79). It decreased referral rates to external services (79). It also decreased costs about one-third, compared with traditional practice, when physicians were involved but only minimal cost savings when nurses were involved (80).

The US Preventive Services Task Force found that screening for obesity in children and adolescents 6 years and older is of moderate net benefit (81). Comprehensive, intensive behavioural interventions lasting for at least 26 contact hours regarding obese children and adolescents 6 years and older can result in improvements in weight status for up to 12 months. In Finland, despite annual screening for overweight and school health care actions, obesity increases and obese children remain obese (33).

Vision screening with provision of free spectacles showed clear benefits in a Cochrane review of two randomised controlled studies conducted in Tanzania and China (82).

Computerised adaptive testing where the computer selects the items to be asked from parents based on previous responses, seems to be a valid procedure for the identification of emotional and behavioural problems of Dutch children aged 10-11 years in preventive child health care (83). The testing was based on items from the Pediatric Symptom Checklist, the Strengths and Difficulties Questionnaire (SDQ), and the Child Behaviour Checklist.

2.4 Quality of school health services

Quality of care can be defined as the degree to which health services for individuals and populations increase the likelihood of desired health outcomes (84).

The Institute of Medicine (IOM) recommends the following six aims for the health care system (85):

- **Safe:** Avoiding harm to patients from the care that is expected to help them.
- **Effective:** Providing services based on scientific knowledge to all who could benefit and refraining from providing services to those not likely to benefit (avoiding underuse and overuse, respectively).
- **Patient-centred:** Providing care that is respectful of and responsive to individual patient preferences, needs, and values and ensuring that patient values guide all clinical decisions.
- **Timely:** Reducing waits and sometimes harmful delays for both those who receive and those who give care.
- **Efficient:** Avoiding waste, including waste of equipment, supplies, ideas, and energy.
- **Equitable:** Providing care that does not vary in quality because of personal characteristics such as gender, ethnicity, geographic location, and socioeconomic status.

In 2018, WHO produced eight standards for improving the quality of care for children and young adolescents (86). These standards include:

- 1) Every child receives evidence-based care and management of illness according to WHO guidelines.
- 2) The health information system ensures the collection, analysis, and use of data to ensure early, appropriate action to improve the care of every child.

- 3) Every child with condition(s) that cannot be managed effectively with the available resources receives appropriate, timely referral, with seamless continuity of care.
- 4) Communication with children and their families is effective, with meaningful participation, and responds to their needs and preferences.
- 5) Every child's rights are respected, protected and fulfilled at all times during care, without discrimination.
- 6) All children and their families are provided with educational, emotional, and psychosocial support that is sensitive to their needs and strengthens their capability.
- 7) For every child, competent, motivated, empathic staff are consistently available to provide routine care and management of common childhood illnesses.
- 8) The health facility has an appropriate, child-friendly physical environment, with adequate water, sanitation, waste management, energy supply, medicines, medical supplies and equipment for routine care and management of common childhood illnesses.

WHO requires that quality of health services across the world should be integrated that is providing care that is coordinated across levels and providers and makes available the full range of health services throughout the life course (87).

WHO has described characteristics of effectiveness and acceptability outcomes in school health services (18). Critical effectiveness outcomes related to short-term mortality or morbidity include suicide-related outcomes such as plans and attempts, hospitalisation, emergency department visits, school absence, and academic performance. Other effectiveness outcomes include violence, sexual health, physical activity, health complaints, quality of life, mental health, substance use, school engagement, and coverage. Critical economic-effectiveness outcomes include cost-saving and cost-effectiveness ratio. Acceptability outcomes include user and provider satisfaction, access, confidentiality, communication, safety and respect, health-care worker spending enough time with the user, and feasibility of implementation from the provider point of view.

Campbell et al defined in 2000 that the quality of care for individuals is whether individuals can access the health structures and processes of care which they need and whether the care received is effective (88).

From a citizen's perspective, the top priorities for the quality of primary care for children in five European countries include accessibility, appropriateness, affordability, continuity, and coordination (89).

In 2004, the Finnish Ministry of Social Affairs and Health produced national quality recommendations for school health care to ensure prerequisites for high-quality school health care and equal provision of school health service throughout the country (43). The recommendations include:

- 1) School health services are easily accessible to school children and families. They are based on planning and regular monitoring and evaluation.
- 2) School health care is implemented as an essential part of student care.
- 3) Information on school health services is regularly provided to children and guardians, as well as to schools.
- 4) School health care requires sufficient, qualified, and permanent personnel to function well.
- 5) School health care has appropriate facilities and equipment.
- 6) The student has a healthy and safe school community and environment.
- 7) The student's well-being and health are monitored with individual health checks and plans, as well as by evaluating the well-being of the class.
- 8) School children's knowledge on health is strengthened and health is promoted.

School-based health centres can advance health equity by improving educational and health-related outcomes in disadvantaged students (7). School-based health centres were associated with improvements in grade point average as well as

in the promotion, continuation, and completion rates among disadvantaged students. Desired changes in outcomes in vaccination coverage, contraceptive use, asthma morbidity, emergency department use, hospital admissions, illegal substance use, and alcohol consumption were found. Direct access to the school nurse and other health services improve clinical outcomes and reduce absences among children with chronic health conditions (9). School based health centres in the United States are generally associated with decreased health care disparities among students, accelerated treatment, and increased school attendance (14).

A recent systematic review of systematic reviews by Levinson et al investigated the effectiveness of school health services for improving the health of school-aged children and adolescents (90). The majority of the systematic reviews assessed special research interventions rather than routinely-delivered school health services. Levinson et al found evidence encouraging the implementation of asthma education and anxiety prevention programs (90). For example, the Friends for life program (FRIENDS) was effective in decreasing anxiety symptoms in four systematic reviews. Schroeder and colleagues found that school nurses can play an important role in implementing effective school-based obesity interventions (91). Stein and colleagues found that oral health educational actions were effective in reducing plaque (92). School-based asthma self-management interventions seemed to decrease hospitalisations and emergency department visits, and to improve health-related quality of life (10). Recent meta-analyses have found conflicting evidence on the effectiveness of school-based anxiety and depression prevention interventions. Caldwell et al found insufficient evidence to support them (93). Werner-Seidler et al concluded that school-delivered psychological prevention programs have small effects in reducing symptoms of depression and anxiety (94). Hugh-Jones et al found that school-based prevention interventions for child and adolescent anxiety can produce small beneficial effects, enduring for up to 12 months (95).

The WHO Health Promoting School framework approach whereby health is promoted through the whole school environment increased students' physical activity, fitness levels and fruit and vegetable consumption and decreased body mass index, cigarette use, and experiences of being bullied (96). However, no evidence of effectiveness on fat intake, alcohol and drug use, mental health, violence, and bullying others was found. In Finland, there are big differences between schools in the way they promote the well-being and health of the school community (97). Pupils and guardians were less involved in the planning, development, and evaluation of school activities in 2020-2021 compared with 2018-2019. Actions to include physical activity in the school day had

also decreased. Student welfare groups met slightly more often than before. No studies on the effectiveness of these health promoting actions on students' health was found.

A recent systematic review investigated the effectiveness of comprehensive or multicomponent school health services that address multiple health domains (98). Seventeen studies conducted in high-income countries found school health services associated with decrease in suicide planning, hospitalisation, emergency department visits, school absence, carrying a weapon, being in a fight, reporting being sexually active, drinking alcohol, and using drugs. Additionally, they were associated with progress in physical activity, testing for sexually transmitted infections, quality of life, and responsiveness to unmet need.

2.5 Prioritising in school health care

The Cambridge dictionary defines prioritising as “to decide which of a group of things are the most important so that you can deal with them first” (99). A recent systematic review defined patient prioritisation as a strategy used to manage access to health care services (100). The root cause for prioritisation is that the expectations for the quantity and quality of health services in tax- or insurance-financed systems are always higher than the available resources allow (101). Prioritisation occurs inevitably and daily at all levels of health care systems.

In Finland, national principles for health care prioritisation have recently been developed (102). In the Finnish project, prioritisation refers to all activities which are intended to lead to changes in the allocation of resources, new allocation, increase or decrease of resources. An essential question is which services from the system financed by taxes should be offered and in what order. The project concluded that discussion should be continuous and transparent. In legislation, it is crucial to balance individual rights and the well-being of the population. If the discussion on prioritisation is open and transparent with development of legislation and other normative guidance hidden prioritisation will discontinue. This may increase the equity of provided health care services.

Children with special health care needs have or are at increased risk for a chronic physical, developmental, behavioural, or emotional condition (103). One quarter of children may require special interventions and children in high-risk communities might benefit from intervention programs for all, instead of

trying to identify outliers through screening (104). Surprisingly, school-based oral health education increases caries inequalities by improving dental health among students with higher socio-economic status and producing no preventive effect in low socio-economic status groups (105).

Investments in the poorest children have saved almost double number of lives compared to similar investments in less deprived children (106). The essential package of health interventions for school-age children in low-income and lower-middle-income countries includes school feeding, deworming, vision screening and provision of ready-made glasses, health education about prevention of tooth decay and usage of insecticide-treated bednets, and tetanus toxoid and human papillomavirus vaccines (107). Part of the interventions are targeted to all children and others based on need. Comparing costs and benefits of the package indicates that the returns to education are highest in low-income countries.

Even in high-income countries, children in low-income families are at increased risk of adverse health outcomes (108). In Finland, child poverty (defined as households with income below 50 per cent of the national median income) is low compared with other high-income countries (109). A recent report showed that relative child poverty rates range from 3% to 25% across the OECD countries (110). In Finland and Denmark, the child poverty rates were lowest. In Finland, the number of children living in low-income households (defined as households with an income below 60% of the national median income) increased significantly after the 1990s, with no significant change in the 2000s (111). In 2021, 12% of children were living in a low-income family. Socioeconomic disparities have increased in bullying at school, cannabis use, smoking, and delinquency among Finnish adolescents between 2000 and 2015 (112).

Several studies have shown that social factors are associated with children's health. Factors such as neighbourhood deprivation, lower parental income/wealth, educational attainment, and occupational social class, higher parental job strain, parental unemployment, lack of housing tenure, and household material deprivation are associated with a wide range of adverse child health and developmental outcomes (113–116).

Similar results have been obtained from studies conducted in Finland. Childhood cancer mortality is elevated for those born abroad and those with parents of foreign background (117). Children of immigrant parents are more likely to be diagnosed with developmental disorders than children with two

Finnish-born parents (118). Multiple social risk factors such as lower maternal education, socioeconomic status based on occupation and single motherhood increase the odds for multiple, more comprehensive learning difficulties (119). Lower parental education is consistently associated with higher probability of mental disorders throughout childhood (120). One study that was based on parents' reports on their child's health suggested that parental socioeconomic factors are not associated with the health of children under 12 years (121). However, the majority of parents in that study were well educated, had a good income, and were working, which may explain the results. Wide evidence exists for allocating more educational and health care resources to areas with more socioeconomic risk factors.

The school physician resources have been insufficient in several Finnish municipalities for years which has resulted in prioritising school physician health checks to the children in greatest need (44). In Helsinki, children have been prioritised to school physician assessments according to evidence-based risk factors for health and the severity of concerns recognised by school nurses in annual health checks or individual school multidisciplinary teams (Table 2). Another example related to the shortage of physicians during the school year 2022 - 2023 comes from the Pirkanmaa wellbeing services county. According to information to guardians from the head of the county (Tuire Sannisto) school physician health checks for grade 5 and, where appropriate, for grades 1 and 8, are offered primarily to pupils whose growth, development, or ability to attend school is of concern to a guardian, school nurse or other professional in the school welfare group.

Table 2 Prioritising school physician assessments in primary schools in Helsinki (directive); modified from the original table by Nikander (122).

1. Concern related to child maltreatment (child protection contacted by concerned person)
2. Concern or need of referral related to problems in school
3. Need for examination or control based on screening result in school health care
4. Extensive health checks of preparatory classes for immigrant children
5. Extensive health checks of special education classes
6. Other extensive health checks in grades 1 and 5

2.6 Summary of the literature

Globally, over one hundred countries have developed school health services that vary in many perspectives. High income countries provide typically vaccination, screening, health education/promotion, counselling, referrals, medication provision/treatment, and support for chronic conditions.

Finland has an exceptionally comprehensive legally regulated school health care system. Preventive health checks must be provided for pupils in each grade of school at ages 7-15 years and according to individual needs. The annual health check is carried out by a school nurse. At ages 7, 11, and 14 years, the health check must be extensive and carried out in cooperation with a physician. The guardians are invited to the extensive health check and the well-being of the whole family is assessed.

The major health concerns of children and adolescents in Europe are childhood obesity and adolescent mental health problems (52). In Finland, almost one third of 2-16-year-old boys and one fifth of girls were overweight or obese in 2021 (54). The prevalence of clinically elevated depression and anxiety symptoms in children and adolescents have doubled during the COVID19-pandemic compared with rates prior to the pandemic (58). In Finland, referrals to child psychiatry (children aged 0-12 years) have increased already before the pandemic and up to 140% between 2011 and 2020 (60).

Evidence supporting the optimal use of school physician skills is scarce. A systematic review in the United Kingdom showed insufficient evidence to evaluate the effectiveness of either the routine or selective school entry medical examination (67). A German study found that selection criteria such as low or medium social status, missed last paediatric routine check-up and migration background could differentiate children for whom school entry examination should include a health check by a physician (68). In the Netherlands, overweight, visual disorders, and psychosocial problems were detected similarly when physicians' assistants performed preventive child health care assessments instead of all children being assessed by a nurse or a physician (78).

Prioritisation occurs inevitably and daily at all levels of health care systems. The school physician resources have been insufficient in several Finnish municipalities for years which has resulted in prioritising school physician health checks according to risk factors for health and the severity of concerns

recognised by school nurses in annual health checks or individual school multidisciplinary teams.

In Finland, scientific evidence regarding the benefits of school physicians assessing the health of all children in addition to health checks by school nurses is lacking. Evidence on whether school physician assessments could be offered as targeted actions in response to the concerns of parents, teachers, and school nurses is needed.

3. AIMS OF THE STUDY

The objective of this thesis was to evaluate the benefits and harms of school physician routine health checks in primary school grades one and five (at ages seven and eleven years) and to explore whether school physician expertise could be targeted to those children that parents, teachers, or school nurses are concerned about.

The aim of this thesis was to answer the following research questions:

- 1) What concerns did parents, teachers and nurses have before the school physician health check? (Study IV)
- 2) What is the need for school physician health check based on study questionnaires that assess the concerns of parents, teachers, and school nurses? (Study II)
- 3) What actions do school physicians undertake in routine health checks? (Study III)
- 4) What is the benefit or harm of the school physician health check according to predetermined criteria used by school physicians and the patient-reported experience measures of parents and children? (Study III)
- 5) How are parent, teacher, and nurse concerns associated with school physician actions? (Study IV)
- 6) How is study-questionnaire-assessed need associated with school physician-evaluated benefit of routine health checks? (Study II)
- 7) How are school physician actions associated with the benefit of the health check assessed by school physicians and parents? (Study III)

4. SUBJECTS AND METHODS

The study protocol development started in June 2015. Study questionnaires for parents, teachers, and school nurses to detect children at risk of later health problems taking into account the principles of screening were developed. Simple questions about concerns regarding the child's growth, physical well-being, eating, sleeping, learning, school absenteeism, and the well-being of the whole family were formulated (123–128). In addition, one question from the Strengths and Difficulties Questionnaire (SDQ) was chosen (129). That question evaluates whether the child has difficulties in one of the following areas: emotions, concentration, behaviour, or being able to get on with other people. It is almost as reliable as the complete SDQ for screening children's psychiatric disorders (130–132). That question was divided into four questions.

An electronic report for physicians to report all their actions during the health check and their evaluation of the benefit or harm of the health check was developed (Tables 3-5). Patient-reported experience measures (PREMs) for the parent and child to evaluate the benefit or harm of the physician's health check without previously defined criteria were developed (Table 6). Children's forms included visual analogues in the form of facial expressions that Borg had used for the "Child's self-evaluation enquiry on emotional-well-being" (132).

Table 3 Actions reported in the electronic report by school physician

Instruction (topic)
Significant discussion* (topic; relates to a different subject than an instruction, a prescription, or a referral)
Prescription (indication)
Referral to laboratory test and/or medical imaging (test and indication)
Referral to other professional (professional and indication)
Referral to specialised care (specialist and indication)
Contacting child protection services
Follow-up appointment (professional, indication and time)

* Additional criteria:

The child's or parent's concern reduced significantly, or their resources strengthened or
The child or parent realised something new that improves their well-being or
The child or parent made a decision towards a healthier lifestyle.

Table 4 Criteria for evaluation of benefit by school physician

A great deal of benefit	Quite a lot of benefit	Only a little benefit
Significant discussion or other action that presumably reduces other health care use	Physician's role irreplaceable by nurse	Nurse could have replaced the physician
Some referrals to specialised care	Presumably reduced concern	No significant harm as a consequence of unhandled situation
Contacting child protection services	Some significant discussions	
	Some referrals to specialised care	

Table 5 Criteria for evaluation of harm by school physician

Only a little harm	Quite a lot of harm	A great deal of harm
Suspicion that interaction failed or suspicion of no progress in care	Interaction failed or there was no progress in care	Suspicion of negative PREM* or refusal of school physician services in the future and no progress in care

*PREM= Patient reported experience measure

Table 6 Scales of patient reported experience measures (PREMs) of benefit and harm

	Benefit				Harm		
	A great deal	Quite a lot	Only a little	No benefit or harm	Only a little	Quite a lot	A great deal
Response options for parents	x	x	x	x	x	x	x
Response options for children		x	x	x	x	x	

Between November 2015 and May 2016, one researcher who worked as a school physician (KN) tested the feasibility of the study questionnaires, the electronic report and the PREMs in a pilot study in three primary schools in the city of Helsinki. In total, 132 children, 90% of those approached, 15 teachers and three nurses participated in the pilot study. Researchers KN and EH reviewed the questionnaires. The research group defined the criteria for study-questionnaire-assessed need for school physician health check and physician-evaluated benefit and harm of the health check.

4.1 Study design

The prospective, observational, multicentre study was conducted in 21 Finnish-speaking public primary schools of four urban cities/municipalities (Helsinki, Tampere, Kirkkonummi, and Kerava) in Southern Finland between August 2017 and August 2018. Fourteen physicians participated in the study. The flow chart of population-based recruitment is shown in Figure 2. The recruitment of physicians is shown in Figure 4 of Study I. In Helsinki, six school physicians gave consent and chose schools from different socioeconomic areas of the city. In Tampere, Kirkkonummi, and Kerava, medical directors chose four, two, and two physicians respectively with varying education and work experience from schools from different socioeconomic areas. The 105 teachers and 31 school nurses were recruited from the respective schools.

The study nurse gave all eligible children a computer-generated random number. Children predominantly studying in special education groups and whose parents needed an interpreter were excluded from the study. The first 30 eligible children in each school and grade and their guardians were invited to participate. If more than five families declined, more children were contacted from the random order list. Altogether, 1341 eligible children were contacted.

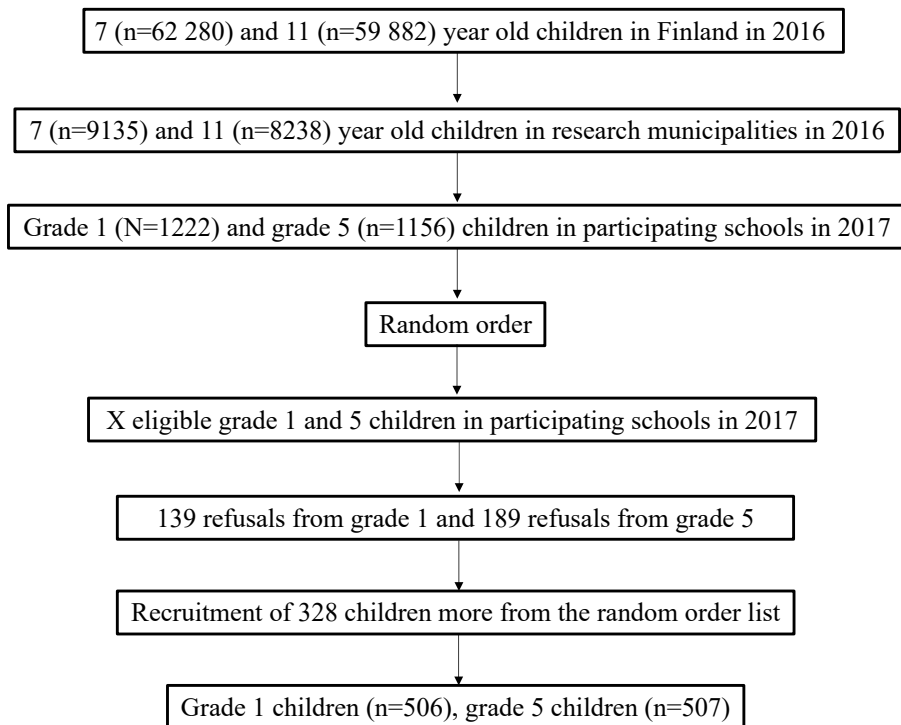


Figure 2 Flow chart of population-based recruitment

Researcher KN trained the participating school physicians, teachers, and nurses and gave detailed written instructions prior to the multicentre study with the help of the study nurse. The trainings included description of the background and aim of the study, material and methods, and of the specific actions required from each professional. The main topics of school physician training included reporting school physician actions and the criteria of benefit. The main topics of school nurse training included organising the delivering and filling of study questionnaires and parent and child consent forms and ensuring all families the chance to participate. Training sessions lasted 1-1.5 hours, 15 minutes and 1.5 hours, respectively. Researcher KN answered questions from all participants during the whole data collection period via phone or e-mail as needed.

An overview of the study design is provided in Figure 3.

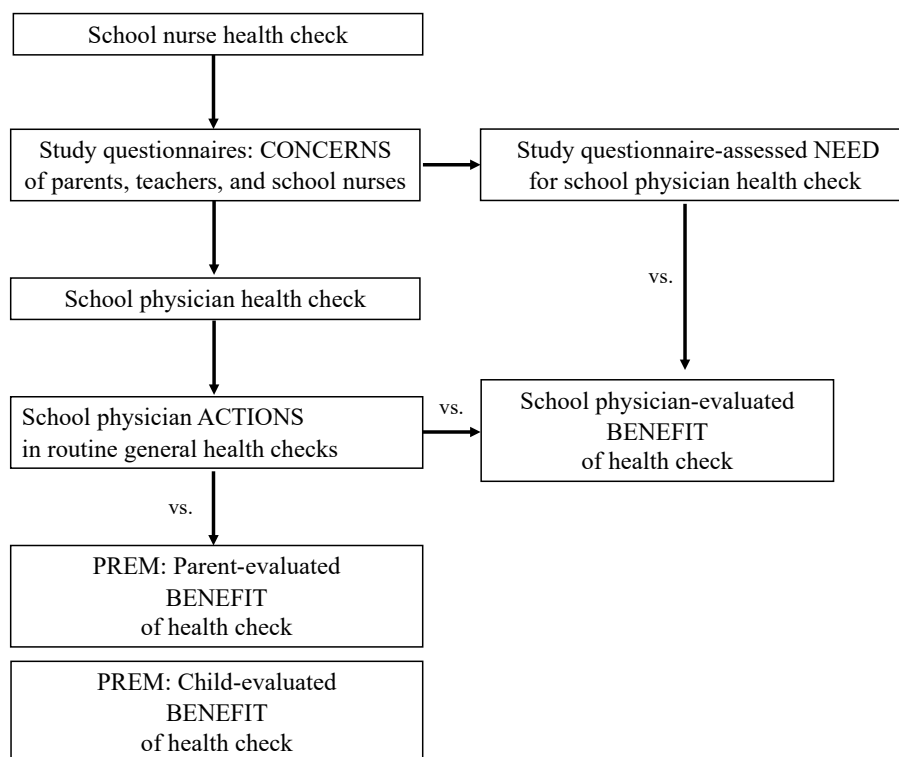


Figure 3 Study design

School nurses conducted their health check as usual. Nurses ordinarily receive background information of the child’s situation from extensive questionnaires provided by the Finnish Institute for Health and Welfare (THL) (parent 1st and 5th grade), child 5th grade and teacher (some schools). The purpose of these questionnaires is to guide discussion with the child and parent. After completing their part of the health check nurses completed their study questionnaires which assessed their concerns regarding the child. Prior to sending the invitation letter to the health check by school physician including consent forms and parents’ study questionnaires, nurses checked their previously filled nurse’s questionnaire for possible changes in their concerns. Nurses delivered the teacher’s questionnaire to the teachers to be completed within one week of receipt and these were returned to the researchers by mail.

School physicians conducted their part of the health check as usual. Typically, the length of the routine health check was 30 min. The physicians had access to the same background information as did the nurses including the THL questionnaires and patient records. However, they were blinded to the study

questionnaire responses. After each health check the physicians had 5-minutes of extra time to report electronically the details of the actions they undertook during the health check and to evaluate the benefit or harm of the health check according to given criteria. Parents and children reported their opinion of the benefit or harm (PREM) of the health check.

4.2 Variables

The concerns of parents, teachers, and nurses comprised growth and/or physical symptoms, emotions, concentration, well-being of the family, behaviour, eating, getting on with others, learning, sleeping, school absenteeism, and hearing. The respondents estimated their concerns on five-point Likert scale (“Not at all”, “Only a little”, “Quite a lot”, “A great deal”, and “I don’t know”). The research group combined the responses “Quite a lot” and “A great deal” to indicate Concern.

We estimated the need for a health check based on the categorisation of study questionnaire responses of parents, teachers, and nurses provided in Figures 4 and 5. The variable need takes into account small concerns (Only a little concern) in contrast to the variable concern which takes into account only obvious concerns (Quite a lot and a great deal of concern). Categorisation included three groups: 1) Needs a health check by a physician, 2) Consulting with a nurse or physician may be sufficient, and 3) No need for a health check by a physician. We combined the first two groups to indicate need for a school physician health check. Missing responses to individual questions were treated as no concern or no wish for a school physician’s assessment of the concerns. An empty questionnaire was treated as missing and excluded from the analyses.

4. Subjects and methods

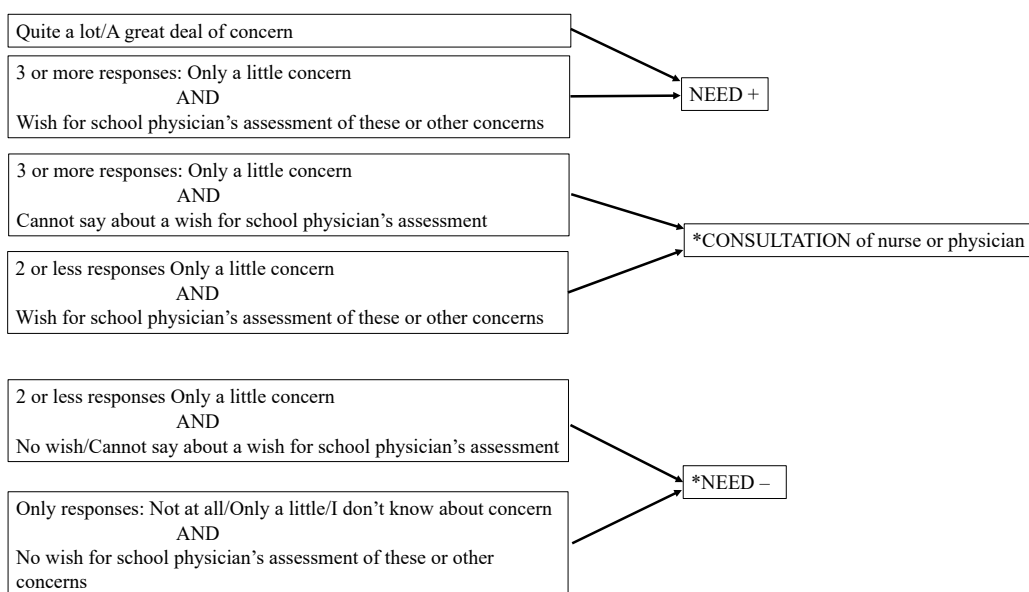


Figure 4 Categorization of parent's and nurse's study questionnaire responses; modified from the original figure 6 of Study I.

*The free description of the concern can alter the categorization to 1) NEED+ for school physician's health check: If there is concern such as parenthood or the relationship between parent and child, sleep problems, behaviour problems in the class, recurrent joint pain/headaches, heel pain, acne, a mole, 2) CONSULTATION a) of physician by nurse if the nurse has only little concern about growth or posture and a wish for school physician's assessment b) of nurse by parent if the parent has concern about: growth but the nurse is not concerned about it, the amount of sleeping, growth pain

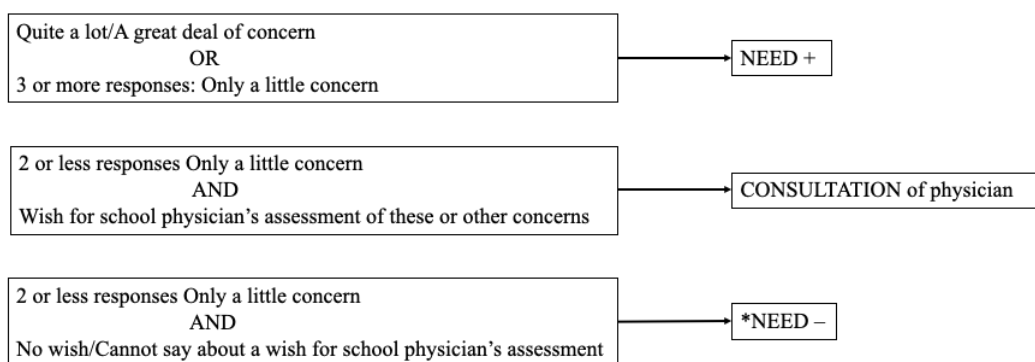


Figure 5 Categorization of teacher's study questionnaire responses; modified from the original figure 7 of Study I.

*The free description of the concern can alter the categorization to NEED+ for school doctor's health check: If there is concern such as parenthood or the relationship between parent and child, sleep problems, behaviour problems in the class, recurrent joint pain/headaches, heel pain, acne, a mole

The questionnaires with a free description of concern necessitate time-consuming individual analysis. Therefore, we also performed an exploratory analysis of the need for a health check by a school physician according to the final wish-question of the study questionnaires. For parents, the question read: “Do you wish to speak with the school doctor about these concerns or some other concern related to the child’s well-being?” For teachers and nurses, the question was: “Do you wish the school doctor to address these concerns or some other concern related to the well-being of the pupil?” The response options included 1) Yes, 2) No, or 3) I don’t know. We categorised responses to the wish question as follows: 1) “Yes” = “Needs a health check by a physician”, 2) “No” = “No need for a health check by a physician”, and 3) “I don’t know” = “Consulting with a nurse or physician may be sufficient”. We combined the first and last response groups to indicate need for a school physician health check. Missing study questionnaire responses were considered as missing values and excluded from the analyses.

We categorised the school physician actions into six groups: instructions and/or significant discussions, prescriptions, laboratory tests and/or medical imaging, scheduling of follow-up appointments in school health services, referrals to other professionals and referrals to specialised care.

The benefit/harm of the appointment was estimated by the physicians on a seven-point Likert scale according to the predetermined criteria shown in Table 2 of Study I. The physicians estimated quite a lot or a great deal of benefit if they considered the physician’s role irreplaceable by nurse. The physicians reported “Only a little benefit” if the nurse could have substituted for the physician or if they estimated no significant harm as consequence of unhandled situation. The physicians estimated harm if they suspected that the interaction failed. The parents and children estimated the benefit or harm of the appointment without predetermined criteria. The eight-point Likert scale in parents’ PREMS and five-point Likert scale with visual analogues in the form of facial expressions in children’s PREMs are described in Table 2 of Study I. The English translations of the PREMs are available in additional files 5 and 6 of Study I. We combined the responses “Quite a lot of benefit and “A great deal of benefit” to indicate benefit or beneficial. We combined the responses “Only a little benefit”, “No benefit or harm”, “Only a little harm”, “Quite a lot of harm”, “A great deal of harm” and “I don’t know” to indicate no benefit. In contrast to the study protocol and for clarity we reported the physicians’ and parents’ estimations of benefit and harm separately.

The number of missing or late questionnaires, electronic reports by physicians, and PREMs of parents and children are collated in Additional file 1 of Study II.

4.3 Statistical methods

Sample size was calculated to perceive a 20% difference (25% vs 45%) in the benefit between children who need and children who do not need a physician's health check (Study I). According to the pilot study, one fourth of children who do not need a physician's health check could benefit from one. To account for the clustered nature of the data, an intra-cluster (intra-school) correlation coefficient (ICC) of 0.06 was presumed. Based on power calculations, the demanded sample size was 450 children from both grades 1 and 5.

Frequencies with percentages and in the case of non-normal distribution medians with interquartile ranges were applied as descriptive statistics. The intrarater and interrater reliability of the evaluation of need for a health check by a physician were calculated with the kappa coefficient. KN assessed the need for a health check by a physician from the whole data and 200 randomly selected cases for intrarater reliability. To evaluate interrater reliability, SK assessed the data from 200 randomly selected children. SK reproduced the assessment of the same 200 children to evaluate her intrarater reliability. TS clarified any discrepancies. Only questionnaires with a free description of concerns demanded manual analysis. Otherwise, the need was evaluated using a formula according to predetermined criteria.

All the associations between variables were analysed using multilevel logistic regression analysis to account for the clustered nature of the data. Study IV compared the concerns of parents, teachers, and nurses with the school physician actions. Study II compared the need for a health check with the physician-evaluated benefit of the health check. Study III compared the school physician actions with the physician- and parent-evaluated benefit. Four-level models with child, school, physician, and city/municipality at different levels were used. Analyses were conducted separately for children in grades one and five (Study II). Models were adjusted for grade (Studies III and IV). Analysis was made using SAS V9.4 System for Windows (SAS Institute Inc., Cary, NC) for multilevel modelling and IBM SPSS Statistics 27.0 for Windows (IBM Corp., Armonk, NY) for other analyses. In all studies, p-values less than 0.05 were considered statistically significant.

4.4 Ethics

The study protocol was approved by the coordinating ethics committee of the Hospital District of Helsinki and Uusimaa (HUS/2174/2017). The Departments of Social Services and Healthcare and the Departments of Education from all participating municipalities gave permission for the study. Written informed consent was obtained from all participating children, parents, physicians, teachers, and school nurses. Consent includes the storage of the research data for 10 years after the end of the study for possible further research in school health services by the research group. Personal data will be destroyed 5 years after they were collected.

No biological specimens were collected for the purpose of this study. Data collection was partly carried out digitally while taking care of appropriate data protection. The confidentiality of participants was protected by using an encryption key prior to data analyses. The key is stored separately from study data. All data was processed according to national data security laws.

If a significant concern were reported in the study questionnaires that was not discussed during the health check a new appointment was organised if necessary. The participants had normal insurance of the city/municipality. Before the school physician's health check, school nurses signed the parents' and children's consent forms which were returned to a sealed box in the waiting room. If the family had forgotten or lost their study forms, they had an opportunity to fill them just prior to the physician's appointment.

The participants received no compensation for taking part in the study. School nurse Laura Aittoniemi worked as a part-time (50%) research assistant for 10 months in 2017 funded by the City of Helsinki.

5. RESULTS

In total, 1013 (75.5%) children and their parents, 506 first graders (78.4%), 507 fifth graders (72.8%), 14 physicians, 105 teachers, and 31 nurses participated in the study. Half of the physicians had a specialist degree and over half were employed full-time in schools and/or well-child clinics (Table 1, Study II). The participation rates of children in cities/municipalities are presented in Table 7.

Table 7 Participation rates of children and parents

City/Municipality	Grade 1	Grade 5	Total
Helsinki	288 (77.0)	300 (72.3)	588 (74.5)
Tampere	125 (84.5)	109 (80.7)	234 (82.7)
Kerava	48 (76.2)	50 (69.4)	98 (72.6)
Kirkkonummi	45 (75.0)	48 (64.9)	93 (69.4)
Total	506 (78.4)	507 (72.8)	1013 (75.5)

Data are expressed as n (%).

The three most common reasons for non-participation of children were that either the child or parent refused to participate (n=245), no show (n=44), and child was alone at the physician's health check with no consent forms (n=29). These are presented in Table 2 of Study II.

5.1 Parent, teacher, and nurse concerns

In total, respondents were concerned (a great deal or quite a lot of concern by at least one respondent) about 480 (47.5%) children (Table 8) (Table 1, Study IV). Parents were concerned about 32%, teachers about 20%, and nurses about 25% of children. Parents and nurses were most concerned about growth and/or physical symptoms, whereas teachers were most concerned about concentration. Altogether, the top five concerns included growth and/or physical symptoms (22.7%), emotions (16.2%), concentration (15.1%), wellbeing of a family member or the whole family (13.6%), and behaviour (12.4%). The concerns did not differ between children in grades one and five.

5.2 Need for school physician health check

Taking into account all questionnaire responses, 212 children (20.9%) had no need for a health check by a school physician (Table 8) (Table 3, Study II). The need according to parent, teacher, and nurse questionnaires respectively was 602 (60.4%), 304 (37.3%), and 517 (53.4%). Parents, teachers, and nurses respectively presented 542 (54.4%), 305 (37.4%), and 563 (58.2%) free descriptions of their concerns. The kappa measures of agreement for inter- and intrarater reliability of the questionnaires showed over 0.7 (good) and 0.8 (excellent), respectively.

We also conducted an exploratory analysis using the single wish question of the study questionnaires to determine the need for a physician health check. Based on the wish question, 257 children (25.4%) had no need for a health check by a physician (Table 8) (Additional file 3, Study II). The need according to parent, teacher, and nurse questionnaires respectively was 503 (53.9%), 183 (23.5%), and 504 (55.8%) (Table 8).

Table 8 Comparing variables concern, need and wish

Respondents	Concern	Need	Wish
	n (%)	n (%)	n (%)
Parents	318 (32.0)	602 (60.4)	503 (53.9)
Teachers	165 (20.3)	304 (37.3)	183 (23.5)
Nurses	238 (24.6)	517 (53.4)	504 (55.8)
Parents, teachers, and nurses*	480 (47.5)	801 (79.1)	753 (74.6)

Concern=A great deal or quite a lot of concern

Need = "Needs a physician's health check" and "Consulting a nurse/physician may be sufficient" combined; Need takes into account also small concerns in contrast to the variable Concern.

Wish = "Needs a physician's health check" and "Consultation with a nurse/physician may be sufficient" combined; Wish-question requires the use of full study questionnaires, because this question refers to all questionnaire responses. For parents, the question read: "Do you wish to speak with the school physician about these concerns or some other concern related to the child's well-being?" For nurses and teachers, the question read: "Do you wish the school physician to address these concerns or some other concern related to the well-being of the pupil?"

*Indicates that at least one of the respondents (parent, teacher, or nurse) had Concern, Need, or Wish.

5.3 School physician actions in routine general health checks

The physicians conducted actions for 78% of the 1013 children (Online supplemental table 1, Study III). The most common action was giving instructions and/or having significant discussions with about 60% of families. These included discussions of physical health with 52% of families and psychosocial health with 16% of families. The five most common topics of discussion included nutrition, skin, weight, pain/prolonged complaints, and growth/development.

Physicians made referrals to other professionals for psychosocial problems in 8.1% of cases, most commonly to psychologists or social workers, and for physical health problems in 5.5% of cases, most commonly to physiotherapists. Physicians made referrals to specialised care for 5.1% of children including referrals handling neurologic or mental health problems for 0.9% of children.

Physicians scheduled follow-up appointments in school health services for 17% of children mostly to check growth or posture. Physicians scheduled follow-up appointments with themselves for 3% of children mostly to check posture or testes. Physicians communicated with child-protection services in less than 0.5% of cases. Physicians made prescriptions for 10.4% of children mostly for skin problems and allergies. Physicians made referrals to laboratory tests and/or medical imaging for 8.5% of children mostly due to abdominal symptoms or overweight/obesity. Physicians carried out actions on cardiac murmurs for six children and made referrals related to the genitals of six boys.

5.4 Benefit and harm of school physician health check

The physicians reported 410 (40.6%) of the health checks as being beneficial (quite a lot of benefit or a great deal of benefit). The parents and children respectively estimated benefit from 812 (83.4%) and 598 (60.3%) health checks (Table 4, Study II). In 42 cases, the physicians considered the health check beneficial but the parents disagreed.

Physicians evaluated harm from six health checks because of failed interaction. Parents considered harm from two health checks because of failed interaction or unnecessary check of a healthy child. One parent's report of harm was a mistake, because the parent appraised receiving advice and help for the problem. Twelve children considered harm because of pain due to vaccination

or planned blood test, dislike of being touched or having to undress, or because of being bored.

5.5 Associating parent, teacher, and nurse concerns with school physician actions

The children whom respondents were concerned about received a school physician action more often than children whom respondents were not concerned about (ORs 1.66-4.27, $p \leq 0.05$) (Figure 1, Study IV). If respondents were concerned about growth and/or physical symptoms children received all categories of actions more often than if respondents were not concerned about those areas (Figures 1 and 2, Supplementary table 1, Study IV).

If respondents had concerns school physicians made referrals to other professionals within schools or community services more often than if respondents had no concerns ORs 1.80-4.52, p(exception wellbeing of family) (Figure 6, Table 9) (Figure 2, Study IV). Emotions had the strongest association with referrals to other professionals (OR 4.52; 95% CI 3.00-6.80, $p < 0.0001$) If respondents were concerned about growth and/or physical symptoms, emotions, behaviour, getting on with others, or learning school physicians made referrals to specialised care more often than if respondents were not concerned about those areas (ORs 2.29-2.62, $p \leq 0.01$) (Table 9) (Supplementary table 1, Study IV). If respondents were concerned about growth and/or physical symptoms or eating school physicians scheduled follow-up appointments more often than if respondents were not concerned about those areas (ORs 1.94-2.89, $p < 0.001$) (Table 9) (Supplementary table 1, Study IV).

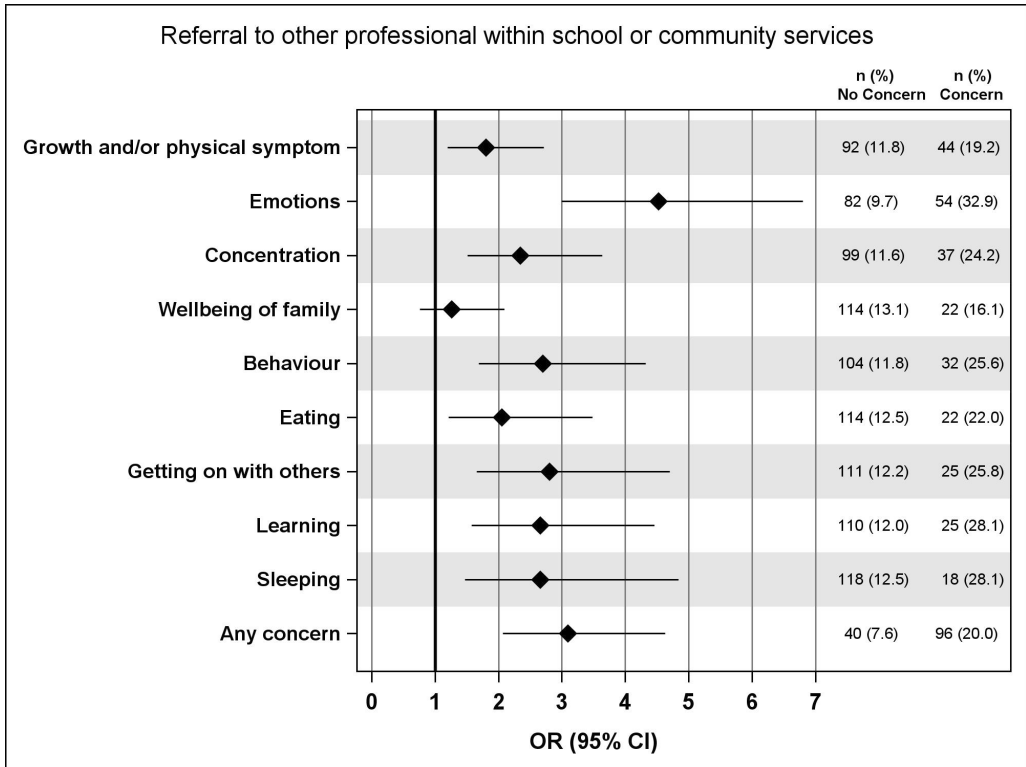


Figure 6 The association of combined concerns of parents, teachers, and nurses with referral to other professional within school or community services; multilevel logistic regression analysis. Numbers are n (%) of actions in concern groups. Concern=A great deal or quite a lot of concern by at least one respondent (parent, teacher, or nurse); No concern=Less than quite a lot of concern by all respondents (parent, teacher, and nurse); OR, Odds ratio; adjusted for grade; CI, Confidence interval. Reproduced with permission from publisher from the original Figure 2 of Study IV.

Table 9 The association of the combined concerns of parents, teachers, and nurses with school physician actions; multilevel logistic regression analysis

Areas of concern	Referral to other professional within school or community services	Referral to specialised care	Follow-up appointment in school health service
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Any concern	3.09 (2.07-4.63)	2.53 (1.37-4.66)	1.71 (1.21-2.41)
Growth and/or physical symptom*	1.80 (1.20-2.71)	2.62 (1.46-4.70)	1.94 (1.34-2.81)
Emotions	4.52 (3.00-6.80)	2.29 (1.22-4.29)	1.32 (0.85-2.03)
Concentration	2.34 (1.51-3.63)	1.87 (0.96-3.65)	0.93 (0.58-1.50)
Wellbeing of family	1.26 (0.76-2.09)	1.71 (0.85-3.47)	1.35 (0.85-2.16)
Behaviour	2.70 (1.69-4.32)	2.56 (1.31-4.98)	1.51 (0.94-2.41)
Eating	2.05 (1.21-3.48)	1.96 (0.91-4.22)	2.89 (1.81-4.64)
Getting on with others	2.80 (1.66-4.70)	2.55 (1.23-5.28)	1.50 (0.88-2.54)
Learning	2.66 (1.58-4.46)	2.54 (1.21-5.35)	0.92 (0.50-1.69)
Sleeping	2.66 (1.47-4.84)	1.17 (0.40-3.42)	1.08 (0.56-2.08)

Concern=A great deal or quite a lot of concern by at least one respondent (parent, teacher, or nurse);

No concern=Less than quite a lot of concern by all respondents (parent, teacher, and nurse);

OR, Odds ratio; adjusted for grade; CI, Confidence interval. OR:s and CI:s with p-value less than 0.05 are marked in bold.

*Specified in the parent's questionnaire: recurrent pain, prolonged complaints, skin symptoms, undescended testes.

5.6 Associating study-questionnaire-assessed need and school physician-evaluated benefit of routine health checks

Need for a school physician health check was associated with physician-evaluated benefit of the health check using any of the respondent (parent, teacher, or nurse) questionnaires. Using all respondent questionnaires gave the strongest association (OR 3.53; 95% CI 2.41-5.17) (Table 5, Study II).

The single wish question was as valuable as analysing all the questionnaire responses for the need for a health check by the school physician. The need

for a health check (based on the wish question) was associated with benefit of the health check assessed by the physician (OR 3.60; 95% CI 2.53-5.11) (Additional file IV, Study II).

5.7 The predictive values of study-questionnaire-assessed need (all study questionnaire responses) for school physician-evaluated benefit

The predictive values of the need for benefit are presented in Table 10. The sensitivity of using all three questionnaires to identify children who would most likely benefit from a school physician's health check was 89.8% (95% CI 86.4–92.3). The negative predictive value of using all three questionnaires was 80.1% (95% CI 74.2–84.9) and specificity was 28.2% (95% CI 24.7–31.9).

Table 10 Predictive values of need (all study questionnaire responses) for benefit of the health check (by physician)

	TP/FP	TN/FN	Sensitivity (95% CI)	Specificity (95% CI)	PPV (95% CI)	NPV (95% CI)
Grade 1						
Parent	152/161	145/37	80.4% (74.1–85.5)	47.4% (41.8–53.0)	48.6% (43.1–54.1)	79.7% (73.2–84.9)
Nurse	112/138	160/67	62.6% (55.3–69.3)	53.7% (48.0–59.3)	44.8% (38.7–51.0)	70.5% (64.2–76.1)
Teacher	66/78	162/90	42.3% (34.8–50.2)	67.5% (61.3–73.1)	45.8% (37.9–54.0)	64.3% (58.2–70.0)
Parent and nurse	166/213	100/25	86.9% (81.3–91.0)	31.9% (27.0–37.3)	43.8% (38.9–48.8)	80.0% (72.1–86.1)
Parent and teacher	163/183	128/28	85.3% (79.6–89.7)	41.2% (35.8–46.7)	47.1% (41.9–52.4)	82.1% (75.2–87.3)
Nurse and teacher	132/174	138/58	69.5% (62.6–75.6)	44.2% (38.8–49.8)	43.1% (37.7–48.7)	70.4% (63.6–76.4)
Parent, nurse, and teacher	173/226	87/18	90.6% (85.5–94.0)	27.8% (23.1–33.0)	43.4% (38.6–48.3)	82.9% (74.4–88.9)
Grade 5						
Parent	148/139	143/69	68.2% (61.7–74.1)	50.7% (44.9–56.5)	51.6% (45.8–57.3)	67.5% (60.9–73.4)
Nurse	140/125	154/70	66.7% (60.0–72.7)	55.2% (49.3–60.9)	52.8% (46.8–58.8)	68.8% (62.4–74.5)
Teacher	86/73	166/93	48.0% (40.8–55.4)	69.5% (63.3–75.0)	54.1% (46.3–61.7)	64.1% (58.1–69.7)
Parent and nurse	187/188	99/32	85.4% (80.1–89.5)	34.5% (29.2–40.2)	49.9% (44.8–54.9)	75.6% (67.5–82.2)
Parent and teacher	172/169	118/47	78.5% (72.6–83.5)	41.1% (35.6–46.9)	50.4% (45.1–55.7)	71.5% (64.2–77.9)
Nurse and teacher	162/157	128/54	75.0% (68.8–80.3)	44.9% (39.2–50.7)	50.8% (45.3–56.2)	70.3% (63.3–76.5)
Parent, nurse, and teacher	195/205	82/24	89.0% (84.2–92.5)	28.6% (23.6–34.1)	48.8% (43.9–53.6)	77.4% (68.4–84.3)
Total						
Parent	300/300	288/106	73.9% (69.4–77.9)	49.0% (45.0–53.0)	50.0% (46.0–54.0)	73.1% (68.5–77.2)
Nurse	252/263	314/137	64.8% (59.9–69.4)	54.4% (50.3–58.4)	48.9% (44.6–53.2)	69.6% (65.2–73.7)
Teacher	152/151	328/183	45.4% (40.1–50.7)	68.5% (64.2–72.5)	50.2% (44.6–55.8)	64.2% (59.9–68.2)
Parent and nurse	353/401	199/57	86.1% (82.4–89.1)	33.2% (29.5–37.0)	46.8% (43.3–50.4)	77.7% (72.2–82.4)
Parent and teacher	335/352	246/75	81.7% (77.7–85.2)	41.4% (37.3–45.1)	48.8% (45.0–52.5)	76.6% (71.7–80.9)
Nurse and teacher	294/331	266/112	72.4% (67.9–76.5)	44.6% (40.6–48.6)	47.0% (43.2–51.0)	70.4% (65.6–74.8)
Parent, nurse, and teacher	368/431	169/42	89.8% (86.4–92.3)	28.2% (24.7–31.9)	46.1% (42.6–49.5)	80.1% (74.2–84.9)

Need+ is categories "Needs physician's health check" and "Consultation of nurse/physician may be sufficient" combined. Need- is "No need for physician's health check". Benefit+ is "Quite a lot or more benefit". Benefit- is responses "Only a little benefit", "No benefit or harm", "Only a little harm", "Quite a lot of harm" and "I don't know" combined. TP=True positive=Need + and Benefit+. FP=False positive=Need+ and Benefit-. TN=True negative=Need- and Benefit-. FN=False negative=Need- and Benefit+. PPV = positive predictive value, NPV = negative predictive value, CI= confidence interval.

5.8 Associating school physician actions with the benefit of the health check

Physicians considered 52% of the health checks with any action beneficial (quite a lot of benefit or a great deal of benefit) and none of the health checks with no actions beneficial (Table 1, Study III). Physicians more often considered beneficial the health checks with any action than the health checks without any action (OR:s 1.91-17.26, $p < 0.001$). The actions most strongly associated with physician-evaluated benefit ($p < 0.001$) included prescriptions (OR: 5.56, 95% CI 3.46 to 8.94), laboratory tests and/or medical imaging (OR: 15.16, 95% CI 7.35 to 31.26) and referrals to specialised care (OR: 17.26, 95% CI 6.61 to 45.05).

Parents considered beneficial 87% of the health checks with any action and 68% of the health checks with no actions (Table 2, Study III). Parents more often considered beneficial the health checks with any action than the health checks without any action (OR: 3.25, 95% CI 2.22 to 4.75). The health checks with instructions and/or significant discussions (OR: 1.71, 95% CI 1.20 to 2.44), the health checks with prescriptions (OR: 7.44, 95% CI 1.34 to 8.55) and the health checks that lead to laboratory tests and/or medical imaging (OR: 3.38, 95% CI 1.34 to 8.55) were associated with parent-evaluated benefit. In contrast, the health checks that resulted in scheduling a follow-up appointment in school health services, a referral to other professional within the school or community services or a referral to specialised care were not associated with parent-evaluated benefit.

6. DISCUSSION

6.1 Summary of the main findings

Overall, parents, teachers, and school nurses were concerned about almost half of the children. Parents expressed concern about almost one third, teachers about one fifth, and nurses about one fourth of all children. The top three concerns included growth/and or physical symptoms (23%), emotions (16%), and concentration (15%). Altogether, 20-25% of the children had no need for a school physician health check.

Physicians conducted actions in four fifths of the health checks. Most actions focused on physical health. The actions comprised instructions and/or significant discussions (60%), scheduled follow-up appointments (17%), referrals to other professionals within schools or community services (13%), prescriptions (10%), laboratory tests and/or medical imaging (9%), and referrals to specialised care (5%). Few children had physical findings that require a physician's expertise to be identified.

Physicians considered two-fifths, parents four-fifths, and children three-fifths of the health checks as being beneficial. Respondents rarely assessed harm.

All concerns were associated with at least one school physician action. Nearly all concerns were associated with referrals to other professionals within schools or community services; the association was strongest with emotions. In addition, several psychosocial concerns were associated with referrals to specialised care.

The need for a health check was associated with physician-evaluated benefit of the health check.

Physicians reported half and parents almost 90% of the health checks with actions beneficial. Both physicians and parents more often estimated the appointments with actions beneficial than the appointments without actions. Furthermore, both physicians and parents more often estimated the appointments with instructions and/or significant discussions, prescriptions, and laboratory tests and/or medical imaging beneficial than the appointments without these actions. In contrast, only physicians more often estimated the appointments with scheduled follow-up appointments, referrals to other

professionals and referrals to specialised care beneficial than the appointments without these actions.

6.2 Interpretation of the results

Comparing the variables Concern, Need, and Wish shows that Need resulted in the highest amount of children requiring school physician health check. This is understandable since the research group aimed at easy access to the school physician when defining the criteria for need for school physician health check. The variable Need takes into account also small concerns (Only a little concern) in contrast to the variable Concern which takes into account only obvious concerns (Quite a lot and a great deal of concern).

Using only the “wish question” to ascertain the need was especially useful, since the considerable amount of free descriptions of concern became unnecessary. However, the “wish question” relates to all the other concern questions of the study questionnaires and thus cannot be utilised alone. In practice, the questionnaires could be provided electronically throughout the school year. The school multiprofessional team including the school physician could organise an appointment with targeted actions by the most suitable professional in response to respondent concerns.

The respondents were partly concerned about different children since parents were concerned about one third, teachers about one fifth, and nurses about one fourth of all children. This is understandable because the respondents observe the children from different perspectives. Dutch studies have showed parental concerns both unconfirmed by health professionals and health professionals more often detecting psychosocial problems in school-aged children compared with parents (133,134). A study conducted in Great Britain showed that if a parent perceived concerns about their child’s mental health, the predictive power of these concerns was significantly increased by evaluating whether the teacher shares these concerns (135).

The Finnish Institute for Health and Welfare (THL) has developed extensive questionnaires for parents, children (5th grade), and teachers to be completed before the extensive health check by the nurse in primary school grades 1 and 5. After the health check by the school nurse or physician the teacher’s questionnaires are advised to be returned to the teacher with appropriate information from the health check with the permission of the parent and child. The purpose of these THL questionnaires is to guide discussion with

the child and parent and improve multidisciplinary collaboration between the health and educational sector. The THL questionnaires are nowadays not allowed to be used for screening children to the school nurse or physician appointment. The possibility of adding one question regarding the wish for school physician assessment of concerns regarding the issues covered in the THL questionnaires could be considered. The THL questionnaires cover the same concerns that are covered in the study questionnaires. However, some parent concerns can probably be alleviated already during the school nurse health check and the wish for school physician assessment could be updated after the school nurse health check.

The need for a health check by school physician according to the wish-question of the nurse questionnaires was over 50% which is surprisingly high. School nurses rarely organise school physician appointments in other grades even when children have special health care needs such as obesity (136). However, many health problems would be most efficiently perceived and treated in the school (1,7).

Few children had physical findings that usually require a physician's examination to be identified, such as heart murmurs or undescended testes. This was expected since children are extensively inspected for major health problems in health checks at the ages of 4-6 weeks, 4 months, 8 months, 18 months, and 4 years in Finland. About half of children have a cardiac murmur at some time in their life (137). Asymptomatic children with a previously unidentified murmur may be conservatively managed to see if they change over time (138). A recent study from Canada questions the need of auscultation suggesting that basic clinical criteria (asymptomatic; normal physical examination other than the murmur; no risk factors for congenital heart disease) that do not require auscultation are highly sensitive for ruling out significant cardiac pathology in children over 12 months of age (139).

The incidence of undescended testis acquired late in childhood is 1-2% (140). The consequences of acquired undescended testes are marginally studied and recommendations for screening vary. Van der Plas and co-workers found that in bilateral cases the fertility potential may decrease without orchiopexy. In unilateral cases, they recommended to wait for spontaneous descent until puberty because over 50% of acquired undescended testis descend spontaneously (75). Hutson and co-workers suggested the screening of all boys for acquired undescended testis at school entry (76). Dinkelbach et al found that ascent occurs throughout all prepubertal ages and recommended yearly follow-up of testicular position until puberty (77). Evidence on yearly follow-up

of testicular position of all prepubertal school-aged children was not found. Furthermore, evidence on testicular self-examination of prepubertal children compared with examination by physicians was not found.

The top concern of parents and school nurses included growth/and or physical symptoms. When respondents were concerned about growth/and or physical symptoms the children received all categories of actions more often than if respondents were not concerned about those areas. The result is reasonable since this group includes a large variety of symptoms which may require diverse actions. The most common action that school physicians undertook was giving instructions or having significant discussions. Common topics of these discussions included nutrition and/or weight. Overweight and obesity are major health concerns of children in Europe (53). In Finland, almost 30% of boys and 20% of girls aged 2-16 years were overweight or obese in 2021 (54).

Treatment of childhood overweight and obesity is challenging. Parents that report concerns about their child's weight may have unhealthy parenting practices such as food restriction and pressure-to-eat (141). Strategies for changing diet or physical activity levels, or both have shown modest effect on preventing overweight or obesity of children (142). Interventions on physical activity as part of an obesity prevention or treatment programme may benefit executive functions of children with obesity or overweight (143). A Cochrane review showed that parent-only interventions for overweight or obesity had similar effects compared with parent-child interventions in children aged 5 to 11 years (144). There were no significant differences between family-based group treatment and routine counselling 2 and 3 years after the beginning of a 6-month intervention of 7-9-year-old obese children (145). Multi-component interventions that incorporate diet, physical activity and behaviour change may be beneficial in achieving small, short-term reductions in BMI in children aged 6 to 11 years (146). Comprehensive multicomponent interventions seem to have the best overall outcomes in treating childhood obesity (147). Referrals to laboratory tests and/or medical imaging were made for 8.5% of children mostly because of abdominal symptoms or overweight/obesity. There is no evidence to evaluate the predictive value of laboratory tests in chronic abdominal pain in children (148). Häkkänen and co-workers showed that 45% of children with obesity received referrals for laboratory tests at least once at ages 7 to 12 years (149). Despite actions of school health care professionals in Finland, obesity increased and obese children remained obese at ages 7-12 years (33).

The respondents were concerned about emotions in 16% of children. A Finnish multicentre study found that 24% of 8-9-year-old children had psychiatric

symptoms (Rutter questionnaires) and 9% were in need of treatment (150,151). About 3.7% of 0-12-year-old children had a contact at child psychiatry in 2017, in Finland (152). These results can be compared with studies of the Dutch preventive health care. In the first study, physicians and nurses working in preventive child health care identified psychosocial problems in one fourth of all children and undertook actions in 85% of the identified children (153). Actions included: advice or reassurance (62%), consultation with school, colleagues, or official authorities (45%), referral to another professional (21%), and follow-up (19%). The amount of advice or reassurance was similar to our study where physicians gave instructions and/or had significant discussions with 60% of families. The amount of referrals to another professional was larger than in our study where physicians made referrals to other professionals within school or community services in 13% of cases. The amount of follow-up appointments was similar to follow-up appointments in our study (17%). In the second study, over 40% of parents of children aged 7-12 years estimated at least some concern and almost 8% of parents frequent concerns for which they felt that they needed assistance or advice from someone outside the family (133). The concerns regarded most commonly parenting in general, behavioural, and emotional problems. The frequency of some parental concern regarding emotional problems was about 17%. Preventive health care professionals assessed parenting problems less than parents. In the third study, preventive health care professionals identified emotional and behavioural problems in about 9% of children aged 5-11 years (154). In the St Louis metropolitan area, USA, paediatrician practice, the most frequently reported parental health concerns regarding their children aged 6 to 11 years included food/activity 34.8%, mental health 23.6%, safety 22.4%, and allergies 22% (155).

Physicians made referrals to other professionals for psychosocial problems in 8.1% of cases, most commonly for psychologists or social workers. In addition, physicians made referrals to specialised care for neurologic or mental health problems in 0.9% of cases. In the Dutch preventive health care, a smaller proportion (0-4%) of children aged 0-18 years were referred to other services mainly to general or specialized mental health/social care (154).

In our study, nearly all concerns were associated with referrals to other professionals within schools or community services with emotions having the strongest association. Furthermore, several psychosocial concerns including topics of emotions, behaviour, getting on with others, and learning were associated with referrals to specialised care. This result is in line with a study conducted in the United States which suggested that parental concerns about

children's development may approach standards for screening tests and be utilised for referral decisions (156).

School physicians may not be the most suitable professionals to alleviate psychosocial problems during childhood. Primary care practitioners often experience time restrictions, lack of resources and providers in addition to patient issues and family barriers to manage childhood mental health problems but desire collaboration with other professionals (30,157). A 2-year family-oriented training programme for Finnish general practitioners raised awareness of the need for multiprofessional collaboration in primary care (158). Psychosocial interventions would require more time in routine work (3,6).

Physicians communicated with child-protection services in less than 0.5% of children even though school professionals could ideally recognise and support maltreated children through multidisciplinary collaboration with child protection services (159). It is possible that the families with burdensome situations in their life declined to participate or were excluded from the study. Health care professionals should not use a universal screening device to identify possible child maltreatment but consider the situation carefully when assessing children with conditions that may be caused or complicated by maltreatment (160). In Finland, the amount of children evaluated by child protection increased 15% from 2018 to 2021 (161). The National Institute for Health and Welfare statistics showed that the number of 0-17-year-old children in custody as a percentage of the population of the same age has increased from 0.9% in 2011 to 1% in 2021 (162). It is likely that child maltreatment is ordinarily suspected and psychosocial problems recognised outside of physician's routine health checks. This finding is similar to a Dutch study in which physicians' assistants identified psychosocial problems as well as nurses or physicians (78). According to the 2017 report by the Association of Finnish municipalities multidisciplinary collaboration between child protection services and child psychiatric services is inadequate (163).

Globally, a shortage of professionals to provide care for children and adolescents facing mental health disorders exists (164). Some referrals to other professionals and specialised care could potentially have been replaced by multidisciplinary meetings, which may improve patient satisfaction and perceived quality of care (165). Effective interventions among the most vulnerable groups with complex problems require multidisciplinary models of care (108). Continuity across time and services and flexibility of appointment times are essential. Intervention during the early stages of a disorder may help diminish the severity of the disorder and prevent secondary disorders (166). Paavonen et al suggested

that most children with anxiety disorders could be treated already in primary care with psychoeducation and short focused behavioural interventions (167). The Finnish Therapies to the Frontline (Terapiat etulinjaan) approach delivers digital tools, training, and services to strengthen the whole system of primary mental health care (168).

Physicians planned follow-up appointments in school health care for 17% of children mostly to check growth or posture including follow-up appointments with themselves for 3% of children mostly to check posture or testes. The evidence base of screening for adolescent idiopathic scoliosis is unclear, although screening may lead to follow-up appointments for years with no further actions (71,72). Follow-up appointments related to socioemotional problems were rare. This can be compared with the Dutch preventive child health care where professionals invited 3-9% of children aged 5-11 years for a follow-up assessment for emotional, behavioural, cognitive developmental or family problems (154).

In Finland, school nurses and physicians are not always able to offer additional appointments as needed (31,169). In the Netherlands, a triage approach in which physicians' assistants performed preventive child health care assessments instead of all children being assessed by a nurse or a physician enabled nurses and physicians to conduct additional assessments of children with specific needs on request by school professionals, parents and children and cooperate in school-based networks. In the triage approach school professionals had more contacts with school health services and they were more satisfied with the appropriateness of received support compared with the usual approach (170).

Physicians made prescriptions for 10.4% of children mostly for skin problems and allergies. Some prescription renewals could potentially have been managed through the electronic health record system instead of an appointment (171).

Parents evaluated most health checks as beneficial. This result is similar to a report by the Finnish Ministry of Social Affairs and Health which described that almost 80% of parents value extensive health checks (172). They may appreciate the extensive check of their child, as well as the opportunity to consult a physician about issues that they exclusively feel difficult to make an appointment for. On the other hand, the physicians evaluated benefit from 42 appointments that the parents reported of minor value. In these cases, the physician may have assessed benefit from actions that were useless to the parent.

Parents considered 87% of the appointments with school physician actions beneficial and estimated benefit from 68% of the appointments with no actions. Parents usually lack knowledge when physician's expertise is necessary. They also lack knowledge that as a consequence of routine health checks at certain grades only limited school physician resources are available to children in other grades. Most paediatric primary care providers reported never or rarely having health policy discussions with families (173). Parents especially appreciated appointments when they received immediate help such as instructions and/or significant discussions, medical prescriptions, and testing from the school physician.

In contrast to parents, physicians more often estimated the appointments with scheduled follow-up appointments, referrals to other professionals and referrals to specialised care beneficial than the appointments without these actions. Parents may consider the barriers in actualising planned care. Children may miss their planned appointment at specialised care or other experts for several reasons, including logistical/practical factors (transport, caring for other children) long waiting times, parents' being worried about being blamed for children's illness, and sometimes anxiety about losing custody of their children (174). In a study from England, non-attenders were more likely than children who did attend to come from an area of greater deprivation and to have a child protection alert recorded in their hospital notes (175). The parent may have disagreed about the physician's action. In a Dutch study, child health professionals more often detected psychosocial problems in children aged 8-12 years than did their parents (134).

Physicians estimated half of the health checks where they undertook actions beneficial. The physicians may have considered that the school nurse or another professional could have conducted the action as well. In the Netherlands, physician's assistants, physicians, and nurses recognised children's overweight, visual disorders, and psychosocial problems equally well (78). In addition, both physicians and nurses working in preventive child health care react to most psychosocial problems by providing advice to parents or through consultations with schools or their own colleagues (153). According to a Cochrane review, nurses may reach similar or better patient health in areas such as heart disease, diabetes, rheumatism, and high blood pressure and higher patient satisfaction than primary care doctors (176). Nurses taking tasks from doctors need facilitators such as proper resources, good referral systems, adequate incentives, and training (177).

Sometimes, the physicians may have been hesitant about the significance of their findings and actions. Overdiagnosis is a problem involving conditions such as ADHD, food allergy, and obstructive sleep apnoea (178–183). Parent characteristics and parent-doctor relationships may affect the extent and content of communication regarding diagnostic uncertainty (184).

The appointments with actions that usually require medical training (prescriptions, laboratory tests and/or medical imaging, and referrals to specialised care) were most strongly associated with physician-evaluated benefit. The physicians estimated none of the health checks without actions beneficial. The validity of the physician-estimated benefit is strengthened by these findings since they are in line with the predetermined criteria of benefit and harm.

One-fifth of the children with no need to meet a physician benefitted from it according to the physician. Several explanations for this are conceivable: 1) the health check may provoke new or forgotten concerns; 2) the parents may expect no help from the physician for psychosocial or learning problems; 3) the physicians may write prescriptions for example skin problems and allergies that may be useful in a different time of the year.

Over half of the children with need for a health check achieved no benefit from it according to the physician. Most of these cases belonged to the categorisation “Only a little benefit” which consists of issues that the school nurse could have handled or of issues of minor importance. Parents and teachers may not share their concerns regarding the child. Despite significant concerns appropriate specialists may already be involved and no actions from the school physician are thus required.

Respondents rarely assessed harm from the health checks. However, indirect harm is also possible. The current Finnish school health care system aims to offer an equal amount of health checks for all children. The obligatory health checks by both the school nurse and the physician have led to allocating school physician resources to health checks of a large group of children who are doing well according to parents, teachers, and school nurses. Children with special needs, related to social inequities, mental health and lifestyle-related problems could possibly benefit from school physician’s assessment more often than is currently possible. School physicians have insufficient time for multidisciplinary work with other professionals working with children in schools and in family counselling, child protection and specialised care. Savolainen et al reported lack of communication with child psychiatry and

feedback on the progress of children's mental health treatments as common problems that professionals from schools experienced (32). Improvement in multiprofessional collaboration is needed to avoid referrals of children from one unit to another (31).

Lack of multiprofessional collaboration between organisations may have serious consequences. In 2012, the investigative team of The Ministry of Justice studied the events leading to the death of an eight-year-old child in Finland (185). One of the investigative team recommendations included that the Ministry of Social Affairs and Health, together with other actors, should develop operational models to ensure good cooperation, information flow, documentation, and the formation of an overall picture of the child between professionals in child protection, school, healthcare, early childhood education and the police.

Effective preventive care demands time for multidisciplinary work related to poverty, poor educational outcomes, unhealthy social and physical environments, and unhealthy lifestyle choices (15,186). Unnecessary steps before providing treatment for identified concerns (failure demand) should be avoided when developing the roles of professionals working in schools (187). Interprofessional collaboration is needed to avoid role overlap and conflict (188). A meta-analysis of randomized clinical trials conducted in 1960 through 2014 demonstrated that integrating mental health care into primary medical care for children and adolescents leads to significant improvements in child and adolescent mental health (189). Recently, telehealth has become a promising possibility to integrate mental health services into primary care and school health services (190–194). The future visions of mental health services in the school comprise a multiprofessional team providing help for both physical and psychosocial health problems (195).

6.3 Methodological considerations

We were unable to conduct a randomised controlled trial because of the obligatory health check system in Finland. However, the unique design of the observational study allowed physicians to perform the health check routinely for all children and evaluate the benefit of the health check without knowing the content of the study questionnaires and the need for the health check.

The exclusion criteria consciously included children mainly studying in special education groups and children whose parents needed an interpreter. We estimated that in these vulnerable groups children have many risk factors for

health and involving the school physician is especially important to ascertain adequate health and social care contacts. In 2021, 9.4% of children aged 7-15 years received special support for their studies in Finland (196). Of these children, one third studied exclusively in a special education group. Small income, large proportion of immigrant children in the school, and need for special support are accumulated in certain schools in Helsinki, Finland (197). Schools from different municipalities and socioeconomic areas and professionals with varying education and work experience participated in the study which increased the generalisability of the results.

The data were collected before the COVID-19 pandemic with a high participation rate in a normal setting of children's routine general health checks. The data represent the challenges of children in high-income countries with an extensive health check system earlier in childhood. A quarter of families refused to participate which may have produced selection bias. Non-participants may have been families with most stressors in their life. However, the concerns regarding these children are usually evident and individual help is offered.

The development of a measurement instrument can be divided into six steps: 1) Definition and elaboration of the construct to be measured, 2) Choice of measurement method, 3) Selecting and formulating items, 4) Scoring issues, 5) Pilot-testing, and 6) Field-testing. It can be described as a continuous process of evaluation and adaptation (198). The development of the study protocol for the multicentre study took place between June 2016 and June 2017 including a pilot study involving one school physician. No golden standard for need for school physician health check and benefit gained from it existed and thus we had to define the criteria. The research group defined the criteria for need for school physician health check to enable easy access to the school physician. The criteria for need using the wish-question (wish to speak with the school physician about some concern or wish for school physician to address some concern) were very simple. If the response to the wish-question was "Yes" or "I don't know" need for school physician was estimated. The criteria for physician-evaluated benefit of the health check were based on actions that require physician's expertise. Actions that the school nurse could have overtaken or actions with no significant harm as consequence of unhandled concerns were regarded in the final analysis as no benefit.

The feasibility of an assessment is defined as "the extent to which an assessment is suitable for use on a routine, sustainable and meaningful basis in typical clinical settings, when used in a specific manner and for a specific purpose" (199). Feasibility can be determined by six characteristics: 1) brevity (looks

short, easy to use), 2) simplicity (no training required, meaning of ratings clear), 3) relevance (results are in accord with clinical judgement, no jargon for patients) 4) acceptability (to professions and patients, flexible administration), 5) availability (free), and 6) value (the benefits outweigh the costs, meaningful feedback). The study group aimed at developing feasible study questionnaires. The questionnaires were simple to read and fast to complete based on the researcher's KN observations during the pilot study. However, the feasibility of the study questionnaires was not rated by the respondents.

We trained the participating professionals systematically and extensively for the study which reduced information bias. The training of teachers (15 minutes) was remarkably shorter than the training of physicians (1-1.5 hours) and nurses (1.5 hours) because the teachers only had to complete their own study questionnaires regarding each child. However, the shorter training may have had an effect on receiving the teachers' study questionnaires of which one-fifth were missing. The multi-informant approach reduced the impact of missing teacher questionnaires. Although we trained physicians similarly, subjectivity was impossible to eliminate when physicians reported their actions and evaluated the benefit of the health check. We considered this in the statistical analyses by using multilevel logistic regression and by incorporating different physicians as one of the four covariates.

The COSMIN study reached international consensus on definitions of measurement properties for health-related patient-reported outcomes (HR-PROs) such as reliability (200). Reliability can be defined as "the degree to which the measurement is free from measurement error" (200). The measurements can be repeated under several conditions such as using different set of items from the same outcomes (internal consistency), over time (test-retest), by different persons on the same occasion (interrater) or by the same persons on different occasions (intrarater). Internal consistency can be defined as "the degree of the interrelatedness among the items" (200). The Kappa Measure of Agreement is commonly used to assess inter-rater agreement (201). Kappa can be defined "as an estimate of the proportion of agreement between two raters that takes into account the amount of agreement that could have occurred by chance" (201). A value of 0.5 for Kappa represents moderate agreement, above 0.7 good agreement, and above 0.8 very good agreement. The researchers evaluated the need for a health check by a physician without knowing the physician- and parent-evaluated benefit of the health check. The interrater and intrarater reliability for need were calculated because the researchers had to assess the free descriptions of concerns in the study questionnaires. The interrater and intrarater values were 0.7 (good) and 0.8 (very good), respectively.

Validity can be defined as “the degree to which an HR-PRO instrument measures the construct(s) it purports to measure” (200). It can be divided into three types: content, construct, and criterion validity. Content validity assesses “the degree to which the content of an HR-PRO instrument is an adequate reflection of the construct to be measured” (200). Construct validity assesses “the degree to which the scores of an HR-PRO instrument are consistent with hypotheses based on the assumption that the instrument validly measures the construct to be measured” (200). It can be used in situations when no golden standard exists. Criterion validity means “the degree to which the scores of an HR-PRO instrument are an adequate reflection of a gold standard” (200). It would have been easier to use a validated measurement instrument instead of developing a new one. However, a simple, validated measurement instrument for evaluating both the physical and psychosocial health and well-being of the child was not found.

The diagnostic accuracy of a test in detecting the presence or absence of a disease can be assessed using statistical parameters sensitivity, specificity, positive and negative predictive values (201,202). Sensitivity reflects the proportion of cases with the disease or condition who gave a positive test result. Specificity is the proportion of cases without the disease who gave a negative test result. Positive predictive value is the proportion of correctly diagnosed patients with disease in subjects with positive test results. Negative predictive value is the proportion of those without the disease in subjects with negative test results. The predictive values of need for school physician health check for school-physician-evaluated benefit of the health check were calculated. The sensitivity of using all three questionnaires to identify children who would most likely benefit from a school doctors’ health check was high, about 90%. The specificity was low, about 28%. Since no golden standard exists for the outcomes need for a school physician health check and benefit gained from the health check we decided not to use the predictive values in the articles.

Physician-evaluated benefit is a surrogate endpoint that may not predict a true clinical outcome (203). A Cochrane review showed that general health checks in adults increased the number of new diagnoses but failed to reduce morbidity and mortality (204). Several reasons may diminish physician-evaluated benefit. Families may fail to follow the suggested tests and treatment plans. Adherence to prescribed medication can fail for several reasons (205–207). The interactional dynamics between the doctor-parent-child triad may be challenging (208). The intensity of the treatment may be insufficient (209). Childhood obesity and mental health problems are key areas of concern related to provision of services for children and adolescents (52,210). One third of

European countries lack community services for providing early intervention with a first episode of a mental health disorder. Legislation that affects the availability of unhealthy foods in schools is insufficient. Despite actions of school health care professionals in Finland, Häkkänen and co-workers showed that obesity increased and obese children remained obese at ages 7-12 years (33). Furthermore, other pathways may affect the health of children. Parents may by their own initiative contact other professionals outside school health services. Unpredictable favourable or adverse life events may occur after the health check. Since we conducted a large number of statistical analyses in study IV, individual results may be biased. Therefore, we decided to discuss topics that showed significant results in several areas.

Since the school physicians were blinded to the study questionnaires, we cannot know whether their actions were direct responses to the respondent concerns. However, the study questionnaires included the areas that are generally evaluated in preventive health care health checks. In addition, school physicians were able to utilise routine background information and patient records including information from the previous school nurse health check. In practice, the questionnaires could be considered prior to the health check to target school physician actions to the respondent concerns even more specifically than in this study.

7. CONCLUSIONS

Parent, teacher, and nurse concerns are valuable predictors of school physician actions in routine general health checks. The need for a school physician health check based on parent, teacher, and school nurse concerns is an important predictor of school-physician assessed benefit of the health check. Health checks by school physicians may result in referrals of children to other professionals particularly for children's psychosocial problems. In such cases, a health check by a school physician may be an unnecessary step before providing treatment for concerns. Both school physicians and parents valued the appointments with school physician actions. Parents appreciated the appointments with immediate help such as instructions, medical prescriptions and testing from the physician compared with appointments with scheduled follow-up or referrals to other professionals. Physicians particularly valued the health checks where actions required their medical competence.

These findings emphasise the value of evaluating parent, teacher, and nurse concerns after the routine school nurse health check and offering school physician expertise in response to the remaining concerns. Especially psychosocial concerns may require a multidisciplinary evaluation of the most suitable treatment method.

8. IMPLICATIONS

8.1 Policies and clinical practice

The provision of targeted, need-based health care services to school-aged children is a delicate subject because it may have unpredictable effects. If the services are associated with stigma, they may be underused. The time needed for case-finding should be considered. Furthermore, omitting obligatory school physician health checks may increase the risk of diminishing school physician resources from schools instead of targeting the resources more efficiently. Targeting school physician resources efficiently requires carefully planned action based on scientific evidence and extensive discussion in the society.

In Finland, a change of legislation is a prerequisite in order to provide flexibility in arranging school physician evaluation and for providing care for detected problems in school health services. Valvira has proposed dismantling the norms and increasing the discretion of the service organisers regarding the way the services are implemented to achieve the targets, as well as the development of methods to identify risk groups to target the services (34). A recent report on increasing the effectiveness of mental health care of children and young people in Finland suggested that the treatment of mild mental health disorders should be included in school health services in grades 1-9 (211). The report suggested that the additional resourcing required should be ensured by adding resources or prioritising existing actions. If school physician evaluations were targeted, school physicians could allocate more time for the treatment of identified problems in collaboration with the school, community services, child protection, and specialised care. The concerns remaining after the school nurse health check could be the basis for multidisciplinary evaluation of the most suitable professional/professionals to provide help instead of all children and families meeting a physician. In my opinion, the law change should be implemented in such a way that physicians are not reduced from school health care (122). When targeting the amount of school physicians per region, service organisers should take into account the educational level of the guardians, the income level of the families and the immigrant background of the children of each school. The school nurses can strengthen the resources, health and well-being of every child and family. The school physician's assessment should be aimed at those who need it most in all age groups.

8.2 Future research

The quality of school health services requires stronger indicators than the coverage of obligatory health checks of school nurses and physicians or the acceptability of the services. Further studies on the long-term effectiveness and cost-effectiveness of school nurse and physician actions are needed. Research is needed on the effectiveness of a multidisciplinary approach to handling parent, teacher, and nurse concerns in a randomised controlled study. Research is also needed on examining the impact of telehealth in improving effectiveness. The quality of school health care should be measured by monitoring the change in children's health status, school performance, and quality of life.

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