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Associating school doctor interventions with the benefit of the health check: an observational study

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5 **Associating school doctor interventions with the benefit of the health check: an observational**
6 **study**
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26 **What is known about this subject**

27 A systematic review on the effectiveness of school health services suggested a need for assessment
28 of routinely-delivered school health services. Previously, doctors regarded 41% and parents 83% of
29 the health checks performed by a school doctor as beneficial.
30

31 **What this study adds** Doctors conducted interventions for 78% of the participating 1013 children.
32 Doctors especially valued the appointments where interventions required their medical expertise.
33 Parents appreciated immediate instructions, medical prescriptions and testing from the doctor
34 compared with scheduled follow-up or referrals to other professionals.
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ABSTRACT

Background: The benefits of school doctor interventions conducted at routine general health checks remain insufficiently studied. This study explored the associations of school doctor interventions with the doctor- and parent-evaluated benefits of routine health checks.

Methods: Between August 2017 and August 2018, we recruited a random sample of 1 341 children from grades one and five from 21 Finnish elementary schools in four municipalities. Doctors routinely examined all children, who were accompanied by parents. The doctor-reported interventions were categorized into six groups: instructions or significant discussions, prescriptions, laboratory tests and/or medical imaging, scheduling of follow-up appointments, referrals to other professionals, and referrals to specialized care. Doctors evaluated the benefit of the appointment using predetermined criteria, and parents provided their subjective perceptions of benefit. Interventions and reported benefit were compared using multilevel logistic regression.

Results: Doctors reported 52% and parents 87% of the appointments with interventions beneficial. All interventions were independently associated with doctor-evaluated benefit (ORs 1.91–17.26). Receiving any intervention during the appointment was associated with parent-evaluated benefit (OR 3.25, 95% CI 2.22-4.75). In analyses of different interventions, instructions and significant discussions (OR 1.71, 95% CI 1.20-2.44), prescriptions (OR 7.44, 95% CI 2.32-23.91), and laboratory tests and/or medical imaging (OR 3.38, 95% CI 1.34-8.55) were associated with parent-evaluated benefit. Scheduled follow-up appointments and referrals to other professionals showed no significant association with parent-evaluated benefit.

Conclusions: Doctors and parents valued the appointments with interventions. Parents especially appreciated immediate help and testing from the doctor.

Trial registration: ClinicalTrials.gov register, NCT03178331

INTRODUCTION

The organization and financing of school health services differ globally across over one hundred countries¹⁻⁴. In Europe, the main features include health promotion, preventive care and medical treatment procedures with a holistic bio-psycho-social approach³. School health services and school-based health centers may improve educational and health-related outcomes and they seem cost-beneficial⁵⁻⁹.

According to a systematic review on the effectiveness of school health services, a need remains for assessment of routinely-delivered school health services¹⁰. The World Health Organization guideline on school health services recommends clarification of what is already being done and by whom, the identification of conditions to be targeted and the set of interventions to be employed¹¹. The benefits of school doctor interventions conducted in the setting of routine general health checks remain insufficiently studied.

Finland is a high-income country with an extensive health check system starting from pregnancy^{12,13}. School doctors perform routine general health checks at certain grades in addition to annual health checks by school nurses. Our previous research concluded that the concern-based need for a school doctor health check is an important predictor of doctor evaluated benefit of the health check¹⁴. This study assessed the associations of school doctor interventions with the benefit of routine health checks as evaluated by both doctors and parents.

METHODS

Study design

In this observational study of randomly selected elementary school children, the interventions provided by school doctors were compared with the benefit or harm of the doctor's appointment as reported by the doctors and parents. In brief, data collection took place in 2017–2018 in four cities/municipalities in Finland¹³. In one of the cities (Helsinki) doctors worked exclusively in schools, whereas in the three other cities/municipalities (Tampere, Kerava and Kirkkonummi), some doctors worked part-time in schools and also provided medical services at well child clinics and health centers.

Participants

In Helsinki, six school doctors gave consent to participate in the study and chose schools from different socioeconomic areas in the city. In Tampere, Kirkkonummi and Kerava, medical directors enrolled doctors with varying education and work experience and schools from different socioeconomic areas. All schools were public elementary schools. The school nurses and teachers were recruited from their respective schools.

Between August 2017 and August 2018, we enrolled a random sample of 1341 eligible children from the participating schools. Exclusion criteria were children mainly studying in special education groups and children whose parents needed an interpreter.

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3 Participation rates, reasons for non-participation, and doctor- and parent-evaluated benefit or harm
4 of appointments have been described previously ¹⁴. In brief, with a participation rate of 75.5%, 1013
5 children participated in the study. This included 506 first graders (age 7-8 years) and 507 fifth
6 graders (age 11-12 years) from 21 public elementary schools. Overall, the 14 participating doctors
7 considered 410 (40.6%) of the health checks as being beneficial. The parents perceived 812 (83.4%)
8 of the health checks as being beneficial, and respondents rarely reported harm.
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19 **Procedures**

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23 All school doctors performed children's health checks as usual and had access to routine
24 background information and patient records. Typically, a health check took 30 minutes. After each
25 health check, the doctors had extra time to fill in an electronic study report including details on all
26 interventions that they undertook during the health check. In addition, the doctors evaluated the
27 benefit or harm of the appointment using predetermined criteria. The parents evaluated their
28 subjective perception of the benefit or harm of the health check in their own report (patient-reported
29 experience measure, PREM).
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42 **Outcomes**

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47 The outcome measures were the interventions undertaken during the health check and the doctor-
48 and parent-evaluations of benefit/harm of the appointment. Intervention types were collected from
49 the electronic study reports completed by school doctors after the health checks.
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56 Doctors assessed the benefit or harm of each health check on a six-point Likert scale (from "Quite a
57 lot of harm" to "A great deal of benefit") according to predetermined criteria (study protocol, Table
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3 2) ¹³. The doctors reported quite a lot or a great deal of benefit if they performed any significant
4 interventions based on predetermined criteria. The category of “Only a little benefit” was used if the
5 school nurse could have replaced the doctor. The doctors recorded harm if the interaction was
6 unsatisfactory, or if they suspected no progress in care or denial of school doctor services in the
7 future. The parents evaluated how beneficial or harmful they considered the school doctor’s
8 examination using the same scale as doctors without predetermined criteria. English translations of
9 the PREMs are provided in Additional files 5 and 6 of the study protocol ¹³.
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21 We combined the responses "Quite a lot of benefit" and "A great deal of benefit" into one category
22 and refer to them as Beneficial. The responses "Only a little benefit", "No benefit or harm", "Only a
23 little harm", "Quite a lot of harm" and "I don't know" were grouped into Little or no benefit.
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30 **Statistical analyses**

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35 According to power calculations, the amount of children needed was sufficient for this study ¹³.
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37 Frequencies with percentages were used as descriptive statistics.
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41 The association of the doctors’ interventions with the doctor- and parent-evaluated benefit of the
42 health check were analyzed using multilevel logistic regression to account for the clustered nature
43 of the data. Four-level models with child at level one, school at level two, doctor at level three, and
44 city/municipality at level four were used and models were adjusted for grade. Odds ratios (OR) with
45 95% confidence intervals (CI) were used to express the results. SAS 9.4 System for Windows (SAS
46 Institute Inc., Cary, NC) was utilized for multilevel modeling. Other analyses were conducted using
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48 IBM SPSS Statistics 25.0 for Windows (IBM Corp., Armonk, NY). P-values less than 0.05 were
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57 regarded statistically significant.
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Patient and public involvement

No patients or public were involved in this study.

RESULTS

The doctors conducted interventions in 78% of the 1013 health checks (Supplemental table 1). The most common intervention was the provision of instructions or a significant discussion regarding physical health for 60% of families. Nutrition, skin, or weight were the most common reasons for instructions or discussions. In 17% of the health checks doctors scheduled new school health care appointments mostly to check growth or posture. Doctors planned follow-up appointments with themselves in 3% of cases. Abdominal symptoms and overweight/obesity were the most common reasons for laboratory testing. Doctors conducted interventions related to cardiac murmurs in six cases. Doctors made referrals for psychiatric, psychosocial, or neurologic problems for 9% of children. Most referrals to other professionals for physical health problems were directed to physiotherapists and for psychosocial problems to psychologists or social workers. Doctors contacted child-protection services in less than 0.5% of cases.

Supplemental table 1 Interventions by school doctors

	Total, n=1013		
	Interventions	Children	
	n	n	% of children
Total interventions	1483	792	78.2 %
Instruction or significant discussion*	887	606	59.8 %
Physical health	697	531	52.4 %
nutrition	130		
skin	94		

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4	weight	88		
5	other recurrent pain or prolonged complaints	78		
6	growth/development	70		
7	posture/chest/position of feet	38		
8	screen time/exercise	33		
9	stomach problems	31		
10	headache	26		
11	wetting	20		
12	allergy	19		
13	other	70		
14				
15	Psychosocial	190	163	16.1 %
16	sleeping	41		
17	ability to get on with others	30		
18	emotions	28		
19	concentration	26		
20	well-being of a family member or the whole family	24		
21	behavior	13		
22	school engagement /absenteeism	19		
23	learning	9		
24				
25				
26				
27				
28				
29				
30	Prescription	114	105	10.4 %
31	skin	61		
32	allergy	20		
33	other	33		
34				
35				
36				
37	Lab. ECG or imaging	104	86	8.5 %
38	Laboratory test	76		
39	X-ray/Ultrasound	22		
40	Electrocardiogram	6		
41				
42				
43				
44				
45				
46				
47	Follow-up appointment	184	175	17.3 %
48	School nurse	142	138	13.6 %
49	School doctor	27	27	2.7 %
50	School nurse/doctor. undefined	15	14	1.4 %
51				
52				
53				
54	Referral to other professional	141	136	13.4 %
55	Physical health problems	56	56	5.5 %
56	Psychosocial problems	85	82	8.1 %
57				
58				
59	Referral to secondary care	53	52	5.1 %
60				

Physical health problems	44	43	4.2 %
Neurologic or mental health problems	9	9	0.9 %

*Relates to a different subject than a prescription or a referral to lab, ECG or imaging, other professional or secondary care

Doctors' evaluations of benefit or harm were available for 1010 children's health checks. The doctors reported 52% of the appointments with any intervention beneficial and none of the appointments with no interventions beneficial. All interventions were independently associated with doctor-evaluated benefit (ORs 1.91–17.26, $p < 0.001$) (Table 1). Prescriptions (OR 5.56, 95% CI 3.46-8.94), laboratory tests or medical imaging (OR 15.16, 95% CI 7.35-31.26), and referrals to specialized care (OR 17.26, 95% CI 6.61-45.05) were most strongly associated with doctor-evaluated benefit ($p < 0.001$).

Table 1 Association of doctor's intervention with doctor-evaluated benefit of the health check; Multilevel logistic regression analysis

Doctor's intervention	Total N	Beneficial health check, as assessed by doctor n (%)	OR (95% CI)	P-value
Any intervention				
Yes	791	410 (51.8)	NA	<0.001*
No	219	0 (0)		
Instruction or significant discussion				
Yes	605	282 (46.6)	1.91 (1.44-2.55)	<0.001
No	405	128 (31.6)	1	
Prescription				
Yes	105	77 (73.3)	5.56 (3.46-8.94)	<0.001
No	905	333 (36.8)	1	
Laboratory tests or medical imaging				
Yes	86	77 (89.5)	15.16 (7.35-31.26)	<0.001
No	924	333 (36.0)	1	
Follow-up appointment in school health service				
Yes	175	114 (65.1)	3.06 (2.13-4.39)	<0.001
No	835	296 (35.4)	1	
Referral to other professional within school or community services				

Yes	136	94 (69.1)	4.29 (2.82-6.52)	<0.001
No	874	316 (36.2)	1	
Referral to specialized care				
Yes	52	47 (90.4)	17.26 (6.61-45.05)	<0.001
No	958	363 (37.9)	1	

Doctor-reported benefit was available for 1010 children.

NA = Not available due to zero frequency

OR = Odds ratio; adjusted for grade

CI = Confidence interval

* Fisher's exact test

Parents' evaluations of benefit or harm were available for 971 children's health checks. Parents reported 87% of the appointments with any intervention beneficial and 68% of the appointments with no interventions beneficial (Table 2). Receiving an intervention during the appointment was associated with parent-evaluated benefit (OR 3.25, 95% CI 2.22-4.75). The appointments with instructions or significant discussions (OR 1.71, 95% CI 1.20-2.44), the appointments with prescriptions (OR 7.44, 95% CI 2.32-23.91), and the appointments that lead to laboratory tests or medical imaging (OR 3.38, 95% CI 1.34-8.55) were more often considered as beneficial than the appointments without these interventions ($p < 0.01$ for all). The appointments that resulted in scheduling a follow-up appointment in school health services, a referral to other professionals within the school or community services, or a referral to specialized care showed no significant association with parent-evaluated benefit (Table 2).

Table 2 Association of doctor's intervention with parent-evaluated benefit of the health check; Multilevel logistic regression analysis

Doctor's intervention	Total N	Beneficial health check, as assessed by parent n (%)	OR (95% CI)	P-value
Any intervention				
Yes	766	669 (87.3)	3.25 (2.22-4.75)	<0.001
No	205	140 (68.3)	1	
Instruction or significant discussion				
Yes	587	507 (86.4)	1.71 (1.20-2.44)	0.003

No	384	302 (78.6)	1	
Prescription				
Yes	102	99 (97.1)	7.44 (2.32-23.91)	<0.001
No	869	710 (81.7)	1	
Laboratory tests or medical imaging				
Yes	85	80 (94.1)	3.38 (1.34-8.55)	0.01
No	886	729 (82.3)	1	
Follow-up appointment in school health service				
Yes	170	146 (85.9)	1.12 (0.69-1.81)	0.66
No	801	663 (82.8)	1	
Referral to other professional within school or community services				
Yes	128	111 (86.7)	1.48 (0.85-2.58)	0.16
No	843	698 (82.8)	1	
Referral to specialized care				
Yes	51	48 (94.1)	3.25 (0.99-10.66)	0.05
No	920	761 (82.7)	1	

Parent-evaluated benefit was available for 971 children.

OR = Odds ratio; adjusted for grade

CI = Confidence interval

DISCUSSION

In this study of routine health checks in elementary school, doctors and parents valued the appointments with interventions more than the appointments with no interventions. Most interventions targeted physical health. Appointments with instructions and significant discussions, prescriptions, and laboratory tests or medical imaging were associated with both doctor- and parent-evaluated benefit. By contrast, appointments that resulted in scheduling of follow-up appointments, referrals to other professionals within school or community services, and referrals to specialized care, were only associated with doctor-evaluated benefit.

Despite the increasing demand for professionals to provide care for children and adults facing mental health disorders¹⁵, doctors in this study rarely made referrals for mental health or neurological problems, seldom guided families to specialized workers for psychosocial problems,

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3 and rarely contacted child-protection services. Some families may have received referrals to these
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5 specialists already earlier or may have refused their help. Although the participation rate in this
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7 study was high, it is possible that the families with most stressors in their life refused to participate
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9 or were excluded from the study, and thus these findings may be skewed. Child maltreatment could
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11 be recognized and support offered through contacts with professionals working in schools ¹⁶,
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13 although universal screening for child maltreatment is unsuitable ¹⁷. Our findings strengthen our
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15 perception that child maltreatment is usually suspected and psychosocial problems are usually
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17 identified outside of doctors' routine health checks. These results are also in line with a Dutch study
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19 in which doctors' assistants were as capable as nurses or doctors to detect psychosocial problems ¹⁸.
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26 Among children who underwent a routine health check in elementary school, few children had
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28 physical findings that require a doctor's expertise to be recognized, such as heart murmurs. Cardiac
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30 murmurs in children are common ¹⁹ but less than 1% of auscultated murmurs are of organic cause
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32 ²⁰. In Finland, doctors already screen children for cardiac and other major physical health problems
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34 in health checks at the ages of 4-6 weeks, four, eight, and 18 months, and four years.
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40 The doctors reported that half of their appointments with interventions were beneficial. The doctors
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42 may have estimated that the school nurse or another professional could have provided the
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44 intervention as well. In the Netherlands, doctors' assistants detected children's overweight, visual
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46 disorders and psychosocial problems as well as did doctors or nurses ¹⁸. According to a Cochrane
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48 review, nurses may achieve higher patient satisfaction than primary care doctors ²¹. In some cases,
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50 the doctors may have been uncertain about the significance of their findings. Overdiagnosis is a
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52 common problem involving childhood conditions such as food allergy, obstructive sleep apnea, and
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54 attention-deficit/hyperactivity disorder ²²⁻²⁶. Prescriptions, laboratory tests or medical imaging, and
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56 referrals to specialized care were most strongly associated with doctor-evaluated benefit. These
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3 interventions usually require medical training. Some prescription renewals could potentially have
4 been handled more effectively through the electronic health record system than during an
5 appointment ²⁷. The doctors regarded none of the appointments without interventions beneficial.
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10 These findings are in line with the predetermined criteria of benefit and harm ¹³ and strengthen the
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12 validity of the output measure of doctor-evaluated benefit.
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17 Parents reported 87% of the appointments with interventions beneficial and reported benefit also
18 after 68% of the health checks with no interventions. The parents may have appreciated the
19 thorough check of their child for abnormalities. Expecting parents to know when doctor's expertise
20 is required is unreasonable. Parents are usually unaware that as a consequence of universal health
21 checks at certain grades only limited school doctor resources are available to children in other
22 grades. Few pediatric primary care providers actually have health policy discussions with families
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Parents' evaluations may reflect the barriers in actualizing planned care. Children may miss their
planned appointment at specialized care or other experts for several reasons, including
logistical/practical factors, long waiting times and quality of interaction between parent and health
professional ²⁹. The parent may have had no concerns regarding their child prior to the health check
and they may even have disagreed about the doctor's concern. In a Dutch study, child health
professionals more often perceived psychosocial problems in children aged 8-12 years than did their
parents ³⁰. Such situations of dissonance may require more time for resolution than is available
during a routine health check. In almost one fifth of the health checks doctors scheduled new school
health care appointments mostly to check growth or posture. However, doctors rarely planned
follow-up appointments with themselves. For an intervention to be effective, continuity across time
and services must be ensured ³¹. Some referrals to other professionals and specialized care could

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3 potentially have been avoided by models of integrated care such as multidisciplinary meetings
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5 which may enhance patient satisfaction and increase perceived quality of care ³².
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10 This study has several strengths. The data included in this study have been collected recently before
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12 the COVID-19 pandemic with a high participation rate, thus representing the situation of today's
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14 generation of children in developed countries with an extensive health check system during
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16 childhood. We increased the generalizability of the results by including schools from different
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18 municipalities and socioeconomic areas. We reduced information bias by systematic training of the
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20 participating doctors on the criteria of benefit.
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26 One of the study limitations is that the physicians participating were not a random sample, though
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28 the participants had varying education and work experience. Second, selection bias is possible as a
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30 quarter of invited families declined participation, and non-participants likely differed from
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32 participants. We excluded vulnerable groups: children mainly in special education groups and
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34 whose parents needed an interpreter. However, many of the challenges in these groups are evident,
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36 children already have contacts with various professionals, and a health check by a school doctor is
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38 offered to confirm adequate services. Although the doctors followed predetermined criteria when
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40 assessing benefit, information bias may have emerged. This was a self-assessment with unavoidable
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42 subjectivity. We considered this in the statistical analyses by using multilevel logistic regression
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44 and comprised different doctors as one of the four covariates. The small number of referrals to
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46 specialized care may have had an effect on the results.
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54 The surrogate outcomes of doctor- and parent-evaluated benefit regarding any intervention should
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56 be appraised critically. Surrogate outcomes can fail to predict a true clinical outcome ³³. Globally,
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58 the provision of services and the intensity and extent of interventions related to obesity and mental
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3 health problems are often inadequate and insufficient^{34,35}. Despite health checks in Finland,
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5 Häkkänen and coworkers showed that obesity increased and obese children remained obese during
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7 elementary school³⁶. The long-term impacts of the interventions in this study remain unknown.
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10 11 12 **Conclusions**

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17 In this study, both school doctors and parents valued the appointments with interventions. Parents
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19 appreciated immediate instructions, medical prescriptions and testing from the doctor compared
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21 with scheduled follow-up or referrals to other professionals. These findings suggest that school
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23 doctors should provide children and families with evidence-based interventions instead of routine
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25 health checks. Future studies should investigate the long-term effectiveness of school doctor
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27 interventions.
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33 **Contributors** KN conceived and designed the study, collected, analyzed, and interpreted the data,
34
35 and drafted the manuscript. SK made significant contributions to the design of the multicenter study
36
37 and analysis plans. TV was responsible for and mainly conducted the statistical analyses. MK made
38
39 significant contributions to the design of the multicenter study and analysis plans. EH participated
40
41 in the design and analyses of the pilot study and the design of the multicenter study. All authors
42
43 interpreted the results and critically reviewed the manuscript. All authors approved the final
44
45 manuscript as submitted and agree to be accountable for all aspects of the work.

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55
56 design, data collection, data analysis, data interpretation, or writing of the report.

57
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59
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children, parents, nurses, teachers, and doctors.

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Data availability statement The datasets generated and analyzed during the current study are not publicly available due to restrictions that applied under the license for the study but are available from the corresponding author KN and MK on reasonable request.

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REFERENCES

1. Baltag V, Pachyna A, Hall J. Global Overview of School Health Services: Data from 102 Countries. *Health Behav Policy Rev.* 2015;2(4):268-283.
2. Baltag V, Levi M. Organizational models of school health services in the WHO European Region. *J Health Organ Manag.* 2013;27(6):733-746.
3. Jansen DEMC, Visser A, Vervoort JPM, et al. School and Adolescent Health Services in 30

- 1
2
3 European countries: a description of structure and functioning, and of health outcomes and costs.
4 2018. Available: [https://www.childhealthservicemodels.eu/wp-content/uploads/Deliverable-](https://www.childhealthservicemodels.eu/wp-content/uploads/Deliverable-173.1_Final-report-on-the-description-of-the-various-models-of-school-health-services-and-adolescent-health-services-1.pdf)
5 [173.1_Final-report-on-the-description-of-the-various-models-of-school-health-services-and-](https://www.childhealthservicemodels.eu/wp-content/uploads/Deliverable-173.1_Final-report-on-the-description-of-the-various-models-of-school-health-services-and-adolescent-health-services-1.pdf)
6 [adolescent-health-services-1.pdf](https://www.childhealthservicemodels.eu/wp-content/uploads/Deliverable-173.1_Final-report-on-the-description-of-the-various-models-of-school-health-services-and-adolescent-health-services-1.pdf) [Accessed Nov 15, 2021].
7
8
9 4. van der Pol S, Postma MJ, Jansen DEMC. School health in Europe: a review of workforce
10 expenditure across five countries. *BMC Health Serv Res.* 2020;20.
11
12 5. Leroy ZC, Wallin R, Lee S. The Role of School Health Services in Addressing the Needs of
13 Students With Chronic Health Conditions: A Systematic Review. *J Sch Nurs.* 2017;33(1):64-72.
14
15 6. Knopf JA, Finnie RKC, Peng Y, et al. School-Based Health Centers to Advance Health Equity: A
16 Community Guide Systematic Review. *Am J Prev Med.* 2016;51(1):114-126.
17
18 7. Best NC, Oppewal S, Travers D. Exploring School Nurse Interventions and Health and
19 Education Outcomes: An Integrative Review. *J Sch Nurs.* 2018;34(1):14-27.
20
21 8. Harris K, Kneale D, Lasserson TJ, McDonald VM, Grigg J, Thomas J. School-based
22 self-management interventions for asthma in children and adolescents: a mixed methods systematic
23 review. *Cochrane Database Syst Rev.* 2019;(1): CD011651.
24
25 9. Ran T, Chattopadhyay SK, Hahn RA. Economic Evaluation of School-Based Health Centers. *Am*
26 *J Prev Med.* 2016;51(1):129-138.
27
28 10. Levinson J, Kohl K, Baltag V, Ross DA. Investigating the effectiveness of school health
29 services delivered by a health provider: A systematic review of systematic reviews. *PLOS ONE.*
30 2019;14(6):e0212603.
31
32 11. World Health Organization. WHO guideline on school health services. 2021. Available:
33 <https://www.who.int/publications-detail-redirect/9789240029392> [Accessed Nov 15, 2021].
34
35 12. Wilson P, Wood R, Lykke K, et al. International variation in programmes for assessment of
36 children's neurodevelopment in the community: Understanding disparate approaches to evaluation
37 of motor, social, emotional, behavioural and cognitive function. *Scand J Public Health.*
38 2018;46(8):805-816.
39
40 13. Nikander K, Kosola S, Kaila M, Hermanson E. Who benefit from school doctors' health checks:
41 a prospective study of a screening method. *BMC Health Serv Res.* 2018;18(1):501.
42
43 14. Nikander K, Hermanson E, Vahlberg T, Kaila M, Sannisto T, Kosola S. Associations between
44 study questionnaire-assessed need and school doctor-evaluated benefit of routine health checks: an
45 observational study. *BMC Pediatr.* 2021;21(1):346.
46
47 15. Skokauskas N, Fung D, Flaherty LT, et al. Shaping the future of child and adolescent
48 psychiatry. *Child Adolesc Psychiatry Ment Health.* 2019;13(1):19.
49
50 16. Gilbert R, Kemp A, Thoburn J, et al. Recognising and responding to child maltreatment. *The*
51 *Lancet.* 2009;373(9658):167-180.
52
53 17. World Health Organization. WHO Guidelines for the health sector response to child
54 maltreatment. 2019. Available: [https://www.who.int/publications/m/item/who-guidelines-for-the-](https://www.who.int/publications/m/item/who-guidelines-for-the-health-sector-response-to-child-maltreatment)
55 [health-sector-response-to-child-maltreatment](https://www.who.int/publications/m/item/who-guidelines-for-the-health-sector-response-to-child-maltreatment) [Accessed Nov 15, 2021].
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52
53
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56
57
58
59
60

18. Bezem J, Theunissen M, Kamphuis M, Numans ME, Buitendijk SE, Kocken P. A Novel Triage Approach to Identifying Health Concerns. *Pediatrics*. 2016;137(3):e20150814-0814.
19. Wen J, Snyder C. Prevalence of Innocent Murmurs in Pediatric Patients. *Pediatrics*. 2019;144:325
20. Kostopoulou* E, Karatza GD and A. Cardiac Murmurs in Children: A Challenge For The Primary Care Physician. *Current Pediatric Reviews*. 2019;15,131-138
21. Laurant M, Biezen M van der, Wijers N, Watananirun K, Kontopantelis E, Vught AJ van. Nurses as substitutes for doctors in primary care. *Cochrane Database Syst Rev*. 2018;(7):CD001271.
22. Coon ER, Quinonez RA, Moyer VA, Schroeder AR. Overdiagnosis: How Our Compulsion for Diagnosis May Be Harming Children. *Pediatrics*. 2014;134(5):1013-1023.
23. Sicherer SH, Wood RA, Immunology the SOAA. Allergy Testing in Childhood: Using Allergen-Specific IgE Tests. *Pediatrics*. 2012;129(1):193-197.
24. Venekamp RP, Hearne BJ, Chandrasekharan D, Blackshaw H, Lim J, Schilder AGM. Tonsillectomy or adenotonsillectomy versus non-surgical management for obstructive sleep-disordered breathing in children. *Cochrane Database Syst Rev*. 2015;(10):CD011165.
25. Morrow RL, Garland EJ, Wright JM, Maclure M, Taylor S, Dormuth CR. Influence of relative age on diagnosis and treatment of attention-deficit/hyperactivity disorder in children. *CMAJ Can Med Assoc J*. 2012;184(7):755-762.
26. Merten EC, Cwik JC, Margraf J, Schneider S. Overdiagnosis of mental disorders in children and adolescents (in developed countries). *Child Adolesc Psychiatry Ment Health*. 2017;11:5.
27. Pattin AJ, Devore N, Fowler J, Weldy D. An Examination of the Prescription Renewal Process and Implications for Primary Care Physicians and Community Pharmacists. *J Pharm Pract*. 2020;33(2):187-191.
28. Vasan A, Krass P, Seifu L, et al. Pediatric provider perspectives and practices regarding health policy discussions with families: a mixed methods study. *BMC Pediatr*. 2020;20(1):343.
29. Arai L, Stapley S, Roberts H. 'Did not attends' in children 0–10: a scoping review. *Child Care Health Dev*. 2014;40(6):797-805.
30. Crone MR, Zeijl E, Reijneveld SA. When do parents and child health professionals agree on child's psychosocial problems? Cross-sectional study on parent–child health professional dyads. *BMC Psychiatry*. 2016;16(1):151.
31. Spencer N, Raman S, O'Hare B, Tamburlini G. Addressing inequities in child health and development: towards social justice. *BMJ Paediatr Open*. 2019;3:e000503.
32. Baxter S, Johnson M, Chambers D, Sutton A, Goyder E, Booth A. The effects of integrated care: a systematic review of UK and international evidence. *BMC Health Serv Res*. 2018;18:350.
33. Fleming TR. Surrogate End Points in Clinical Trials: Are We Being Misled? *Ann Intern Med*.

1
2
3 1996;125(7):605.
4

5 34. Alemán-Díaz AY, Backhaus S, Siebers LL, et al. Child and adolescent health in Europe:
6 monitoring implementation of policies and provision of services. *Lancet Child Adolesc Health*.
7 2018;2(12):891-904.
8

9 35. Rocha TBM, Graeff-Martins AS, Kieling C, Rohde LA. Provision of mental healthcare for
10 children and adolescents: a worldwide view. *Curr Opin Psychiatry*. 2015;28(4):330-335.
11
12

13 36. Häkkänen P, Ketola E, Laatikainen T. Development of overweight and obesity among primary
14 school children—a longitudinal cohort study. *Fam Pract*. 2016;33(4):368-373.
15
16
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Associating school doctor interventions with the benefit of the health check: an observational study

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5 **Associating school doctor interventions with the benefit of the health check: an observational**
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26 **What is known about this subject**

27 A systematic review on the effectiveness of school health services suggested a need for assessment
28 of routinely-delivered school health services. Previously, doctors regarded 41% and parents 83% of
29 the health checks performed by a school doctor as beneficial.
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31 **What this study adds** Doctors conducted interventions for 78% of the participating 1013 children.
32 Doctors especially valued the appointments where interventions required their medical expertise.
33 Parents appreciated immediate instructions, medical prescriptions and testing from the doctor
34 compared with scheduled follow-up or referrals to other professionals.
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ABSTRACT

Background: The benefits of school doctor interventions conducted at routine general health checks remain insufficiently studied. This study explored the associations of school doctor interventions with the doctor- and parent-evaluated benefits of routine health checks.

Methods: Between August 2017 and August 2018, we recruited a random sample of 1 341 children from grades one and five from 21 Finnish elementary schools in four municipalities. Doctors routinely examined all children, who were accompanied by parents. The doctor-reported interventions were categorized into six groups: instructions or significant discussions, prescriptions, laboratory tests and/or medical imaging, scheduling of follow-up appointments, referrals to other professionals, and referrals to specialized care. Doctors evaluated the benefit of the appointment using predetermined criteria, and parents provided their subjective perceptions of benefit. Interventions and reported benefit were compared using multilevel logistic regression.

Results: Doctors reported 52% and parents 87% of the appointments with interventions beneficial. All interventions were independently associated with doctor-evaluated benefit (ORs 1.91–17.26). Receiving any intervention during the appointment was associated with parent-evaluated benefit (OR 3.25, 95% CI 2.22-4.75). In analyses of different interventions, instructions and significant discussions (OR 1.71, 95% CI 1.20-2.44), prescriptions (OR 7.44, 95% CI 2.32-23.91), and laboratory tests and/or medical imaging (OR 3.38, 95% CI 1.34-8.55) were associated with parent-evaluated benefit. Scheduled follow-up appointments and referrals to other professionals showed no significant association with parent-evaluated benefit.

Conclusions: Doctors and parents valued the appointments with interventions. Parents especially appreciated immediate help and testing from the doctor.

Trial registration: ClinicalTrials.gov register, NCT03178331

INTRODUCTION

The organization and financing of school health services differ globally across over one hundred countries¹⁻⁴. In Europe, the main features include health promotion, preventive care and medical treatment procedures with a holistic bio-psycho-social approach³. School health services and school-based health centers may improve educational and health-related outcomes and they seem cost-beneficial⁵⁻⁹.

Finland is a high-income country with an extensive health check system starting from pregnancy^{10,11}. The system is based on the Finnish law and instructions provided by The National Institute for Health and Welfare¹². School doctors perform routine general health checks in grades 1, 5 and 8 (at ages 7, 11 and 14 years, respectively) in addition to annual health checks by school nurses. Our previous research concluded that the concern-based need for a school doctor health check is an important predictor of doctor evaluated benefit of the health check¹³.

According to a systematic review on the effectiveness of school health services, a demand remains for assessment of routinely-delivered school health services¹⁴. The World Health Organization guideline on school health services recommends clarification of what is already being done and by whom, the identification of conditions to be targeted and the set of interventions to be employed¹⁵. The benefits of school doctor interventions conducted in the setting of routine general health checks remain insufficiently studied. This study aimed to elucidate the potential benefits.

METHODS

Study design

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3 In this observational study of randomly selected elementary school children, the interventions
4 provided by school doctors were compared with the benefit or harm of the doctor's appointment as
5 reported by the doctors and parents. In brief, data collection took place in 2017–2018 in four
6 cities/municipalities in Finland ¹¹. In one of the cities (Helsinki) doctors worked exclusively in
7 schools, whereas in the three other cities/municipalities (Tampere, Kerava and Kirkkonummi),
8 some doctors worked part-time in schools and also provided health checks before school-age and
9 medical services at health centers.
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21 **Participants**

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26 In Helsinki, six school doctors gave consent to participate in the study and chose schools from
27 different socioeconomic areas in the city. In Tampere, Kirkkonummi and Kerava, medical directors
28 enrolled doctors with varying education and work experience and schools from different
29 socioeconomic areas. All schools were public elementary schools. The school nurses and teachers
30 were recruited from their respective schools.
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40 Between August 2017 and August 2018, we enrolled a random sample of 1341 eligible children
41 from the participating schools. Exclusion criteria were children mainly studying in special
42 education groups and children whose parents needed an interpreter.
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49 Participation rates, reasons for non-participation, and doctor- and parent-evaluated benefit or harm
50 of appointments have been described previously ¹³. In brief, with a participation rate of 75.5%, 1013
51 children participated in the study. This included 506 first graders (age 7-8 years) and 507 fifth
52 graders (age 11-12 years) from 21 public elementary schools. Overall, the 14 participating doctors
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3 considered 410 (40.6%) of the health checks as being beneficial. The parents perceived 812 (83.4%)
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5 of the health checks as being beneficial, and respondents rarely reported harm.
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10 **Procedures**

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14 All school doctors performed children's health checks as usual and had access to routine
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16 background information and patient records from the health center and specialist care. The
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18 extensive health check in Finnish school health services is described in Figure 1 and Table 1 of the
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20 study protocol ¹¹. Typically, a routine health check takes 30 minutes. After each health check in this
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22 study, the doctors had 5 minutes extra time to fill in an electronic study report including details on
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24 all interventions that they undertook during the health check. In addition, the doctors evaluated the
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26 benefit or harm of the appointment using predetermined criteria. The parents evaluated their
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28 subjective perception of the benefit or harm of the health check in their own report (patient-reported
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30 experience measure, PREM).
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38 **Outcomes**

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42 The outcome measures were the interventions undertaken during the health check and the doctor-
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44 and parent-evaluations of benefit/harm of the appointment. Intervention types were collected from
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46 the electronic study reports completed by school doctors after the health checks.
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52 Doctors assessed the benefit or harm of each health check on a six-point Likert scale (from "Quite a
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54 lot of harm" to "A great deal of benefit") according to predetermined criteria (study protocol, Table
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56 2) ¹¹. The doctors reported quite a lot or a great deal of benefit if they performed any significant
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58 interventions based on predetermined criteria. The category of "Only a little benefit" was used if the
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3 school nurse could have replaced the doctor. The doctors recorded harm if the interaction was
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5 unsatisfactory, or if they suspected no progress in care or denial of school doctor services in the
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7 future. The parents evaluated how beneficial or harmful they considered the school doctor's
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9 examination using the same scale as doctors without predetermined criteria. English translations of
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11 the PREMs are provided in Additional files 5 and 6 of the study protocol ¹¹.
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17 We combined the responses "Quite a lot of benefit" and "A great deal of benefit" into one category
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19 and refer to them as Beneficial. The responses "Only a little benefit", "No benefit or harm", "Only a
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21 little harm", "Quite a lot of harm" and "I don't know" were grouped into Little or no benefit.
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26 **Statistical analyses**

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30 According to power calculations, the amount of children needed was sufficient for this study ¹¹.
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33 Frequencies with percentages were used as descriptive statistics.
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36 The association of the doctors' interventions with the doctor- and parent-evaluated benefit of the
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38 health check were analyzed using multilevel logistic regression to account for the clustered nature
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40 of the data. Four-level models with child at level one, school at level two, doctor at level three, and
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42 city/municipality at level four were used and models were adjusted for grade. Odds ratios (OR) with
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44 95% confidence intervals (CI) were used to express the results. SAS 9.4 System for Windows (SAS
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46 Institute Inc., Cary, NC) was utilized for multilevel modeling. Other analyses were conducted using
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48 IBM SPSS Statistics 25.0 for Windows (IBM Corp., Armonk, NY). P-values less than 0.05 were
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50 regarded statistically significant.
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56 **Patient and public involvement**

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59 No patients or public were involved in this study.
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RESULTS

The doctors conducted interventions in 78% of the 1013 health checks (Supplemental table 1). The most common intervention was the provision of instructions or a significant discussion regarding physical health for 52% of families. Nutrition, skin, or weight were the most common reasons for instructions or discussions. In 17% of the health checks doctors scheduled new school health care appointments mostly to check growth or posture. Doctors planned follow-up appointments with themselves in 3% of cases. Abdominal symptoms and overweight/obesity were the most common reasons for laboratory testing. Doctors conducted interventions related to cardiac murmurs in six cases. Doctors made referrals for psychosocial, neurologic or mental problems for 9% of children. Most referrals to other professionals for physical health problems were directed to physiotherapists and for psychosocial problems to psychologists or social workers. Doctors contacted child-protection services in less than 0.5% of cases.

Doctors' evaluations of benefit or harm were available for 1010 children's health checks. The doctors reported 52% of the appointments with any intervention beneficial and none of the appointments with no interventions beneficial. All interventions were independently associated with doctor-evaluated benefit (ORs 1.91–17.26, $p < 0.001$) (Table 1). Prescriptions (OR 5.56, 95% CI 3.46–8.94), laboratory tests or medical imaging (OR 15.16, 95% CI 7.35–31.26), and referrals to specialized care (OR 17.26, 95% CI 6.61–45.05) were most strongly associated with doctor-evaluated benefit ($p < 0.001$).

Table 1 Association of doctor's intervention with doctor-evaluated benefit of the health check;
Multilevel logistic regression analysis

Doctor's intervention	Total N	Beneficial health check, as assessed by doctor n (%)	OR (95% CI)	P-value
Any intervention				
Yes	791	410 (51.8)	NA	<0.001*
No	219	0 (0)		
Instruction or significant discussion				
Yes	605	282 (46.6)	1.91 (1.44-2.55)	<0.001
No	405	128 (31.6)	1	
Prescription				
Yes	105	77 (73.3)	5.56 (3.46-8.94)	<0.001
No	905	333 (36.8)	1	
Laboratory tests or medical imaging				
Yes	86	77 (89.5)	15.16 (7.35-31.26)	<0.001
No	924	333 (36.0)	1	
Follow-up appointment in school health service				
Yes	175	114 (65.1)	3.06 (2.13-4.39)	<0.001
No	835	296 (35.4)	1	
Referral to other professional within school or community services				
Yes	136	94 (69.1)	4.29 (2.82-6.52)	<0.001
No	874	316 (36.2)	1	
Referral to specialized care				
Yes	52	47 (90.4)	17.26 (6.61-45.05)	<0.001
No	958	363 (37.9)	1	

Doctor-reported benefit was available for 1010 children.

NA = Not available due to zero frequency

OR = Odds ratio; adjusted for grade

CI = Confidence interval

* Fisher's exact test

Parents' evaluations of benefit or harm were available for 971 children's health checks. Parents reported 87% of the appointments with any intervention beneficial and 68% of the appointments with no interventions beneficial (Table 2). Receiving an intervention during the appointment was associated with parent-evaluated benefit (OR 3.25, 95% CI 2.22-4.75). The appointments with instructions or significant discussions (OR 1.71, 95% CI 1.20-2.44), the appointments with

prescriptions (OR 7.44, 95% CI 2.32-23.91), and the appointments that lead to laboratory tests or medical imaging (OR 3.38, 95% CI 1.34-8.55) were more often considered as beneficial than the appointments without these interventions ($p < 0.01$ for all). The appointments that resulted in scheduling a follow-up appointment in school health services, a referral to other professionals within the school or community services, or a referral to specialized care showed no significant association with parent-evaluated benefit (Table 2).

Table 2 Association of doctor's intervention with parent-evaluated benefit of the health check; Multilevel logistic regression analysis

Doctor's intervention	Total N	Beneficial health check, as assessed by parent n (%)	OR (95% CI)	P-value
Any intervention				
Yes	766	669 (87.3)	3.25 (2.22-4.75)	<0.001
No	205	140 (68.3)	1	
Instruction or significant discussion				
Yes	587	507 (86.4)	1.71 (1.20-2.44)	0.003
No	384	302 (78.6)	1	
Prescription				
Yes	102	99 (97.1)	7.44 (2.32-23.91)	<0.001
No	869	710 (81.7)	1	
Laboratory tests or medical imaging				
Yes	85	80 (94.1)	3.38 (1.34-8.55)	0.01
No	886	729 (82.3)	1	
Follow-up appointment in school health service				
Yes	170	146 (85.9)	1.12 (0.69-1.81)	0.66
No	801	663 (82.8)	1	
Referral to other professional within school or community services				
Yes	128	111 (86.7)	1.48 (0.85-2.58)	0.16
No	843	698 (82.8)	1	
Referral to specialized care				
Yes	51	48 (94.1)	3.25 (0.99-10.66)	0.05
No	920	761 (82.7)	1	

Parent-evaluated benefit was available for 971 children.

OR = Odds ratio; adjusted for grade

CI = Confidence interval

DISCUSSION

In this study of routine health checks in elementary school, doctors and parents valued the appointments with interventions more than the appointments with no interventions. Most interventions targeted physical health. Appointments with instructions and significant discussions, prescriptions, and laboratory tests or medical imaging were associated with both doctor- and parent-evaluated benefit. By contrast, appointments that resulted in scheduling of follow-up appointments, referrals to other professionals within school or community services, and referrals to specialized care, were only associated with doctor-evaluated benefit.

Despite the increasing demand for professionals to provide care for children and adults facing mental health disorders ¹⁶, doctors in this study rarely made referrals to specialist care for neurologic or mental health problems (0.9%), and rarely contacted child-protection services. Some families may have received referrals to these specialists already earlier or may have refused their help. Although the participation rate in this study was high, it is possible that the families with most stressors in their life refused to participate or were excluded from the study, and thus these findings may be skewed. Child maltreatment could be recognized and support offered through contacts with professionals working in schools ¹⁷, although universal screening for child maltreatment is unsuitable ¹⁸. Our findings strengthen our perception that child maltreatment is usually suspected and psychosocial problems are usually identified outside of doctors' routine health checks. These results are also in line with a Dutch study in which doctors' assistants were as capable as nurses or doctors to detect psychosocial problems ¹⁹.

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3 Among children who underwent a routine health check in elementary school, few children had
4 physical findings that require a doctor's expertise to be recognized, such as heart murmurs. Cardiac
5 murmurs in children are common²⁰ and usually harmless²¹. In Finland, doctors already screen
6
7 murmurs in children are common²⁰ and usually harmless²¹. In Finland, doctors already screen
8 children for cardiac and other major physical health problems in health checks at the ages of 4-6
9 weeks, four, eight, and 18 months, and four years.

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17 The doctors reported that half of their appointments with interventions were beneficial. The doctors
18 may have estimated that the school nurse or another professional could have provided the
19 intervention as well. In the Netherlands, doctors' assistants detected children's overweight, visual
20 disorders and psychosocial problems as well as did doctors or nurses¹⁹. According to a Cochrane
21 review, nurses may achieve higher patient satisfaction than primary care doctors²². In some cases,
22 the doctors may have been uncertain about the significance of their findings. Overdiagnosis is a
23 common problem involving childhood conditions such as food allergy, obstructive sleep apnea, and
24 attention-deficit/hyperactivity disorder²³⁻²⁷. Prescriptions, laboratory tests or medical imaging, and
25 referrals to specialized care were most strongly associated with doctor-evaluated benefit. These
26 interventions usually require medical training. Some prescription renewals could potentially have
27 been handled more effectively through the electronic health record system than during an
28 appointment²⁸. The doctors regarded none of the appointments without interventions beneficial.
29 These findings are in line with the predetermined criteria of benefit and harm¹¹ and strengthen the
30 validity of the output measure of doctor-evaluated benefit.

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51 Parents reported 87% of the appointments with interventions beneficial and reported benefit also
52 after 68% of the health checks with no interventions. The parents may have appreciated the
53 thorough check of their child for abnormalities and the invitation to meet a doctor. Expecting
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60 parents to know when doctor's expertise is required is unreasonable. Parents are usually unaware

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3 that as a consequence of universal health checks at certain grades only limited school doctor
4 resources are available to children in other grades. Few pediatric primary care providers actually
5 have health policy discussions with families ²⁹.
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11 Parents' evaluations may reflect the barriers in actualizing planned care. Children may miss their
12 planned appointment at specialized care or other experts for several reasons, including
13 logistical/practical factors, long waiting times and quality of interaction between parent and health
14 professional ³⁰. The parent may have had no concerns regarding their child prior to the health check
15 and they may even have disagreed about the doctor's concern. In a Dutch study, child health
16 professionals more often perceived psychosocial problems in children aged 8-12 years than did their
17 parents ³¹. Such situations of dissonance may require more time for resolution than is available
18 during a routine health check. In almost one fifth of the health checks doctors scheduled new school
19 health care appointments mostly to check growth or posture. However, doctors rarely planned
20 follow-up appointments with themselves. For an intervention to be effective, continuity across time
21 and services must be ensured ³². Some referrals to other professionals and specialized care could
22 potentially have been avoided by models of integrated care such as multidisciplinary meetings
23 which may enhance patient satisfaction and increase perceived quality of care ³³.
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45 This study has several strengths. The data included in this study have been collected recently before
46 the COVID-19 pandemic with a high participation rate, thus representing the situation of today's
47 generation of children in developed countries with an extensive health check system during
48 childhood. We increased the generalizability of the results by including schools from different
49 municipalities and socioeconomic areas. We reduced information bias by systematic training of the
50 participating doctors on the criteria of benefit.
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3 One of the study limitations is that the physicians participating were not a random sample, though
4 the participants had varying education and work experience. Second, selection bias is possible as a
5 quarter of invited families declined participation, and non-participants likely differed from
6 participants. We consciously excluded vulnerable groups: children mainly in special education
7 groups and whose parents needed an interpreter. Many of the challenges in these groups are evident,
8 children already have contacts with various professionals, and school health care should be
9 involved to confirm adequate services. Although the doctors followed predetermined criteria when
10 assessing benefit, information bias may have emerged. This was a self-assessment with unavoidable
11 subjectivity. We considered this in the statistical analyses by using multilevel logistic regression
12 and comprised different doctors as one of the four covariates. The small number of referrals to
13 specialized care may have had an effect on the results.
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30 The surrogate outcomes of doctor- and parent-evaluated benefit regarding any intervention should
31 be appraised critically. Surrogate outcomes can fail to predict a true clinical outcome ³⁴. Globally,
32 the provision of services and the intensity and extent of interventions related to obesity and mental
33 health problems are often inadequate and insufficient ^{35,36}. Despite health checks in Finland,
34 Häkkänen and coworkers showed that obesity increased and obese children remained obese during
35 elementary school ³⁷. The long-term impacts of the interventions in this study remain unknown.
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47 **Conclusions**

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51 In this study, both school doctors and parents valued the appointments with interventions. Parents
52 appreciated immediate instructions, medical prescriptions and testing from the doctor compared
53 with scheduled follow-up or referrals to other professionals. Doctors especially valued the
54 appointments where interventions required their medical expertise. These findings suggest that
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3 school doctors should provide children and families with evidence-based interventions instead of
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5 routine health checks. Future studies should investigate the long-term effectiveness of school doctor
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7 interventions and school doctor participation in school multidisciplinary teams.
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13 and drafted the manuscript. SK made significant contributions to the design of the multicenter study
14 and analysis plans. TV was responsible for and mainly conducted the statistical analyses. MK made
15 significant contributions to the design of the multicenter study and analysis plans. EH participated
16 in the design and analyses of the pilot study and the design of the multicenter study. All authors
17 interpreted the results and critically reviewed the manuscript. All authors approved the final
18 manuscript as submitted and agree to be accountable for all aspects of the work.
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28

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30 **Competing interests** None declared.
31

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33 children, parents, nurses, teachers, and doctors.
34

35 **Ethics approval** The coordinating ethics committee of the Hospital District of Helsinki and
36 Uusimaa approved the study plan (HUS/2174/2017).
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39 **Provenance and peer review** Not commissioned; externally peer reviewed
40

41 **Data availability statement** The datasets generated and analyzed during the current study are not
42 publicly available due to restrictions that applied under the license for the study but are available
43 from the corresponding author KN and MK on reasonable request.
44

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27 28 REFERENCES

- 29
30 1. Baltag V, Pachyna A, Hall J. Global Overview of School Health Services: Data from 102
31 Countries. *Health Behav Policy Rev.* 2015;2:268-83.
32
33 2. Baltag V, Levi M. Organizational models of school health services in the WHO European
34 Region. *J Health Organ Manag.* 2013;27:733-46.
35
36 3. Jansen DEMC, Visser A, Vervoort JPM, *et al.* School and Adolescent Health Services in 30
37 European countries: a description of structure and functioning, and of health outcomes and costs.
38 2018. Available: https://www.childhealthservicemodels.eu/wp-content/uploads/Deliverable-173.1_Final-report-on-the-description-of-the-various-models-of-school-health-services-and-adolescent-health-services-1.pdf [Accessed 15 Nov, 2021].
39
40
41
42
43 4. van der Pol S, Postma MJ, Jansen DEMC. School health in Europe: a review of workforce
44 expenditure across five countries. *BMC Health Serv Res.* 2020;20:206.
45
46
47 5. Leroy ZC, Wallin R, Lee S. The Role of School Health Services in Addressing the Needs of
48 Students With Chronic Health Conditions: A Systematic Review. *J Sch Nurs.* 2017;33:64-72.
49
50 6. Knopf JA, Finnie RKC, Peng Y, *et al.* School-Based Health Centers to Advance Health Equity:
51 A Community Guide Systematic Review. *Am J Prev Med.* 2016;51:114-26.
52
53
54 7. Best NC, Oppewal S, Travers D. Exploring School Nurse Interventions and Health and
55 Education Outcomes: An Integrative Review. *J Sch Nurs.* 2018;34:14-27.
56
57 8. Harris K, Kneale D, Lasserson TJ, *et al.* School-based self-management interventions for asthma
58 in children and adolescents: a mixed methods systematic review. *Cochrane Database Syst Rev.*
59 2019. Available: <https://doi.org/10.1002/14651858.CD011651.pub2> [Accessed 25 Jan 2022].
60

- 1
2
3 9. Ran T, Chattopadhyay SK, Hahn RA. Economic Evaluation of School-Based Health Centers. *Am*
4 *J Prev Med.* 2016;51:129-38.
5
- 6
7 10. Wilson P, Wood R, Lykke K, *et al.* International variation in programmes for assessment of
8 children's neurodevelopment in the community: Understanding disparate approaches to evaluation
9 of motor, social, emotional, behavioural and cognitive function. *Scand J Public Health.*
10 2018;46:805-16.
11
- 12 11. Nikander K, Kosola S, Kaila M, Hermanson E. Who benefit from school doctors' health checks:
13 a prospective study of a screening method. *BMC Health Serv Res.* 2018;18:501.
14
- 15 12. Ministry of Social Affairs and Health. Valtioneuvoston asetus neuvolatoiminnasta, koulu- ja
16 opiskeluterveydenhuollosta sekä lasten ja nuorten ehkäisevästä suun terveydenhuollosta (The
17 government decree on maternity and child health clinic services, school and student health services
18 and preventive oral health services for children and youth). 2011.
19 <http://www.finlex.fi/fi/laki/smur/2011/20110338> [Accessed 18 Jan, 2022].
20
21
- 22 13. Nikander K, Hermanson E, Vahlberg T, *et al.* Associations between study questionnaire-
23 assessed need and school doctor-evaluated benefit of routine health checks: an observational study.
24 *BMC Pediatr.* 2021;21:346.
25
- 26 14. Levinson J, Kohl K, Baltag V, *et al.* Investigating the effectiveness of school health services
27 delivered by a health provider: A systematic review of systematic reviews. *PLOS ONE.*
28 2019;14:e0212603.
29
30
- 31 15. World Health Organization. WHO guideline on school health services. 2021. Available:
32 <https://www.who.int/publications-detail-redirect/9789240029392> [Accessed 15 Nov, 2021].
33
34
- 35 16. Skokauskas N, Fung D, Flaherty LT, *et al.* Shaping the future of child and adolescent
36 psychiatry. *Child Adolesc Psychiatry Ment Health.* 2019;13:19.
37
- 38 17. Gilbert R, Kemp A, Thoburn J, *et al.* Recognising and responding to child maltreatment. *The*
39 *Lancet.* 2009;373:167-80.
40
- 41 18. World Health Organization. WHO Guidelines for the health sector response to child
42 maltreatment. 2019. Available: [https://www.who.int/publications/m/item/who-guidelines-for-the-](https://www.who.int/publications/m/item/who-guidelines-for-the-health-sector-response-to-child-maltreatment)
43 [health-sector-response-to-child-maltreatment](https://www.who.int/publications/m/item/who-guidelines-for-the-health-sector-response-to-child-maltreatment) [Accessed 15 Nov, 2021].
44
45
- 46 19. Bezem J, Theunissen M, Kamphuis M, *et al.* A Novel Triage Approach to Identifying Health
47 Concerns. *Pediatrics.* 2016;137:e20150814-0814.
48
- 49 20. Wen J, Snyder C. Prevalence of Innocent Murmurs in Pediatric Patients. *Pediatrics.* 2019.
50 Available:
51 [https://publications.aap.org/pediatrics/article/144/2_MeetingAbstract/325/3509/Prevalence-of-](https://publications.aap.org/pediatrics/article/144/2_MeetingAbstract/325/3509/Prevalence-of-Innocent-Murmurs-in-Pediatric)
52 [Innocent-Murmurs-in-Pediatric](https://publications.aap.org/pediatrics/article/144/2_MeetingAbstract/325/3509/Prevalence-of-Innocent-Murmurs-in-Pediatric) [Accessed 25 Jan 2022].
53
54
- 55 21. Kostopoulou* E, Dimitriou G, Karatza A. Cardiac Murmurs in Children: A Challenge For The
56 Primary Care Physician. *Current Pediatric Reviews.* 2019;15,131-8.
57
- 58 22. Laurant M, Biezen M van der, Wijers N, *et al.* Nurses as substitutes for doctors in primary care.
59 *Cochrane Database Syst Rev.* 2018. Available: <https://doi.org/10.1002/14651858.CD001271.pub3>
60

[Accessed 25 Jan 2022].

23. Coon ER, Quinonez RA, Moyer VA, *et al.* Overdiagnosis: How Our Compulsion for Diagnosis May Be Harming Children. *Pediatrics*. 2014;134:1013-23.
24. Sicherer SH, Wood RA, and the SOAA. Allergy Testing in Childhood: Using Allergen-Specific IgE Tests. *Pediatrics*. 2012;129:193-7.
25. Venekamp RP, Hearne BJ, Chandrasekharan D, *et al.* Tonsillectomy or adenotonsillectomy versus non-surgical management for obstructive sleep-disordered breathing in children. *Cochrane Database Syst Rev*. 2015. Available: <https://doi.org/10.1002/14651858.CD011165.pub2> [Accessed 25 Jan 2022].
26. Morrow RL, Garland EJ, Wright JM, *et al.* Influence of relative age on diagnosis and treatment of attention-deficit/hyperactivity disorder in children. *CMAJ Can Med Assoc J*. 2012;184:755-62.
27. Merten EC, Cwik JC, Margraf J, *et al.* Overdiagnosis of mental disorders in children and adolescents (in developed countries). *Child Adolesc Psychiatry Ment Health*. 2017;11:5.
28. Pattin AJ, Devore N, Fowler J, *et al.* An Examination of the Prescription Renewal Process and Implications for Primary Care Physicians and Community Pharmacists. *J Pharm Pract*. 2020;33:187-91.
29. Vasan A, Krass P, Seifu L, *et al.* Pediatric provider perspectives and practices regarding health policy discussions with families: a mixed methods study. *BMC Pediatr*. 2020;20:343.
30. Arai L, Stapley S, Roberts H. 'Did not attends' in children 0–10: a scoping review. *Child Care Health Dev*. 2014;40:797-805.
31. Crone MR, Zeijl E, Reijneveld SA. When do parents and child health professionals agree on child's psychosocial problems? Cross-sectional study on parent–child health professional dyads. *BMC Psychiatry*. 2016;16:151.
32. Spencer N, Raman S, O'Hare B, *et al.* Addressing inequities in child health and development: towards social justice. *BMJ Paediatr Open*. 2019;3:e000503.
33. Baxter S, Johnson M, Chambers D, *et al.* The effects of integrated care: a systematic review of UK and international evidence. *BMC Health Serv Res*. 2018;18:350.
34. Fleming TR. Surrogate End Points in Clinical Trials: Are We Being Misled? *Ann Intern Med*. 1996;125:605-13.
35. Alemán-Díaz AY, Backhaus S, Siebers LL, *et al.* Child and adolescent health in Europe: monitoring implementation of policies and provision of services. *Lancet Child Adolesc Health*. 2018;2:891-904.
36. Rocha TBM, Graeff-Martins AS, Kieling C, *et al.* Provision of mental healthcare for children and adolescents: a worldwide view. *Curr Opin Psychiatry*. 2015;28:330-5.
37. Häkkinen P, Ketola E, Laatikainen T. Development of overweight and obesity among primary school children—a longitudinal cohort study. *Fam Pract*. 2016;33:368-73.

Supplemental table 1 Interventions by school doctors

	Total, n=1013		
	Interventions	Children	
	n	n	% of children
Total interventions	1483	792	78.2 %
Instruction or significant discussion*	887	606	59.8 %
Physical health	697	531	52.4 %
nutrition	130		
skin	94		
weight	88		
other recurrent pain or prolonged complaints	78		
growth/development	70		
posture/chest/position of feet	38		
screen time/exercise	33		
stomach problems	31		
headache	26		
wetting	20		
allergy	19		
other	70		
Psychosocial	190	163	16.1 %
sleeping	41		
ability to get on with others	30		
emotions	28		
concentration	26		
well-being of a family member or the whole family	24		
behavior	13		
school engagement /absenteeism	19		
learning	9		
Prescription	114	105	10.4 %
skin	61		
allergy	20		
other	33		
Lab. ECG or imaging	104	86	8.5 %
Laboratory test	76		
X-ray/Ultrasound	22		
Electrocardiogram	6		

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3				
4	Follow-up appointment	184	175	17.3 %
5	School nurse	142	138	13.6 %
6	School doctor	27	27	2.7 %
7	School nurse/doctor. undefined	15	14	1.4 %
8				
9				
10	Referral to other professional	141	136	13.4 %
11	Physical health problems	56	56	5.5 %
12	Psychosocial problems	85	82	8.1 %
13				
14				
15	Referral to secondary care	53	52	5.1 %
16	Physical health problems	44	43	4.2 %
17	Neurologic or mental health problems	9	9	0.9 %

*Relates to a different subject than a prescription or a referral to lab, ECG or imaging, other professional or secondary care