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Research Article

JOURNAL OF PEDIATRICS, PERINATOLOGY AND CHILD HEALTH

ISSN: 2641-7405

Is Adherence to Physical Activity and Screen Media Guidelines Associated with A Reduced Risk of Sick Days Among Primary School Children?

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Abstract

Sedentary behaviour is considered an independent risk factor, while physical activity (PA) is ascribed protective effects in childhood. 60 minutes of moderate-to-vigorous PA (MVPA) daily and reduced screen media use (SMU) is recommended for 5-17 year-olds. There are suggested associations of PA and sedentarism with illness-related absence from school or the frequency of visits to the doctor. Therefore, it was examined whether there is an association between the adherence to PA and SMU guidelines and days absent from school, children's visits to the doctor, and the frequency of parents having to stay off work due to their children's illness. Body composition of 1942 primary school children was assessed objectively, guideline adherence, sickness, absent days, and socio-economic factors were provided by parents, which were all analysed using binary-logistic regression analyses.

Adherence to PA guidelines was positively associated with less absenteeism from school. Adherence to SMU guidelines showed significant results with regard to parental inability to work. Children from a low socio-economic status and / or with migration background showed more absence from school and visits to the doctor. Children adhering to PA and SMU guidelines seem to have at least partly reduced absence days and their parents have to stay at home less often. Preventive measures encouraging children to adhere to those guidelines can reduce the economic burden of sickness days and should be implemented early. Children with migration background and / or from a lower socio- economic status should be involved especially in order to benefit from such interventions.

Keywords: Overweight; Childhood; Screen Media Use; Moderate-To-Vigorous Physical Activity; Absenteeism; Sedentarism

Introduction

Social change and technological advances in recent decades have led to an increased sedentary lifestyle and insufficient physical activity in industrialised countries [1]. It is well known that physical inactivity increases the risk of numerous secondary diseases [2, 3] and can contribute to the development of obesity [4-6], which is already present in children [7]. Overweight and obesity are, in turn, risk factors for many secondary diseases. An increase of risk of cardio metabolic and orthopaedic diseases has been observed as well as psychosocial complications and the risk of developing certain types of cancer [8]. This results in enormous follow-up costs for the health system [9, 10].

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Citation: Susanne Kobel, Olivia Wartha, Julia Amberger, Jens Dreyhaupt, Katie E Feather, Jürgen M Steinacker. Is Adherence to Physical Activity and Screen Media Guidelines Associated with A Reduced Risk of Sick Days Among Primary School Children?. Journal of Pediatrics, Perinatology and Child Health 6 (2022): 397-408.

Received: July 20, 2022
Accepted: July 29, 2022
Published: September 28, 2022

Kobel S et al., J Pediatr Perinatol Child Health 2022
DOI:10.26502/jppch.74050123

Since the effects of physical activity and sedentary behaviour on children's health state are of growing interest, scientifically based recommendations have been developed to promote physical activity and limit sedentarism [11, 12]: The recommendations for physical activity of the World Health Organization (WHO) were revised in 2020 and recommend for children and adolescents between five and seventeen years of age at least 60 minutes of moderate-to- vigorous physical activity (MVPA) per day. The reduction of sedentarism, in particular screen media use in leisure time, should be kept to a minimum, but no more than 60 minutes per day [12].

In Germany, the WHO guideline to be physically active for at least 60 minutes a day is adhered to by 22.8% of girls among seven to ten year olds and 30% of boys of that age group [13]. At the same time, the use of screen media becomes more important in children's everyday life and leads to an increase in sedentarism [14, 15]. The advantages of an active lifestyle on the healthy physical and psychological development as well as on the well-being of children are well documented [16, 17]. Sedentary behaviour is considered an independent risk factor, while physical activity is ascribed a protective effect [18, 19]. Positive effects could be demonstrated both with regard to the reduction of cardio metabolic risk factors and psychosocial abnormalities as well as with regard to an improvement of motor skills, cognitive development, and mental health. Active children have, among other things, better physical fitness, lower blood pressure and a higher health- related quality of life [20-22].

Migration background, household income, and family education level

In this sample, the presence of a migration background correlated significantly with net household income and parental educational level. Children with a migration background were more likely to come from households with a net income of less than € 1750 per month ($p < 0.001$) and their parents were less likely to have a tertiary education ($p < 0.001$). Children with a migration background as well as children from a low-income household were more often overweight and obese than children without migration background or from households with medium and high income, respectively ($p < 0.001$). On the contrary, children whose parents had a tertiary education level were significantly less likely to be overweight and obese ($p = 0.002$) compared to children whose parents had a primary or secondary education level.

Physical activity

4.3% of children were moderately-to-vigorously physically active for at least 60 minutes a day on every day of the week. The boys achieved this goal significantly more often than girls did (5.4% vs. 3.2%; $p = 0.038$). 26.9%

Table 1: Participant's characteristics for the total sample, boys, and girls.

Variable	Missing values	Total (n=1942)	Girls (n=947)	Boys (n=995)
Age (years); m (sd)	0	7.1 (0.6)	7.1 (0.6)	7.1 (0.6)
Height (cm); m (sd)	48	123.9 (6.3)*	123.2 (6.3)	124.4 (6.3)
Body weight (kg); m (sd)	49	24.8 (5.0)*	24.5 (5.0)	25.0 (5.0)
BMI Percentilesa; m (sd)	49	49.0 (27.9)	49.2 (27.9)	48.8 (27.9)
Overweightb; n (%)	49	190 (10.0)	88 (9.5)	102 (10.5)
Migration backgroundc; n (%)	297	525 (31.9)	270 (32.9)	255 (30.9)
Tertiary family education leveld; n (%)	322	522 (32.2)	261 (32.6)	261 (31.9)
Monthly household income <€1750; n (%)	451	207 (13.9)	106 (14.4)	101 (13.4)
Adherence to physical activity guidelinee; n (%)	319	437 (26.9)*	177 (22.1)	260 (31.7)
Adherence to screen media guidelinef; n (%)	250	1448 (85.6)*	733 (87.1)	715 (84.1)
Absent daysg; m (sd)	390	7.2 (7.0)	7.5 (7.5)	6.8 (6.4)
Visits to the doctor; m (sd)	403	3.0 (3.0)	3.1 (3.0)	2.9 (2.9)
Maternal inability to workh (days); m (sd)	947	2.6 (4.3)	2.7 (4.4)	2.6 (4.3)
Paternal inability to worki (days); m (sd)	1214	0.6 (2.0)	0.5 (1.6)	0.6 (2.3)
Parental inability to workj (days); m (sd)	901	2.9 (4.7)	2.9 (4.6)	2.9 (4.8)

a) BMI percentiles according to national reference values (Kromeyer-Hauschild et al., 2001); b) overweight incl. obesity (BMI percentile > 90); c) migration background = at least one parent was born outside of Germany or a language other than German was predominantly spoken with the child in the first years of life; d) tertiary family education level = at least one parent has a university degree; e) adherence to physical activity guideline = moderate to vigorous physical activity of ≥ 1h per day on ≥ 4 days per week; f) adherence to screen media guideline = daily screen media use ≤ 1h; g) absent days = children's sick days during the last kindergarten / school year; h) maternal inability to work = days of which the mother had to stay at home from work due to children's illness; i) paternal inability to work = days of which the father had to stay at home from work due to children's illness; j) parental inability to work = days of which mother or father had to stay at home from work due to children's illness. m = mean; sd = standard deviation; n = number *) significant gender difference

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Kobel S et al., J Pediatr Perinatol Child Health 2022
DOI:10.26502/jppch.74050123

of children were sufficiently active (MVPA) for at least 60 minutes on most days of the week, i.e. four days or more per week. Again, girls showed significantly lower values compared to boys (22.1% vs. 31.7%; $p < 0.001$). Children whose parents have a tertiary education level reached the physical activity guideline on at least four days per week significantly more often than children of parents with primary or secondary education level ($p = 0.009$). Further, a household income of more than € 1750 was significantly associated with the adherence to physical activity guideline on most days per a week ($p = 0.021$).

Children's adherence to physical activity guidelines on most days of the week was significantly associated to gender and family education level, with an additional trend to an association with weight status, this however, was not significant (see Table 2). Boys and children with parents who had a tertiary level of education were more likely to achieve at least 60 minutes of MVPA most days of the week.

Screen media use

According to parental report, 14.4% of children used screen media for more than one hour per day. Thus, 84.1% of boys and 87.1% of girls complied with screen media guidelines. Overweight and obese children adhered significantly less often to screen media guidelines than their normal-weight classmates ($p < 0.001$). Similarly, children with a migration background and those from households with low income used screen media significantly more often for more than one hour a day than children without a migration background or from households with medium or high income, respectively ($p < 0.001$). Children whose parents had a tertiary education level used screen media significantly less often than children whose parents have a primary or secondary education level ($p < 0.001$).

As shown in table 3, gender, weight status, migration background, as well as family education level, and household income were significantly associated to adherence to screen media guidelines. A BMI above the 90th percentile, having a migration background, and a household income of less than € 1750 increased the risk of using screen media for more than one hour per day. Children with parents who had a tertiary education level, had greater chances to adhere to screen media guidelines and used less screen media. Adherence to screen media guidelines was not associated with adherence to physical activity guidelines ($p = 0.342$).

Adherence to physical activity and screen media guidelines

Whereas 27% of children adhered to physical activity guidelines and 86% of children did not use screen media for one hour per day, 23% of children (n=375) adhered to both, screen media as well as physical activity guidelines. As shown in table 3, gender, family education level, and household income were significantly associated to adherence to physical activity and screen media guidelines.

Absent days due to sickness during the last year

On average, children missed 7.2 (± 7.0) days of school or kindergarten the previous year with 7.1% of children not missing any day, whereas the highest number of absent days was 90 days in one year. There was a slight gender difference with girls being ill more often than boys ($p = 0.050$) and a significant age difference with younger children missing more days of school or kindergarten ($p < 0.001$). Children whose parents had a tertiary education level were sick less often (6.10 ± 5.65 days) than children whose parents had a primary

Table 2: Odds ratios for adherence to physical activity guidelines on most days of the week, i.e. moderate to vigorous physical activity for at least 60 min on at least four days per week (n= 1291).

Variable	OR	95% CI	*p*
Adherence to screen media guidelinea	0.85	[0.59; 1.22]	0.378
Gender (male)	**0.66**	**[0.52; 0.85]**	**0.001**
Age	0.94	[0.77; 1.16]	0.578
Overweightb	1.51	[0.99; 2.30]	0.057
Migration backgroundc	0.96	[0.72; 1.26]	0.746
Tertiary family education leveld	**1.36**	**[1.04; 1.76]**	**0.022**
Monthly household income <€1750	0.74	[0.48; 1.13]	0.167

OR = Odds Ratio; CI = Confidence interval; bold = statistically significant ($p < 0.05$). a) Adherence to screen media guideline = daily screen media use ≤ 1h; b) overweight incl. obesity = BMI percentile > 90; c) migration background = at least one parent was born outside of Germany or a language other than German was predominantly spoken with the child in the first years of life; d) tertiary family education level = at least one parent has a university degree

Table 3: Odds ratios for adherence to screen media guidelines, i.e. screen media use of 60 min or less per day (n = 1291).

Variable	OR	95% CI	*p*
Adherence to physical activity guidelinea	0.84	[0.58; 1.21]	0.342
Gender (male)	**1.41**	**[1.01; 1.96]**	**0.044**
Age	1.04	[0.80; 1.36]	0.748
Overweightb	**0.59**	**[0.30; 0.96]**	**0.033**
Migration backgroundc	**0.42**	**[0.30; 0.59]**	**< 0.001**
Tertiary family education leveld	**2.17**	**[1.44; 3.28]**	**< 0.001**
Monthly household income <€1750	**0.61**	**[0.39; 0.94]**	**0.026**

R = Odds Ratio; CI = Confidence interval; bold = statistically significant ($p < 0.05$). [a]) Adherence to physical activity guideline = moderate to vigorous physical activity of ≥ 1h per day on ≥ 4 days per week; [b]) overweight incl. obesity = BMI percentile > 90; [c]) migration background = at least one parent was born outside of Germany or a language other than German was predominantly spoken with the child in the first years of life; [d]) tertiary family education level = at least one parent has a university degree.

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Kobel S et al., J Pediatr Perinatol Child Health 2022
DOI:10.26502/jppch.74050123

or secondary education level (7.54 ± 7.30 days; p < 0.001). Also, children living in a household with an income below € 1750 per month were more often absent from school or kindergarten due to sickness than children from households with more net income per month (8.28 ± 9.00 days vs. 6.88 ± 6.40 days, p = 0.011). Children with a migration background also had significantly more days of absence due to illness than children without a migration background (p = 0.003).

Individually analysed, physical activity as well as screen media use were significantly associated with school/kindergarten absence due to sickness. Children who adhered to physical activity guidelines were significantly less absent than children who were active for 60 minutes on three days or less per week (p < 0.001). Children who used screen media for more than one hour per day were significantly more absent from school/kindergarten than children who adhered to screen media guidelines (8.39 ± 9.13 days vs. 6.96 ± 6.58 days; p = 0.007). Children who adhered to physical activity guidelines on at least four days per week had a significantly lower risk of having more than five sickness-related absent days from school (table 5). Young age and having a migration background increased the risk of more than five days of absence; a tertiary family education level lowered that risk.

Analysing gender separately, adherence to physical activity guidelines showed slightly different associations for girls and boys on absent days (OR = 0.61 [0.43; 0.87], p = 0.007; OR = 0.72 [0.53; 0.99], p = 0.041, respectively); as well did age (OR = 0.61 [0.48; 0.77], p < 0.001; OR = 0.51 [0.40; 0.65], p < 0.001, for girls and boys, respectively). Having a migration background increased the risk of more sick days only in girls (OR = 1.65 [1.21; 2.27], p = 0.002), while a household income of less than € 1750 per month increased the risk of more than five days absent from school only for boys (OR = 2.33 [1.47; 3.71], p < 0.001). Differences were also seen for absent days when investigating children with migration background compared to those without. Adherence to physical activity guidelines decreased the risk for more than five absent days only in children without migration background (OR = 0.58 [0.43; 0.77], p < 0.001). Further, for children without migration background, but not children with migration background, a tertiary family education level reduced the risk for more than five absent days (OR = 0.62 [0.48; 0.81], p < 0.001), while a household income below € 1750 increased this risk (OR = 2.07 [1.27; 3.38], p = 0.004).

Table 4: Odds ratios for adherence to physical activity and screen media guidelines, i.e. moderate to vigorous physical activity for at least 60 min on at least four days per week and screen media use of 60 min or less per day (n = 1291).

Variable	OR	95% CI	*p*
Gender (male)	**0.7**	**[0.54; 0.91]**	**0.007**
Age	0.96	[0.78; 1.19]	0.724
Overweighta	1.33	[0.85; 2.10]	0.218
Migration backgroundb	0.84	[0.63; 1.14]	0.262
Tertiary family education levelc	**1.53**	**[1.17; 2.00]**	**0.002**
Monthly household income <€1750	**0.6**	**[0.37; 0.97]**	**0.038**

OR = Odds Ratio; CI = Confidence interval; bold = statistically significant ($p < 0.05$). [a]) overweight incl. obesity = BMI percentile > 90; [b]) migration background = at least one parent was born outside of Germany or a language other than German was predominantly spoken with the child in the first years of life; [c]) tertiary family education level = at least one parent has a university degree.

Table 5: Odds ratios for more than five absent days due to sickness during the previous year (n = 1208).

Variable	OR	95% CI	*p*
Adherence to physical activity guidelinea	**0.61**	**[0.46; 0.80]**	**< 0.001**
Adherence to screen media guidelineb	1.19	[0.83; 1.71]	0.353
Gender (male)	1.12	[0.88; 1.42]	0.352
Age	**0.52**	**[0.43; 0.64]**	**< 0.001**
Overweightc	1.29	[0.84; 1.98]	0.25
Migration backgroundd	**1.56**	**[1.19; 2.04]**	**0.001**
Tertiary family education levele	**0.71**	**[0.55; 0.91]**	**0.007**
Monthly household income <€1750	1.36	[0.91; 2.02]	0.132

OR = Odds Ratio; CI = Confidence interval; bold = statistically significant ($p < 0.05$). [a]) Adherence to physical activity guideline = moderate to vigorous physical activity of ≥ 1h per day on ≥ 4 days per week; [b]) adherence to screen media guideline = daily screen media use ≤ 1h; [c]) overweight incl. obesity = BMI percentile > 90; [d]) migration background = at least one parent was born outside of Germany or a language other than German was predominantly spoken with the child in the first years of life; [e]) tertiary family education level = at least one parent has a university degree.

Visits to the doctor

No child visited the doctor more than 40 times during the previous year, 9.0% of children did not visit to the doctor once during the last year of kindergarten/school. On average, children had 2.97 ± 2.98 visits to the doctor (due to illness – no prevention visits) in the previous year. There was a slight but not significant gender difference with girls visiting the doctor more often than boys (3.08 ± 3.03 times per year vs. 2.87 ± 2.92 visits per year, respectively). The differences for age and migration background, however, were significant (p < 0.001 and p = 0.002, respectively), with younger children and those with a migration background visiting the doctor more frequently. Family education level, household income, as well as the adherence to physical activity and screen media guidelines showed no statistically significant connection with children's visits to the doctor. Children with a BMI above the 90th percentile tended to visit a doctor more often than normal weight children (3.43 ± 3.82 times per year vs. 2.92 ± 2.87 times per year, p = 0.066). Older children had a lower risk of seeing a doctor more than twice a year due to illness

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DOI:10.26502/jppch.74050123

compared to younger children (table 6). Having a migration background increased the risk of more visits to the doctor.

Parental inability to work

Mothers missed work on average on 2.62 ± 4.33 days during the previous year, because they had to care for their sick child, whereas 46.8% of mothers did not miss any day of work due to illness of their child. Among fathers, 83.4% had no day off due to illness in their child; on average, they missed work on 0.59 ± 1.96 days the previous year due to the care for their sick child. Together, 45.6% of parents did not have a day of inability to work during the last year, on average, parental inability to work due to the care for their sick child was 2.91 ± 4.69 days. There was no difference in number of days absent from work to care for their sick child with regards to the child's gender, weight status or family education level.

However, young age, having a migration background, and low household income were positively associated with a higher number of days parents were unable to work ($p = 0.029$, $p < 0.001$, and $p = 0.006$, for age, migration background, and household income, respectively). Adherence to physical activity and screen media guidelines was not significantly associated to parental inability to work due to the care for a sick child. Yet, for both, there was a trend observed towards less days absent from work if the child used more screen media (3.41 ± 6.60 days per year vs. 2.84 ± 4.37 per year for children not adhering to screen media guidelines and adherence to screen media guidelines, respectively), no statistical significance was reached though.

Table 7 shows, that adherence to screen media guidelines and having a migration background increased the likelihood of parental incapacity for more than one day per year. Analysing maternal and paternal inability to work separately, young age and having a migration background were only associated with maternal inability to work for more than one day. Whereas low household income was associated with mothers having to stay at home for more than one day (OR = 1.73 [1.14; 2.64], p = 0.010) and with fathers having to stay off work for one day or more (OR = 0.23 [0.05; 0.96], p = 0.043), but not with parental absenteeism for more than one day per year.

Discussion

This study investigated whether there is an association between primary children's health behaviours and their health status. Children's physical activity and screen media use as well as various co- variables were set into relation to their sick days, visits to the doctor, and days of the parents' inability to work because they had to care for their sick child. Whereas most children (86%) adhered to screen media guidelines, around one quarter of children adhered to physical activity guidelines and respectively to both, screen media as well as physical activity guidelines. Using no more than 60 minutes of screen media per day was positively associated with parents' inability to work because they had to care for their sick child, whereas engaging in moderate-to- vigorous physical activity for one hour daily was positively associated with less than five sickness days per year.

On average, children missed school due to sickness on seven days per year, which reduced with age, but also if children adhered to physical activity guidelines and came

Table 6: Odds ratios for more than two sickness-related visits to the doctor during the last year (n = 1197).

Variable	OR	95% CI	*p*
Adherence to physical activity guidelinea	0.84	[0.65; 1.09]	0.185
Adherence to screen media guidelineb	1.18	[0.83; 1.67]	0.37
Gender (male)	1.08	[0.86; 1.37]	0.499
Age	**0.72**	**[0.59; 0.87]**	**< 0.001**
Overweightc	1.08	[0.71; 1.65]	0.708
Migration backgroundd	**1.45**	**[1.11; 1.88]**	**0.006**
Tertiary family education levele	0.93	[0.73; 1.20]	0.583
Monthly household income <€1750	1.06	[0.72; 1.57]	0.764

OR = Odds Ratio; CI = Confidence interval; bold = statistically significant ($p < 0.05$). [a]) Adherence to physical activity guideline = moderate to vigorous physical activity of ≥ 1h per day on ≥ 4 days per week; b) adherence to screen media guideline = daily screen media use ≤ 1h; c) overweight incl. obesity = BMI percentile > 90; d) migration background = at least one parent was born outside of Germany or a language other than German was predominantly spoken with the child in the first years of life; [e]) tertiary family education level = at least one parent has a university degree.

Table 7: Odds ratios for parental inability to work (> 1 day per year) (n = 843).

	OR	95% CI	*p*
Adherence to physical activity guidelinea	1.16	[0.86; 1.57]	0.338
Adherence to screen media guidelineb	**1.97**	**[1.24; 3.12]**	**0.004**
Gender (male)	0.83	[0.63; 1.10]	0.195
Age	0.8	[0.63; 1.01]	0.056
Overweightc	0.78	[0.46; 1.32]	0.355
Migration backgroundd	**1.61**	**[1.16; 2.24]**	**0.005**
Tertiary family education levele	0.98	[0.74; 1.31]	0.908
Monthly household income <€1750	1.08	[0.64; 1.82]	0.771

OR = Odds Ratio; CI = Confidence interval; bold = statistically significant ($p < 0.05$). [a]) Adherence to physical activity guideline = moderate to vigorous physical activity of ≥ 1h per day on ≥ 4 days per week; [b]) adherence to screen media guideline = daily screen media use ≤ 1h; [c]) overweight incl. obesity = BMI percentile > 90; [d]) migration background = at least one parent was born outside of Germany or a language other than German was predominantly spoken with the child in the first years of life; [e]) tertiary family education level = at least one parent has a university degree.

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DOI:10.26502/jppch.74050123

from a home with tertiary family education level. Children with a migration background on the other hand showed more absence from school due to sickness, as well as more visits to the doctor because of an illness and therefore, their parents had to stay off work for more days to care for their children. Previous research shows that having a migration background can affect children's health [51, 52]. For instance, children with a migration background (and those with a lower social status) take part in preventive screening examinations less often than German children or children with a higher social status [53]. Having a migration background could therefore potentially lead to less concern about children's health behaviour [54] (for example because only little health education is provided in a language that is understood) and thus increase the risk of secondary diseases. This could ultimately result in a higher number of sick days and visits to the doctor and, consequently, more days of incapacity for work for the parents.

An international comparison with other studies is difficult with regard to parental inability to work, which was significantly associated with having a migration background and the non-adherence to screen media use. In Germany, parents generally receive continued wages or sick pay if they have to stay at home due to an illness of their child. However, this is not common in many other countries. Parents who do not receive sick pay tend to be more likely to send their child to school sick [55]. In an American study, it was shown that parents who can stay home paid if their child is sick, also visit the doctor more often with their child, so a better health care is ensured for their children [56]. Further, in this study, only parental absent days from work were included. I.e. unemployed housewives or housemen as well as parents with a part-time job will naturally have less or no absent days from work. Mothers of children with a migration background worked for more hours per week (data not shown); therefore, a bias cannot be ruled out.

Moreover, compared to children without a migration background, children with migration background used screen media more often for more than one hour a day and were more often overweight or obese. Both findings are supported by previous research [57, 58]. Screen media use however, was not only associated to migration background, but also to gender, overweight, and a lower socio-economic level (i.e. less household income and a lower education level). It was shown, that girls, normal weight children, as well as those without a migration background, and from a family with a higher socio-economic status adhered significantly more often to screen media guidelines. Compared to other German research, screen media use in this study was very low. Whereas 86% of children adhered to screen media guidelines, in a reprehensive national sample of six- to eleven- year-olds, only 30% met the requirement to use screen media for no more than one hour per day [12, 59]. In both studies, screen media use was assessed subjectively via their parents, the national sample included slightly older children.

Further, overweight and obese children used screen media significantly more often for over an hour a day than their normal-weight classmates. Although many other studies have also found an association of screen media use and overweight or obesity (e.g. [60-62]), not all authors come to this conclusion [18, 63]. One possible explanation for the development of overweight or obesity is that a high level of screen media usage replaces or at least reduces physical activity, thus reducing the calorie consumption of children [64, 65]. However, screen media use and physical activity do not necessarily have to be mutually exclusive [66]. It is known that some children who use screen media for longer also engage in a lot of sport and exercise [67]. In this study however, no correlation between screen media consumption and moderate-to-vigorous physical activity could be demonstrated.

Only few studies that have analysed the relationship between screen media use and sick days and visits to the doctor in children. To our knowledge, there is only one study, that explored the relationship between screen media use and school absenteeism. There, children who watched television for more than two hours per day had a higher risk of being absent for more than 10% of the school days [33]. Due to the cross-sectional data, however, no statements can be made about causality and thus about the direction of the relationship. For computer use, however, no significant result with regard to the number of days absent could be observed [33]. Furthermore, a Canadian study found no difference in the number of visits to the doctor or the costs of visits to the doctor with regard to screen media use among schoolchildren [68]. Neither of which was associated to adherence to screen media guidelines in this study. Yet, adherence to limited screen media use reduced the likelihood that parents had to stay off work to care for their sick child. In the previous literature, no such connection was found, it can therefore only be speculated, especially since non-adherence to screen media guidelines was not associated to more absent days at school.

There is ample evidence, that e.g. the reduction in sleep through increased screen media use can play a role in the development of obesity, since a shorter sleep duration is associated with obesity [69, 70] and its associated risk factors [71]. Also, screen media use can affect children's mental health [5, 72]. Since however, children with more screen media use recorded no more sickness / absent days, but their parents more days of inability to work to care for their sick child, it can be assumed that either parents of children with little screen media use have a good social network and therefore, had the opportunity to have their child looked after by other people, so no parent had to stay off work if the child fell ill.

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Additionally, only absent days from school were recorded, therefore, it could be possible, children were sick during their school holidays. Alternatively, due to the fact the parental questionnaire only recorded days of inability to work among employed parents, some days might have been missed. Many mothers in this sample did not work or only worked part-time. At the same time, it was evident that mainly mothers stayed at home from work to look after their sick child. It is therefore possible that children were ill, but the parent did not have to stay off work because they only worked a few days per week or did not have any paid work at all.

Nonetheless, although adherence to screen media guidelines was not associated to children's school absence, non-adherence to physical activity recommendations was significantly associated to them missing days of school due to sickness. Children engaging in regular and sufficient physical activity reduced the likelihood of them missing school because of sickness. In this study, 27% of children achieved a minimum of 60 minutes of moderate-to-vigorous physical activity on most days of the week, i.e. on at least four days per week or more. In other national surveys, similar values have been reported; 30% of boys and 23% of girls between seven and ten years of age in Germany adhered to physical activity guidelines [13].

The lower number of absent days at school in connection with adherence to physical activity guidelines could be due to the beneficial effects of moderate-to-vigorous physical activity. Positive aspects of physical activity on children's health have already been discussed extensively in the literature [73-75]. It is now considered undisputed that sufficient physical activity is of vital importance for children's physical, mental, and cognitive health [73- 75]. Direct physical benefits include a positive effect on the cardiovascular and metabolic risk profile [5, 76], lower blood pressure at rest [77, 78], lower triglycerides, higher HDL cholesterol and lower insulin resistance [78, 79]. Moreover, physical activity can provide indirect benefits such as better social [80] and cognitive development [81, 82], and increased self-confidence [83, 84] as well as positive effects on children's mental wellbeing [85]. Associations between adhering to physical activity guidelines and lower levels of mental health problems were found [86, 87]. More physically active children seem to suffer less from certain mental illnesses such as depression and anxiety disorders [86, 88]. This was also confirmed by a recent study investigating children's mood during the COVID-19 pandemic in association with their physical activity levels [89].

Children who adhere to physical activity guidelines could therefore benefit from the above-mentioned health benefits and thus suffer less from possible comorbidities. This in turn could result in a lower absenteeism rate from school [33]. Despite the positive aspects of physical activity on health, the necessary evidence from further studies is still lacking to clearly clarify whether physical activity has a direct effect on objectively measurable health in childhood or whether the consequences only become noticeable later with a latency period. So far, there are hardly any studies that have investigated this direct connection between children's physical activity or screen media use and their absence days from school [33, 90]. Data from the US showed that both, inactive children and extremely active children had a higher risk of missing more than 10% of school days [33]. Another study showed that children with less (objectively assessed) moderate-to-vigorous physical activity are absent from school more often [90]. In Dutch adolescents on the other hand, no connection was found between sick days and physical activity, but with cardiovascular fitness [91]. A connection between physical fitness and school absenteeism was also confirmed in adolescents in New York [92].

Physical fitness was not assessed in this study, and there was no significant relationship with children's physical activity for visits to the doctor due to illness or days of parental incapacity for work. This is in agreement with results of a Canadian study, which did not find a difference in the number of visits to the doctor or the costs of visits to the doctor with regard to physical activity and screen media use among schoolchildren, either [68] Nor did a German study find a connection between the use of health care or direct health expenditure, i.e. the cost of visiting a doctor, and moderate-to-vigorous physical activity for children between the ages of nine and twelve years [93]. In the respective studies, however, all visits to the doctor were included, i.e., for example, sports injuries or preventive examinations as well. In this study, parents were asked about visits to the doctor due to illness.

Despite such clarifications, this study has some limitations, which should be considered when interpreting these results. Those are largely due to the cross-sectional study design, which allows no causal conclusions. Health-related data used in this study were mainly assessed subjectively via a parental questionnaire. Although the questions used are from a very widely used and validated instrument [94], recall and social desirability could bias the given data. In addition, selection may have occurred at different levels: teachers, parents and children decided to participate on a voluntary basis, which may have led to a selection of very committed, possibly more health-conscious participants. Further, language difficulties and social barriers could also have prevented some parents from answering certain questions (correctly).

More importantly, some possibly important factors that could act as confounders were not included in the study. Sleep habits and/or sleep duration, for example, were not included. Yet, sleep can affect children's health. Studies show that the more recommendations on health habits (such as those summarised in the Canadian 24-Hour Movement Guidelines

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[95] in which sleep habits play an important role), are followed, the greater the health benefits [96, 97]. Therefore, further research including more health behaviours should be carried out in order to come to more precise conclusions.

Notwithstanding these limitations, there are also several strengths that should be highlighted. The data was collected in almost all parts of Baden- Württemberg, so that comprehensive sample allows for far-reaching conclusions about a broad mass of primary school children in south-west Germany. However, since the study was only carried out in one federal state, this sample cannot be used to draw conclusions about Germany as a whole. In addition to a large variety of variables surveyed and a high response rate of the parental questionnaire (87%), it should be noted that anthropometric measurements, which were used to classify children's weight status, were carried out by trained and experienced staff using a standardised protocol, ensuring a high standard.

Conclusion

Most previous work on this topic was performed on the basis of subjective health-related quality of life [98, 99], very few studies have looked at sick leave days and visits to the doctor by children, as well as the days of parents' incapacity for work. The results of this study show that physical activity and screen media consumption can already be related to the health status of primary school children. Children who adhered to physical activity guidelines had fewer sick days in the previous year of kindergarten / school and parents with children adhering to screen media guidelines had to stay of work fewer than those whose children use more screen media.

Since the decrease in physical activity begins at a very young age and screen media consumption continues to increase with age [100] interventions aiming to increase physical activity and to reduce screen media use should start as early as possible. Reducing the number of absent days and visits to the doctor is an important social and economic goal: Regular participation in class is considered an essential component for cognitive and psychosocial development [33] whereas more absenteeism from school reduces educational opportunities and thus the options for a higher school qualification. More frequent doctor visits are in turn associated with higher direct health costs and the increase in parental days of inability to work increases indirect costs due to the loss of productivity in paid work. This study therefore helps to identify health behaviours and protective factors in children.

Acknowledgements

The school-based health promotion programme "Join the Healthy Boat" and its evaluation study was financed by the Baden-Württemberg foundation, which had no influence on the content of this manuscript. This work is part of Julia Amberger's doctoral thesis and the authors would like to thank all members of the research group for their input: the Institute of Epidemiology and Medical Biometry, Ulm University, the Institute of Psychology and Pedagogy, Ulm University, all assistants who were involved in the performance of measurements and especially all teachers and families for their participation.

Conflicts of Interest

The authors declare that there is no conflict of interest.

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