

Research Article

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

1. 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].

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].

Since behaviours learned in childhood are often retained into adulthood [23, 24], many preventive approaches aim to establish a healthy and active lifestyle as early as possible in order to minimise negative consequences in the further course of life [25]. Although some secondary diseases caused by lack of exercise, such as high blood pressure or type 2 diabetes, are also increasingly occurring in children [26, 27], the consequences of these diseases, such as cardiovascular complications and the associated morbidity and mortality, usually develop with a latency period in adulthood [28, 29], and can therefore, not be used as an objective measure of children's health.

In adults, health problems that arise as a result of illness are associated with an increased number of sickness-related absences [30], increased use of health services and more frequent visits to the doctor [31], and are therefore objective measures for the state of health of adults [32]. In children and adolescents, the number of days absent from school due to illness and the number of visits to the doctor could also represent an objective possibility. Whether or not children who meet the aforementioned guidelines on physical activity and screen media use, are healthier and less often absent from school has rarely been investigated. In two studies in the US, for example, an association between physical activity and chronic school absenteeism was shown [33, 34]. At the same time, school absenteeism as a serious problem becomes more of interest and represents a major challenge for the public health sector [35]. Illnesses are cited as a frequent reason for absent days from school [35, 36].

Regular participation in lessons is important for

success in school and thus for a good graduation. A high number of absent days is negatively associated with school performance and can lead to early school leaving [37, 38]. A higher school leaving certificate and thus an adequate education often lead to a better socioeconomic status and can therefore contribute to more stable health in the long term [39, 40]. Socially disadvantaged groups of the population with a low income and educational level have a higher risk for poor health [41]. A low attendance at school can therefore have an unfavourable effect on the further course of life in a variety of ways [38, 42]. In addition, many schoolchildren's sick days lead to an economic burden, both because of higher costs for the health system through more visits to the doctor, and because of the loss of productivity for parents who have to stay at home from work to care for the sick child [43].

At a national and international level, only few authors have dealt with the associations of physical activity and screen media use with illness-related absence from school or the frequency of visits to the doctor. This however, is a topic of high relevance since sick days and visits to the doctor represent in contrast to the measurement of subjective health-related quality of life, an objective measure of the state of health. Previous studies relate either to the connection between physical activity and chronic absenteeism, to data that only consider adolescents and no children, or to the effect of children's fitness level and not their physical activity (e.g. [34, 44]). Therefore, the aim of this study is to close this research gap. Using data of primary school children from south-west Germany, the aim was to examine whether there is an association between the adherence to physical activity and screen media guidelines and the 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.

2. Materials and Methods

2.1 Study design

Data used are baseline data collected within the so-called Baden-Württemberg Study, which is a prospective, stratified cluster-randomised longitudinal study in a waiting-control group design [45]. It examines the effects of the intervention programme “Join the Healthy Boat”, which is a school-based prevention programme aiming to engage primary school children in a healthy lifestyle. The focus is on promoting physical activity, reducing screen media use and eating healthily. The study is registered with the German Clinical Trials Register (DRKS-ID: DRKS00000494) and was approved by the university's ethics committee. Prior to data collection, written and informed consent was given by parents and teachers; verbal assent was obtained by participating children on the day of examination.

2.2 Recruiting and participants

All primary schools in Baden-Württemberg (south-west Germany) received written information about the programme and its intervention study. Interested teachers contacted the programme centre, as participation was voluntary. A total of 172 primary school teachers from 94 schools gave written consent to participate. Teachers who had previously participated in the programme were excluded. Therefore, 157 classes from 86 schools were included in the study (for further details: see [45]). 1968 parents consented to participate after receiving detailed information, 1947 children in first and second grade took part. For this work, cross-sectional

baseline data collected prior to any intervention were used.

2.3 Instruments

Anthropometric measurements were carried out according to the guidelines of the International Society for the Advancement of Kinanthropometry (ISAK) [46]. Body weight was measured using calibrated body scales and height was measured using mobile stadiometers (Seca® 826 and Seca® 217, respectively, Hamburg, Germany). Children's BMI was calculated (kg/m^2) and converted into age- and gender-specific BMI percentiles. Using German reference data, overweight was defined as BMI above the 90th percentile and children with a BMI above the 97th percentile were classified as obese [47].

After all objective measurements at school were completed, parental questionnaires were sent out. 1714 parents (87%) completed the questionnaire, which assessed information on children's medical history, their own health status and behaviour as well as that of their children, especially their physical activity and screen media use. Further, various socio-demographic variables, such as household income, level of education, and migration background, were collected via parental questionnaire. The questions included are based on validated questionnaires of the national Health Survey of Children and Adolescents (KiGGS) [48].

Migration background was determined for children with at least one parent born abroad or for children with whom at least one parent spoke predominantly a language other than German in the first years of life. Monthly household income was recorded as the net income all household members have together after

deduction of taxes and social contributions including parental and child benefit per month. Using a seven-point scale, the Winkler Index [521] was used to dichotomise into low income (\leq € 1750) and medium or high income ($>$ € 1750).

The highest parental educational level was recorded as an indicator for the family's socio-economic status according to CASMIN classification [49, 50]. A primary (up to secondary school leaving certificate with completion of apprenticeship / apprenticeship training or master craftsman/ technical training) and secondary (up to (technical) university entrance qualification) educational qualifications were compared as a common category to a tertiary educational qualification (university qualification) and thus dichotomised for analyses. Family education level was defined as the highest level of education of both parents or of the single parent.

In order to assess adherence to physical activity guidelines, parents were asked to provide how many days of a normal school week their child is physically active for at least 60 minutes so he/she starts to sweat and/or gets out of breath (= moderate-to-vigorous-physical-activity (MVPA)). Children's physical activity was dichotomised using median split into 60 minutes of MVPA on at least four times per week and on three times or less per week. Children's screen media use was determined by parents indicating on a 7-point scale how much time their child spends each day with screen media (watching television or playing computer/video games), for weekdays and weekends, respectively. Average daily screen media use was calculated as [(screen media on weekdays \times 5) + (screen media on weekends \times 2)] / 7. In order to assess adherence to screen media

guidelines, screen media use was dichotomised using a cut-off point of one hour per day based on national recommendations [12].

To determine children's sick days, parents stated the number of days on which their child was sick during the last school / kindergarten year and how often the children had to see a doctor because of illness during that period. For statistical analysis, children's sick days were dichotomised using median split and therefore divided into a maximum of five sick days per year, and more than five sick days per year. Children's illness-related doctor's visits during the last school / kindergarten year were divided based on the median of two. Absence from work due of the care for their sick child was recorded separately for mother and father. Mothers stayed home from work once per year (median = 1) to care for their sick child, fathers showed no absence days for that reason (median = 0). For analyses, absence days of mother and father were added and median was calculated on basis of the sum of parental absence days. The days of absence of both parents were then dichotomised using median split (median = 1).

2.4 Data analysis

Group differences were examined depending on scale level and distribution using Chi² test or Fisher's exact test for categorical data and Mann-Whitney U or t-test for continuous data. The level of significance was set at $p < 0.05$ (two-sided). Binary logistic regression models were used to identify factors associated with children's sick days, children's doctor's visits, or parental absence from work. For this purpose, sick days at school, visits to the doctor by the children, and days of parental incapacity for work were dichotomised using median split and physical activity

and screen media use were dichotomised according to the respective guidelines. Age, migration background, family education level, household income, and children’s weight status were controlled for.

After testing all variables and covariates individually, all variables were analysed in a binary-logistic regression model. In addition, the binary logistic model, in which the sick days of children due to illness was the dependent variable, was carried out separately for gender, grade levels, weight status, parents’ level of education and monthly net household income. Due to missing values, there were large differences in the sample size in the individual analyses: missing values were not included in the calculation of the binary logistic regressions. However, since missing values may distort the results, Fisher’s exact test for categorical data and the Mann-Whitney-U test for continuous data were used

to reveal systematic differences between complete cases and cases with missing values. IBM SPSS Statistics Version 26 for Windows was used for statistical analysis.

3. Results

Valid data of 1942 children in first and second grade were available for analyses. Their descriptive characteristics can be found in table 1. Children’s mean age was 7.1 ± 0.6 years with a range from 5.4 to 9.8 years. 48.8% of children were girls, 31.9% had a migration background, and 32.2% of children came from a household with tertiary education level. 10% of children were overweight, and there are significant gender differences with regards to height, weight, and adherence to the guidelines; with boys adhering more often to the physical activity guideline and girls adhering more often to the screen media guideline than boys.

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 Percentiles ^a ; m (sd)	49	49.0 (27.9)	49.2 (27.9)	48.8 (27.9)
Overweight ^b ; n (%)	49	190 (10.0)	88 (9.5)	102 (10.5)
Migration background ^c ; n (%)	297	525 (31.9)	270 (32.9)	255 (30.9)
Tertiary family education level ^d ; 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 guideline ^e ; n (%)	319	437 (26.9)*	177 (22.1)	260 (31.7)
Adherence to screen media guideline ^f ; n (%)	250	1448 (85.6)*	733 (87.1)	715 (84.1)
Absent days ^g ; 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 work ^h (days); m (sd)	947	2.6 (4.3)	2.7 (4.4)	2.6 (4.3)
Paternal inability to work ⁱ (days); m (sd)	1214	0.6 (2.0)	0.5 (1.6)	0.6 (2.3)
Parental inability to work ^j (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

3.1 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.

3.2 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% 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.

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 guideline ^a	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
Overweight ^b	1.51	[0.99; 2.30]	0.057
Migration background ^c	0.96	[0.72; 1.26]	0.746
Tertiary family education level ^d	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 ≤ 1 h; ^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.

3.3 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 ($p = 0.342$).

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 guideline ^a	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
Overweight ^b	0.59	[0.30; 0.96]	0.033
Migration background ^c	0.42	[0.30; 0.59]	< 0.001
Tertiary family education level ^d	2.17	[1.44; 3.28]	< 0.001
Monthly household income <€1750	0.61	[0.39; 0.94]	0.026

OR = Odds Ratio; CI = Confidence interval; bold = statistically significant ($p < 0.05$). ^a) Adherence to physical activity guideline = moderate to vigorous physical activity of ≥ 1 h 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.

3.4 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.

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
Overweight ^a	1.33	[0.85; 2.10]	0.218
Migration background ^b	0.84	[0.63; 1.14]	0.262
Tertiary family education level ^c	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.

3.5 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 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.

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 guideline ^a	0.61	[0.46; 0.80]	< 0.001
Adherence to screen media guideline ^b	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
Overweight ^c	1.29	[0.84; 1.98]	0.25
Migration background ^d	1.56	[1.19; 2.04]	0.001
Tertiary family education level ^e	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 ≥ 1 h per day on ≥ 4 days per week; ^b) adherence to screen media guideline = daily screen media use ≤ 1 h; ^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.

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], $p = 0.004$).

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

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 guideline ^a	0.84	[0.65; 1.09]	0.185
Adherence to screen media guideline ^b	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
Overweight ^c	1.08	[0.71; 1.65]	0.708
Migration background ^d	1.45	[1.11; 1.88]	0.006
Tertiary family education level ^e	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 ≥ 1 h per day on ≥ 4 days per week; ^b) adherence to screen media guideline = daily screen media use ≤ 1 h; ^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.

3.7 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.

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

	OR	95% CI	p
Adherence to physical activity guideline ^a	1.16	[0.86; 1.57]	0.338
Adherence to screen media guideline ^b	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
Overweight ^c	0.78	[0.46; 1.32]	0.355
Migration background ^d	1.61	[1.16; 2.24]	0.005
Tertiary family education level ^e	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 ≥ 1 h per day on ≥ 4 days per week; ^b) adherence to screen media guideline = daily screen media use ≤ 1 h; ^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.

4. 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 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 representative 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. 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 [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.

5. 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.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

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