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Frequency and effects of meeting health behaviour guidelines among adolescents

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Background: To assess the relationship between overweight status and the concomitant adherence to physical activity, daily screen time and nutritional guidelines. **Methods**: Data were derived from the Swiss Health Behaviour in School-aged Children Survey 2006. Participants ($n = 8130$, 48.7% girls) were divided into two groups: normal weight ($n = 7215$, 44.8% girls) and overweight ($n = 915$, 34.8% girls), using self-reported height and weight. Groups were compared on adherence to physical activity, screen time and nutritional guidelines. Bivariate analyses were carried out followed by multivariate analyses using normal-weight individuals as the reference category. **Results**: Regardless of gender, overweight individuals reported more screen time, less physical activity and less concomitant adherence to guidelines. For boys, the multivariate analysis showed that any amount exceeding screen time recommendations was associated with increased odds of being overweight [>2–4 h: adjusted odds ratio (AOR) = 1.40; >4–6 h: AOR = 1.48; >6 h: AOR = 1.83]. A similar relation was found for any amount below physical activity recommendations (4-6 times a week: AOR = 1.67; 2–3 times a week: AOR = 1.87; once a week or less: AOR = 2.1). For girls, not meeting nutritional guidelines was less likely among overweight individuals (0–2 recommendations: AOR = 0.54). Regardless of weight status, more than half of the adolescents did not comply with any guideline and <2% met all three at the same time. **Conclusions**: Meeting current nutritional, physical activity and screen time guidelines should be encouraged with respect to overweight. However, as extremely low rates of concomitant adherence were found regardless of weight status, their achievability is questionable (especially for nutrition), which warrants further research to better adapt them to adolescents.

Introduction

Over the past decades, the prevalence of overweight and obesity has increased in the paediatric population and Switzerland is no exception.[1] Many concerns have been voiced, as evidence shows that overweight and obesity in children and youths increase the odds of similar conditions in adulthood with all its consequences.[2] Thus, a great deal of effort has been spent investigating the underlying mechanisms of this rise in order to understand it and devise prevention and treatment programs accordingly.

This increase in overweight and obesity is thought to be caused by a complex mix of genetic and environmental factors.[3] Biro and Wien[4] stated that the majority of the studies were focused on the effect of environmental and behavioural factors with three major topics: physical activity (PA), sedentary behaviour (television, video games and computers) and dietary factors. Independent relations to excess weight were also reported for each of these three topics.[5–7] Furthermore, interactions between those three factors were described: for example, high television time was associated with reduced amounts of PA[8] and higher food intake after food advertisement exposure,[9] which would lead to an imbalance between energy intake and expenditure, favouring weight gain.

Specific Swiss guidelines for screen time,[10] PA[11] and nutrition[12] have been published and prevention programmes have been launched to promote their adherence and awareness. However, recent evidence suggests that these recommendations are largely unmet.[13–15]

The combined effect of meeting more than one guideline and its relation to overweight has been, to our knowledge, investigated only once.[16] Sanchez *et al.*[16] found that a low observance of guidelines is associated with a higher likelihood of being overweight. However, the sample used was not representative at a national level, and certain aspects relative to the screen time and nutritional guidelines were not investigated (namely computer time and several nutritional variables, respectively). Therefore, the aim of

our study is to investigate, among adolescents, the relation between overweight status and the concomitant adherence to nutritional, screen time and PA guidelines. We hypothesize that overweight persons will show lower levels of adherence to guidelines.

Methods

Data were taken from the Swiss participation in the 2006 Health Behavior in School-aged Children (HBSC) survey investigating fifth to ninth graders. To ensure national representativeness, the selection was based on a list including all public school classes (primary sampling unit) in the country using random cluster sampling. The study was conducted under authorization from the local educational authorities and the principals of the selected schools. Data collection was undertaken according to the Institutional Review Board Guidelines, ensuring participation on a voluntary basis and anonymity at all stages of the survey. The resulting sample consisted in 9791 adolescents, aged 11–15 years. Further information can be found elsewhere.[17] For the purpose of this study, individuals with missing values to both height and weight were excluded ($n = 220$, 2.2%). Furthermore, participants with missing data on three or more variables included in the analysis were discarded as well ($n = 360$, 3.7%). The values of the remaining participants with missing data ($n = 1766$, 18.0%) were imputed by means of chained equation,[18] using the imputation by chain equation procedure described by Royston.[19] Five imputation sets were generated using this procedure. The total sample consisted of 9211 adolescents.

Dependent variable

Overweight was defined using age- and sex-specific body mass index (BMI) cutoff points according to the International Obesity Task Force.[20] BMI {weight (kg)/[height (m)]^2} was computed using self-reported data. Due to the low numbers ($n = 95$, 1.0%), obese individuals were included in the 'overweight' category, and both will be referred to as 'overweight' from hereafter.

Since the focus of our study was the association between overweight status and the adherence to current guidelines, individuals classified as 'underweight' were excluded from the analysis ($n = 1081$, 60.4% girls) and normal-weight subjects were used as the control group, resulting in a study sample of 8130 participants (48.7% girls).

Independent variables

The Swiss national recommendations[10] for screen time state that children should not engage in more than 2 h/day of such activities. To assess daily screen time-based activities, a score was created as proposed by Melkevik *et al.*[21] Three items from the questionnaire asking about the time spent playing electronic games, using computers and watching television were used. All had separate entries for weekends and schooldays, with nine possible answers ranging from 'None at all' to 'About 7 h or more'. To obtain a daily total screen time measure, the answers were assigned a value of 0 for 'None at all', 0.5 for 'About 30 min a day', 1 for 'About 1 h a day' to 7 for 'About 7 h or more'. A weighted score was then created to represent the daily mean amount of specific screen time by adding the answers for schooldays and weekend usage for electronic games, computer and television, respectively. Those in turn were added to create the daily total screen time score. The score was then divided into four categories (≤ 2, >2–4, >4–6 and >6 h), according to its quartile distribution, rounded up to the nearest whole hour. Being in the '≤ 2 h' category was considered meeting current screen time guidelines.

Adherence to Swiss nutritional guidelines[12] was assessed by means of a Food Frequency Questionnaire (FFQ), asking participants to report their frequency of consumption of different food items on a seven entries scale (from 'Never' to 'Several times a day'). Furthermore, we relied on another item investigating alcohol consumption over the last 30 days, as national recommendations include alcohol consumption. Since the FFQ only assesses intake frequency, adherence was solely based on this criterion. As observance of nutritional guidelines has previously been reported as low in Switzerland,[13] the achievement of recommendations was interpreted in a relatively loose manner to maximize the chances of adherence.

Since none of the reviewed indices was compatible with the format of the FFQ or the published guidelines, we constructed a score, ranging from 0 to 9, by adding 1 point for each individual recommendation achieved as follows. The four categories fruits, vegetables, carbohydrates and milk and dairy were each coded 1 if taken 'Several times a day' and 0 if less. Meat was coded 1 if '$\leq$5-6 times a week' and 0 if more often, while fish consumption scored 1 if '$\geq$Once a week' and 0 if less frequent. Sweets and snacks were coded 1 if taken 'Once a day or less' and 0 if more often. As they are age-specific, caffeinated drinks were coded as 1 if '$\leq$2-4 times a week' for 15-year-olds or '$\leq$once a week' for younger ones and 0 if otherwise. Finally, for alcohol consumption, 'Never use' was coded 1 and any use was coded 0. Due to very few individuals ($n = 14$, 0.2%) achieving all nine individual recommendations, the score was divided according to its 10th and 90th percentiles into three categories: 0–2 recommendations, 3–5 recommendations and 6–9 recommendations. The latter was considered meeting nutritional guidelines.

The Swiss national guidelines for PA state that adolescents should spend at least 60 min in PA each day.[11] PA levels were assessed in two ways in the HBSC questionnaire: one asking about the number of days in which adolescents did a total of 60 min of PA in the past week and the other examining extracurricular sports participation [referred to as vigorous physical activity (VPA) by Melkevik *et al.*[21]]. Regarding VPA questions, Pate *et al.*[22] stated that individuals tend to include the whole time spent doing PA rather than the actual time being vigorously active. In light of this possible confusion, we decided to use the item asking about the frequency of sports participation as a proxy for PA. Answers were divided as follows: 'every day', '4-6 times a week', '2-3 times a week' and '$\leq$once a week' (the latter regrouping all answers equal to or lower than 'once a week' due to low numbers for the remaining possibilities). PA guidelines were considered to be met when participants answered 'every day'.

To assess concomitant levels of adherence, individuals were attributed one point for each of the three guidelines achieved using the aforementioned cutoffs.

Several factors described in the literature as associated with overweight were used as potential confounding factors in the analyses. Breakfast frequency[23] was measured by means of a score created by adding the reported frequency on weekends and schooldays. Socio-economic status[24] was controlled for by means of the Family Affluence Scale.[25] Due to very few individuals in the 'low' class ($n = 194$, 2.3%), it was included in the 'medium' category. For tobacco smoking,[26] individuals who reported any consumption over the last 30 days were classified as 'smokers'. Self-related health[27] was dichotomized into 'high' ('excellent' or 'good') and 'poor' ('average' or 'bad'). Family structure[24] was coded according to having both parents living together or not. Finally, we also included age.

All analyses were conducted separately by gender, as differences regarding the amount of screen time,[14] levels of PA[28] and eating patterns[13] have been reported.

Statistical analysis

Bivariate analyses were carried out to compare both overweight and normal-weight participants. Exploratory multivariate analyses were performed for each guideline separately. As results were not

significantly different in comparison to the all-inclusive model, only data from the latter are presented. Results are given as adjusted odds ratios (AORs) using normal-weight individuals as the reference category and controlling for the aforementioned confounding factors.

We used STATA 11.1 (StataCorp LP, College Station, TX, USA) for all calculations to take into account the cluster sampling design of the HBSC study. Significance level was set at $P < 0.05$. Given results are aggregated from all five imputation data sets.

Results

Regardless of gender, more than half of our sample reported not meeting a single recommendation, whereas a third complied with only one. Moreover, <2% met all three guidelines at the same time (tables 1 and 2).

Boys

As shown in table 1, overweight boys were significantly less likely than their normal-weight counterparts to follow the recommended guidelines and more likely to be sedentary and to spend more screen time, while no differences were noted for nutritional guidelines. Overweight boys were significantly older, less likely to have breakfast frequently and more likely to smoke, to report being in poor health, to live in a non-intact family and to have a high socio-economic status.

At the multivariate level, overweight boys were significantly more likely to be sedentary, and the likelihood increased as the amount of PA decreased (to a maximum AOR of 2.10 for less than once a week). Similarly, they were also more likely to spend time in front of a screen for any reported value higher than 2 h of screen time to an AOR of 1.83 for 6 h/day or more. No differences were found for the nutritional score (table 1).

Girls

Overweight girls were also significantly less likely to follow the recommended guidelines and more likely to be sedentary or to spend time in front of a screen. As it was the case for boys, there were no differences for nutritional recommendations. Overweight girls were less likely to have breakfast regularly and more likely to report poor health and to be in the upper part of the affluence scale (table 2).

When controlling for potential confounders, the only significant difference between overweight and normal-weight girls was that the former were less likely (AOR = 0.54) to follow 0–2 nutritional recommendations (table 2).

Discussion

Our hypothesis that higher levels of adherence to guidelines would translate into lower rates of overweight was only partially supported by this study. In addition, our results confirm that gender differences exist regarding the association with overweight. For girls, overweight seems to be more associated to nutrition, while for boys the association appears to be mediated through PA and screen time.

With regard to total screen time, a low level of adherence was found throughout our sample, predominantly among boys. Our results parallel previous reports with regard to this gender difference and the low guideline adherence.[29] The direct association with overweight for boys is in agreement with other publications.[14] Our results indicate that exceeding current recommendations is associated with increased odds of being overweight, which continue to grow as more time is spent in such activity. For girls, the lack of association might be due to the low number reporting high usage, as girls tend to spend less time on screen-based activities than boys.[30] Therefore, it could be speculated that girls spend more time in other sedentary activities, which are not screen based, as Marshall *et al.*[6] stated.

Along the same lines, we found low levels of adherence to PA, with more boys than girls meeting recommendations. For boys, the

Table 1 Boys' characteristics by weight status

	Normal weight ($n = 3571$), % (95% CI)	Overweight ($n = 597$), % (95% CI)	P^a	AOR[b]
Concomitant guidelines adherence				
3 guidelines	1.6 (1.2–2.0)	0.5 (0.0–1.1)	<0.001	
2 guidelines	9.8 (8.9–10.8)	5.0 (3.3–6.8)		
1 guideline	34.7 (33.1–36.2)	26.9 (23.4–30.5)		
0 guideline	53.9 (52.3–55.6)	67.5 (63.7–71.2)		
Physical activity				
Every day	24.7 (23.3–26.1)	14.9 (12.1–17.8)	<0.001	1
4–6 times a week	27.3 (25.8–28.7)	26.2 (22.7–29.8)		1.68 (1.24–2.26)
2–3 time a week	32.0 (30.5–33.6)	37.4 (33.5–41.2)		1.87 (1.43–2.45)
≤once a week	16.0 (14.8–17.2)	21.5 (18.2–24.8)		2.10 (1.53–2.89)
Total screen time (h/day)				
≤2 h	21.1 (19.8–22.5)	13.3 (10.6–16.1)	<0.001	1
>2–4 h	32.9 (31.3–34.4)	30.1 (26.4–33.7)		1.39 (1.05–1.83)
>4–6 h	21.5 (20.1–22.8)	22.6 (19.2–25.9)		1.48 (1.09–2.02)
>6 h	24.6 (23.2–26.0)	34.0 (30.2–37.8)		1.83 (1.35–2.49)
Nutritional score				
6–9 recommendations	13.3 (12.2–14.4)	10.4 (8.0–12.9)	0.16	1
3–5 recommendations	69.0 (67.5–70.5)	71.4 (67.7–75.0)		1.03 (0.77–1.39)
0–2 recommendations	17.8 (16.5–19.0)	18.2 (15.1–21.3)		0.86 (0.60–1.25)
Age, mean (95% CI) (years)	13.0 (12.9–13.1)	13.2 (13.0–13.3)	0.001	
Breakfast frequency (days/week)	5.0 (5.0–5.1)	4.4 (4.2–4.6)	<0.001	
Smoking status (smoker)	11.1 (10.1–12.1)	16.1 (13.2–19.1)	0.001	
Self-rated health (poor)	5.5 (4.7–6.2)	11.0 (8.5–13.5)	<0.001	
Family structure (parents not together)	19.3 (18.0–20.6)	24.2 (20.7–27.6)	0.005	
Family Affluence Scale (high)	36.5 (35.0–38.1)	47.6 (43.6–51.6)	<0.001	

a: *P*-value of the bivariate analysis comparing normal weight and overweight boys
b: AOR = adjusted odds ratio using the normal-weight group as the reference. Adjusted for age, breakfast frequency, smoking status, self-rated health, family structure and Family Affluence Scale

Table 2 Girls' characteristics by weight status

	Normal weight ($n = 3644$), % (95% CI)	Overweight ($n = 318$), % (95% CI)	P^a	AOR[b]
Concomitant guidelines adherence				
3 guidelines	1.1 (0.8–1.5)	1.3 (0.1–2.6)	0.04	
2 guidelines	9.8 (8.8–10.8)	5.7 (3.1–8.2)		
1 guideline	32.5 (31.0–34.0)	31.4 (26.3–36.5)		
0 guideline	56.6 (55.0–58.2)	61.6 (56.3–67.0)		
Physical activity				
Every day	9.4 (8.5–10.4)	7.5 (4.6–10.4)	0.009	1
4–6 times a week	16.3 (15.1–17.5)	10.7 (7.3–14.1)		0.85 (0.50–1.47)
2–3 time a week	36.5 (35.0–38.1)	37.7 (32.4–43.0)		1.30 (0.82–2.07)
≤once a week	37.7 (36.2–39.3)	44.1 (38.7–49.6)		1.40 (0.88–2.22)
Total screen time (h/day)				
≤2 h	31.0 (29.5–32.5)	25.4 (20.6–30.1)	0.02	1
>2–4 h	36.1 (34.5–37.7)	35.8 (30.5–41.1)		1.17 (0.84–1.62)
>4–6 h	18.6 (17.4–19.9)	22.0 (17.5–26.6)		1.29 (0.90–1.86)
>6 h	14.2 (13.1–15.4)	16.8 (12.7–20.9)		1.28 (0.86–1.92)
Nutritional score				
6–9 recommendations	15.1 (13.9–16.2)	13.8 (10.1–17.6)	0.37	1
3–5 recommendations	71.3 (69.8–72.8)	76.5 (71.9–81.2)		1.00 (0.70–1.43)
0–2 recommendations	13.6 (12.5–14.8)	9.6 (6.4–12.9)		0.54 (0.31–0.94)
Age, mean (95% CI) (years)	13.1 (13.0–13.2)	13.0 (12.9–13.2)	0.79	
Breakfast frequency (days/week)	4.7 (4.6–4.8)	4.0 (3.7–4.3)	<0.001	
Smoking status (smoker)	12.8 (11.7–13.9)	14.0 (10.2–17.9)	0.56	
Self-rated health (poor)	9.4 (8.4–10.3)	15.7 (11.7–19.7)	<0.001	
Family structure (parents not together)	21.2 (19.9–22.6)	25.6 (20.8–30.4)	0.11	
Family Affluence Scale (high)	43.6 (42.0–45.2)	51.9 (46.4–57.4)	0.005	

a: *P*-value of the bivariate analysis comparing normal-weight and overweight girls
b: AOR = adjusted odds ratio using the normal-weight group as the reference. Adjusted for age, breakfast frequency, smoking status, self-rated health, family structure and Family Affluence Scale

direct association with overweight found for any amount of PA below what is recommended parallels findings in a longitudinal study in younger children where only high levels of PA resulted in a lower BMI in early adolescence.[7] For girls, the lack of association might be explained by the low number of girls reporting high sports participation.[28]

Rodriguez *et al.*[31] reported that nutrition has been inconsistently related to overweight, which is in line with the lack of association found for boys. For girls, the negative relationship found for the lowest category might be explained by a possible report bias. Overweight individuals have been described to underreport their daily energy intake,[32] and underreporting has been associated with specific food groups (commonly considered as 'unhealthy'),[33] which would result in biased answers towards healthier eating patterns. Alternatively, overweight individuals might adhere to the recommended frequency but consume increased quantities, as it was found that portion sizes, among other things, were directly associated with BMI for girls.[34]

Although not an objective of our study, the finding that >50% of the adolescents reported not meeting a single guideline and <2% met all three guidelines, deserves further discussion of current guidelines, mainly those regarding screen time and nutrition.

In 2001, 20% of the Swiss students declared frequently using computers within the school setting.[35] Furthermore, another report described that school computer usage increased[36] between 2003 and 2006. In light of this evidence, it is likely that the proportion of students frequently using computers at school has grown, adding to leisure screen time and inflating the total amount. Given this context, it is understandable that current guidelines (no more than 2 h/day) are becoming increasingly difficult to comply with when the total amount is considered. Moreover, evidence speaks in favour of a lack of significant relationship between overweight and the academic use of computers.[37] Therefore, current recommendations should distinguish between academic and recreational screen time and not take the former into account when limiting daily screen time.

Globally, even with a loose interpretation of the recommendations, adherence to nutritional guidelines was found to be extremely low. Had we applied more stringent cutoffs, or been able to take the quantity criterion into account, the rates would have probably been even lower. In view of these results, the achievability of current nutritional guidelines is questionable, which warrants further research on how to adapt them to adolescents to increase adherence, as mentioned by Meier *et al.* [13]

In their recent review of treatment interventions in obese children (aiming for the most part at an increase of PA and/or better dietary habits), Whitlock *et al.*[38] concluded to a significant but modest effect of behavioural interventions on excess weight. Combined with the low levels of adherence to the above-mentioned guidelines found in our sample, promoting them should be encouraged in overweight and obese individuals. However, Summerbell *et al.*[39] concluded to an absence of significant effect on excess weight when reviewing interventions in the general paediatric population. In light of this discrepancy and with the findings that very few individuals do follow current guidelines, other factors must be considered.

The main strengths of this study are that it is based on a large nationally representative sample of youths and it analyses the effect of all three guidelines at the same time. Nevertheless, several limitations need to be taken into account. First, our results are based on cross-sectional data, therefore, preventing the identification of any cause–effect relationship. Secondly, BMI values were based on self-reported height and weight which has been shown to underestimate the prevalence of overweight and obesity.[40] This could explain the slightly lower prevalence rate found in our research when compared with other Swiss studies,[41] although it is in the average range of the HBSC international study.[15] Thirdly, the score created to assess nutritional adherence is not comprehensive, as it did not examine the quantity criterion. Therefore, nutritional adherence might have been overestimated.

In the present study, meeting screen time, PA and nutritional guidelines have been partially associated with reduced odds of being overweight. Their adherence should therefore be encouraged.

The finding that more than half of the adolescents do not comply with a single guideline raises the question of their achievability, especially for nutritional guidelines, which warrants their review to better adapt them to adolescents' lifestyles.

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Key points

- There are gender differences regarding the association with overweight.
- Meeting nutritional, PA and screen time guidelines should be encouraged among adolescents.
- However, as very few youths follow all guidelines, their achievability needs to be reviewed.

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Infant feeding: the effects of scheduled vs. on-demand feeding on mothers' wellbeing and children's cognitive development

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Background: Many popular childcare books recommend feeding babies to a schedule, but no large-scale study has ever examined the effects of schedule-feeding. Here, we examine the relationship between feeding infants to a schedule and two sets of outcomes: mothers' wellbeing, and children's longer-term cognitive and academic development. **Methods:** We used a sample of 10 419 children from the Avon Longitudinal Study of Parents and Children, a cohort study of children born in the 1990s in Bristol, UK. Outcomes were compared by whether babies were fed to a schedule at 4 weeks. Maternal wellbeing indicators include measures of sleep sufficiency, maternal confidence and depression, collected when babies were between 8 weeks and 33 months. Children's outcomes were measured by standardized tests at ages 5, 7, 11 and 14, and by IQ tests at age 8. **Results:** Mothers who fed to a schedule scored more favourably on all wellbeing measures except depression. However, schedule-fed babies went on to do less well academically than their demand-fed counterparts. After controlling for a wide range of confounders, schedule-fed babies performed around 17% of a standard deviation below demand-fed babies in standardized tests at all ages, and 4 points lower in IQ tests at age 8 years. **Conclusions:** Feeding infants to a schedule is associated with higher levels of maternal wellbeing, but with poorer cognitive and academic outcomes for children.

Introduction

Many of the childcare books on sale today advocate that babies should feed and sleep according to a schedule, and provide plans whereby parents may bring this about.[1–4] Among these are a number of extremely popular titles: in 2006, three books by a single author accounted for 25% of all sales of childcare books in the UK.[5] Authors of these books claim that schedules lead to happier babies, lower levels of stress and fatigue for parents, and an altogether easier experience of parenting; some also make indirect assertions relating to children's cognitive development.[3] However, no research exists investigating the validity of these claims. We believe the current study is the first to do this: we used a large-scale child development survey to examine the relationship between schedule-feeding and maternal wellbeing, and the relationship between schedule-feeding and children's later cognitive development.

The few studies which have investigated feeding schedules find that demand feeding produces better outcomes, in terms of preterm babies' growth and health[6,7]; breastfeeding duration and exclusivity[8,9]; and infants' psychological adjustment.[10] However, these are considered short-term outcomes and cannot be used to draw inferences about longer-term effects. Conversely, studies which do consider longer-term outcomes in relation to infant feeding are concerned with the effects of *what*, rather than *when*, babies are fed. Most of these studies[11–15] report that breastfeeding is related to better cognitive outcomes; none report any findings related to feeding schedules.

Methods

Data

This study is based on the Avon Longitudinal Study of Parents and Children (ALSPAC, also known as Children of the 90 s), a cohort survey of children born in the early 1990s in the Bristol area of the UK.[16,17] A total of 14 541 mothers enrolled for the study during pregnancy; families were re-interviewed at intervals before and after the child's birth; and school attainment test data were obtained from local authorities.

Schedule-feeding

The variable of interest in this study is whether children were fed according to a schedule. When babies were 4 weeks old, mothers were asked: 'Is your baby fed (either by breast or bottle) on a regular