



Associations between eating habits and food intake in Austrian adolescents

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Abstract

Objective: Dietary habits play an important role in the prevention of chronic diseases as well as the development of children and adolescents. Changes in lifestyle patterns during the last several decades have contributed to less structured eating behaviors in youth which could also affect food choices. There remains, however, limited research on the association between eating habits and food consumption in Austrian youth.

Methods: A total of 165 students (55% male) between 11 and 16 years of age from 9 middle school classes in the federal state of Tyrol, Austria participated in the study. Information on the frequency of meal consumption (breakfast, lunch, dinner, snacks between meals) along with the frequency of the consumption of various foods was obtained via a questionnaire that was administered during regular class time. In addition, body weight (kg) and height (cm) was measured according to standard procedures.

Results: The majority of participants reported daily lunch and dinner (85% and 70%, respectively) while only 52% reported daily breakfast consumption. Almost half of the participants (46%) reported having late night snacks at least once a week. Regular breakfast consumption was associated with healthier dietary choices even though there was an association with higher intake of sweets. Late night snacks, on the other hand, were associated with higher consumption of fast food and softdrinks.

Conclusion: Regular breakfast appears to be an important contributor to the establishment of healthy dietary patterns even though healthy food choices should be emphasized. The detrimental effects of late night snacks on food choices may indicate the importance of regular meal patterns during the day. Regular family meals also allow parents to have more control over food choices of their children and to serve as role model. Further, healthy food choices should be emphasized in school and after-school settings.



Introduction

Dietary habits have been associated with a number of chronic diseases and play a crucial role in the development of children and adolescents [1]. In addition to the risks associated with poor dietary choices at the individual level, they also induce significant costs on the health care system [2]. Dietary intake is not only associated with the regulation of body weight [3,4]; several studies have shown associations of eating behavior with cognitive function, memory, academic performance and psychological well-being [5-8]. Adolescence is a particularly vulnerable period due to the nutritional requirements, which are exceeding adult requirements, associated with growth and maturation [1,9]. Further, dietary habits that are established during childhood and adolescence tend to track into adulthood [10,11].

During the last several decades many countries have experienced significant changes in lifestyle patterns that affect dietary intake. In part, this may be attributed to an increasing number of advertisements specifically targeting youth and affecting eating behaviors in children and adolescents [12,13]. Secular trends reveal an increase in food consumption away from home as well as increases in the contribution of snacks to total energy intake [14-16]. Along with fewer meals taken together with the family, skipping breakfast has become more common, particularly in adolescents [12,17-19]. These changes may have contributed to the consumption of too much meat and sweets while not meeting current recommendations for fruit and vegetable consumption in many youth [12,20,21].

Family meals, therefore, may have an important impact on dietary habits in youth as they give parents the opportunity to serve as role model and provide healthy foods while limiting access to highly processed foods [22]. Nevertheless, various studies have shown that fewer than 1/3 of adolescents eat dinner together with their family [23,24] and a majority of youth does not consume regular breakfast [12]. The importance of breakfast consumption regarding healthy dietary choices has been addressed in several studies [19,23 25-29]. A recent study, for example, showed a higher micro nutrient intake and greater likelihood of meeting current dietary guidelines with regular breakfast consumption in children and adolescents compared to participants who skipped breakfast [19]. Epidemiological evidence further indicates a protective effect against overweight and obesity in youth [25, 30-32] even though intervention studies have failed to demonstrate a causal relationship between regular breakfast consumption and body weight [33-35]. Most studies examining the association between eating habits and dietary intake, however, were carried out in North America, Australia and the UK and there is currently limited research on the association between dietary habits and nutrient intake in Austrian adolescents. Further, previous research focused predominantly on the association of specific meals (i.e. breakfast) or snacks rather than total eating habits. The purpose of the present study, therefore, was to examine the association between eating habits (i.e. breakfast, lunch, dinner, snacks) and food consumption in Austrian adolescents.

Methods

Students from 9 middle school classes (Neue Mittelschule, NMS) in the Federal State of Tyrol, Austria between grades 6 and 8 were invited for participation, resulting in a sample size of 172 participants. Parents were informed about the nature of the study via mail and provided written informed consent. Oral

assent was obtained from the participants at the time of data collection. The study protocol was approved by the Institutional Review Board of the University of Innsbruck as well as the school board of the Federal State of Tyrol and the principals of the participating schools. Data collection occurred during May and June of 2018.

Anthropometric measurements

Body height (cm) and weight (kg) were measured during a physical education class according to standard procedures by trained technicians. Children were barefoot and wore gym clothes during the measurements. Body height was measured to the nearest 0.1 cm with a mobile stadiometer (SECA® 217, Seca, Hamburg, Germany). Body weight was measured to the nearest 0.1 kg with a gauged body scale (SECA® 803, Seca, Hamburg, Germany). Subsequently body mass index (BMI) was calculated (weight in kilograms divided by the square of height in meters, kg/m²) and converted to BMI percentiles based on the German reference system [36]. Using the 90th percentile as cutpoint, participants were classified as non-overweight or overweight/obese.

Eating habits and food intake

Dietary information was obtained via a questionnaire that was administered by a trained technician during regular class time. Participants reported the average number of days per week they consumed breakfast, lunch and dinner along with the number of days per week they consumed snacks in between meals and after dinner. Further, frequency of the consumption of various foods and drinks (days/week) was reported. In addition to classifying main food groups, principal component analysis was used to identify dietary patterns. The analysis revealed 3 factors with an Eigenvalue > 1, which explained 55.9% of the total variance of food consumption. Specifically, factor 1 was characterized by high loadings of meat, fish, bread, pasta and sweets consumption (meat/CHO), factor 2 was characterized by high loadings of milk, nuts and fruits (milk/cereal), and factor 3 was characterized by high consumption of water and vegetables as well as low consumption fast food and softdrink (water/low FF).

Statistical analysis

Descriptive statistics were calculated. Differences between boys and girls were determined via ANOVA for continuous variables (anthropometric measurements, diet factors) and Mann-Whitney-U tests for ordinal variables (eating habits and food intake). Spearman correlation analyses were used to examine the association between eating habits and food intake for the total sample and separately for boys and girls. Due to multiple comparisons a p-value of 0.01 was selected for significance. The strength of the relationship was defined, for positive and negative trends, as strong ($r > 0.5$), moderate ($0.5 \geq r \geq 0.3$), or weak ($0.3 > r > 0.1$) [37]. In addition, differences in eating habits across diet factor tertiles were examined via Kruskal-Wallis Tests. All statistical analyses were performed using SPSS 24.0 (IBM, Armonk, NY).

Results

A total of 165 adolescents (55.2% male) between 11 and 16 years of age provided complete and valid data. The prevalence of overweight/obesity was 20.4% with no difference in overweight/obesity rates between boys and girls. No sex differences were observed for BMI percentiles even though boys were taller

and heavier than girls, which may have been attributed to their older age (Table 1).

Slightly more than half of the participants (52%) reported daily breakfast consumption and more than two thirds (71%) reported breakfast consumption on 5 days per week. Having daily lunch and dinner was reported by 85% and 70% of the participants, respectively. Morning snacks on at least 5 days per week were reported by 80% of the participants while only 22% reported afternoon snacks on at least 5 times per week. Only 8% reported late night snacks on 5 or more days per week

but almost half of the participants (46%) reported having a late night snack at least once a week. No differences were observed for self-reported dietary habits and food intake between normal weight and overweight/obese participants. There were also no sex differences in eating habits. Boys, however, reported a higher frequency of meat and softdrink consumption ($p < 0.01$), while they reported less frequent intakes of vegetables compared to girls ($p < 0.01$) (Table 2). This resulted in significantly higher scores on the meat/CHO factor ($p = 0.02$) and lower scores on the water/low FF factor ($p < 0.01$) in boys compared to girls.

Table 1: Descriptive Characteristics for the total sample and separately for boys and girls. Values are Mean \pm SD.

	Total Sample (N = 165)	Girls (N = 74)	Boys (N = 91)	p-value
Age (years)	13.5 \pm 1.1	13.2 \pm 1.0	13.7 \pm 1.1	0.015
Height (cm)	161.3 \pm 8.9	158.8 \pm 6.8	163.4 \pm 9.9	0.001
Weight (kg)	53.8 \pm 14.3	51.3 \pm 9.9	55.9 \pm 16.9	0.043
BMI percentile	59.4 \pm 29.4	60.9 \pm 27.5	58.2 \pm 31.0	0.563

Table 2: Eating habits and dietary intake of the total sample and separately for boys and girls. Values are Mean with 95% Confidence Intervals.

	Total Sample	Girls	Boys
Breakfast (days/week)	5.2 [4.9, 5.6]	5.3 [4.8, 5.8]	5.1 [4.7, 5.6]
Morning Snack (days/week)	4.8 [4.6, 5.1]	4.8 [4.4, 5.2]	4.9 [4.5, 5.2]
Lunch (days/week)	6.5 [6.2, 6.7]	6.4 [6.0, 6.8]	6.5 [6.2, 6.8]
Afternoon Snack (days/week)	2.7 [2.4, 3.1]	2.6 [2.1, 3.1]	2.8 [2.3, 3.3]
Dinner (days/week)	6.1 [5.9, 6.4]	6.3 [5.9, 6.7]	6.0 [5.7, 6.4]
Late Night Snack (days/week)	1.2 [0.9, 1.5]	0.9 [0.5, 1.3]	1.2 [0.9, 1.5]
Meat (days/week) *	2.5 [2.3, 2.6]	2.1 [1.9, 2.4]	2.7 [2.5, 3.0]
Fish/Eggs (days/week)	1.8 [1.6, 2.0]	1.6 [1.4, 1.8]	2.0 [1.7, 2.2]
Milk (days/week)	2.2 [2.1, 2.4]	2.2 [1.9, 2.4]	2.3 [2.1, 2.5]
Rice & Noodles (days/week)	2.2 [2.0, 2.4]	2.2 [1.9, 2.4]	2.2 [2.0, 2.4]
Bread (days/week)	3.2 [3.0, 3.3]	3.3 [3.1, 3.5]	3.1 [2.9, 3.3]
Nuts & Seeds (days/week)	1.2 [1.1, 1.3]	1.2 [1.0, 1.5]	1.2 [1.0, 1.3]
Fruits (days/week)	2.7 [2.6, 2.9]	2.9 [2.6, 3.2]	2.6 [2.4, 2.8]
Vegetables (days/week) *	2.5 [2.3, 2.7]	2.9 [2.5, 3.3]	2.2 [1.9, 2.5]
Fast Food (days/week)	1.6 [1.5, 1.7]	1.5 [1.3, 1.7]	1.7 [1.5, 1.9]
Sweets (days/week)	2.6 [2.5, 2.8]	2.5 [2.3, 2.8]	2.7 [2.4, 2.9]
Softdrink (days/week) *	2.3 [2.2, 2.5]	2.0 [1.7, 2.3]	2.6 [2.4, 2.9]
Water (days/week)	4.4 [4.1, 4.6]	4.6 [4.2, 5.0]	4.2 [3.9, 4.5]

* significant sex differences based on Mann-Whitney-U Tests ($p < 0.01$)

Table 3: Association between eating habits and dietary intake for the total sample and separately for boys and girls. Values are Spearman's rho.

		Breakfast	Morning	Lunch	Afternoon	Dinner	Late Night
			Snack		Snack		Night
							Snack
Meat	Total	0.03	0.09	0.20 *	0.19	0.01	0.03
	Girls	0.01	-0.16	0.02	0.07	-0.02	0.06
	Boys	0.08	0.24	0.34 *	0.24	0.10	-0.03
Fish/Egg	Total	0.04	-0.02	-0.01	0.22 *	-0.01	0.05
	Girls	-0.07	-0.15	0.06	0.25	-0.13	0.06
	Boys	0.14	0.07	-0.08	0.20	0.12	0.10
Milk	Total	0.14	0.10	-0.08	0.10	-0.02	0.12
	Girls	0.10	0.15	-0.13	0.09	-0.06	-0.05
	Boys	0.17	0.04	-0.05	0.12	0.02	0.25
Rice/Noodles	Total	0.07	0.04	0.02	0.11	0.02	0.25 *
	Girls	-0.04	-0.10	-0.01	-0.09	-0.09	0.17
	Boys	0.17	0.14	0.04	0.25	0.13	0.32 *
Bread	Total	0.11	0.04	0.12	0.10	0.13	0.07
	Girls	-0.02	0.10	-0.05	0.09	0.02	0.06
	Boys	0.19	0.01	0.25	0.10	0.19	0.12
Nuts & Seeds	Total	0.14	0.04	-0.02	0.03	-0.06	0.09
	Girls	0.07	0.10	-0.22	0.09	0.02	0.06
	Boys	0.19	0.00	0.14	-0.01	0.02	0.13
Fruits	Total	0.23 *	0.06	0.19	0.20	0.05	-0.06
	Girls	0.20	0.08	0.20	0.12	-0.10	-0.09
	Boys	0.25	0.05	0.16	0.27	0.15	0.01
Vegetables	Total	0.07	-0.10	0.11	-0.03	-0.12	-0.08
	Girls	0.03	-0.08	0.21	0.07	0.00	-0.07
	Boys	0.08	-0.11	0.01	-0.12	-0.27 *	-0.01
Fast Food	Total	-0.03	-0.02	-0.09	0.02	0.08	0.23 *
	Girls	-0.09	-0.11	-0.09	-0.02	0.09	0.08
	Boys	0.03	0.04	-0.10	0.04	0.10	0.31 *
Sweets	Total	0.28 *	0.15	0.01	0.15	0.16	0.07
	Girls	0.17	0.06	-0.13	0.07	0.16	0.20
	Boys	0.34 *	0.19	0.08	0.19	0.18	-0.04
Softdrink	Total	-0.05	0.06	-0.15	0.10	-0.01	0.24 *
	Girls	-0.08	0.12	-0.22	0.14	-0.02	0.26
	Boys	0.01	0.00	-0.09	0.03	0.07	0.17
Water	Total	0.19	-0.11	0.05	-0.03	0.07	-0.03
	Girls	-0.02	-0.22	-0.02	-0.05	0.06	0.06
	Boys	0.37 *	-0.02	0.10	0.01	0.08	-0.04

* significant association based on Spearman's correlation at $p < 0.01$

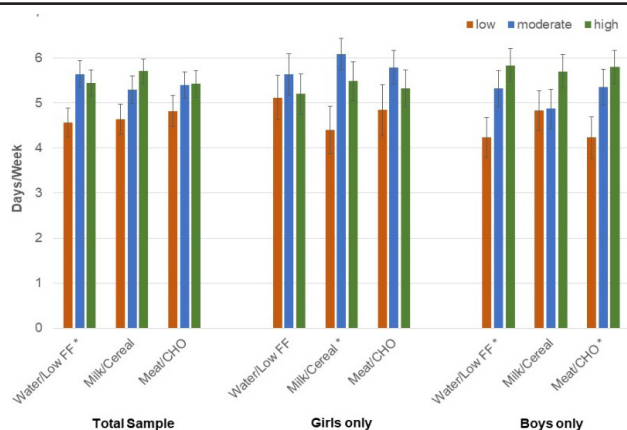


Figure 1: Frequency of breakfast consumption across tertiles of diet factor scores in the total sample and separately for girls and boys. Values are means with S.E.

* significant differences across tertiles of diet factor scores based on Kruskal-Wallis-Test ($p < 0.05$)

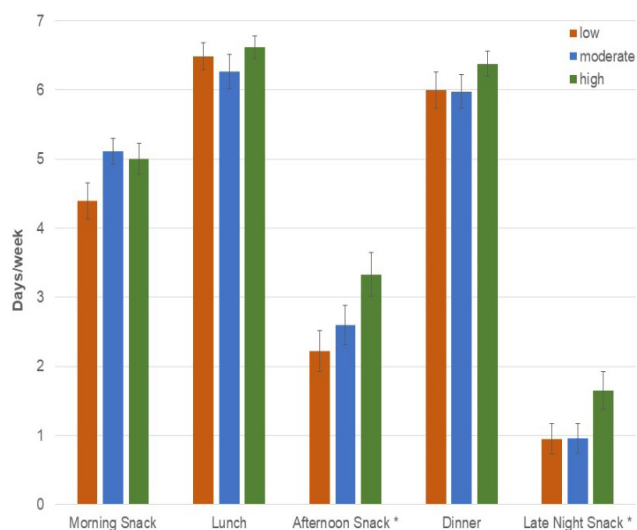


Figure 2: Frequency of meal consumption across tertiles of the meat/CHO factor in the total sample. Values are means with S.E.

*significant differences across tertiles of diet factor scores based on Kruskal-Wallis-Test ($p < 0.05$)

Weak positive correlations were observed between breakfast frequency and frequency of morning snacks ($r_s = 0.23$, $p < 0.01$) as well as lunch ($r_s = 0.27$, $p < 0.01$). Further, lunch frequency was positively correlated with the frequency of dinner ($r_s = 0.22$, $p < 0.01$). Correlations between eating habits and food consumption were generally weak for the total sample (Table 3). Significant positive associations were observed between breakfast frequency and frequency of fruit and sweet consumption. Frequency of lunch was positively associated with the frequency of meat intake. Further, there was a positive association between the frequency of afternoon snack and fish/egg consumption as well as late night snack and consumption of rice/noodles, fast food and softdrink. Sex specific analyses did not reveal any significant associations between eating habits and dietary intake in girls. In boys, several significant moderate associations between eating habits and dietary intake were observed (Table 3). Specifically, breakfast frequency was positively associated with the consumption of sweets and water. Lunch

frequency was positively associated with the consumption of meat while dinner frequency was negatively associated with consumption of vegetables. In addition, the frequency of late night snacks was positively associated with the consumption of rice/noodles and fast food.

Higher frequency of breakfast consumption was associated with higher scores on the water/low FF in the total sample ($p = 0.03$) and in boys ($p < 0.01$) (Figure 1). Boys also displayed higher scores in the meat/CHO factor with higher breakfast frequency ($p = 0.02$). In girls, higher frequency of breakfast consumption was associated with higher scores on the milk/cereal factor ($p = 0.04$). Further, higher scores on the meat/CHO factor were associated with more frequent afternoon ($p = 0.03$) and late night snacks ($p = 0.04$) in the total sample (Figure 2). In the sex specific analyses no significant associations between eating habits and diet factor scores were observed beyond the previously reported associations with breakfast consumption.

Discussion

The results of the present study support the importance of regular breakfast consumption in the establishment of healthy eating habits in adolescents. In addition, it was shown that more frequent late night snacks were associated with poorer dietary choices. It was also shown that boys have poorer dietary choices than girls, even though there were no sex differences in eating habits. Specifically, boys reported a more frequent consumption of meat and softdrinks, while their fruit and vegetable intake was lower compared to girls. Further, associations between eating habits and food intake were more pronounced in boys. This finding may also indicate that girls make more conscious decisions on their diet than boys. No differences in dietary pattern were observed between overweight and non-overweight participants, which has been reported previously as well [19].

Beneficial effects of regular breakfast consumption on diet quality as well as general health and cognitive function have been shown in previous studies [19,29 38-41]. In addition to the observed beneficial association with fruit intake, regular breakfast has been associated with higher intake of Calcium [19]. This is of particular importance during childhood and adolescence given the increased needs for growth and the accretion of bone mass [42]. Breakfast skipping has also been associated with dieting in youth, which increases the risk for nutritional deficiencies as well as the development of eating disorders [43]. Healthy dietary choices during breakfast, however, need to be emphasized as the quality of breakfast foods has been shown to decline with increasing age in youth [44]. The present study also indicates a potential risk of higher consumption of sweets during breakfast. Particularly ready-to-eat cereals have been associated with higher carbohydrate and sugar consumption [19]. Nevertheless, regular breakfast consumption appears to play an important role in the establishment of healthy dietary habits, including a more regular eating pattern and main meals as breakfast skipping increases the frequency of snacking [41].

Snacks have been shown to provide a considerable amount to total daily energy intake in adolescents [45,46]. This may be attributed to poor dietary choices while snacking as children and adolescents commonly select snacks based on taste rather than nutrition, resulting in the selection of foods that are highly processed, energy dense and rich in sodium [41,46]. Nevertheless, frequency of snacking has been inversely associated with body weight in youth. A possible explanation is a higher snack-

ing frequency in more active youth in order to meet their increased energy needs. Exercising adolescents have also been shown to make healthier food choices [47]. Further, the amount of energy consumed during regular meals may be reduced with higher eating frequency (i.e. snacking between meals) [46]. The present study also did not show poorer dietary choices with high snack frequency during the day. Late night snacks, however, were associated with increased fast food and softdrink consumption as well as the consumption of rice/noodles, which could also reflect a higher intake of ready-to-eat meals. Poor dietary choices during late night snacks may, at least partially, be attributed to the setting of snack consumption. Snacking while watching TV is a common habit in youth [46,48,49] and may be particularly pronounced during the evening following dinner. TV advertisements also affect the choices of snacks as energy dense foods are commonly advertised on TV [50]. Late night snacks may further affect subsequent meal intake (i.e. breakfast) as not being hungry was a key reason for skipping breakfast in addition to lack of time [51]. Given the beneficial effects of regular breakfast consumption on dietary intake, this may be an additional explanation for poor dietary choices specifically with late-night snacks rather than snacks during the day.

Late night snacks may also be a result of less structured eating behavior and fewer family meals throughout the day, which has been associated with poorer diet quality. Previous research showed that regular meal patterns were associated with healthier food choices [52], greater dietary diversity [53] and better nutrient intakes [23]. This may be attributed to a greater number of family meals, which give parents the opportunity to positively influence the dietary choices of their children by providing nutritious and healthy food as well as serving as role model for healthy eating behaviors [22]. Guidance on dietary choices is particularly important during childhood and adolescence as eating habits are generally less consolidated at younger ages [54]. Accordingly, there is considerable potential to promote healthy eating habits and dietary choices in youth [40,54]. Gillman et al. [24], for example, showed higher fruit and vegetable intake along with more fiber and micronutrient intake during family dinner, while the consumption of fried food, softdrinks, saturated and trans fat was lower. Less healthy food choices, on the other hand, were observed in adolescents with irregular lunch and breakfast habits [23], which may indicate less parental involvement in dietary choices. Given the poorer dietary choices in boys compared to girls in the present study, regular family meals along with guidance on food choices may be particularly important with boys.

While the present study provides several interesting findings, some limitations need to be considered when interpreting the results. Dietary habits were assessed via self-report and there is a risk for misreporting due to social desirability and social approval. Further, frequency of foods consumed rather than total amount were reported and there was no differentiation between weekdays and the weekend. Participants may also have had problems remembering all foods consumed during the last week or they may have consumed some foods that were not listed on the questionnaire, which potentially affects the displayed dietary intake of the sample. These problems, however, are common in dietary measurements in a real-world setting and the administration of the diet reports under supervision should have contributed to more accurate reports. The inclusion of all major meals and snacks between meals when assessing eating patterns should also be considered a strength of the study as it provides a better picture on overall eating pat-

tern compared to studies relying only on specific meals, such as breakfast.

Conclusion

In conclusion, the results of the present study indicate the importance of regular meal patterns and particularly regular breakfast consumption. Late night snacking, on the other hand, should be limited. As eating habits and dietary preferences are established during childhood and adolescence it is important to target eating behaviors and food choices at young ages [55]. Particularly the importance of healthy breakfast habits should be emphasized. Family meals along with guidelines regarding late night snacks appear to play a crucial role in the promotion of healthy eating patterns and food choices. Further, healthy snack choices, which contribute to meeting dietary guidelines and help in the prevention of chronic diseases as well as supporting healthy growth and development in youth [56], should be promoted in schools as well as after-school settings.

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