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ORIGINAL ARTICLE

Dietary intake and physical activity of German university students

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Abstract

Aim A balanced diet is important for health and well-being. The aim of this study was to investigate dietary intake and physical activity in German university students.

Subjects and methods A cross-sectional nutrition study was conducted at the University of Education, Schwäbisch Gmünd (Germany). Food consumption (3-day estimated dietary record) and physical activity level (PAL, standardized questionnaire) were assessed in 329 female (f) (age 22.7±3.4 years) and 60 male (m) students (age 24.0±3.1 years) and compared with recommendations (one-sample *t*-test, $\alpha = 0.05$).

Results On average, students consumed less vegetables (f: 177±119, m: 152±163 g/day), fruit (f: 169±117, m: 146±158 g/day), and potatoes/grain products (f: 303±126, m: 362±163 g/day) than recommended. Meat consumption was too high in men (1155±651 g/week), but not in women (490±455 g/week). The consumption of milk/dairy products was slightly too low in women (190±129 g/day), but in the recommended range for men (279±253 g/day). Nutrient recommendations were almost achieved (exceptions: fiber, vitamin D and folate [f, m], fat, iron and vitamin E [f], carbohydrate [m]). Leisure time physical activity was 259±222 min/week (f) and 359±236 min/week (m), and PAL was 1.60±0.11 (f) and 1.65±0.12 (m).

Conclusions Dietary intake and physical activity in university students is roughly equivalent to that in the average German population and needs to be improved.

Keywords University students · Food consumption · Energy intake · Nutrient intake · Physical activity

Introduction

In Germany as well as globally, chronic non-communicable diseases such as cardiovascular diseases, diabetes, and cancer are the leading cause of morbidity and mortality (Robert Koch-Institut [RKI] 2015). In this context, nutrition is the most important risk factor complex, and about 26% of all deaths among both sexes can be attributed to this complex (Plass et al. 2014). Regarding disability-adjusted life years, nutritional risk and a high body mass index (BMI) are among the top five factors of cause. In addition, physical inactivity is one of the top five factors in women (Plass et al. 2014). Therefore, nutrition and physical activity are core components in health promotion.

A plant-based diet, rich in vegetables and fruit, reduces the risk of premature death (Schwingshackl et al. 2017). However, the average consumption of plant-based foods among the German population is below the German recommendations, particularly for vegetables (Gose et al. 2016). Consequently, the mean fiber intake also does not achieve the recommendations (Gose et al. 2016). Products of animal origin are consumed in too high an amount. The consumption of meat and meat products in particular is associated with a higher risk of mortality (Schwingshackl et al. 2017). Mean consumption of meat and meat products in both sexes exceeds the recommended amount, with men markedly exceeding the recommended 600 g/week (Gose et al. 2016).

Physical inactivity, as a contributor to the abovementioned diseases and mortality (Katzmarzyk et al. 2019), is also common in Germany. More than half of the German population (57% female, 52% male) do not achieve the recommended 150 min of exercise per week (Finger et al. 2015).

These deficient behaviors are more prevalent in subpopulations with low socioeconomic status (Krug et al. 2013; Mensink et al. 2017). It would be expected that young and well-educated groups, such as university

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students, would display comparatively good health behaviors. As potential leaders, they may be involved in creating healthier environments. Environmental prevention measures are strategies to change dietary and exercise habits among all social groups equally. But some analyses indicate that university students struggle with barriers to healthy behavior such as time and other resource-related barriers (Hilger-Kolb and Diehl 2019; Middendorff et al. 2017). Only a few studies have analyzed the behavior of university students in Germany regarding dietary intake (Hilger et al. 2017; Stroebele-Benschop et al. 2018) and physical activity (Baumgarten 2010; Krems et al. 2004), and not all studies have determined the quantities of food consumption, thus preventing comparisons with the recommendations regarding dietary intake (Hilger et al. 2017; Stroebele-Benschop et al. 2018). Therefore, the aim of this study was to quantitatively investigate whether unfavorable dietary intake and physical activity are also present in university students. It further examines whether this applies equally to females and males. These quantitative data are relevant for the precise targeting of specific measures in the university setting.

Methods

Study design, participants, and recruitment

A cross-sectional study on the nutritional and health status of university students was carried out at the University of Education in Schwäbisch Gmünd, Germany (Jäger 2010; Nössler 2020; Schleicher 2010). The University of Education has a main focus on education, health, and interculturality. About one third of the students are enrolled in a health-related study course or subject (teacher training programs, health promotion, and childhood education). Figure 1 shows the generation of the final sample with a complete data set. All enrolled students of the University of Education in Schwäbisch Gmünd were asked to participate in this study. They were contacted by email, the learning management system, a flyer, during lectures, or face-to-face contact. In 2009/2010 and 2011/2012 all measurements were carried out at the University of Education in Schwäbisch Gmünd. Measurements were performed during the course of the day at the testing center of the university. First, anthropometric data were measured for the students. In order to assess their sociodemographic data and lifestyle habits, students had to fill out a standardized questionnaire. The participants also received a dietary record, which they were asked to fill out at home (see details below). No anthropometric measurements were carried out in 2014; students only had to fill out the standardized lifestyle questionnaire and the dietary record. The study protocol and the questionnaires and measurement protocols were submitted to the university's ethics committee, reviewed, and approved. The study was carried out according to the recommendations of the Helsinki Declaration (World Medical Association 2008). All study participants provided written informed consent before participating in the study.

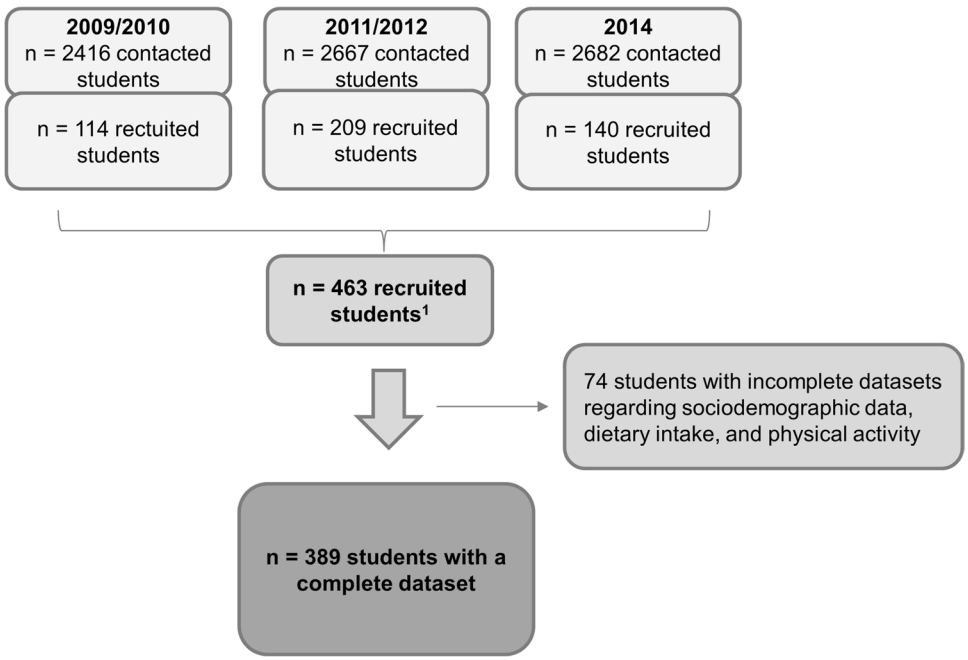

Fig. 1 Generation of the final sample with a complete data set. [1] Students could be contacted at different measurement times. Each individual was included only once in the present data set

Dietary intake

Dietary intake was assessed via a structured 3-day estimated and validated dietary record. The 3-day estimated record consists of 146 food items, which are divided into 16 food groups (supplements not included). For each food item, the normal household portion size (slice, tablespoon, cup, etc.) and the corresponding weight were recorded in the 3-day estimation (Lührmann et al. 1999). The protocol was carried out on three consecutive days (Sunday to Tuesday or Thursday to Saturday). The entries of the participants were checked for plausibility. Energy and nutrient intake was calculated using the Federal Nutrient Data Base version II.3. Average daily food consumption or average daily energy and nutrient intake was calculated from the three protocol days.

Results of food consumption and energy and nutrient intake were compared with the food-based dietary guidelines of the German Nutrition Society (Deutsche Gesellschaft für Ernährung [DGE] 2013), the recommendations for the consumption of "tolerated" foods such as sweets and pastries (aid infodienst Ernährung, Landwirtschaft, Verbraucherschutz e.V. 2012), and the current D-A-CH reference values for nutrient intake (Deutsche Gesellschaft für Ernährung [DGE] et al. 2018).

In addition, the Healthy Eating Index (HEI-NVS) was determined. The HEI-NVS is a nutritional index for the estimation of nutrition quality (Hoffmann and Spiller 2010). The estimation is based on the food-based dietary guidelines of the German Nutrition Society. HEI-NVS is composed of ten food components: vegetables, fruit, grains, dairy products, fish and fish products, meat and meat products, eggs, alcohol, spreadable fats, and non-alcoholic beverages. For each food component, a maximum score of ten points can be achieved, except for the fruit and vegetable components, with a maximum of 15 points each (range of HEI-NVS: 0 to 110). A high HEI-NVS score indicates intake close to the recommended ranges or amounts.

Anthropometric data and body composition

Between 2009 and 2012, body weight was measured to the nearest 0.1 kg using a calibrated beam scale (Seca 877, Seca, Hamburg, Germany), with the participants in lightweight clothing and without shoes. Height was assessed to the nearest 0.5 cm using a measuring tape, with participants standing straight and looking straight ahead, also not wearing shoes. In 2014, data regarding weight and height were collected via questionnaire. BMI was classified according to the World Health Organization categories as underweight, normal weight, or overweight (World Health Organization [WHO] 2000)

Physical activity and lifestyle

A questionnaire was also used to collect sociodemographic data and activity behavior. Physical activity was recorded using a questionnaire developed by Krems et al. (2004). The university students were asked how many hours per week they spent engaged in low, medium, and vigorous physical activity (sports), how many hours they spent doing part-time work, and how they rated the physical activity of their work (low, medium, vigorous). Furthermore, they were asked how many hours they spent doing housework and gardening, walking, using media, and sleeping. The physical activity level (PAL) was calculated as a measure of the students' physical activity in accordance with WHO's approach (World Health Organization [WHO] 1985). It defines the average daily energy consumption for physical activity as a multiple of the resting metabolic rate (RMR). RMR was calculated using the equation of Müller et al. (2004). Times of physical activity or inactivity asked in the questionnaire were multiplied by the multipliers for RMR proposed by WHO (studying: 1.7, part-time job: low: 1.7, medium: 2.2, vigorous: 2.8, walking: 3.0, physical activity [sports]: low: 3.2, medium: 5.3, vigorous: 6.3, housework and gardening: 2.7, social activities: 3.3, media use: 1.4, sleeping: 1.0, remaining time: 1.4). The time spent on academic studies was estimated to be 41 h/week (Isserstedt et al. 2010). Furthermore, 1 h/day was estimated to be spent on social activities (cinema or theatre visits, meeting friends, club meetings) (World Health Organization [WHO] 1985). The difference between the listed activity or inactivity and the duration of a day was defined as the remaining time. Total energy expenditure was calculated as the pooled total of all time spent in activities multiplied by their respective energy expenditure magnitudes (World Health Organization [WHO] 1985). Actual PAL was then calculated by dividing the total energy expenditure by estimated RMR. PAL was classified according to the classification provided by the WHO, where a PAL of 1.40–1.69 indicates a sedentary or light activity lifestyle, a PAL of 1.70–1.99 an active or moderately active lifestyle, and a PAL of 2.00–2.40 a vigorous or vigorously active lifestyle (World Health Organization [WHO] n.d.). Leisure time physical activity was calculated by adding "physical activity (sports), total" and "biking" (Finger et al. 2015).

Data analysis

Data were analyzed with SPSS Statistics version 25 for Microsoft Windows (IBM Deutschland, Ehningen). Statistical parameters are given as mean values (*M*) and standard deviations (*SD*). Normal distribution was examined using the Kolmogorov–Smirnov test. The one-sample *t*-test was used to examine whether the mean values of food consumption,

energy and nutrient intake, and physical activity deviated from the German recommendations. For the comparison by sex, the *t*-test for independent samples and Pearson's chi-square test were used. Differences between energy intake and total energy expenditure were tested using the *t*-test for paired samples. The null hypothesis was rejected only if the significance level (p) was < 0.05.

Results

Sample characteristics

The sample consisted of 329 (84.6%) female and 60 (15.4%) male university students (Table 1). Female students were aged 17 to 53 years and male students were between 18 and 36 years old. About half of female and male students had a part-time job. A majority of female and male students were of normal weight; 16.0% of female students and 33.3% of male students were overweight. Female and male students differed significantly from each other in terms of age, body height, body weight, mean BMI, and BMI categories.

Dietary intake

Table 2 shows the daily food consumption of the university students. Results show that, compared with the German recommendations, university students did not eat enough vegetables and fruit, potatoes and grain products, and fish. Female students did not consume enough milk and dairy products. Male students ate too much meat and meat products. The consumption of "tolerated" foods was too high in both sexes. There were significant differences in sex for the consumption of potatoes and grain products, milk and dairy products as well as meat. There were also significant differences in the intake of oils and fats and alcoholic beverages. Male students consumed significantly more of these food groups than female students. The mean HEI-NVS was 73.8 ± 8.9 points for female students and 68.0 ± 9.4 points for male students, respectively. Female students had a significantly higher HEI than male students (Table 2).

Table 3 shows the total energy expenditure for the university students calculated on the basis of the activity questionnaire and the energy intake determined from food consumption. Energy intake was significantly lower than total energy expenditure and the recommendation for energy intake.

Female students exceeded the recommendations of the German Nutrition Society for fat intake (Table 3). Also, protein intake exceeded the acceptable intake of 15 energy% for female and male students. Although recommendations for carbohydrate intake were almost achieved, there was low intake of fiber and high intake of monosaccharides and disaccharides. Significant differences were found between male and female students regarding protein and carbohydrate intake. Data also showed significant differences for mono- and disaccharides.

Figures 2 and 3 show the intake of vitamins and minerals (supplements not included). German recommendations for micronutrients were mainly achieved. Exceptions were vitamin D, folate, and iodine (iodized salt not included), as well as iron and vitamin E for female university students. There were significant sex differences in vitamins and minerals. Male students had significant higher intake of biotin ($p = 0.000$), folate ($p = 0.000$), cobalamin ($p = 0.000$), pyridoxine ($p = 0.002$), niacin ($p = 0.000$), vitamin B2 ($p = 0.001$), vitamin B1 ($p = 0.004$), and vitamin A ($p = 0.042$), as well as iron ($p = 0.000$), sodium ($p = 0.000$), calcium ($p = 0.002$), and phosphorus ($p = 0.000$). Among female students, the intake of vitamin C ($p = 0.044$) was significantly higher.

Table 1 Sample characteristics (*M*, *SD*; %)

	Female students ($n = 329$)	Male students ($n = 60$)	p-value[a,b]
Age [years]	22.7 ± 3.4	24.0 ± 3.1	0.009
Carrying out a part-time job [%]	51.4	51.7	0.97
Body height [cm]	167 ± 6	180 ± 7	< 0.001
Body weight [kg]	61.9 ± 9.3	78.1 ± 11.8	< 0.001
BMI [kg/m^2]	22.2 ± 3.0	24.0 ± 3.0	< 0.001
BMI categories			
- BMI < 18.5 kg/m^2 [%]	6.1	1.7	0.004
- BMI 18.5–24.9 kg/m^2 [%]	77.9	65.0	
- BMI > 25.0 kg/m^2 [%]	16.0	33.3	

BMI = body mass index

[a]Independent-samples *t*-test

[b]Pearson's chi-square test

Table 2 Food consumption (*M*, *SD*)

	Recommendation[b]	Female students ($n = 329$)	p-value[c]	Male students ($n = 60$)	p-value[c]	p-value[d]
Vegetables [g/d]	> 400 g/d	177 ± 119	< 0.001	152 ± 163	< 0.001	0.17
Fruit [g/d]	> 250 g/d	169 ± 117	< 0.001	146 ± 158	< 0.001	0.19
Potatoes and grain products [g/d]	200–300 g/d bread OR 150–250 g/d bread and 50–60 g/d cereals AND 200–250 g/d potatoes OR 200–250 g/d noodles OR 150–180 g/d rice	303 ± 126	< 0.001	362 ± 163	< 0.001	0.009
Milk and dairy products [g/d]	200–250 g/d milk and dairy products and 50–60 g/d cheese	190 ± 128	< 0.001	279 ± 253	0.98	0.010
Meat and meat products [g/wk]	< 300–600 g/wk	490 ± 455	0.12	1155 ± 651	< 0.001	< 0.001
Fish and fish products [g/d]	80–150 g/wk saltwater fish and 70 g/wk oily fish	11 ± 25	< 0.001	14 ± 34	0.005	0.43
Eggs [g/d]	< 3 eggs per week	10 ± 17	< 0.001	13 ± 23	< 0.001	0.36
Oils and fats [g/d]	< 15–30 g/d margarines or butter and 10–15 g/d vegetable oils	11 ± 8	< 0.001	15 ± 11	< 0.001	0.005
Non-alcoholic beverages [ml/d]	> 1500 ml/d	1664 ± 614	< 0.001	1804 ± 877	0.009	0.24
Alcoholic beverages [ml/d]	-	23 ± 71	-	263 ± 551	-	< 0.001
"Tolerated" foods (e.g. snacks, sweets) [% of the energy intake]	< 10%	21 ± 12	< 0.001	23 ± 12	< 0.001	0.21
HEI-NVS[a] [points]	110	73.8 ± 8.9	< 0.001	68.0 ± 9.4	< 0.001	< 0.001

[a]Healthy Eating Index

[b]Recommendation of the German Nutrition Society (DGE)

[c]One-sample *t*-test: vegetables: 400 g/d; fruit: 250 g/d; potatoes and grain products: 457.5 g/d; dairy products: 280 g/d; meat and meat products: 450 g/wk; fish and fish products: 26.4 g/d; eggs: 23.6 g/d; oils and fats: 35 g/d; non-alcoholic beverages: 1500 ml/d; "tolerated" foods: 10%; HEI-NVS: 110 points

[d]Independent-samples *t*-test

Table 3 Total energy expenditure, energy intake, and intake of macronutrients and fiber (*M*, *SD*)

	Recommendation[a]	Female students ($n = 329$)	p-value[b]	Male students ($n = 60$)	p-value[b]	p-value[c]
Total energy expenditure [kJ/d]	-	9256 ± 979	-	12453 ± 1224	-	< 0.001
Energy intake [kJ/d]	Female (19–24 years): 9205 Male (19–24 years): 11715	7251 ± 2477[d]	< 0.001	10376 ± 2512[d]	< 0.001	< 0.001
Fat [energy%]	< 30	31.9 ± 5.9	< 0.001	30.5 ± 6.9	0.56	0.10
Protein [energy%]	< 15	15.6 ± 3.1	< 0.001	17.6 ± 4.3	< 0.001	0.001
Carbohydrates [energy%]	> 50	50.8 ± 6.7	0.04	48.0 ± 7.5	0.05	0.005
Monosaccharides and disaccharides [energy%]	-	22.9 ± 7.1	-	20.9 ± 6.9	-	0.04
Fiber [g/d]	> 30	20.1 ± 7.8	< 0.001	23.0 ± 12.2	< 0.001	0.08

[a]D-A-CH reference values for nutrient intake based on a PAL value of 1.6

[b]One-sample *t*-test, test value: recommendation

[c]Independent-samples *t*-test

[d]Paired-samples *t*-test energy intake vs. total energy expenditure: female: $p < 0.001$, male: $p < 0.001$

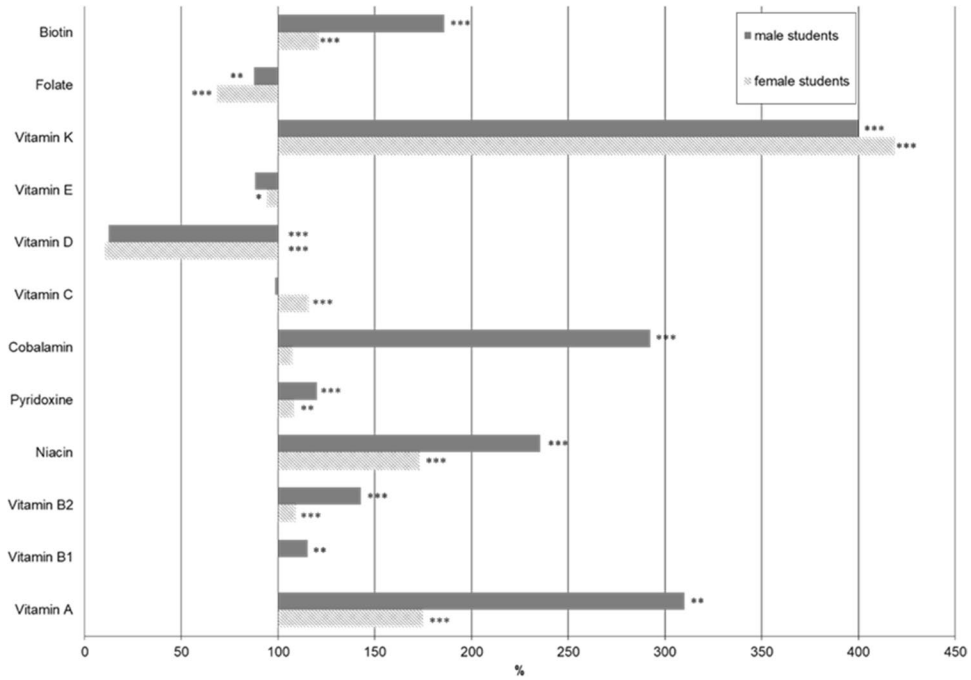

Fig. 2 Mean vitamin intake compared with D-A-CH reference values in percent (*, **, *** significant difference from D-A-CH reference values, one-sample *t*-test: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$)

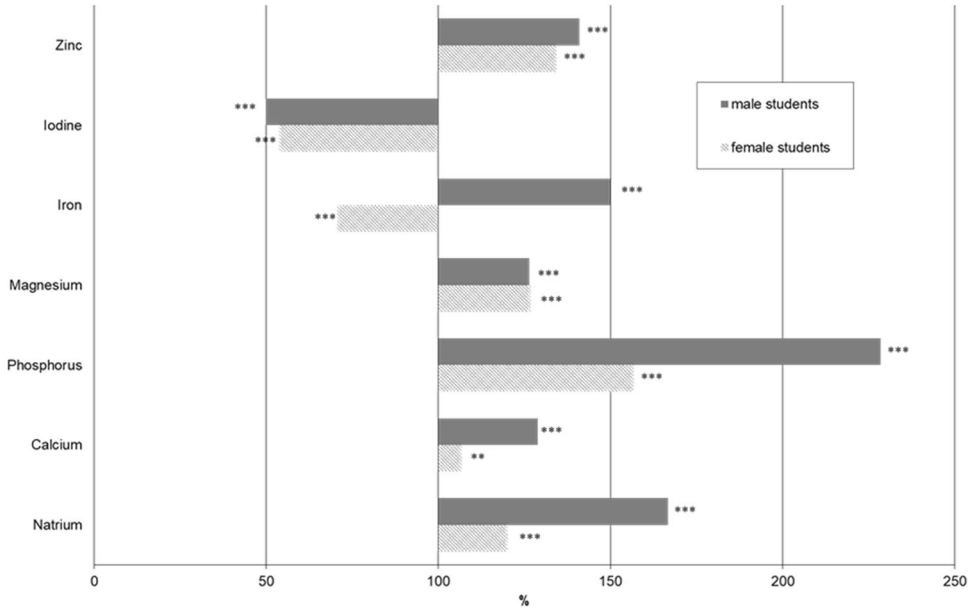

Fig. 3 Mean minerals intake compared with D-A-CH reference values in percent (**, *** significant difference from D-A-CH reference values, one-sample *t*-test: ** $p < 0.01$, *** $p < 0.001$)

Physical activity

The amount of physical activity is shown in Table 4. University students spent very little time in their part-time jobs or doing housework and gardening. Almost all female (92.7%) and male (93.3%) students were physically active in their leisure time. On average, female students exercised about 260 min/week, and male students about 360 min/week. Thus, on average, leisure time physical activity was significantly above the recommended 150 min/week for both female (*t*-test: $p = 0.000$) and male students (*t*-test: $p = 0.000$). However, 30.4% of female and 20.0% of male students did not achieve this recommendation. While female students spent significantly more time on housework and gardening, male students spent more time sleeping and in vigorous physical activities (sports). Consequently, PAL score and leisure time physical activity were higher in male students. In summary, the physical activity of university students was rated as sedentary or light activity, with 85.6% of female students and 73.3% of male students having a PAL score below 1.70.

Table 4 Physical Activity (*M*, *SD*)

	Female students ($n = 329$)	Male students ($n = 60$)	p-value[a]
Part-time job [min/d]	35.1 ± 49.6	36.5 ± 44.1	0.84
Housework and gardening [min/d]	26.0 ± 25.7	15.1 ± 20.1	< 0.001
Media use [min/d]	178.6 ± 129.5	209.9 ± 130.5	0.09
Sleeping [min/d]	463.1 ± 68.9	442.7 ± 51.6	0.03
Walking [min/d]	35.5 ± 27.9	35.1 ± 31.4	0.91
Biking [min/d]	5.3 ± 12.5	5.0 ± 7.6	0.86
Physical activity (sports), low [min/d]	5.2 ± 9.3	3.6 ± 9.2	0.22
Physical activity (sports), medium [min/d]	14.5 ± 15.8	17.8 ± 19.9	0.24
Physical activity (sports), vigorous [min/d]	12.0 ± 18.7	24.9 ± 26.8	0.001
Physical activity (sports), total [min/d]	31.7 ± 27.6	46.2 ± 32.1	< 0.000
Leisure time physical activity [min/d]	37.0 ± 31.7	51.2 ± 33.8	0.002
Leisure time physical activity [min/wk]	259 ± 222	359 ± 236	0.002
PAL	1.60 ± 0.11	1.65 ± 0.12	0.001

PAL = physical activity level

[a]Independent-samples *t*-test

Discussion

Participants

In the present study, the dietary intake and physical activity of 389 students at the University of Education, Schwäbisch Gmünd, Germany, were investigated. In contrast to other nutrition-related studies of students in Germany (Stroebele-Benschop et al. 2018; Hilger et al. 2017), our study provides data on the quantity of food consumption and nutrient intake.

The study sample is relatively large compared with previous studies by Baumgarten (2010), Krems et al. (2004), and Stroebele-Benschop et al. (2018). However, it should be noted that this group of students is not representative of German students, as in all other investigations (Hilger et al. 2017; Stroebele-Benschop et al. 2018; Krems et al. 2004; Baumgarten 2010). A large proportion of the participating students were enrolled in a health-related study course or subject (teacher training programs, health promotion, and childhood education).

This also explains the high proportion of female students, because health-related courses/subjects are predominantly chosen by women. Women also have a greater interest in health issues (Stock et al. 2001), which presumably results in a greater willingness to participate in health-related studies. In contrast, people who have a low level of health awareness decline above average to participate in health-related studies (Schneider 1997). Such observations are also known from other studies with students (Max Rubner-Institut 2008).

The percentage of overweight female participants (16.0%) is clearly lower than the national average for 20–29-year-old women (30.0%) (Mensink et al. 2013). This observation may also be related to the interest in health issues. However, male students in the present study do not differ regarding overweight from the national average (35.3% versus 33.3%) (Mensink et al. 2013).

Dietary intake

This study offers quantifiable data on the dietary intake of university students, allowing a comparison with the German recommendations. It provides a more precise picture of the dietary consumption of students than previous studies, which only used a food frequency questionnaire (Hilger et al. 2017; Stroebele-Benschop et al. 2018). Results of the 3-day estimated record show that the food consumption of university students is roughly comparable to the age-specific national average. Only vegetable consumption is slightly higher than the age-specific national average (19–24 years, female: 97 g/day, male: 103 g/day) (Max Rubner-Institut 2013). Nevertheless, students also fall well short of the recommendations for vegetable consumption, as determined by Hilger et al. (2017) and Stroebele-Benschop et al. (2018). In contrast to Hilger et al. (2017) and Stroebele-Benschop et al. (2018) male students in our study consume significantly more meat and meat products than that recommended by the German Nutrition Society. Our findings are consistent with those in the German population (Gose et al. 2016).

Overall, the nutritional quality in students' diet can be described as moderate (HEI-NVS 73.8 and 68.0 points out of 110), with female students eating slightly more favorably than male students. Overall, the HEI-NVS of students is comparable to that of the general German population (mean, female: 69 points, male: 67 points) (Gose et al. 2016).

Even if the recommendations of the German Nutrition Society are not fully met, similar to the national

average, most of the recommendations for nutrient intake are achieved. However, fat intake in female students and protein intake in both female and male students is marginally too high. The main sources of fat and protein are meat and meat products as well as milk and dairy products (Max Rubner-Institut 2008). While meat consumption can be reduced without any problems, the intake of milk and dairy products is already slightly below the recommendations and should therefore not be further reduced. In addition, vegetable oils should be used, as these would also increase vitamin E intake. The insufficient consumption of vegetables (the main source of folate) is also reflected in the insufficient folate intake. The observed deficits in vitamin D intake are not problematic if sufficient time is spent outdoors. The low iodine intake is certainly related to the low consumption of fish and fish products. Iodized table salt is mainly used in private households in Germany (Großklaus 2017); hence the iodine intake is presumably significantly higher in reality. The overall adequate meat consumption in female students is accompanied by relatively low iron intake. Female students are therefore advised to increase their consumption of plant-based, iron-rich foods. The relatively high consumption of "tolerated" foods (e.g. snacks, sweets), or rather mono- and disaccharides, and the low fiber intake can be countered by increasing the consumption of whole grain products.

Physical activity

The results of the present study show that students' leisure time physical activity is relatively high compared with the national German average for their ages. The observed gender differences are also found again. In the present collective, 69.6% of female and 80.0% of male students achieve the recommendations. In the age-matched German population, it is only 45.2% of women and 56.7% of men (Finger et al. 2017). Studies with students from other German universities report different results. In a study with students in the bachelor's degree program in health promotion and management in Magdeburg, 37.1% of the students were found to be physically inactive (Baumgarten 2010). On the other hand, students from Gießen were on average physically more active (sports, total) than female students (56 versus 31.7 min/day) and male students (73 versus 46.2 min/day) in the present study (Krems et al. 2004). Even if a comparison of the different studies is only possible to a limited extent due to different survey methods, it can nevertheless be deduced that most of the female and male students in the present study engage in a high degree of physical activity in their free time, especially the men, and thus also achieve the recommendations for physical activity on average. Nevertheless, 30.4% of women and 20.0% of men do not reach the recommendations for activity during leisure time.

In contrast, physical activity for other daily activities such as housework, gardening, or walking is very low (about 60 min/day). For example, according to the representative German National Nutrition Survey II study, adult women spend an average of about 260 min/day and men about 200 min/day doing housework and gardening, biking, and walking (Max Rubner-Institut 2008). This difference could be due to the life stage of students and the specifics of Schwäbisch Gmünd. The University of Education in Schwäbisch Gmünd is characterized by a high proportion of students from the surrounding area. Many students still live at home with their parents. It is possible that the parents do a large part of the daily household chores for their children. Overall, it is noticeable that despite their high level of physical activity (sports, total), on average the students achieve relatively low PAL values (females 1.60, males 1.65). These values represent a sedentary or light activity lifestyle and are within the range found in experimental studies of adults with predominantly sedentary behavior (1.60–1.70) (Black et al. 1996; Deutsche Gesellschaft für Ernährung [DGE] et al. 2018).

According to the Food and Agriculture Organization of the United Nations (FAO) and the World Cancer Research Fund (WCRF), in adults, a PAL value of at least 1.7 is associated with a low risk of various diseases such as obesity, coronary heart disease, type 2 diabetes mellitus, or cancer (Food and Agriculture Organization [FAO], World Health Organization [WHO], United Nations University [UNU] 2004; World Cancer Research Fund [WCRF], American Institute for Cancer Research [AICR] 2007). However, this value is achieved by only 14.4% of female and 27.7% of male students. That is, the majority of students do not reach the desirable PAL of 1.7 despite high levels of leisure time physical activity. Accordingly, an increase in physical activity for the female and male students is recommended.

Limitations

When interpreting the results, it must be kept in mind that the present study is not representative for students at other universities in Germany. Students enrolled in a health-related study course/subject are clearly overrepresented. In addition, the study sample is of moderate size and homogeneous.

Moreover, the data on physical activity and food consumption could only be obtained by questionnaire and not experimentally because of the relatively large effort and costs involved. Both physical activity and food consumption are self-reported, which is associated with bias. Food consumption was recorded in this study using a structured 3-day estimated dietary record. Although this is a valid survey instrument, the observation that the determined energy intake is lower than the calculated energy expenditure suggests that the protocol slightly underestimates food

consumption (underreporting). This phenomenon is known from other nutritional epidemiological studies and must be considered when interpreting the data (Lührmann et al. 1999; Poslusna et al. 2009).

Implications for research and practice

Our study, which for the first time quantitatively recorded food consumption data for students in Germany as well as their physical activity, confirms the deficits in these behaviors. The quantitative determination clearly showed how large the deficits are, particularly the high meat consumption among male students and low vegetable consumption among both sexes. Therefore, similar to the national average, it is important to increase the consumption of plant-based foods such as vegetables and whole grain products and, especially among men, to reduce meat consumption. It is also recommended that both sexes increase their physical activity, especially everyday activity.

Student life is a time of reorientation and offers good opportunities to shape new behaviors (Allgöwer 2002). The university setting is therefore of particular relevance, as health can be improved here by creating a healthy learning and living environment and by practicing health-promoting teaching and research (Tsouros et al. 1998). As possible behavioral and environmental prevention measures, the university could provide incentives to increase physical activity and make more favorable food choices (Maes et al. 2012). University sports programs are of particular importance in this regard. The university canteen is also an important resource, as at least 71% of female and 74% of male students in Germany regularly use the university canteens (Middendorff et al. 2017). Therefore, it is necessary to review supply structures and create health-promoting offers, for example, the implementation of the Guidelines on Quality Standards for Canteens in the Workplace of the German Nutrition Society (Deutsche Gesellschaft für Ernährung [DGE] 2020).

Since a large proportion of the university students will be multipliers for health in their future careers, this is also a worthwhile investment over the long term from a health promotion and public health perspective.

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Data availability The data files are available on request from the authors.

Code availability Not applicable

Declarations

Ethical approval The study protocol and the questionnaires and measurement protocols were submitted to the Ethics Committee of the University of Education, Schwäbisch Gmünd, and were reviewed and approved. The study was carried out according to the recommendations of the Helsinki Declaration (World Medical Association 2008)

Consent to participate All study participants signed written informed consent before participating in the study.

Consent for publication Not applicable

Conflicts of interest The authors declare that they have no conflict of interest.

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