Arch Lebensmittelhyg 73,
101–107 (2022)
DOI 10.2376/0003-925X-73-101

ISSN 0003-925X

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Study of the differences in the types of meals, energy intake, food type, and nutrients in an Algerian university population

Studie über Unterschiede bei Mahlzeiten, Energieaufnahme sowie Art der Lebensmittel und Nährstoffe an einer algerischen Universität

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Summary

The objective of this study is to describe the nutritional quality of meals offered by a university in Algeria based on the eating behavior of students. Food data were copied from daily consumption sheets for 2000 students of the Chlef University (Algeria), and provide the information needed to calculate the food ration for the three meals of the day (breakfast, lunch, and dinner), as well as the amount of food eaten per day, menus per meal, nature of the food, and quantities of foodstuffs used. Furthermore, a complementary descriptive cross-sectional nutritional survey through a food questionnaire was applied to a sample of 500 students, and the average daily ration, the share of each food group, the average nutritional potential, and the share of major nutrients in the total energy intake were determined by estimating the quantity and frequency of consumption and determining the Total Energy Expenditure, dietary diversity, and Food Variety Score.

Furthermore, the Body mass index of the participants suggest a balanced nutritional state, and the menu consists of a main course with little variety (Food Variety Score = 4.18 ± 0.66) but diverse (dietary diversity score = 6.17 ± 0.92); the amount of food consumed per day is estimated at 2398.07g. The energy intake from this diet is 3249.27 ± 614.55Kcal. The Total Energy Expenditure is 1277.52 ± 230.21 Kcal.

Even if the recommendations vary between countries, it is clear that using these nutritional parameters combined with the feeding behavior allows both the evaluation of the effect of a diet on the nutritional status and the adjustment of the food options.

Keywords: Nutritional survey, consumption, food, energy expenditure

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Introduction

Collective catering is part of a group called out-of-home catering (Lessirard et al. 2017) (Engelmann et al. 2017), and it consists on supplying of meals to a community of regular consumers (bounded by agreement or contract (Doutoum et al. 2019) (Mekhancha et al. 2017), and university restaurants are part of collective catering (Lessirard et al. 2017) (Rodriguez and Seguin 2019) (Lautre 2016). In Algeria, the food supply in university restaurants benefit more than 1.5 million students and is provided by nearly 500 catering units (Mekhancha et al. 2017).

On the other hand, evaluating the nutritional status of populations by evaluating university food consumption may be essential for identifying nutritional problems in different populations. Moreover, several studies have evaluated food consumption, as well as the quality or quantity of food at university caterings in Algeria (Mahmoud and Zoheir31 2017) (Tafer and Mokdad 2013). Among the information necessary to calculate the food ration is the number of people fed, menus per meal, type, and quantities of foodstuffs used, among others (Doutoum et al. 2019). From these data, the average ration per person per day was calculated, and the energy and amounts of sugars provided were estimated (Dhob and Ismaili 2019). However, it is challenging to analyze the data collected from both a quantitative and qualitative point of view, as the eating behavior is conditioned by multiple factors that are complex and varied. Moreover, even if it is challenging to study food consumption in developed countries, it is even more challenging in developing countries (Latham 2001) (Mahmoud and Zoheir31 2017). Furthermore, in countries like France, the association between nutritional knowledge and food-consumption behavior analyzed in the context of transversal population surveys has been found to be significant (Escalon, Beck, and Bossard 2013).

For example, a single government survey in Alegria carried out by the national statistics office on consumption expenditure of Algerian households (Abla, Agli, and Boukazoula 2016) included 12,150 households spread across the national territory and collected information for a year to study the effects of seasonality in food consumption. Food was one of the main expenses in Algerian households, with 41.8% at the national level, with 40.1% in urban areas and 45.9% in rural areas in 2011. Cereal products occupied the first place in the food budget of Algerian households (17.5% of total food expenditure) directly followed by fresh vegetables (13.4%) (Office National des Statistiques 2014) (Touati 2016).

Nevertheless, it should be noted that a food balance sheet or food expenditure does not give an exact approach to real consumption (Faostat 2020) (Naska et al. 2008). For this reason, it is necessary to use direct assessing techniques for food consumption, like nutritional surveys that have consumption estimation questions (Truswell 2017) (da Silva Ferreira 2020).

Our work aims to assess the food consumption of a university cafeteria using both the data collected on the consumption sheet and the standard food consumption questionnaire combined with different scores of variety and dietary diversity; furthermore, we used the survey to calculate the macronutrient energy intake and to assess the nutritional status of students.

Material and methods

Our work was to study dietary diversity in meal types, intake, energy, foods, and nutrients on a college menu based on the behavior of young adults.

The first part consists in collecting the data from the daily consumption sheets available at the Chlef University Services Directorate to estimate the usual consumption of 2000 students:

It has to be noted that Chlef University has seven restaurants to support students, with a capacity of 3980 seats. Also, among the conditions that the students need to meet to have access to the lunch is that they cannot be over 28 years old, that the student must live more 50 km from the campus for males and more 30 km for girls, and that the student does not have an infectious disease.

The second part consists of studying the actual consumption of resident students and establishing a link between the diets through a descriptive cross-sectional survey (food consumption questionnaire):

The questionnaire was filled in at the university restaurant of the faculty of science of nature and life, in the city of Chlef, Algeria, where the food survey was carried out in April and May 2019 on 500 students (149 men and 351 women) whose age varies between 18 and 28 years to collect the quantity and frequency of food consumption, eating behavior, anthropometric parameters (weight and height), sex, and age.

Individuals had to complete a questionnaire that contained two sections. The first section was general information to classify the subjects, and it had simple questions that allowed the subject to become familiar with the process (age, sex, and weight). The second section of the questionnaire was designed to assess food consumption. The subjects were asked about their consumption of certain types of food and their level of consumption. Each respondent was then asked to fill out the information about a series of food, indicating one out of three frequencies of consumption and the quantity ingested each time.

Determination of the Total Energy Expenditure (TEE)

The total energy expenditure (TEE) was calculated using the Harris and Benedict prediction equation and applying a correction coefficient (Wémeau, Schlienger, and Vialettes 2014)(Picolo et al. 2016).

- **Resting Energy Expenditure** (REE) (man) = 664,7 + 13,75× weight (kg) + 5 × size (m) – 6,76 × age (years).
- **Resting Energy Expenditure** (REE) (women) = 655,1 + 9,56 × weight (kg) + 1,85 × size (m) – 4,68 × age (years).
- **TEE = REE** (man and women)*25/100.
  (TEE) = (664,7 + 13,75×weight (kg) + 5 × size (m) – 6,76 × age (years) + 655,1 + 9,56 × weight (kg) + 1,85 × size (m) – 4,68 × age (years)) × 25/100.

In addition, the **energy intake** is estimated by using food composition tables, nutritional needs, and food balance sheets provided by the food and agriculture organization in its document Nutrition in Developing Countries (Dahdouh et al. 2019).

The nutrients concerned are proteins (g), lipids (g), and carbohydrates (g) (Maclean et al., 2003).

Estimation of food consumption frequency

The food consumption frequency was estimated as the number of times a type of food was consumed per day,

week, and month and expressed by time/day (Belhadj Benziane et al., 2019).

The data provided by Chlef University Services Directorate was used as the theoretical average because the Restaurants are not closed communities. Moreover, on the same day, the numbers of students per meal vary. A student is free not to attend the Restaurant or attend only one meal of its election. Therefore, an assumption was included that calculated the average standard ration offered to a student that frequented the Restaurants at the three meals of the day.

For the part using the food consumption questionnaire, the daily amount consumed is estimated using the household units (dishes and portion of food) for the three meals of the day (breakfast, lunch, and dinner).

Determination of dietary diversity (DDS) and a Food Variety Score (FVS)

Food Variety Score (FVS) is the number of different foods consumed by the person; the Dietary Diversity Score (DDS) is the number of different food groups the person consumes (Savy et al. 2004)(Keding et al. 2012)(Zainal Badari et al. 2012).

A "correct FVS" is achieved when the meal offers over nine items (representing approximately 1/3 items), while an "Insufficient FVS" is obtained when the mall has fewer than nine items (representing approximately 2/3 items).

A "correct DDS" is achieved when the meal offers over six food groups (representing approximately 1/3), while an "Insufficient SDA" is obtained when the meal has less than six groups (representing approximately 2/3).

Before calculating an SDA, the food groups to be included are defined in a manner compatible with the eating habits and practices of the study population. Afterward, the SDA is calculated by counting the food groups that are included. The number of food groups consumed reflects the degree of diversity in the SDA food intake.

Statistical studies

The data was analyzed using an ANOVA statistical analysis (Microsoft Excel 2010), and the results obtained are summarized in Tables 1 and Figures 1–3, where the mean and standard deviation are also calculated.

The limits and obstacles encountered during the conduct of the survey

One of the limitations of the diet questionnaire used would be the difficulty in remembering and clearly identifying the regular consumption or the monthly frequency of food consumed. Thus, the data obtained by this questionnaire may be biased by the subjects' memory (forgetting or unintentional addition concerning the consumption of certain foods), which could lead to an underestimation or an overestimation of the usual food consumption. Another limitation is the small number of investigators (two) available during this research (Two). Finally, a factor affecting this study is the refusal of some people to participate in the survey, as they might lack availability or interest in the subject studied, while in other cases, the surveys were not correctly filled out, with too many erasures or illegible, while others were not rendered. Moreover, 112 poorly completed questionnaires were had to be excluded from our study.

Results and Discussion

The subjects were 350 women and 150 men, 70% and 30%, respectively. Their average age was 22.97 ± 1.87 years (18-28 years). The average age of women is 23 ± 1.82 years, while that of men is 22.92 ± 1.99 years.

In the studied population, we were able to define three groups according to different eating behaviors:

- **Group1 (level1):**
  People following a university diet (N = 41).
- **Group2 (level2):**
  People following a university diet with improvements (N = 400).
- **Group3 (level3):**
  People with a personal diet (N = 59).

The vast majority of students surveyed (80%) said they ate other meals besides the offered in the college restaurant, 12% of students surveyed followed a college diet there, and only 8% of subjects had a personal diet.

The Body mass index or BMI is used to define anthropometric height/weight characteristics in adults and for classifying (categorizing) them into groups, and it is fairly well correlated with body fat where BMI 18.5 to 24.9 kg / m2 is the range for a "normal" status (Wémeau, Schlienger, and Vialettes 2014).

The category overweight corresponds to a BMI equal to or greater than 25, while total obesity corresponds to a BMI equal to or greater than 30 (Atek et al. 2010). Although the Body mass index (BMI) of the participants suggested that they had a balanced nutritional state (BMI 23.83 ± 3.01 kg/m², on average), we notice that there is a significant difference ($p \leq 0.01$) between the BMI of Men and Women, as well as between the groups ($p \leq 0.01$) (except between Group 2 and Group 3), meaning that the difference in diet behavior influences the nutritional status of the students (Figure 1).

Moreover, it has been shown that students who frequented fast-food restaurants or nibbled more often between

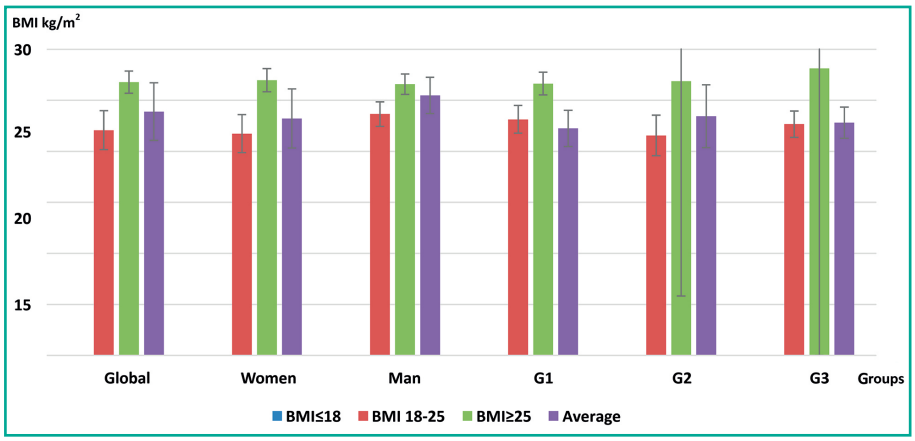

FIGURE 1: *Distribution of subjects surveyed according to Body mass index (BMI). (G1) Group1: Person following a university diet, (G2) Group2: Person following a university diet with improvements, (G3) Group3: People with a personal diet. Global (N=494), Women (N=347) Man (N=147) BMI≤18 (N=0) BMI 18–25 (N=303) BMI ≥25(N=191)*

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meals had a weight increase compared to their weight at the start of the year (Soufis 2017).

In another study, the BMI included 4112 people, and the average BMI of women was higher than for men ((25.9 ± 0.2 kg/m^2 and 23.8 ± 0.2 kg/m^2, respectively), and this increases significantly with age (WHO 2018); moreover, BMI is also used in the diagnosis of obesity status (body mass index [BMI] < 18.5, 18.5 to 24.9, 25 to 29.9, ≥ 30 kg/m^2) (Yang et al. 2017)(Banack et al. 2018).

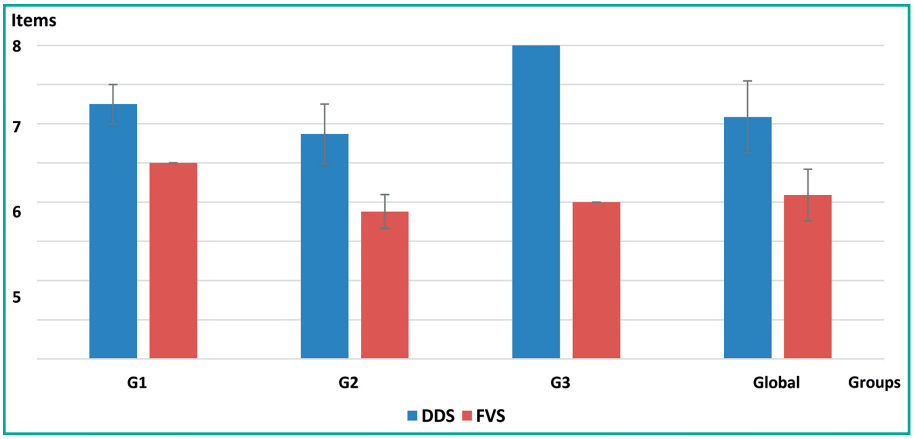

FIGURE 2: *Study of diversity of meal type using the Food Variety Score (FVS) and Dietary Diversity Score (DDS) depending on behavior. (G1)Group1: Person following a university diet, (G2) Group2: Person following a university diet with improvements, (G3) Group3: People with a personal diet.*

Estimation of the amount and frequency of usual consumption

The frequencies of usual food consumption and the nutritional amount are given in Table 1. The amount of food consumed per day is 2045 ± 712 g, and the share of each food is 95.94 ± 77.26 g, on average. The protein, carbohydrate, and fat intake are 90.94 ± 56.78 g, 301.05 ± 125.13 g, and 135.40 ± 23.29 g, respectively.

We find that the frequency of consumption and the amount of food consumed varies considerably from one food group to another, leading to different nutrient intake and energy intake between groups. Moreover, the consumption of Potato and their derivatives is 96.26 ± 104.68 g/day, with consumption frequencies being around 0.57 ± 0.40 times/day.

The usual frequency of milk and milkderivatives consumption is 2.38 ± 1.00 times/day. This average is close to the international consumption benchmarks of the national health nutrition program (PNNS) launched in 2001 and the second in 2006, where it is estimated that three dairy products should be consumed per day (Jourdain-Menninger et al., 2010).

Cereals and cereal products are part of the usual consumption of all the subjects questioned, where the subjects consumed around 88.59 ± 77.73 g/day and had a frequency of consumption of 0.85 ± 0.67 times/day.

Moreover, another study assessed the intake of foods and drinks consumed Eating out of home (OH) and at home (AH), as well as their nutritional contribution to the daily diet of university students. It was found that the average quantity of sugars (76.9g) and fats (173.7g) consumed per day was higher AH than the amount consumed OH (33.7g of sugars and 142.0g of fats) (Llanaj et al. 2018).

In this study, the amount of food consumed in Group 2 is greater than the amount of food consumed in Group 3 p≤0.01, and this suggests that the quantity of foods offered by university catering is much greater than the individual consumption outside the university.

TABLE 1: *Estimation of the quantity and frequency of usual consumption according to eating behavior.*

Eating behavior	number of students N	Quantity g/day	Frequency Times/day
Group 1	(N = 41)	2256,65 (90,27±97,02)*	0,72 ±0,67
Group 2	(N = 400)	2626,63 (105,07±89,47)*	0,96±0,55
Group 3	(N = 59)	1251,22 (95,92±77,26)*	0,56±0,71
Global	500	2398,07 (95,92±77,26)*	0,85± 0,56

*) Average per item; G1: university diet; G2: mixed diet; G3: personal diet

Our results are similar to those carried out on the University catering in Algeria, in which the average daily food ration is around 2000 grams (Mekhancha et al., 2017).

Study of differences in meal type

In this part, we measured the quality of the diet using the Food Variety Score (FVS) and Dietary Diversity Score (DDS). We referred to the values proposed in the literature (Savy et al. 2004)(Keding et al. 2012)(Zainal Badari et al. 2012), and the limit between 8 and 9 food items was chosen after observing the distribution of the score to divide the sample into a "correct FVS" group (≥ 9 items), and an "insufficient FVS" group (<9 items); Two classes of DDS have been defined: correct DDS (≥ 6 groups) and insufficient DDS (<6).

The diet of most of the respondents appears to have low variety (average FVS = 4.18 ± 0.66 foods) but remains diverse (average DDS = 6.17 ± 0.92 food groups), as can be seen in Figure 2.

Besides, there is a significant difference in the DDS/FVS ratio between the three groups (p≤0.01), which confirms the reduced diversity and variability of the meals on the menu during the week and the months for collective catering. It is also worth mentioning that the BMI varies depending on DDS. Moreover, our study agrees with the findings of Mekhancha et al. (2017), who found that the food supply of a University Restaurant in Algeria also had little diversity, and they also found that for some values, the food supply met nutritional recommendations, but, in other cases, it dangerously exceeded recommendations for energy and protein (Mekhancha et al. 2017).

When comparing food consumption by gender, there is a significant difference in FVD and DDS of the three levels p≤0.01. It is observed that both DDS and FVS are higher in women than in men, and by comparing BMI, there is a significant difference in DDS compared to the change in BMI of the three levels p≤0.01.

It is crucial to mention that a higher dietary diversity score is associated with healthy dietary habits and better metabolic features. Moreover, the findings suggest the possible preventive role of a higher dietary diversity score against metabolic syndrome (Farhangi and Jahangiry 2018); however, more studies are required to confirm the findings

On the other hand, Krebs-Smith et al. (2016) suggested that consuming a varied diet reduces the risk of developing a deficiency or over-consumption of any one nutrient

(Krebs-Smith et al. 1987). Moreover, Kant described the use of foods or food groups as one of the major methods for assessing the overall quality of a diet (Kant 2018). Despite much research about food variety, its relation to dietary adequacy has been less emphasized (Mirmiran et al. 2004), which is surprising, especially considering that it has been found that the dietary diversity score in adolescents is a good indicator of the nutritional adequacy of diets (Bilici et al. 2018).

Moreover, there was a significant and positive correlation between DDS and most nutrient adequacy ratios (NARs). It is concluded that FVS and DDS are useful methods and indicators to evaluate nutrient intake adequacy in adolescents and that the performance of the indicators is improved when considering the quantities of food consumed (Mirmiran et al. 2004) (Rathnayake, Madushani, and Silva 2012) (Oldewage-Theron and Kruger 2008).

Study of the differences in energy type

Our results suggest that the average energy intake from all diet is 3249.27 ± 614.55Kcal. The total energy expenditure for the study population was 1277.52 ± 230.21 Kcal, and the Resting Energy Expenditure (REE) accounts for 60–75% of the total energy expenditure (TEE), as can be seen in Figure 3. Moreover, our results agree with Mekhancha et al. (2017), who found that the average daily food ration provides an energy value of 3700 kcal (Mekhancha et al. 2017).

A significant variation between the values of TEE ($p \leq 0.01$) was found between the three groups: level1 consumes 1388.43 ± 225.76 Kcal, level2 consumes 1243.64 ± 222.97 Kcal, and level 3 consumes 1104.54 ± 39.39 Kcal. On the other hand, when the results were analyzed by gender (female or male) it was 1145.58 ± 91.17 Kcal for females and 1587.97 ± 143.38 Kcal for males. On the other hand, when it was compared between BMI, we found that people with a BMI between 18–25 had a calory consumption of 1162.26 ± 147.63 Kcal, and when the BMI was higher than 25, the people had a calory consumption of 1460.37 ± 219.26 Kcal.

In addition, our results suggest that protein contributed to 23% of the total energy intake, while fat and sugars contributed 37% in the studied population. These results are in agreement with those carried out in a study in which the average daily food ration represents a mass of food of 2000 grams with an energy value of 3700 kcal(Mekhancha et al. 2017) The Acceptable Macronutrient Distribution Range (AMDR) (10–35% of calories as protein) was developed to express dietary recommendations in the context of a complete diet(Wolfe et al. 2017)[37] Usual protein intakes (mean ± SE) averaged from 88.2 ± 1.1 g/d (adults aged 19–30y). Protein comprised 14–16% of total energy intakes(Berryman et al. 2018).

Also, it is recommended that the dietary fat intake is between 35 to 40% of the energy intake and that the minimum overall fat intake should be between 20 and 25 g per day (Legrand 2013). On the other hand, the minimum or essential protein requirements are 0.35 g per kg of the body per day, but, in reality, this figure is increased to 0.55 g / kg per kg of the body per day after applying a safety correction coefficient to consider individual variations. Finally, the recommended Global carbohydrate intake of the general population was fixed at 0.8 g / kg per kg of the body per day in adults, and the ideal carbohydrate intake should be about 50 to 55% of the energy intake to reduce the energy intake of lipid origin (Wémeau, Schlienger, and Vialettes 2014). On the other hand, the World Health Organization recommends reducing the intake of free sugars to less than 10% of total daily energy intake (Organization 2016).

Nevertheless, in our results, the share of energy derived from saturated fatty acids was below the recommended 10% (Stanikowski et al. 2020). Moreover, protein consumption was above the recommended 23.1% in the Food diet and 33.5% in the Food and Supplements diet. For lipids, intake was above the recommended 47.3% in the Food diet and 50.0% in the Food and Supplements diet (Wolfe et al. 2017).

On the other hand, the energy intake recommended for adult women and men who do regular activities of the population are 2500 and 2700 kcal/day, respectively (Martin 2002). In fact, in our study, the energy values found are higher than the recommendations. Finally, although the diet of the population studied seems rich in macronutrients essential for providing energy, it is difficult to judge the dietary behavior of students with international recommendations because the energy intake is conditioned by the different food scores, physical activity, BMI, and micronutrient intake.

Similarly, the energy intake recommendations (EIRs) vary for different countries. The joint Australian-New Zealand committee modified the US-Canadian recommendation based on evidence from national dietary intake surveys, population-based observational studies, experiments from humans and animals, and also considered existing food cultures, cultural diversity, sustainability, and cost when developing guidelines (Alavi et al. 2013). In Algeria, our results can be exploited with other studies monitoring of energy additions or any improvement envisaged.

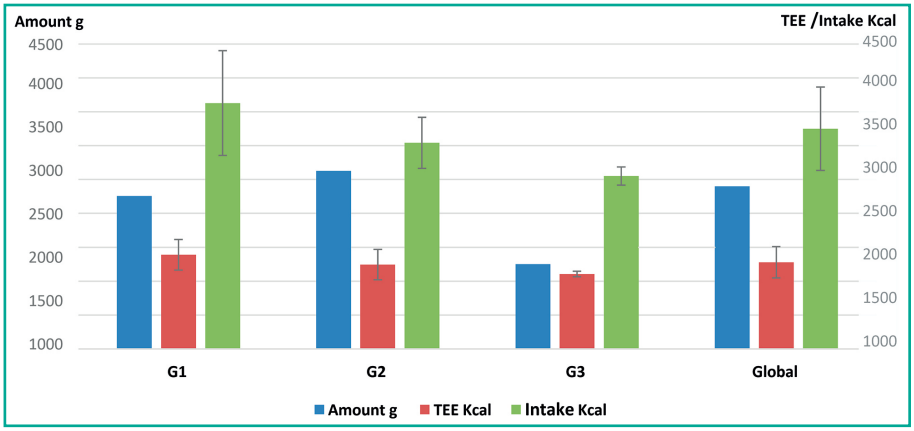

FIGURE 3: *Study of the differences in energy type according to behavior. (G1) Group1: Person following a university diet, (G2) Group2: Person following a university diet with improvements, (G3) Group3: People with a personal diet.*

Conclusion

The university cafeteria is an important contributor to the out-of-home consumption of the main meal for students. Our study shows that 80% of students eat a restaurant diet plus snacks outside of college. Therefore, the catering sector is increasingly

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being recognized as a stakeholder to promote healthy diets and lifestyles that consider these behaviors.

In our study population, the average ration of the food supply is too large, and its energy value too high. These high amounts and the high content of sugars and fats are explained by a standard menu/diet that is diverse but has little variety. This should call on the public authorities and the managers of university restaurants to increase dietary diversity, save budget, and use these savings for more fruits and vegetables.

Acknowledgments

The authors would like to thank the Chlef University Services Directorate at Hassiba Ben Bouali Chlef University. for providing us with the necessary information.

Conflict of interest

The authors declare that they have no conflicts of interest.

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