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Physical activities, dietary profile and nutritional status of students from the Higher Institute of Physical and Sports Education (ISEPS), Marien Ngouabi University in Congo-Brazzaville

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ABSTRACT: A study of the physical activities**,** food profile and nutritional status of the students was carried out at the Higher Institute of Physical and Sports Education (ISEPS) of Marien Ngouabi University in Congo-Brazzaville. Its objective was to assess the physical activity level, food profile and nutritional status of these students in order to compare them with the current recommendations. A food consumption survey that included all activities performed during the day was conducted on 291 students ranging in age from 18 to 48 years. The weekly method was used. Energy expenditure was calculated by multiplying a base expenditure by the physical activity level (PAL). The individual's nutritional status was determined using the body mass index (BMI). Chi-square and ANOVA tests were used for statistical analysis. The students' physical activity level was high, with an average PAL of 1.89. Energy expenditure was 2531.64 kcal for girls and 3045.18 kcal for boys. These expenditures were consistent with moderately active athletes' recommendations. These students' dietary profiles did not adhere to current nutritional recommendations, with unbalanced, non-diversified food rations and certain meals skipped or even eliminated. Despite the high prevalence of overweight, including obesity (17.5% overweight and 9.3% obesity) and a few cases of underweight (6.5%), the nutritional status was normal overall (23.91 kg/m^2 in girls and 23.88 kg/m^2 in boys). The findings of this study showed that ISEPS students have a high physical activity level, an unbalanced food intake, and normal nutritional status.

Keywords: Physical activity level, energy expenditure, nutritional status, food intake, Congo-Brazzaville.

Running title: Physical activities, dietary profile and nutritional status of sportive students

INTRODUCTION

Malnutrition affects physical growth, morbidity, mortality, cognitive development, reproduction, and physical work capacity (Pelletier and Frongillo, 2003). The nutritional status, which represents the body status resulting from the ingestion, absorption and use of food, as well as factors of a pathological nature, is therefore a reliable indicator

making it possible to assess the energy balance. Regarding the determination of the nutritional status of the individual, the body mass index (BMI) is the most used measure (WHO/FAO, 2003). The body mass index (BMI) is an international standard adopted to determine a person's corpulence based on height and weight. It allows categorising people based on their corpulence as lean, normal weight, overweight, or obese (OMS, 2005a; Dubot-Guais, 2005). Normal BMI values are between 18.50 and 24.99 kg/m^2; those overweight are between 25 and 29.99 kg/m^2; those of obesity greater than 30 kg/m^2. Values below 18.50 kg/m^2 determine leanness. For this purpose, a BMI $\geq$ 30 shows that the person consumes more than 2,580 kcal, i.e.- eats more and spends little and has less physical activity. It may be also due to overeating (obesity is the consequence of a positive imbalance in the energy balance over too long a period) and genetic factors. A BMI $<$ 18.5 reflects undernourishment. Weight loss occurs when dietary energy intake does not compensate for calorie expenditure for body maintenance and metabolic reactions that occur after rest and during movement. Insufficient calorie intake is contemporaneous with a relative deficiency in proteins and micronutrients (vitamins, zinc, iron, and selenium), all cofactors of important functions (healing, immunity, and fight against oxidative stress). The body then draws on the reserves. These values are independent of age and similar for both sexes (Barbe and Ritz, 2005). It should be noted that the BMI can represent very different proportions of fat mass, depending on age, gender, ethnicity and sports training (NNR, 2014). A normal BMI for adults between 18 and 65 years old is between 18.5 and 24.9 kg/m² (WHO, 2000). In the elderly (> 65 years), taking into account a loss of height of 1 to 2 cm per decade, the BMI will increase and will no longer present the same associations of morbidity-mortality. A BMI < 23 kg/m² accompanied by involuntary weight loss is associated with an increased risk of mortality, this is also the case with a BMI > 33 kg/m². While overweight does not appear to be associated with an increased risk after the age of 65. For pregnant or breastfeeding women, the BMI is calculated on the weight before pregnancy. The preconception BMI is an independent predictor of several complications during pregnancy (EFSA, 2013; IOM, 2009).

There is therefore not a point that corresponds to a good nutritional status, but rather a zone of good nutritional status (Agbessi Dos-Santos and Damon, 1991). Beyond this zone or below, there are biochemical abnormalities responsible for diseases (Saccoun, 2008). Nutritional status is therefore a reliable indicator for assessing energy balance.

The determination of an individual's energy expenditure, taking into account his physical activity level and nutritional status, is critical in order to adjusting his nutritional intake (Pinheiro Volp et al., 2011). Energy expenditure is divided into three items of unequal importance: (1) the energy required to maintain basic physiological functions (breathing, heartbeat, etc.) at rest, on an empty stomach, awake and in a neutral environment (EFSA, 2013) which accounts for 45-75% of 24-hour energy expenditure (CSS, 2016); (2) the amount of energy required for digestion or thermic effect of food which is proportional to the amount of food intake and corresponds to approximately 10% of the total energy expenditure of an individual (FAO/WHO/UNU, 2004); and (3) the rate of energy expenditure in case of physical activity (variable according to factors such as age, weight or intensity of effort) which represents between 15% and 50% or more of the expenditure total energy (CSS, 2016). The last two expenditures are referred to as extra-basal expenditures. The 24-hour energy expenditure therefore makes it possible to determine the daily energy requirement of an individual. Several methods are used to determine this energy expenditure. Among them, we can cite indirect calorimetry, bioelectrical impedance, the doubly labeled water method and predictive equations. Concerning the predictive equations, the energy expenditure is estimated by determining a basal expenditure which is multiplied by the physical activity level (PAL). To assess basal metabolic rate (BMR), predictive equations are proposed based on easily observable parameters (weight, height, sex, age, etc.). The equations proposed by Henry (2005), Schofield et al. (1985), Harris and Benedict (1919), Mifflin et al. (1990) and Müller et al. (2004) show almost identical validity, but no equation can predict the BMR very precisely (EFSA, 2013). Some research has aimed to create or validate equation models for measuring energy expenditure (Alhassan et al., 2012; Audrey et al., 2012; Choi et al., 2010; Butte et al., 2010; Corder et al., 2005; 2008; Zakeri et al., 2008, 2010). Given the prevalence of overweight in the population, EFSA and the UK use Henry's formula, the benefit of which would be to avoid an over-evaluation of the BMR (CSS, 2016). In the case of overweight or obesity (BMI 25 to 40 kg/m^2), there is no consensus on the predictive equation to use. EFSA proposes Mifflin's equation, while the UK specifies that Henry's equation shows an accuracy of 79% in this population (CSS, 2016).

Intense sports activity corresponds well to specific calorie, macronutrient and, no doubt, micronutrient needs as well. Non-compliance with these specificities is a frequent cause of poor performance. The choice between the two fuels will depend on three factors (Brooks and Mercier, 1994): (1) exercise intensity (carbohydrates are the fuel for high-intensity exercise, lipids are the fuel for exercise at low or medium intensity); (2) the respective share of these two substrates varies greatly from one subject to another, but is markedly modifiable by training; low- or medium-intensity endurance training amplifies the ability to oxidize lipids, and high-intensity training or intermittent exercise amplifies the ability to oxidize carbohydrates; (3) exercise duration, when prolonged without interruption, increases lipid utilization, which actually remains stable for 45 minutes and then gradually increases. Thus, depending on the type of exercise, the

energy sources used are different and an appropriate diet during training will support the athlete during competition (Strauss, 1990).

Because ISEPS is a higher education institution where students generally participate in physical and sports activities on a regular basis, evaluating their nutritional status and food profile will allow for the detection and correction of any nutritional errors, resulting in improved athletic performance. This is the main objective of this study.

MATERIAL AND METHODS

Material

The study took place at the Higher Institute of Physical and Sports Education of Marien NGOUABI University in the Republic of Congo-Brazzaville. To carry out this study, the following equipment was used:

a. A questionnaire that collected information on diet and anthropometric data (height, weight and age) of students evolving within this university establishment;
b. A height chart: represented by a vertical ruler graduated from 0-200 cm from STALEY on which a slider slides to measure the height of the subject;
c. A SECA brand scale graduated from 0-150 kg in division of 100 g with an accuracy of ±100g to measure the mass of the students concerned.

Methods

This was a prospective study based on a cross-sectional survey which consisted in evaluating the food profile and nutritional status of students at the Higher Institute of Physical Education and Sports. To this end, two (2) methodological approaches were used: anthropometry and the weekly planner. Qualitative variables (level of study, profession, marital status, type of food) and quantitative variables (age, weight, height, number of daily meals, quantities of food consumed by each group) were determined.

The study's population consisted of ISEPS students for the 2020-2021 academic year. Sampling was done using the simple random method. Thus, a sample of undergraduate and master's level students was compiled.

With regard to the dietary profile, the foods and beverages consumed, to a certain extent their quantities were recorded over a period of seven (7) days. Throughout this time, checks were made on a regular basis to ensure that the weekly planner was correctly filled out. The respondents described the number of meals they ate each day, the food composition of each meal, and the frequency with which they consumed foods from the seven food groups listed: the meat, egg and fish group, the dairy products group, the fat group, the fruits and vegetables group, the cereals and derivatives-legumes group, the sugars and sweet products group and finally the beverages group. They also indicated the times of food intake (food timetable) and the volumes of water consumed.

When it comes to nutritional status, body mass index (BM) has been used to determine a person's build based on height and weight.

$$\mathrm{BMI} = \frac{\mathrm{W}}{H^2}\ (\mathrm{kg}/m^2)$$

With, W = body weight in kg and H^2 = height in m^2.

Weight and height measurements were taken using the same measuring devices for each participant. The weight was measured in light clothing and without shoes in order to obtain the most precise result possible to within 0.05 kg. Height was measured without shoes to within 0.1 cm. Each student surveyed presented a student card or a national ID to authenticate their age.

The energy expenditure of each student was estimated by determining the basal expenditure multiplied by the physical activity level (PAL). To determine BMR, the following predictive equations proposed by Harris and Benedict (1919), recalculated by Roza and Shizgal (1984) was used.

Male: BMR = 13.707 × W + 492.3 × H - 6.673 × A + 77.607
Female: BMR= 9.740 × W + 172.9 × H - 4.737 × A + 667.051

Where: BMR = Basal Metabolic Rate in kilocalories (kcal), W = Body mass in kilograms (kg), H = Height in meters (m) and A = Age in years.

The physical activity level (PAL) of the students was evaluated by the 24-hour daily recall method. This involved estimating the number of hours spent, per day, for each type of activity or sport, by taking an average from the duration of these activities counted over a day. Each student was asked to record the duration of all activities performed during the day, then categorise the activities based on their intensities (PAL) and totalize the duration of all activities in each category (in hours), with the sum of the durations equaling 24 hours by using the following equation:

$$\text{Mean PAL} = (\sum MET\ x\ number\ of\ hours\ per\ category)/24$$

MET: *Metabolic Equivalent of Task*

In this study, a group has an adequate diet if, for a nutritional variable:

a. The average is within the normal range of recommendations;
b. At least 50% of group participants meet the standards (Moussavou-Nzamba, 2008).

Data entry, processing and statistical analysis

The data were analyzed using IBM SPSS Statistics version 26 software. A descriptive analysis made it possible to describe the different characteristics of the students. This analysis also made it possible to describe individual dietary diversity and the frequencies and proportions of consumption of food groups. The results of the analyzes concerning the quantitative variables are presented in the form of number, average, standard deviation, minimum and maximum and median. Concerning the analysis which relates to the qualitative variables, the results are presented in the form of number and percentage. The chi-square test was used for the comparison of variables with a significance level of 5% ($p<0.05$). The ANOVA test was used for the comparison of the calculated means, in order to highlight the influences between the differences in the factors studied.

RESULTS

Social characteristics of students

The social characteristics of the students (Table 1) studied in the present study concerned the following variables: gender (sex), age, level of education and department (PES, Sport and Supervision). The population of students surveyed consisted of 291 subjects including 185 male (63.6%) and 106 female (34.4%) with a significant difference ($p<0.001$). The average age of the students was 26.55±6.4 years with a minimum of 18 years and a maximum of 48 years (Table 4); the median was 24 years and the mode, 22 years. The mean age had a high dispersion and was not superimposable on the median, which shows the studied sample did not approach a normal distribution; in view of the mode, this distribution was shifted towards the age groups below the average. The most representative age group was 20-25 years old (61.2%), followed by 26-30 years old (12.7%), the least representative was under 20 years old (2.1%). Students over 30 represented only 24.1% with only 3.1% being over 40. It was therefore an essentially young population. The difference in age groups between the students surveyed was very significant ($p<0.001$).

The majority of the students surveyed were in a bachelor's degree BAC (78%) with 32% in the first year of the bachelor's degree (BAC 1), 24.7% in the second year (BAC 2) and 21.3% in the third year (BAC 3); master's students represented only 22% with 14.1% in Master 2 and 7.9% in Master 1. The difference in level of education is very significant ($p<0.001$). More than half of the students surveyed (51.9%) were from the Department of Physical Education and Sports (PES) followed by students in the Department of Sports (39.9%), and the Department of Pedagogical Supervision were the least concerned by the survey (8.2%) with $p<0.001$.

Physical and sports activities (PSA) and energy needs

Table 2 indicates the different types of physical and sports activities practiced by ISEPS students, the duration of a session and their weekly frequency. This table shows that the ISEPS students surveyed practiced a variety of PSA. Most of them did not have a specific PSA (54%); only 37.4% had a specialization, of which 28.9% only practiced fitness walking. It should be noted that 8.6% of the students surveyed did not practice any PSA.

The frequency of PSA practice varies very significantly ($p<0.001$). Students who practiced PSA daily represented 39.5% of the total number of respondents. They were followed respectively by those who practiced for 4-6 days (24.7%) and 2-3 days (20.6%). Therefore, the majority of students surveyed (84.8%) practiced physical exercise for at least 2-3 days per week. Those who practiced PSA only one day a week were the least representative (6.5%).

More than half of the students surveyed (52.2%) practiced PSA during sessions lasting more than 60 min, followed by the group of students who practiced PSA during sessions of 30-60 min (30.9%). Students who practiced PSA during sessions of less than 30 min were less concerned by the survey (5.8%) as well as those whose duration varied from one session to another (2.4%) with $p<0.001$.

Physical activity level (PAL)

The results recorded in Table 3 show that 10.3% of the students had a low PAL with an average of 1.35±0.23, while 24.7% had a moderate PAL with an average of 1.48±0.03, 25.1% had a high PAL with a mean of 1.86±0.05 and 39.9% had a very high PAL with a mean of 2.4±0.42. Overall, ISEPS students had an average physical activity level of 1.92±0.42, corresponding to that of a high active population.

Figure 1 shows the interpretation of the physical activity levels of the students surveyed. It emerges from this study that 40% of ISEPS students had high intense physical activity ($PAL \geq 1.9$), 25% intense physical activity ($1.6 \leq PAL < 1.89$), 25% moderate physical activity ($1.4 \leq PAL \leq 1.59$) and 10% low physical activity ($PAL \leq 1.39$).

Physical activity level according to sex and department

Whatever the department, the majority of students had a very high PAL followed by students who had a moderate PAL, except for the students in the Sports Department whose PAL was high and occupied the second position (Table 3). Students who had a low PAL were the least representative regardless of their department. The chi-square test showed that the difference in PAL was not significant from one department to another ($p>0.05$). The

Table 1. Distribution of students according their features social.

Variables	Modalities	Effective (n=291)	%	p-value
Sex	Male	185	63.6	<0.001
	Female	106	36.4	
Age groups (year)	<20	6	2.1	<0.001
	20-25	178	61.2	
	26-30	37	12.7	
	31-35	30	10.3	
	36-40	31	10.7	
	>40	9	3.1	
Educational level	BAC 1	93	32	<0.001
	BAC 2	72	24.7	
	BAC 3	62	21.3	
	Master 1	23	7.9	
	Master 2	41	14.1	
Department	PES	151	51.9	<0.001
	Sport	116	39.9	
	Supervision	24	8.2	

PES: Physical Education and Sports.

Table 2. Distribution of students according to physical and sports activities.

Variables	Modalities	Effective (n=291)	%	p-value
Types of PSA	Walking	84	28.9	<0.001
	Athletics	1	0.3	
	Soccer	6	2.1	
	Handball	3	1.0	
	Basketball	1	0.3	
	Judo	2	0.7	
	Karate	1	0.3	
	Jogging	2	0.7	
	Volleyball	2	0.7	
	Gymnastic	2	0.7	
	Others	5	1.7	
	Variables	157	54.0	
	None	25	8.6	
Frequency of PSA practice	One day a week	19	6.5	<0.001
	2-3 days	60	20.6	
	4-6 days	72	24.7	
	Every day	115	39.5	
	None	25	8.6	
Duration of practice of a physical therapy session	< 30 min	17	5.8	<0.001
	30-60 min	90	30.9	
	> 60 min	152	52.2	
	Variable	7	2.4	
	None	25	8.6	

Table 3. Distribution of students' level of activity according to their department, level of study and sex.

Variables	Modalities	Physical activity level (%)				p-value	Average PAL
		Low	Moderate	High	Very high		
Department	EPS	11.3	27.2	22.5	39.0	0.584	1.91±0.43
	Sport	9.5	22.4	30.2	37.9		1.93±0.40
	Supervision	8.3	20.8	16.7	54.2		2.03±0.43
Sex	Male	8.1	25.9	26.5	39.5	0.376	1.93±0.41
	Female	14.2	22.6	22.6	40.6		1.92±0.42
Study level	BAC 1	15.2	14.2	37.0	33.7	0.033	1.92±0.40
	BAC 2	12.5	31.9	16.7	38.9		1.88±0.44
	BAC 3	8.1	30.6	22.6	38.7		1.91±0.42
	Master 1	00.0	21.7	17.4	60.9		2.11±0.40
	Master 2	4.9	29.3	22.0	43.9		1.96±0.42
Overall sample		10.3	24.7	25.1	39.9	0.05	1.92 ± 0.42
		Average PAL					
		1.35±0.23	1.48±0.03	1.86±0.05	2.4±0.42		

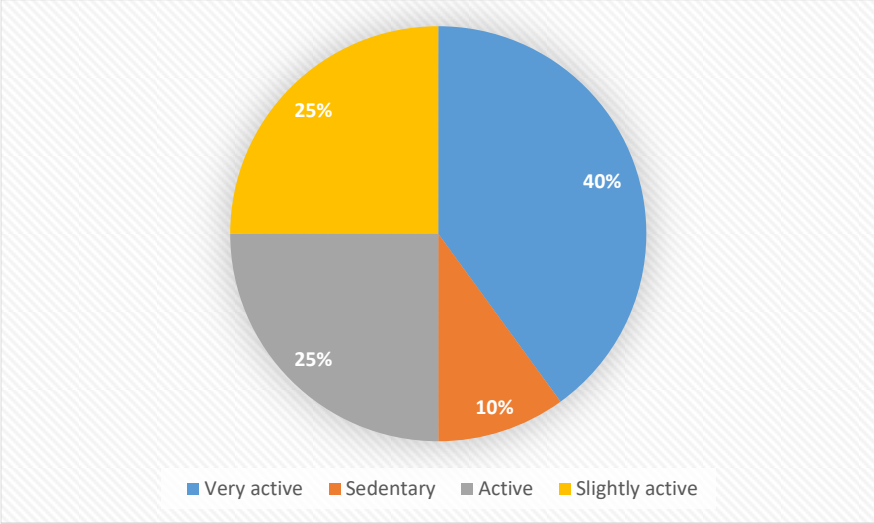

Figure 1. Physical activity level of ISEPS students.

students' average PALs by department were all within the very high PAL range. The ANOVA test showed no significant difference between these mean PALs (p=0.423).

Regarding the students' gender (sex), the majority of the students also had a very high PAL regardless of their gender. The students who had a high PAL and those who had a moderate PAL were in almost equal proportions regardless of their sex and occupied the second position after those who had a very high PAL; in both sexes, students who had a low PAL were the least representative. The Chi-square test showed that the difference in PAL was not significant from one sex to another (p>0.05). The students' average PALs by gender were all within the very high PAL range. The ANOVA test showed no significant difference between these mean PALs (p=0.810).

For students at all levels of study, with the exception of those in BAC 1, the majority had a high PAL followed respectively by students who had a moderate PAL and a very high PAL. The low PAL was less representative, with a zero rate in Master 1. For those in BAC 1, the majority had a high PAL (37.0%) followed by those who had a very high PAL (33.7%); BAC 1 students who had a low PAL (15.2%) and those who had a moderate PAL (14.2%) were almost evenly matched. The Chi-square test showed that the difference in PAL by students' study level was

Table 4. Average energy needs according to sex, study level and department.

Variables	Modalities	Mean ER (kcal)	p-value
Department	PES	2810.96±765.85	0.129
	Sport	2862.14±676.0	
	Supervision	3135.34±724.71	
Sex	Male	3045.18±720.22	0.001
	Female	2531.64±629.27	
Study level	BAC 1	2769.50±688.78	0.043
	BAC 2	2827.59 ±716.15	
	BAC 3	2795.28±745.15	
	Master 1	3247.29±701.92	
	Master 2	2989.43±785.82	
Mean		2858.12±730.60	
Mode		3897.55	

significant (p<0.05). Average student PALs by study level were within the very high PAL range for BAC 1 and BAC 3 and master's students, and within the high PAL range for BAC 2 students. However, the ANOVA test showed no significant difference between these mean PALs (p=0.252).

Energy requirement (ER) of students

Table 4 presents the average energy needs of the students surveyed. The average ER of the students surveyed was 2858.12±730.60 kcal and presented a very high dispersion, in view of the mode (3897.55 kcal), most of the students surveyed had an ER higher than the sample average.

Regarding the ER according to the student's gender, the average ER of male students was higher (3045.18±720.22 kcal) than that of female students (2531.64±629.27 kcal) with a high significant difference (p<0.001).

Students in the Department of Pedagogical Supervision had the highest average ER (3135.34±724.71 kcal) and those of PES Department, had the lowest (2810.96±765.85 kcal) with a non-significant difference (p=0.129).

The highest average ER was observed among Master 1 students (3247.29±701.92 kcal) and the lowest among BAC 1 students (2767.83±691.17 kcal). The ANOVA test showed a significant difference between these average ERs from one study level to another (p=0.042).

Food profile

Modalities of food intake and hydration

Figure 2 presents the methods of food intake and hydration of the students surveyed. It appears from this table that 59.11% of the students surveyed took three (3) meals per day, namely breakfast, lunch and dinner versus 40.89% who ate either a single daily meal or two meals. The chi^2 test shows that there is a very significant difference (p<0.001) between these two categories of students. Moreover, among those who did not systematically take one of the three daily meals, 2.1% of the students did not take breakfast, 10.3% lunch and 2.7% dinner.

With regard to the rate of intake of the three meals, 89.1% of the students regularly ate dinner, 80% breakfast and 59.2% lunch with p<0.001. Some students showed irregularity in taking the three daily meals: 13.7% for breakfast, 21.6% for lunch and 6.5% for dinner.

Regarding meal time table, they were not respected by 99% of students versus only 1% who admitted to respecting these hours. The difference is very significant (p<0.001).

Regarding snacks, 75.5% of the students regularly took the snack at 10 a.m. versus 12% at 4 p.m. The majority of students (77%) did not systematically take the snack at 4 p.m. or dinner and only 6.9% with p<0.001. As for the three main meals, some students showed irregularity in taking snacks: 10.7% took snack at 10 a.m. and 7.2% without precised time. 59.2% of students snacked regularly versus 6.5% who did not took snack; the others nibbled either rarely (5.5%) or irregularly (27.8%). The difference being very significant (p<0.001).

Concerning the modality of hydration, 98.6% of the students hydrated themselves properly, at least three times a day and on a regular basis, against 1.4% who had irregular hydration 3 times and 16% 1 to 2 times a day. The difference in hydration modality is very significant (p<0.001).

Regarding drinks other liquid drinks than water, only 18.9% of the students surveyed consumed sugary drinks daily; 36.4% drink irregularly and 27.5% rarely with

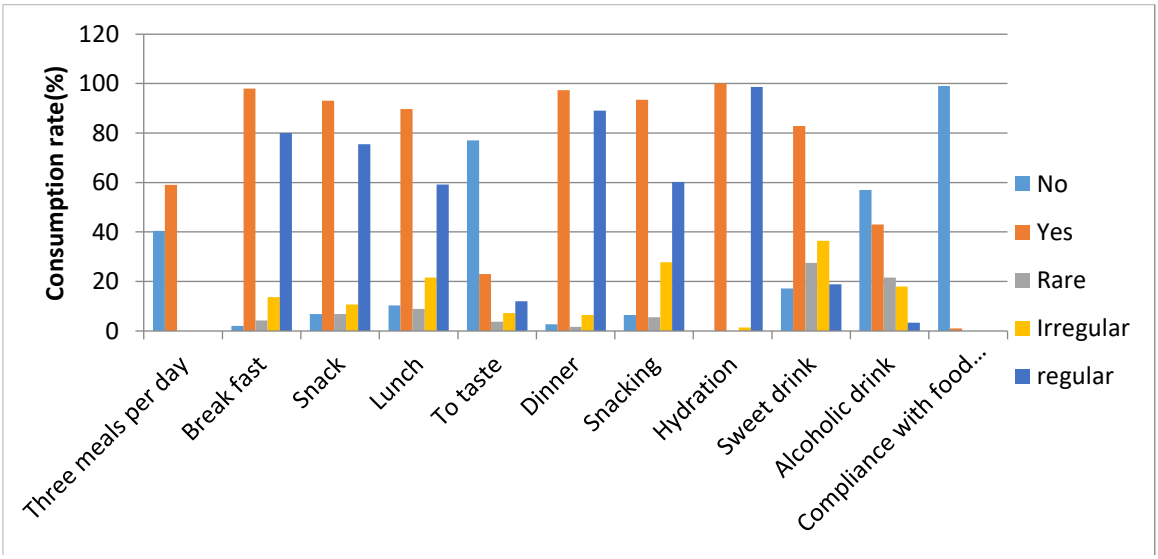

Figure 2. Distribution of students according to food intake methods.

p<0.001. The students surveyed consumed less alcoholic beverages; 57% did not consume these drinks, 21.67% consumed rarely, 18% irregularly; only 3.4% consumed daily.

Food composition of the main daily meals and times of their intake

Breakfast: The Figure 3 relating to food composition shows that the breakfast of the IESPS students surveyed consisted mainly of cereals (96.9%), fat (74.9%), milk and dairy products (72.2%) and sugary drinks (46%). It included less fruits (26.1%), vegetables (17.9%), meats (16.19%) and rarely eggs (6.5%), tubers (7.9%).) and legumes (3.1%); one breakfast only included fish (0%). Most students consumed water during breakfast (97.6%). A small proportion of the students surveyed (2.4%) also consumed alcoholic beverages during breakfast; the difference is very significant (p<0.001). With regard to the time of breakfast, it was very variable (p<0.001): 48.8% of the students had the habit of having breakfast before 8 am and 49.1% after 8 am.

Lunch: Lunch consisted mainly of fat (45%), vegetables (44%), meats (38.8%), sugary drinks (38.8%), fruits (37.1%) and cereals (29.9%). Legumes (21.1%), tubers (19.9%) and dairy products (24.1%) also made up the lunch of some students. Fish made up less and less of the lunch of these students (6.5%). In any case, no food reached a consumption rate of 50% at lunch, except water which was consumed by all the students who ate this meal (89.7%). Alcohol consumption by students during lunch was rare (3.1%). Regarding lunchtime, 44.4% of students took their lunch after 1 p.m., 40.5% between 12 p.m. and 1 p.m. and 4.8% before 12 p.m. with p<0.001.

Dinner: Tubers (57%) and cereals (40.9%) were the two main staple foods that accompanied vegetables (67%), meats (52.9%) and fat (82.1%) for dinner. Fruit was consumed less during this meal than during lunch (28.9% versus 37.1%). They were followed respectively by sugary drinks (27.9%) and dairy products (26.1%). Fish (6.6%) and legumes (5.9%) were the foods that were less and less eaten at dinner; the consumption of eggs during this meal had not been observed (0%). Water was consumed by all students who took this meal (97.3%). Alcohol consumption by students during dinner was not observed (0%). Regarding lunchtime, 79.4% of students had lunch between 7 p.m. and 8 p.m., 8.9% before 7 p.m. and 8.9% after 8 p.m. with p<0.001.

Weekly consumption frequency of food types

Figure 4 presents the frequency of weekly consumption of the types of food by the students surveyed in terms of number of days per week. It appears that most students (73.0%) consumed cereals at least five days a week with 24.2% every day. The most consumed cereals were respectively bread, pasta and rice. Students who had consumed cereals at least 3 days a week accounted for 92.6%. During this study, a small percentage of students (3.7%) had not consumed a cereal product. Statistical analysis showed a very significant difference between these different categories of students (p<0.001).

About the tubers, 56.6% of the students had consumed them at least 3 days a week with 10.3% every day. The most consumed tubers were cassava tubers (*Manihot esculenta*) processed into cossettes (*foufou*) or

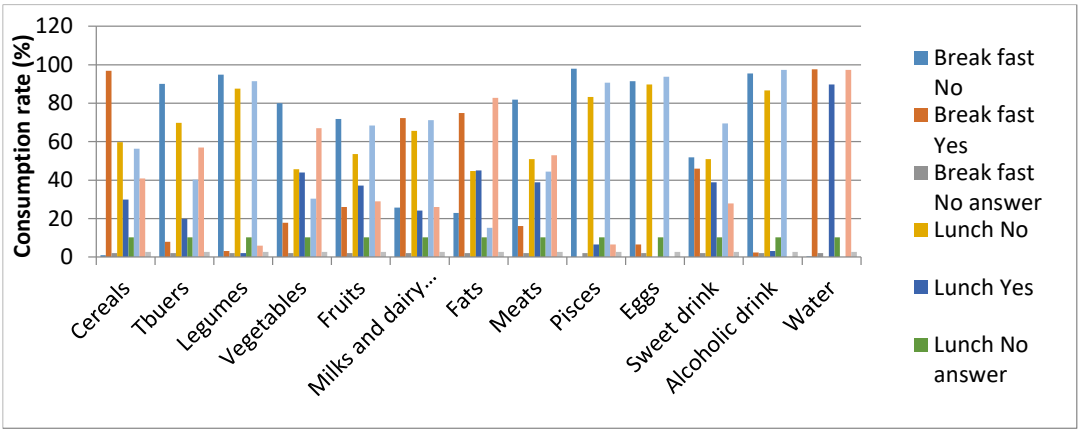

Figure 3. Distribution of students according to the food composition of the main daily meals.

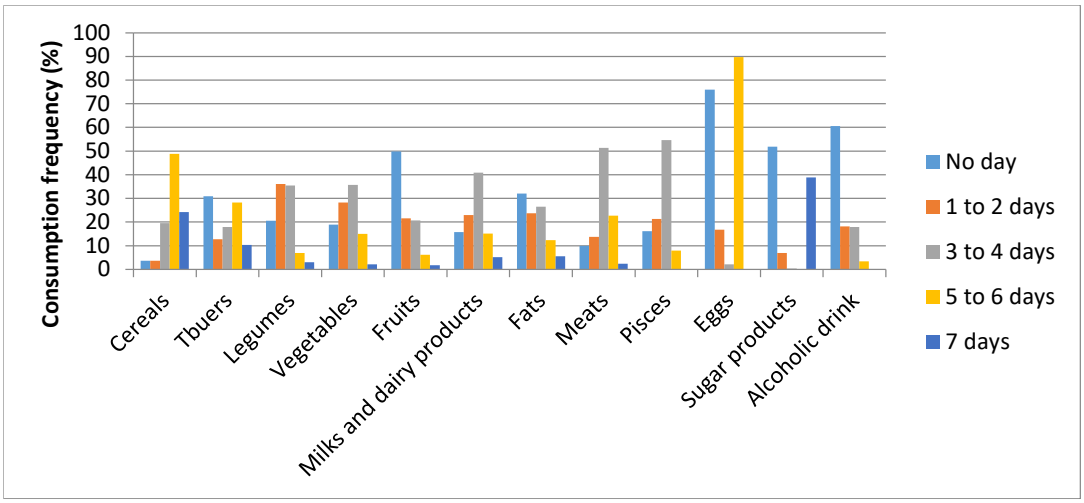

Figure 4. Weekly consumption frequency of food types.

chikwangue. A fairly large proportion of students (30.9%) had not consumed tuber foods during this study.

Regarding legumes, 45.5% of students had these foods at least three days a week with only 3% every day. The most consumed legumes were beans (*Phaseolus vulgaris*) and peas (*Pisum sativa*). Students who had not consumed this type of food were fairly representative (20.6%). These differences were statistically significant ($p<0.001$).

For fruits, a significant proportion of students (49.8%) had not consumed fruits during the entire survey week. Only 28.6% of the students concerned by the survey had consumed fruits at least three days a week, with 1.7% every day. Statistical analysis showed a very significant difference between these different categories of students ($p<0.001$).

Regarding vegetables, more than half of the students surveyed (52.8%) had consumed these foods at least three days a week with only 2.1% every day ($p<0.001$).

The daily consumption of meat was important; 51.3% ate meat three to four times a week and 76.4% at least three times a week with only 2.4% every day. The most consumed meat was poultry. A fairly small proportion (9.9%) of students had not consumed meat with $p<0.001$. Regarding the weekly consumption of fish, more than half of the students (62.7%) had consumed fish at least three times a day but not every day, with 54.6% eating fish three to four days. In a week students who had not consumed fish represented a fairly large proportion (16.2%). Statistical analysis showed a very significant difference between these different categories of students ($p<0.001$).

Egg consumption was very low (24.1% with 7.2% at least three days a week and not every day). The majority of students (75.9%) had not consumed eggs or egg-based foods). These differences were statistically significant ($p<0.001$).

The weekly consumption of milk was high: 61.2% of the students had consumed milk and/or dairy products at least three days a week, with only 5.2% every day. Milk was consumed more compared to other dairy products such as cheese, yogurt and cream. The consumption of other

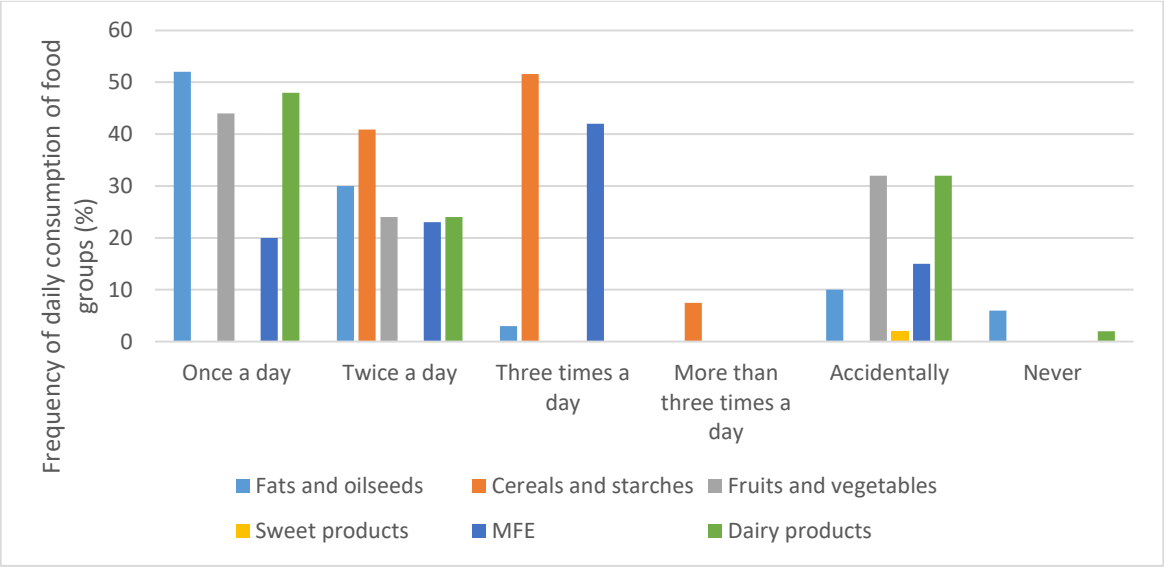

Figure 5. Daily consumption frequency of different food groups.

dairy products was very irregular. A fairly large proportion of students (15.8%) had taken neither milk nor dairy products ($p<0.001$).

A significant proportion of students (44.3%) had consumed meals or foods with fat such as margarine, oilseeds and vegetable oils at least three days a week with only 5.5% every day. Students who did not consume the non-hidden fat represented a proportion of 32.8%. Statistical analysis showed a very significant difference between these different categories of students ($p<0.001$).

The weekly consumption of sugary products at least three days a week was very high, more than half of the students (55.4%) with only 5.5% every day. The most consumed sugary products were sugary drinks, cookies, candies and sugary fats. The proportion of students who had not consumed these products was also high (20.5%, $p<0.001$).

More than half of the students (60.5%) had not consumed alcoholic beverages. Students who had consumed alcoholic beverages at least three days a week, but not every day, represented a proportion of 21.3% ($p<0.001$).

Daily consumption frequency of food groups

Figure 5 presents the daily consumption frequency of food groups in terms of number of times per day.

Cereals and starches: More than half of the students surveyed (51.6%) had consumed cereals and starchy foods three times a day. It was followed by students who had consumed cereals and starchy foods twice a day (40.9%); a small proportion of students (7.5%) had consumed them more than three times a day.

Dairy products: Milk and dairy products were consumed only once a day by 48% of the students questioned, twice a day by 24% of the respondents and accidentally by 32% of the participants. Rare were those who had not consumed them (2%).

Meat, fish and eggs (MFE): Regarding the consumption of meat, fish and eggs, 42% of the students surveyed had consumed meat three times a day. Those who had consumed the meat twice a day accounted for 23% and once a day for 20%. Fish were eaten more often than once a day; eggs were eaten infrequently each day. Students who had accidentally consumed foods from this group were the least representative (15%).

Fruits and vegetables: Most of the students surveyed (44%) had consumed fruit or vegetables only once a day. These students were followed by those who accidentally consumed them (32%) and those who consumed them twice a day (24%).

Fats and oilseeds: Most students (52%) ate a fat or oilseed product only once per day. These students were followed by those who had consumed them twice a day (30%). Students who had consumed group foods three times a day were the least representative (3%). A small portion had accidentally consumed (10%) or never consumed (6%) fats or oilseeds.

Sweet products: The majority of students (56%) consumed a sweet product twice a day. They were followed by those who had consumed them only once (42%). A small proportion of students (2%) had consumed a sugary product daily.

In all food groups, the frequency of daily food consumption shows a very significant difference ($p<0.001$).

Table 5. Distribution of anthropometric characteristics of the students surveyed.

Variables	Mean	Median	Mode	δ	Minimum	Maximum	p-value
Age (years)	26.55	24	22.00	6.40	18	48	<0.001
Weight (kg)	64.16	64	60	9.77	35	96	<0.001
Height (m)	1.65	1.66	1.70	0.13	1.20	1.91	<0.001
BMI (kg/m^2)	23.95	23.23	22.09	4.44	14.87	39.64	<0.001

Nutritional status of ISEPS students

Anthropometric characteristics of students

Table 5 presents the anthropometric characteristics of the students surveyed. The average weight of the students surveyed was 64.16±9.77 kg with a minimum of 35 kg and a maximum of 96 kg; the median was 64 kg and the mode 60 kg. The body mass mean exhibited high scatter and was almost superimposable to the median, showing the sample studied did not approximate a normal distribution with respect to body mass; in view of the mode, this distribution was shifted towards the lower than average body mass ranges.

The average weight of the students surveyed was 64.16±9.77 kg with a minimum of 35 kg and a maximum of 96 kg; the median was 64 kg and the mode 60 kg. The body mass mean exhibited high scatter and was almost superimposable to the median, showing the sample studied did not approximate a normal distribution with respect to body mass; in view of the mode, this distribution was shifted towards the lower than average body mass ranges.

The average height of the students surveyed was 1.65±0.13 m with a minimum of 1.20 m and a maximum of 1.91 m; the median was 1.66 m and the mode 1.70 m. The size mean had low scatter and was superimposable on the median, showing that the studied sample was close to a normal distribution with respect to size; in view of the mode, this distribution was shifted towards the slices of size above the average.

The average BMI of the students responding to the questions was 23.91±4.44 kg/m^2 with a minimum of 14.81 kg/m^2 and a maximum of 39.64 kg/m^2; the median was 23.23 kg/m^2 and the mode 22.09 kg/m^2. The mean BMI had a high scatter and was nearly superimposable on the median, showing the sample studied approximated a normal distribution with respect to BMI; in view of the mode, this distribution was shifted towards the lower than average BMI groups.

BMI and weight status of students

Table 6 presents the BMI and weight status of the students surveyed according to their sex, study level and department. It shows that the average BMI of female students was almost similar to that of male students with non-significant difference (p=0.876). Also, it was within the normal BMI range for weight. Most students had normal build (64.6%) in both sexes followed by overweight students (17.5%) and then obese students (9.3%). However, the obesity rate was more remarkable among women students (14%) than among men (9.7%). A few cases of thinness (6.5%) were observed in both sexes. However, the corpulence of the responding students did not vary significantly from one gender to another (p=0.361).

With regard to the BMI and the weight status of the students according to the study level (Table 6), the significant differences were observed between the mean BMIs of the undergraduate students, who were in the normal weight BMI range, and those Master's students, included in the BMI range indicating overweight (p=0.018). More than half of the BAC and Master 2 students had a normal corpulence while those of Master 1 were mostly overweight including obesity (60.8% with 21.7% of obesity cases); the cases of wasting were more observed in BAC 1 and in BAC 3, with rates higher than the rate of the sample and almost of each of the other levels. However, the statistical test shows that there was no significant difference in the nutritional status of the students from one to another (p>0.05).

Concerning the BMI and the weight status of the students according to the departments, there was no significant difference observed between the mean BMIs of the sport students (23.64 ± 4.48 kg/m^2) and of PES (23.67 ± 4.32 kg/m$^{2)}$, but a very significant difference between the mean BMIs of these students and those of pedagogical supervisor (p=0.006). The mean BMIs of the sport and PES students were within the normal weight BMI range, while that of the pedagogical supervision students (26.69±4.26 kg/m^2) was in the BMI range reflecting overweight. More than half of the students of sport department (72.4%) and those of PES (61.6%) had a normal corpulence while those of supervision were overweight including obesity (54.2% with 29.2% of obesity cases). cases of thinness were observed only in sport (6.1%) and in PES (8.0%). Statistical analysis had shown (p=0.026) a significant difference in the nutritional status of students from one department to another.

DISCUSSION

Physical and sports activities and energy needs

Physical activity

Majority of the students surveyed (84.8%) practiced physical exercise for at least 2-3 days per week and more

Table 6. Distribution of BMI and weight status of students by sex, study level and department.

Variables	Modalities	Average BMI (kg/m²)	Nutritional status			
			Normal %(n)	Overweight %(n)	Obesity %(n)	Thinness %(n)
Sex	Male	23.88±4.38	66.5 (123)	17.3(32)	9.7(18)	5.5(12)
	Female	23.96±4.57	61.3 (65)	17.9(19)	14.0(15)	6.5(7)
	Overall sample	23.91±4.40	64.6	17.5	9.3	6.5
	p-value	0.876		0.361		
Level of education	BAC 1	23.25±4.02	69.9(65)	11.8(11)	9.7(9)	8.6(8)
	BAC 2	23.54±4.22	69.4(50)	19.4(14)	7.0(5)	4.2(3)
	BAC 3	23.67±4.76	67.7(48)	12.9(8)	11.3(7)	8.0(5)
	Master 1	26.17±4.73	34.8(8)	39.1(9)	21.7(7)	4.3(2)
	Master 2	25.13±4.64	56.1(23)	22(9)	17.0(7)	4.9(2)
	p-value	0.018		0.109		
Department	PES	23.67±4.32	61.6 (93)	21.2(32)	9.2(14)	8.0(12)
	Sport	23.64±4.48	72.4(84)	11.2(13)	10.3(12)	6.1(7)
	Supervision	26.69±4.26	45.8(11)	25.0(6)	29.2(7)	0.0(0)
	p-value	0.006		0.026		

than half (52.2%) practiced physical exercise during sessions lasting more than 60 min. This is well above the minimum recommended physical activity threshold, i.e. the equivalent of 30 minutes per day of walking at a sustained pace (brisk walking) at least 5 days a week (WHO, 2020). This could be explained by the fact that the teaching provided in this university is more focused on STPSA (Sciences and Techniques of Physical and Sports Activities) associated with compulsory practice of physical and sports activities within the framework of their university course. The results obtained show that the students surveyed were physically active with an average PAL of 1.89, considered favourable to health in accordance with current international recommendations. Indeed, engaging in regular physical activity has been shown to reduce the risk of coronary heart disease and stroke, type II diabetes, hypertension, colon cancer, breast cancer, and depression (Global Health Risks, 2009; OMS, 2002; 2005b; 2007). A dose-response relationship has been demonstrated for cardiovascular disease and coronary heart disease. To reduce the risk of these diseases, it is usually advisable to practice an activity that is at least of moderate intensity, at the rate of 150 minutes per week (WHO, 2020; Bauman et al., 2005; Cook et al., 2008). Furthermore, physical exercise is an essential determinant of energy expenditure and is therefore fundamental for energy balance and weight control (WHO, 2020; Grelot, 2016).

Energy needs

The energy needs corresponding to the estimated energy expenditure of the students surveyed were evaluated at 3045.18±720.22 kcal in men and 2531.64±629.27 kcal in women, with an average of 2858.12±730.60 kcal. The results of this study are different from those obtained by Bouhika *et al*. (2021) in Congolese middle-distance athletes during the competition period who presented as follows: 2244.34±74.89 kcal in girls and 2852.78±166.5 Kcal in boys.

Dietary profile of the students surveyed

Student eating habits

The results of this study showed that more than half (59.11%) of the students surveyed took the three (3) main daily meals, namely breakfast, lunch and dinner. The results are similar to those of Mabossy-Mobouna and Mokémiabéka (2018) in a study conducted among high school students at the Lionil modern school in Brazzaville on the evaluation of the nutritional status and quality of food consumed, who had found that 51.87% had consumed the three (3) daily meals. However, the results are different from those of Coulibaly (2007) obtained during a study on the diet of basketball players during pre-competitive preparations in Bamako (Mali) where all the students surveyed consumed three (3) daily meals. This difference could be explained by the fact that the basketball players in Coulibaly's study were interned, while that of this study depended on the household ration subject to the economic and financial constraints of the country. Therefore, 48.13% of the students surveyed had an unstructured diet (lack of regularity in taking meals with some meals missed), which leads to an energy and micronutrient deficit that can thus explain the cases of malnutrition observed.

Among the meals not taken, 2.1% of the students did not eat breakfast, 10.3% lunch and 2.7% dinner. In a study on the eating habits of students at the University of Tlemcen in Algeria at the Faculty of Medicine, it was revealed that the majority of students surveyed eat breakfast regularly while 23% neglect this meal (Zohra, 2007) which is in line with the results of this study. It is to note that, missing breakfast has negative effects on athletic performance. Indeed, the work of Mbemba et al. (2007) on the carbohydrate intake in the diet of top athletes in Brazzaville showed that eating in the morning improves performance. In addition, after a long period of nocturnal fasting, breakfast provides the energy needed to start physical activities and have cognitive performance (Mabossy-Mobouna and Mokémiabéka, 2018; Lecerf, 2012). Furthermore, the absence of dinner could have additive effects on nocturnal fasting. This is because most people use most of their hepatic carbohydrate stores at night while sleeping.

As for the snack, 77 % of the students surveyed had not eaten the 4 p.m. snack. This observation was also made by Hassani (2021) during a study in Constantine (Algeria) on the diet of the poor where the majority of households (44.4%) had not taken a snack. Likewise, Mabossy-Mobouna and Mokémiabéka (2018) had noticed that the majority of high school students at the modern Lionil School in Brazzaville (96.5%) also did not take the snack. This shows that even among those who took the three meals, some took no snack. This could accentuate the nutrient deficit highlighted above. Furthermore, some students took neither took lunch nor the 4 p.m. snack and had a long period of daytime fasting, which constitutes a factor of poor performance. Indeed, according to the work of Cascua and Rousseau (2005), when training, it is better to eat three daily meals with at least one or two snacks.

Food time table

Regarding meal times table, they were not respected by 99% of students versus 1%. This same observation was made during a study conducted by Mabossy-Mobouna and Mokémiabéka (2018) among high school students at the modern Lionil School where 54% of students did not respect food time table. Failure to respect the frequency of food intake is responsible for the disruption of insulin secretion that can lead to weight gain and poor athletic performance. Indeed, the work of Maugham et al. (1989) showed that achieving unrealistic body weight and body fat can compromise both short-term athletic performance and long-term health. This could explain the high rate of overweight observed in the sample studied.

Hydration modality

Regarding the amount of liquid consumed, 98.6% of the students surveyed hydrated regularly and consumed at least 1.5-2 litres or more per day, which is in line with recommendations (ANSES, 2017). It is advisable to consume a lot of water, 2.5-3.5 litres per day, to avoid dehydration and fatigue and to allow the elimination of metabolic waste. Correct rehydration improves cardiovascular functions and favours the quality of glucose storage and, therefore, sports performance (Roberto and Camille, 2017).

Snacks

Regarding snacking, 59.2 % of student respondents snacked regularly. This could explain the cases of obesity and overweight observed in this study. Indeed, snacking unbalances the food intake with weight gain (Isacco *et al*., 2010; Bénard *et al*., 2018; Temessek *et al*., 2018).

Composition of the different meals

Breakfast consisted mostly of cereals (92.9% with mostly bread) and milk (72.22%). Margarine and peanut paste were the most consumed fats used as spreads. Some students (46%) took the sugary drinks with the bread. Fruits and vegetables rarely entered the composition of breakfast. These students therefore did not have a balanced breakfast. Indeed, according to nutritional recommendations (ANSES, 2017) a balanced breakfast must have: a cereal product, a dairy product and fruits and vegetables.

Regarding lunch, it was mainly made up of vegetables and meat accompanied by cereals or tubers (chikwangue or foufou). Some students consumed fruits, legumes and/or milk during this meal. Fish were rarely eaten. As with breakfast, lunch did not meet the recommendations for a full meal. Indeed, a full lunch must be made according to the rules for preparing a meal, i.e. containing an animal protein (meat, fish, egg, etc.), a raw or cooked vegetable, a starch, a dairy product and a raw or cooked fruit.

As for dinner, it consisted mainly of meat and vegetables accompanied either by bread, rice or tubers. A fairly large number of students, but less than 50% of the total number, consumed fruit, sugary drinks or dairy products during dinner; fish and legumes were rarely eaten. The dinner also did not obey the recommendations of a full meal. Overall, the students' food intake was deficient and unbalanced.

Frequency of food groups' consumption

Regarding the group of cereals, starches and legumes, cereals had a higher consumption rate (92.6% at least three days a week) than tubers (56.6% at least three days a week) and legumes (45.5% at least three days a week).

Among cereals, bread was consumed more than rice and pasta. On the whole, more than half (51.6%) of the students had consumed cereals and starches three times a day, therefore consumption obeying the normal recommendation for foods in this group. In fact, according to the recommendations, cereals and starchy foods must be consumed at least three times a day, i.e. at each meal and snack (ANSES, 2017).

Regarding the milk and milk products group, 61.2% of respondents had consumed these foods at least three days a week; the most frequent daily consumption was once a day (48%) and milk was consumed more than yogurt and cheese. But this frequency of daily consumption was very low and did not respect the recommendations because it is necessary to consume a dairy product with each meal.

For the fruits and vegetables group, only 28.6% of respondents had consumed fruits three days a week against 52.8% who had consumed vegetables; the most frequent consumption of foods in this group was also once a day (44%). Regarding the daily frequency of fruit and vegetable consumption, none of the students surveyed consumed fruit and vegetables five times a day, which is contrary to the recommendation that one should consume 5 fruits and vegetables per day, i.e. three vegetables and two fruits per day (PNNS, 2019). This could constitute a diet deficient in micronutrients.

Regarding the group of meat, fish and eggs, 62.7% of respondents had consumed fish three days a week; 51.3% had consumed meat at the same frequency compared to 7.2% eggs. The most frequent daily consumption was three times a day (42% corresponding to that of meats). More than 50% of the students had consumed at least three days per week. This complies with the nutritional recommendation (ANSES, 2017). These students who rarely consumed eggs could have deficiencies in cholesterol and certain essential amino acids.

Regarding the fat group, 44.3% of the respondents had consumed the group foods at least three days a week; margarine was consumed more than peanut paste and animal fat. Similarly, daily consumption of margarine was higher than for peanut paste and animal fat. The most frequent daily consumption was once for fat per day (52%). This is in accordance with the nutritional recommendation, according to which it is necessary to limit the consumption of fats. The quantity of vegetable oil consumed had not been determined, nor their nature. This does not make it possible to deduce if the food of the students provided the essential fatty acids.

Concerning the sugar-sweetened drinks group, 53.4% of the students had consumed foods from this group at least three days a week; juice was consumed more than other sugary drinks. In addition, the majority of students (53.4%) had consumed sugary drinks twice a day, which is not in line with the recommendation that sugary drinks should be consumed in moderation because they are too rich in carbohydrates and have a high glycemic index.

Assessment of the students' nutritional status

The majority (64.6%) of the students surveyed had a normal nutritional status. However, 17.5% were overweight, 6.5% were thin and 9.3% were obese. The high prevalence of overweight cases including obesity in the student population studied could be due to the low physical activity level of some students leading to a largely positive energy balance. While the prevalence of observed weight deficit could be due to the high physical activity level of these students with a negative energy balance or to the type of physical activity practiced mobilizing more lipid reserves. Indeed, data from the scientific literature indicate that endurance physical activity representing a volume of at least 150 minutes per week is associated with a weight loss of approximately 1-3%, which is generally considered to be the level at which the weight is maintained (PAGAC, 2008). These results are almost similar to those obtained by Bouhika *et al*. (2021), the energy intake of Congolese middle-distance athletes during competition, 77.33% of whom were normal weight, 20% overweight and 6.67% underweight. However, no cases of obesity were observed in their results. To this end, an additional study on the determination of the fat mass of supposed cases of obesity should be conducted to confirm or invalidate these results. Overall, the study sample had a normal nutritional status (mean BMI= 23.91±4.40 Kg/m^2). These results corroborate those reported by Coulibaly (2007), Bouhika *et al*. (2021) and Diakité (2000) who had respectively obtained an average BMI of 21.51±2.86 Kg/m^2, 21.55±2.64 Kg/m^2 and 21.31 Kg/m^2 during the wearing studies in athletes.

Conclusions

Despite some cases of sedentary lifestyle observed, the respondents' level of activity was high. These students' dietary profiles did not adhere to current nutritional recommendations, with unbalanced, non-diversified food rations and certain meals skipped or even eliminated. Despite the high prevalence of overweight, including obesity, and some cases of underweight, their overall nutritional status was normal. Similarly, responding students had energy expenditures that were within the recommended range for an athletic population. To reduce the prevalence of the double nutritional burden observed, students are advised to follow the rules of a balanced and diverse diet.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

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