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Correlation between Dietary Habits, Physical Activity, and Nutritional Status of Adolescents Schooling in Yaoundé

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ABSTRACT

Background: *Adolescence, a critical stage where many physiological and developmental changes occur in the body. Poor dietary habits and inadequate physical activity leads to poor nutritional status. This study aimed to explore the correlation between dietary habits, physical activity, and nutritional status among adolescents schooling in Yaoundé.*

Methodology: *A cross sectional descriptive and analytical study with adolescents aged 10 to 19 years was carried out. The 8 health districts of Yaoundé were used, and 2 schools were randomly selected per health district and for each school we randomly selected students using research randomiser 4.0. A well-structured questionnaire was used for data collection and anthropometric measurements registered. The data was analysed using SPSS PASW (version 18). Multivariate logistic regression analysis was done to determine the association with odds ratio, with CI at 95% and p value <0.05.*

Results: *Out of 1118 adolescents, females were 60.4% with a sex ratio of 0.66 and average age of 14.81+/-2.63. Prevalence of malnutrition was 3.8% for underweight, 14.8% for overweight and 7.0% for obesity. Associated factors to overweight/obesity were the feminine gender (OR = 1.75 [1.22-2.51]), snacking on chocolates (OR = 1.51 [1.08-2.10]) and eating at least four groups of food a day (OR = 2.51 [1.42-4.45]). Protective factors were snacking on biscuits (OR = 0.67 [0.47-0.93]), and a moderate to vigorous physical activity at least thrice a week (OR = 0.60 [0.43-0.87]).*

Conclusion: *Overweight/obesity is significantly high among adolescents aged 10 to 19years schooling in Yaounde with identified factors: female gender, nibbling on chocolate and eating at least 4 different food groups in 24 hours. Whereas vigorous physical activity at least thrice a week was a protective factor.*

Keywords
Adolescent, Dietary habits, Physical activity, Nutritional status, Overweight/obesity.

Introduction
Nutritional status is one of the health indicators proposed by the World Health Organization (WHO), which corresponds to an individual's physiological state resulting from the relationship between nutrient intake and requirements and the body's capacity to digest, absorb and use these nutrients [1]. It is mainly influenced by dietary habits, health status and the socio-cultural and economic living standards. In pediatrics, it represents an important element of health transition, economic and social development. Good child nutrition promotes optimal physical and mental growth, which gives young people the strength and concentration needed to study, work, fight disease and participate fully in the growth of their community [1].

Malnutrition is a pathological state corresponding to deficiencies, excesses or imbalances in the energy and/or nutritional intake of an individual [2]. In high-income countries, the problems of overweight, obesity and related medical pathologies remain a major challenge. In low- and middle-income countries, the main concern has rather being malnutrition due to lack of food intake [3]. However, an increase in westernization and globalization of food habits in these countries has led to a nutritional transition characterized by the coexistence of undernutrition and deficiency diseases on one hand, and overweight and obesity on the other. Now referred to as "the double burden of malnutrition". It's magnitude among adolescents remains poorly defined [4]. It was reported in the year 2020 that more than 2.3 billion people (or 30% of the world's population) lacked all year-round access to adequate food. Malnutrition persisted in all its forms, with children being the most affected. In 2020, an estimate of about 149 million children were stunted (low height for age); more than 45 million were wasted (low weight for height); and nearly 39 million were overweight. More than half of the total number of malnourished people were in Asia; more than a third in Africa; and a lower proportion in Latin America and the Caribbean. Nonetheless, Africa has experienced the greatest surge in hunger, with an estimated prevalence of undernourished children at 21% of the population, a proportion that is more than double that of all other regions [5]. A global study conducted in 57 low- and middle-income countries in 2018, in a population of 129,276 adolescents, found that the prevalence of stunting was 10.2% and that of wasting (underweight) was 5.5%; while that of overweight and obesity was 21.4% [4]. Studies have outlined various factors such as environmental, social, economic and genetic influencing the nutritional status of children and adolescents. In Europe, the Helena's study conducted from 2006 to 2007 on 3500 adolescents aged from 12 to 17 years old showed a high impact of environmental factors such as poor dietary habits and availability of meals in school canteens; low socioeconomic status (SES), physical inactivity and some genetic mutations involved in adiposity and metabolism [6]. Despite adolescents comprising the largest population in low-and-middle-income countries (LMICs), resources are geared towards pregnant women and children under-five due to high mortality rate in these groups. The period of childhood beyond the age of five and adolescence are also crucial periods in the human life cycle. Hence, targeting this age group within the school milieu gives us an opportunity to break the intergenerational cycle of malnutrition [4]. Few studies so far have dealt with eating habits and physical activity of adolescents in Cameroon. Thus, there is a need to examine the health and nutritional status of adolescents through behavioral risk factors like unhealthy eating habits and physical inactivity. So, this research will help assess how the lifestyle related factors such as dietary habits and physical activity affects the nutritional status of adolescents schooling in the city of Yaounde, Cameroon to facilitate the design and implementation of interventions aimed at promoting good nutrition in adolescents through school and to contribute to the improvement of adolescents' health in urban and rural areas.

Materials and Methods
A cross-sectional analytical study, with prospective data collection took place in Yaounde, the capital of Cameroon with an estimated population of about 4,509,000 as of the year 2023 (a 3.97% increase from 2022) [7], with a cosmopolitan population representing the ten regions of Cameroon. The study lasted for eight months from November 2022 to June 2023, targeting adolescents schooling in Yaounde. We included, Adolescent enrolled in the academic year 2022-2023 in either public or private schools within the ages of 10-19 years old, free of any handicap that could affect their physical activity level and whose parents or guardians signed the consent form. Adolescents excluded from the study were, those with any physical handicap which could influence anthropometric measurement, those schooling in schools not selected for the study, those with an incomplete or poorly filled questionnaire, those who refused to go through the anthropometric measurements process and those whose parents or guardians did not give consent. The sample size was estimated at 278 adolescents using the Cochran`s formula with estimated percentage of adolescents (10-19 years) in Yaounde at 20.7% [8]. Administrative authorization and ethical clearance from the Ethics Committee of the Faculty of Medicine and Biomedical Sciences were obtained. The selection criteria of participants was done in 3 stages, first, We obtained a list from the Regional Delegation of Secondary Education containing all the secondary schools in the 7 sub-divisions of Mfoundi and we organized them into the 8 health districts of Yaounde. Using Research Randomizer version 4.0 [9] we randomly selected 2 secondary schools per health district that is 1 private and 1 public school (in order to have a representative sample of our target population) making a total of 16 schools. Secondly, For each school chosen, we randomly selected one class per level; for example, from form 1A to form 1F, using Research Randomizer version 4.0 [9] we randomly selected one class, that is 7 classes per school, making a total of 112 classes. And finally, using the list of registered students of each class chosen, obtained from the administration from form 1 to upper sixth, we randomly selected 12 students per class using the software Research Randomizer

version 4.0 [9] making a total of 84 students per school hence 1344 students from all 16 schools but 236 were excluded for incomplete data. Our data was collected using two types of measurements: a questionnaire written in both English and French language and anthropometric measurements. The preparatory phase was pre-tested on 21 (3 students per class) students in a secondary school not selected for the study. Two training sessions of one hour each was scheduled to train the team of medical students on the field work in general and anthropometric measurements. Our first descent was to inform the selected participants of the study on the purpose, as well as to distribute the consent and information forms destined for their parents. The second descent was to collect data from the participants the questionnaire was self-reported without the involvement of the main teacher or research team. The questionnaire was organised into 5 sections: the background, eating habits, dietary assessment, sedentary lifestyle, and physical activity. The dietary assessment used a food frequency questionnaire (FFQ) which was developed based on instructions from nutritional surveys and FFQ used to assess food habits in Cameroon [10,11]. Physical activities included those done at different times of the day either at school, after school, at home, or at free time. Information was collected using the guidelines of GPAQ (WHO 2002) [12]. Data survey was modified according to our participants' age group and settings. Activities performed during school were evaluated according to participants' personal involvements in some activities. Physical activity out of school was assessed using 4 levels based on the 1997 UK Survey for young people [13]. Hence we concluded on adolescent physical activity following WHO guidelines for adolescents [14]. Sedentary behaviours were designed to give information about sitting or reclining after school or at home, including time spent doing homework, reading, playing on computer or computer games, or watching television or videos. The third descent was for anthropometric measures (weight, height, body mass index, waist circumference). For height measurement, a UNICEF stadiometer was used. The weight was measured with a portable calibrated scales [Seca Flat Scales – S876 (G3217)]. From the ratio of weight to height square, the Body Mass Index (BMI) was determined, where BMI = Weight (kg) /Height^2 (m). The cut-off percentiles we used to classify the nutritional status of the participants was as follows [15]: underweight, BMI p<3rd; normal, BMI p≥3rd to p<85th; overweight, p≥85th to p<97th; and obese, BMI p≥97th. At the end of the anthropometric measurements process, a report card containing the nutritional status and management recommendations by our team was handed to the participants who were malnourished (underweight, overweight, and obese). We entered data from validated questionnaires into an automated data entry form in IBM SPSS (Statistical Package for Social Sciences). The categorical variables were expressed in frequency and percentage, and the numerical variables were expressed using averages, standard deviations, minimums, medians, maximums, and valid observation totals. The BMI and nutritional status was determined using WHO AnthroPlus version 1.0.4. Associations between variables in the study were analysed using Fisher's exact test. Odd's ratio with a confidence interval of 95% was used to determine the associated factors to the nutritional. In all the analyses, a p-value < 0.05 was considered significant.

Results

A total of 1118 adolescents were included in the study. The average age of the students was 14.81 ± 2.63 years, with extremes of 10 and 19 years. The sex ratio was 0.66. The majority lived in urban areas (76.7%). Most students attended state schools and were in upper sixth, that is 51.0% and 20.1% respectively. Fifty-seven percent (57.0%) of students used cars or moto bikes as the main transportation methods to and from school while 42.1% walked to school (Table 1). Most students (93.9%) lived with both parents. The modal category of education of the mothers was secondary education (42.7%). The most represented social class was the middle class (50.9%). As for household size, the median number of inhabitants in the household was 6 [5-8], with extremes of 2 to 20 inhabitants per household. The incidence of co-morbidities was 1.6%, dominated by asthma (0.7%). The nutritional status of the participants revealed that, most of our participants i.e. 74.4% were within the normal limits. About 3.8% were underweight. The prevalence of overweight and obesity was 14.8% and 7.0% respectively as shown in (Figure 1). The modal category of consumption of at least 4 meals a day per week, was between one to three times a week (43.7%). All students reported to have skipped at least a meal, dominated by the absence of snacks (67.2%) and elevens (44.9%). Although amongst the three main meals (breakfast, lunch, and dinner) lunch was the most skipped meal (27.3%). Nibbling (eating in between meals) was frequent in 94.2% of cases, mainly biscuits (64.5%). Most of the students reported that their choice of food was mainly influenced by their pocket money (62.3%). As for the speed with which they ate food, most were slow eaters (63.8%). A total of 48 students (4.3%) admitted to initiating the vomiting reflex after a meal. The quantity of food served per meal was considered sufficient by many respondents (78.4%), as was the feeling of satiety (90.6%). Most (75.9%) refilled their plate during a meal at least once. The most consumed liquid was water, followed by soft drinks (non-alcoholic carbonated) (59.8%). The modal category of daily water consumption was 1 to 1.5L (35.7%). The meals eaten most in the last 24 hours were breakfast and dinner, at 92.3% and 87.9% respectively (Figure 2), most students (78.9%) had eaten at least 3 meals in the previous 24 hours and most students (97.7%) had eaten at least 4 food groups in the last 24 hours. The three main food groups consumed in the last 7 days were grains/tubers (99.8%), fats/oils (98.8%) and vegetables (96.2%). More adolescents reported to doing sports (physical education) in school (82.6%) than out of school (72.1%). On multivariate analysis, protective factors against overweight/obesity were nibbling on biscuits (ORa: 0.67, P=0.02) and moderate to intense physical activity at least 3 times a week for 20 minutes (ORa: 0.60, P=0.007). Risk factors included the feminine gender (ORa: 1.75, P=0.02), nibbling on chocolates (ORa: 1.51, P=0.014) and eating more than 4 food groups (ORa: 2.51, P=0.02) (Table 2).

Table 1: Distribution of the population according to socio-demographic characteristics.

Variables	Frequency (N=1118)	Percentage (%)
Age groups (years)		
10-13	388	34.7
14-16	384	34.3
17-19	346	30.9
Gender		
Masculine	443	39.6
Feminine	675	60.4
Residence		
Urban	858	76.7
Rural	260	23.3
Type of school		
Public	570	51.0
Private	548	49.0
Class		
1st cycle 777		69.6
2nd cycle 341		30.4
Means of transportation to school		
Taxi/Bike/Bus/personal car	637	57.0
On foot	471	42.1
Bicycle	10	0.9

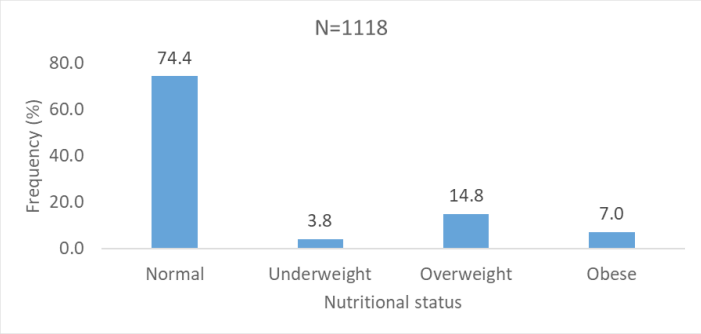

Figure 1: Distribution of the population according to nutritional status.

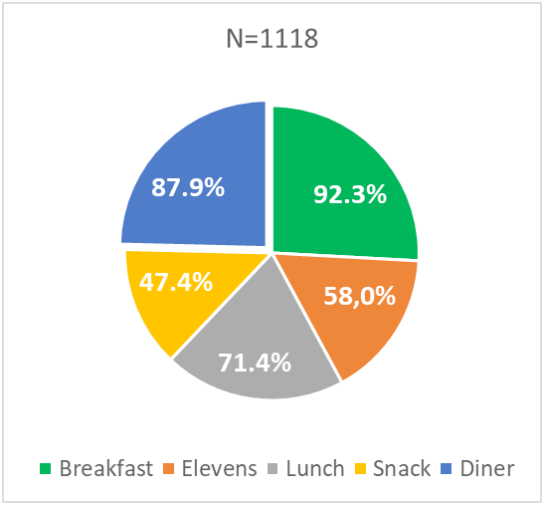

Figure 2: Distribution of meal types in the last 24 hours before the survey.

Table 2: Independent factors associated with overweight/obesity.

Variables	Over-nutrition		ORa (CI at 95%)	Adjusted p value
	Yes=243; n (%)	No=875; n (%)		
Gender				
Feminine	185 (27,4)	490 (72,6)	**1,75 (1,22-2,51)**	**0,002**
Class				
2nd Cycle (lower and uppersixth)	107 (24,4)	331 (75,6)	1,14 (0,82-1,59)	0,414
Transportation means to school				
Automobile	157 (24,6)	480 (75,4)	1,25 (0,89-1,75)	0,182
Types of snack				
Biscuits	142 (19,7)	579 (80,3)	**0,67 (0,47-0,93)**	**0,020**
Peanuts	61 (17,4)	289 (82,6)	0,72 (0,51-1,03)	0,080
Chocolate	108 (25,0)	324 (75,0)	**1,51 (1,08-2,10)**	**0,014**
Speed of food consumption				
Very slowly/slowly	182 (23,8)	582 (76,2)	1,24 (0,86-1,78)	0,235
Number of servings per meal				
2 times or more	62 (17,9)	284 (82,1)	0,85 (0,60-1,20)	0,363
Type of liquid consumption				
Fruit juice	40 (17,5)	189 (82,5)	0,72 (0,48-1,08)	0,113
Food groups				
> 4	226 (23,3)	743 (76,7)	**2,51 (1,42-4,45)**	**0,002**
Daily physical activity of any sort for a minimum of 30 minutes				
Yes	183 (19,2)	771 (80,8)	0,71 (0,45-1,10)	0,133
Moderate to vigorous physical activity at least 3 times a week				
Yes	110 (16,6)	554 (83,4)	**0,60 (0,43-0,87)**	**0,007**

Discussion

This study which was conducted in 16 secondary schools in Yaoundé, aimed to correlate the dietary habits and physical activity to the nutritional status of adolescents aged 10 to 19 years schooling in Yaounde. The findings enabled us to determine the prevalence of malnutrition (underweight, overweight and obesity) and to identify the sociodemographic, behavioural and nutritional risk factors associated with overweight and obesity in these adolescents. Majority of our participants were females (60.4%) with a male to female sex ratio of 0.66, which was similar to the findings in Cameroon in 2009 (57.3%, sex ratio; 0.74) [16]. This finding was in contrast to those of a study done in 2010 in Nigeria (48.6%, sex ratio;1.05) [17]. This difference could be attributed to the fact that Cameroon has a slightly higher percentage of female population with respects to the male population because males have a lower life expectancy [18]. The average age of our population was 14.81 ± 2.63 years, with extremes of 10 and 19 years. This was comparable to the results from a study done in Ghana in 2011, on adolescents 12-18 years where in the average age was 15.7 ± 1.6 [19]. This could be explained by the fact that most of our study population was from the first cycle.

The total prevalence of malnutrition for our study was 25.6% i.e. 3.8% for underweight, 14.8 % for overweight and 7.0% for obesity. The prevalence of underweight in this study was very low (3.8%). This is below that of the adolescents of Addis Ababa in Ethopia in

2012 (6.2%) [20]. This could be because most of our respondents reported to have been eating well and had a good dietary diversity score (89.4%%). The prevalence of overweight and obesity was 14.8% and 7.0% respectively. This was way below the prevalence of overweight and obesity (21.5% and 11.4%) observed on adolescents aged 10-15 years in Yaoundé in 2013 (Cameroon) [9] . This difference could be attributed to non-response bias as some students who were overweight/obese refrained from participating in this study for fear of mockery from their peers during the anthropometric measurement process. Also, it could be due to difference in study design .Most of our participants reported to eating in-between meals (94.2%), which was similar to the findings in 2013 in Nigeria (93.0%) [21]. This could be explained by the fact that adolescents spend most of their time in school. According to their school program, they have two breaks in between classes daily and their school canteens sell mostly snacks. Majority of our respondents had consumed at least 4 food groups 24 hours prior to the survey (97.7%) and hence had an adequate dietary diversity score (89.4%). This was in contrast to the findings by in Nigeria, wherein only about 49.0% of respondents had an adequate dietary diversity score [21]. This discrepancy could be attributed to the fact that most of our study population were in an urban setting and were from well to do homes, as the predominant social class for this study was the middle class (50.9%). Of all the adolescents, 87.6% responded to less daily consumption of fruits. This was in line with a study carried out in Ghana in 2011, they reported that over half (56%) of the respondents rarely ate fruits [19]. This could be explained by the fact that adolescents spend most of their time at school, and most school canteens don't sell fruits or natural fruit juices. Most students practised physical education (sports) in and or out of school (82.6% and 72.1% respectively). Those who did sports in and out of school were more likely to meet the recommended guidelines for adolescent physical activity (59.4% of our study population met the recommended guidelines). This was different from the results of a study carried out in Spain on adolescents 6-18 years in 2008, wherein just about 48% of the students met up to the guidelines [22]. This disparity could be justified by the fact that adolescents in developed countries are generally more inactive with respects to those in the LMICs (low- and middle-income countries). Also, in Cameroon, physical education is part of our school curriculum, and it is practiced as a subject especially by the first cycle students. With respect to the factors associated with overweight and obesity, We found a higher prevalence of overweight/obesity in girls compared to boys (27.4% versus 13.1%) i.e. females were more likely to be overweight/obese (OR = 1.75 95%CI p =0,002). This was in line with the findings in 2013 in Cameroon [9]. The predisposition of the female gender to overweight/obesity can be explained by the physiological changes occurring during puberty wherein the female sex hormones influence the hormonal mechanisms controlling storage of fats. During adolescence, and more specifically during puberty, girls and boys store the same amount of fat, but boys grow taller than girls, so their BMI (body mass index) appears to be lower than that of girls; moreover, boys burn fat more quickly than girls due to a higher basal metabolic rate (BMR) [9]. Conversely a study in China in 2011 showed that overweight and obesity was significantly associated to the male gender (p< 0,05**)** [23]. In the bivariate analysis, adolescents who walked to school were less likely to be overweight/obese with respect to adolescents who used automobile transportation. This was similar to the findings in Colombia were adolescents who walked to school were less likely to be overweight [24]. This is justifiable by the fact that walking augments the usage of calories by the body hence reducing body fat composition. Adolescents who snacked on biscuits were less likely to be overweight/obese. On the multivariate analysis, snacking on peanut was less significant ,this finding was similar to that in Cameroon in 2013 wherein snacking on peanuts in the univariate analysis was seen to be a protective factor against overweight and obesity, but not in the multivariate analysis [9]. These results could be justified by the fact that a biscuit is mainly composed of sugars (carbohydrate) and 1 g of carbohydrate provides just about 4cal. Not forgetting peanuts which are legumes by nature hence they are an important source of healthful fats, protein, and fibers. In the multivariate analysis snacking on chocolates was positively related to overweight and obesity .This finding was similar to that in Cameroon in 2013 [9]. This could be explained by the fact that chocolate is mainly composed of fats and oils, hence it is more energy dense as 1g of fats provides 9cal. The adolescents who ate at least four different food groups and 3 meals in 24 hours were more likely to be overweight/obese. This finding was different from the study in Cameroon who found that eating at least 3 meals daily was a significant protective factor against overweight and obesity [9]. This difference could be explained by the fact that the four main food groups consumed by our population were: grains/tubers (99.8%), fats and oils (98.8%), vegetables (96.2%) and sugars (88.8%) which are mostly energy dense foods. Also, our study population englobed adolescents from 10 to 19 years. Adolescence is a stage that bridges the gap between adulthood and childhood. As they get older, they gain more autonomy over their food choices and are more exposed to making unhealthy food choices. Adolescents who were consistent with physical education (sports) in and out of school were significantly less likely to be overweight/obese (OR = 0.60, 95%CI 0.43-0.87, p = 0.007), similar to the findings in Mekone et al., were absence of physical education out of school was identified as significant risk factor to overweight and obesity in adolescents (OR =2.32, p = 0.00) [9]. This could be explained by the fact that during sports calories are burned hence reducing body fat composition.

Conclusion

The findings of the study revealed that, overweight/obesity is relatively high among adolescents aged 10 to 19years schooling in Yaounde with promoting factors as: female gender, nibbling on chocolate and eating at least 4 different food groups in 24 hours. Whereas vigorous physical activity at least thrice a week was a protective factor. These results can facilitate the design and implementation of interventions aimed at promoting good nutrition in adolescents through school and to contribute to the improvement of adolescents' health in urban and rural areas.

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