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ASSOCIATION BETWEEN OBESITY, BEHAVIOURAL AND ENVIRONMENTAL FACTORS AMONG ADOLESCENTS ATTENDING PRIVATE COLLEGES IN BRAZZAVILLE

Moussouami Simplice Innocent[1,*], Bio Nigan Issiako[1], Nouatin Basile[1], Gouthon Polycarpe[1], Akplogan Barnabé[2] and Mbemaba François[3]

[1]Sport, Health and Evaluation Research Unit (UR/SSE), National Institute of Youth, Physical Education and Sport (INJEPS), University of Abomey-Calavi (UAC), 01 BP: 169. Porto-Novo (Benin).
[2]Biomechanics and Performance Laboratory (LaBioP), National Institute of Youth, Physical Education and Sport (INJEPS), University of Abomey-Calavi (UAC), 01 BP: 169. Porto-Novo (Benin).
[3]Laboratory of Effort Physiology and Biomechanics (LPB), Institut Supérieur d'Education physique et Sportive (ISEPS), Université Marien Ngouabi (Congo). BP: 69

ABSTRACT

Introduction: The purpose of this study is to estimate the prevalence of obesity among students attending private secondary schools in Brazzaville and identify factors that contribute to weight gain. **Methods:** This was a cross-sectional, descriptive and analytical study of 1030 students in private schools. Data analysis was performed using Epi Info7 and SPSS 2.2 software. Pearson's Chi2 test, varied and multi-varied uni logistic regression were used. **Results:** among the 1030 students who responded to the questionnaire, 15.3% were overweight, and 5.1% were obese. The age of the subjects ranged from 13 to 18 years with a median of 15 years; 57.1% were female. Factors associated with obesity/overweight were: fruit and vegetable consumption, the number of daily meals, snacking, video games, extracurricular sports and walking to school. **Conclusion:** The study showed a high prevalence of obesity and overweight in private schools in Brazzaville and will allow the implementation of management strategies for these students.

INTRODUCTION

The prevalence of obesity and overweight has increased dramatically worldwide in recent decades in children and adults. The issues of obesity and overweight during adolescence are a worrying public health problem because of their potential health impact and their increasing frequency (Noirez, 2019). In 2011, WHO estimates that there will be one billion obese people over 20 years of age and 40 million children under 5 years of age worldwide. Obesity is defined as an abnormal or excessive accumulation of body fat that represents a health risk, and it is caused by the ingestion of more energy than is expended over a long period of time (OMS, 2016).

*Corresponding author: **Moussouami Simplice Innocent**
Sport, Health and Evaluation Research Unit (UR/SSE), National Institute of Youth, Physical Education and Sport (INJEPS), University of Abomey-Calavi (UAC), 01 BP: 169. Porto-Novo (Benin).

In general, obesity and excess weight are the result of an imbalance between calories consumed and calories expended. The state of obesity is nowadays associated with the appearance of various pathologies. It is clearly established that obesity in adolescents is associated with social and psychological problems, risk factors for cardiovascular disease, metabolic abnormalities, liver and gastric disorders, sleep apnea and orthopedic complications (OMS, 2015). The causes of adolescent obesity are relatively well identified in developed countries, but much less recognized in sub-Saharan countries. However it is clear that the rapid increase in obesity in Africa is attributed to the socio-demographic evolution of urban populations, the shift from traditional diets mainly based on cereals, tubers and vegetables, to increasingly diversified diets rich in increasingly fatty, sugary animal products and less rich in fibre and micronutrients (vitamins, trace elements, antioxidants) (Popkin, 2012). This change in habits is often "the result of development-related environmental and societal

changes and a lack of supportive policy in sectors such as health, agriculture, transport, urban planning, the environment, the agri-food industry, distribution, marketing and education (OMS, 2015). Global estimates of the prevalence of obesity and overweight among children and adolescents have shown that about 150 to 160 million school-age children (5 to 17 years old) are overweight, of whom 35 to 40 million are obese (Wang, 2011). In sub-Saharan Africa, much of the work on nutrition focuses on malnutrition and food health problems. However, little work focused on adolescent obesity is available. In Senegal, a study found 8% overweight and 1.4% obesity among students in the teaching cycle (Papa, 2016). The prevalence of obesity was 1% and that of overweight was 8% in the Democratic Republic of Congo among adolescents in school settings in Lubumbashi (Mbaz Musungi, 2019). In Congo, some studies on overweight individuals have been carried out: a survey of overweight and obesity among schoolchildren in Brazzaville in 2012 reported 7.1% overweight and obesity among children aged 12 to 13 years (Mabiala-Babela, 2011). Another school study of students, repoted that among a total of 862 students aged 7 to 18 years percentage of overweightstudents reacheds 4.1% (Mabiala-Babela, 2012). Taking into account the paucity of reliable epidemiological data on overweight and obesity in schools and existing ones considered outdated and heterogeneous, it appeared necessary to carry out this epidemiological study, the objective of which is to determine the behavioural and environmental factors related to obesity and overweight in private schools in Brazzaville.

MATERIALS AND METHODS

Subjects: This was a descriptive and analytical study of adolescents (n = 1030) attending private secondary schools in Brazzaville during the period April to June 2018. The data collection period was two months. Obese adolescents and parents have duly signed written informed consent to participate in this study. In addition, the Scientific Committee of the Higher Institute of Physical Education (ISEPS) of the Marien Ngouabi University of Brazzaville has given its approval for this research project.

Study site: The study took place in Brazzaville, the capital city of the Republic of Congo located in the south-east of the country on the right bank of the Congo River opposite Kinshasa, the capital of the Democratic Republic of Congo.

Selection of private schools: For the recruitment of adolescents in our study, four schools were selected on the basis of the following criteria: belonging to a geographical area of the city (north, south, centre), high number of adolescents to cover the number required for the age group studied, accessibility to our interviewers. Sample of the sample: A sample of 1030 adolescents aged 14 to 18 years was selected for this study. Subjects should meet the following criteria: be Congolese enrolled in a private secondary school, aged 14 to 18 years, not have a chronic disease that may not be present, not have a deformity that may affect their eating habits and body composition. The sample size was calculated using the formula: n = t2 x p x (1-p)/m2 where t is the 95% confidence level, p is the estimated prevalence of the obese population and m is the margin of error set at 5% (Cochran, 2006; Ardilly, 2006). The prevalence of obesity among adolescents in the Brazzaville region was estimated at 7.1% (Mabiala-Babela, 2011). Thus, the size required to represent the population was 852 adolescents who were considered necessary for inclusion to obtain statistically significant results. This number was increased by 10% to predict cases of non-response and resulted in 937. However, the total number of subjects meeting the inclusion criteria was 1030.

Data collection: The data were collected using a questionnaire that consisted of three parts: the first part was reserved for socio-demographic data. The second part is devoted to data on eating habits, collected using a food consumption frequency questionnaire. Environmental and behavioural factors were assessed and anthropometric measurements were performed by a nurse and validated by a physician. The body mass index (BMI) was calculated and the anthropometric weight status was defined according to the International Obesity Task Force (IOTF) standards for each subject (Cole, 2000).

Simplified food consumption frequency questionnaire: Schoolchildren's eating habits were explored through questions on the weekly frequency of consumption of specific foods, divided into 2 groups called "healthy" foods and "superfluous" foods. The five healthy foods are: fruits, vegetables, fish, legumes and milk and the five "superfluous" foods are: cookies, cakes, candy, ice creamand sweetened/carbonated drinks. These foods were chosen for this study based on their contribution to food quality and the effect they can have on overload problems. These foods have also been chosen because they are widely consumed by the Congolese population and particularly by schoolchildren (Mbemba, 2005). With regard to "healthy" foods, fruits and vegetables are known for their health benefits (Sercia, 2018). Consumption of "healthy" and "superfluous" foods was measured over a week.

Anthropometric measures: Anthropometric measurements were taken for all subjects in lightweight clothing and without shoes. The weight was measured using the scale. The height was measured using a measuring tape, the participant stood without shoes, looking straight with his heels joined. The BMI was calculated as the ratio of weight (kilograms) to square height (metres).

Weight status assessment: Weight status was determined using data defined by the International Obesity Task Force (IOTF). The BMI curve equal to 25 at age 18 defines the threshold of overweight, including obesity (IOTF 25) and the BMI percentile curve equal to 30 at age 18 defines the threshold of obesity (Cole, 2000). Statistical analyses: Data entry was made using EPIINFO version 7 software and analysis (descriptive and analytical aspects) using SPSS version 22 software. The characteristics of the sample have been described. To measure the strength of the association between the occurrence of overweight and the independent variables, the estimated proportions and odds ratios or odd ratios (OR) were calculated with their 95% confidence interval (CI95%). Pearson's chi2 test was used for frequency comparison. A regression model was constructed using a step-by-step logistic regression analysis. The variables were entered into the multiple model from the univariate analysis between the dependent variable and the independent variables. The significance level for all tests was 0.05.

RESULTS

Characteristics of the participants: The age of the subjects surveyed was between 14 and 18 years with an asymmetric age

distribution, the median was 16, with an interquartile interval ranging from 15 (Q1) to 17 years (Q2). More than fifty percent (57.1%) were girls with a ratio of 0.75, the proportion of high school graduates was 42.5% and 57.5% for middle school students. Only 16.6% came from parents who were engaged in manual work.

Three variables had p-value > 0.01: poultry consumption and gender (Table 2). Subjects who nibbled regularly, who frequently consumed fast food and who played video games from time to time had 11.70; 5.87 and 5.27 times the risk of being obese, respectively.

Table 1. Weight status of surveyed students (n = 1030)

Body Build	Girls % [CI 95%]	Boys % [CI 95%]	Total % [CI 95%]
Lean	16.3 [13.3-19.3]	28.3 [24.0-32.4]	21.5 [21.1-29.2]
Weighted standard	61.4 [57.4-65.3]	53.6 [48.9-58.2]	58.1 [57.4-63.3]
Overweight	15.8 [12.8-18.7]	14.7 [11.4-18.0]	15.3 [13.4-17.8]
Obesity	6.5 [4.4-8.4]	3.4 [1.7-5.0]	5.1 [4.1-6.9]

CI: confidence interval; numbers in boxes represent percentages and confidence intervals

Table 2. Distribution of food consumed by weight status

Variables	Modalities	Obose/Overweight	Not obese	p-value	OR[CI 95%]
Sex	Male	80 (37.9)	362 (44.2)	0.1	-
	Female	131 (62.1)	457 (55.8)		
Vegetables*	Frequently	42 (19.9)	669 (81.7)	0.001	0.90 [0.62-1.33]
	Rarely	169 (80.1)	150 (18.3)		
Chiken	Frequently	9 (4.3)	67 (8.2)	0.05	-
	Rarely	202 (95.7)	752 (91.8)		
Red meats*	Frequently	145 (68.7)	485 (59.2)	0.01	1.51 [1.09-2.09]
	Rarely	66 (31.3)	334 (40.8)		
Fish*	Frequently	137 (64.9)	93 (11.4)	0.001	0.23 [0.16-0.33]
	Rarely	74 (35.1)	726 (88.6)		
Egg	Frequently	162 (76.8)	656 (80.1)	0.28	-
	Rarely	49 (23.2)	163 (19.9)		
Milk*	Frequently	144 (68.2)	688 (85.2)	0.001	0.37 [0.26-0.52]
	Rarely	67 (31.8)	121 (14.8)		
Fruits*	Frequently	24 (11.4)	636 (77.7)	0.001	0.03 [0.02-0.05]
	Rarely	187 (88.6)	183 (22.3)		
Sweet drinks*	Frequently	203 (96.2)	701 (85.6)	0.001	4.27 [2.18-9.64]
	Rarely	8 (3.8)	118 (14.4)		

OR: odds ration; CI: confidence interval; numbers in boxes represent percentages and confidence intervals; *association between independent variable and dependent variable

Table 3. Univariate analysis of the association between overweight/obesity and behavioural and environmental factors

Variables	Modalities	Obese/Overweight	Not obese	P-value	OR[CI 95%]
Snacking*	Yes	192 (91.0)	65 (7.9)	0.001	11.7 [7.02-22.58]
	No	19 (9.0)	754 (92.1)		
Fastfood*	Yes	141 (66.8)	209 (25.5)	0.001	5.87 [4.25-8.18]
	No	70 (33.2)	610 (74.5)		
Vidéo games*	Yes	131 (62.1)	194 (23.7)	0.001	5.27 [3.83-7.29]
	No	80 (37.9)	625 (76.3)		
School sport	Yes	146 (69.2)	616 (75.3)	0.76	/
	No	65 (30.8)	203 (24.8)		
Out-of-school sport*	Yes	34 (16.1)	710 (86.6)	0.001	0.02 [0.01-0.04]
	No	177 (83.9)	109 (13.4)		
Walk to school*	Yes	42 (19.9)	293 (35.8)	0.001	0.13 [0.09-0.19]
	No	169 (80.1)	526 (64.2)		
Consumption of out-of-home meals	Yes	98 (46.4)	386 (47.1)	0.85	/
	No	113 (53.6)	433 (52.9)		
Number of meals*	< 3times/day	178 (84.4)	385 (47.0)	0.001	0.16 [0.10-0.24]
	≥ 3times/day	33 (15.6)	434 (53.0)		

OR: odds ration; CI: confidence interval; numbers in boxes represent percentages and confidence intervals; * association between independent variable and dependent variable

The frequency of consumption of fish, fruit and sweetened drinks was 64.9%; 11.4% and 96.2% for overweight students respectively. However, it was 11.4%; 85.2% and 85.6% respectively for non-obese people.

Factors related to obesity/overweight: Of the seventeen variables studied, twelve were significantly associated with weight gain in the varied uni analysis:

Thus, subjects who frequently consumed vegetables, fish, milk and fruit had 0.09; 0.23; 0.37 and 0.03 times less risk of obesity occurring respectively (p< 0.001). Since subjects frequently consumed red meat, sweets were significantly more likely to be overweight at 1.51 and 4.27 times respectively.

Subjects participating in extracurricular sports, coming to school on foot, respecting the different daily meals had respectively 0.02 ; 0.13 and 0.16 times less risk of developing overweight (p< 0.001). Two variables had p-value > 0.01: school sport and out-of-home meal consumption (Table 3). These twelve variables were introduced into the multiple regression model (Table 4). By adjusting the consumption of vegetables, red meat, fish, milk, fruit, sugary drinks, fast food, snacks, number of meals per day, video games, extracurricular sports and means of transport on the body, subjects who frequently consumed milk, fruits were respectively 0.06 and 0.07 times less likely to be overweight and subjects who frequently consumed sweets were 2.91 times more likely to be obese than those who rarely consumed them.

Table 4. Multivariate analysis of the association between overweight/obesity and other variables

Variables	Modalités	P-value	ORaj [IC 95%]
Vegetables	Frequenty	0.75	1
	Rarely		1.23 [0.32-4.84]
Red meats	Frequenty	0.45	1
	Rarely		1.48 [0.53-4.23]
Fish	Frequenty	0.20	1
	Rarely		0.45 [0.13-1.53]
Milk*	Frequenty	0.001	1
	Rarely		0.06 [0.01-0.20]
Fruit*	Frequenty	0.001	1
	Rarely		0.07 [0.02-0.22]
Sweet drinks	Frequenty	0.93	1
	Rarely		0.06 [0.01-0.20]
Snacking*	No	0.001	1
	Yes		6.12 [1.55-3.50]
Fastfood	No	0.08	1
	Yes		0.23 [0.04-1.20]
Vidéo games*	No	0.001	1
	Yes		8.03 [1.19-7.04]
Out-of-school sport*	No	0.001	1
	Yes		0.03 [0.01-0.09]
Walk to school*	No	0.001	1
	Yes		0.10 [0.03-0.29]
Number of meals*	<3fois/jour	0.001	1
	≥ 3fois/jour		0.09 [0.02-0.33]

OR: odds ration; CI: confidence interval; numbers in boxes represent percentages and confidence intervals

Subjects who nibbled regularly had a significantly higher risk of being overweight (p< 0.001). Subjects who regularly played video games had a significantly higher risk of developing obesity (p<0,001). In contrast, subjects who participated in extracurricular sports, walked to school and ate at least three meals a day had respectively 0.03; 0.10 and 0.09 less risk of excessive weight gain.

DISCUSSION

The prevalence rate of overweight and obesity was 15.3% (95% CI: 13.4-17.8) and 5.1% (95% CI: 4.1-6.9) respectively. This prevalence is lower than that observed in developed countries in Europe and America: In England, overweight alone affects 18.64% of children and obesity affects 5.26%of children (Smolina, 2010). In the United States, a prevalence of 16.9% obesity and about 28% overweight was reported among overweight adolescents (CDC, 2008). This result also indicates that the prevalence of obesity and overweight in the study population was extremely high compared to other studies in sub-Saharan countries. In Togo, the prevalence of obesity and overweight was reported to be 2.86% and 1.72% respectively (Djabou *et al.*, 2010). In Benin, 5% of children aged 13 ± 2.4 years were overweight and none were obese (Makoutodé, 2017). This high prevalence rate of obesity, obesity and overweight could be explained by the fact that adolescents in the study population are mostly from wealthy families, adopt a sedentary lifestyle, spend a lot of time in front of the screens playing video games, and mostly travel by car. To this, it is necessary to add the consumption of hyper-carbohydrate foods. This difference could also be explained by the environment of these countries, particularly diet and physical activity levels (OMS, 2016). However, the prevalence rate obtained is much lower than in some European and American countries, sometimes higher or slightly higher than in other African countries. This difference is due to variations in the standard of living of these countries. An interesting conclusion of this study is that the consumption of sweets has been associated with obesity. This association has been documented by most studies.

A study in low-income countries showed an increase in the consumption of processed foods among children and adolescents, especially in urban areas, such as cookies and cakes, sweet candies, sweetened drinks and ice cream (Ochola, 2014). These observed changes are described as "westernization of eating habits and are coupled with a reduction in physical activity and an increase in leisure activities (Zeba, 2014). Another study conducted after Lebanese children showed a positive association between sugar consumption and obesity (Lubna, 2018). The results obtained in this study could be explained by the changes in the behaviour of the students surveyed. Dairy consumption was also inversely associated with obesity in our study. Indeed, some authors have shown that children who consume dairy products were 38% less likely to be overweight/obese (OR = 0.62) (Lu, 2016). Other authors have shown that the consumption of high-fat dairy products is not associated with adiposity or poor metabolic health, and sometimes even reverses the trend (Kratz, 2013). Fruit consumption was significantly associated with obesity in our study. The low proportion of fruit consumption may explain this result because insufficient consumption of fruits and vegetables, sources of micronutrients (vitamins) and phytoaliments (antioxidants) in obese children often results from increased consumption of foods rich in energy, fat, sugars and micronutrients that are less expensive and more accessible than healthy foods such as fruits and vegetables (OMS, 2015).

However, this insufficient intake increases the risk of cardiovascular disease in these subjects. A recent study focused on the main natural antioxidants found in three categories of herbal foods (fruit, vegetables and legumes) and the mechanism of these products can be used to promote cardiovascular health. These different categories of foods have different bioactive compounds, whose antioxidant capacities, specific foods, when consumed together, can produce synergistic antioxidant interactions and in turn have greater physiological effects and benefits for cardiovascular health than when consumed alone (Wang, 2011). In this study, there was a significant relationship between snacking and obesity. Snacking is a factor in the development of obesity (Othman,

2018). These authors noted that snacking provides a relatively high portion of energy from fatty and/or sweet foods that are low in nutrients (vitamins and minerals). Some studies show that eating habits that include snacking can help meet nutritional needs in some cases. For example, a beneficial aspect of fruit consumption. Other studies, however, report that snacking contributes to reducing the nutrient density of the food ration (Lubna, 2018). In this study, video games were significantly associated with obesity. This association has been found in most of the studies carried out on this subject. In a study of children, it was shown that those who often eat in front of the television eat more than others in terms of energy, fat and sweet foods and consume less fruit and vegetables (Flenon, 2018). The adoption of sedentary leisure activities, television, computer games and computers is a factor that contributes to reducing energy expenditure and therefore weight gain. This association could result, on the one hand, from the energy imbalance due to sedentary lifestyles that promote weight gain. On the other hand, looking at the screen is likely to encourage people to consume more fatty and sweet foods (Flenon, 2018). The habits of extracurricular sports and walking to school were also identified as protective factors against obesity in this study. This result is consistent with a study that showed that children with regular physical activity tend to have a lower body fat composition (Sersar, 2019). The number of meals per day has also been identified as a protective factor against obesity. This result is in agreement with that of a study conducted in France which showed that skipping a meal disrupts hormonal and digestive secretions, leading to an increase in energy "storage" and therefore an increase in weight (Stea, 2015).

Conclusion

This study provided information on the prevalence of overweight and obesity among adolescents in private institutions in Brazzaville using the IOTF BMI criteria. This frequency was 15.3% (95% CI: 13.4-17.8) for overweight and 5.1% (95% CI: 4.1-6.9) for obesity. Factors associated with obesity/overweight were also determined in this study population. Four factors have been found to be associated with obesity/overweight. These are: snacking, fast food, video games and skipping meals. Obesity is a public health problem that is often not considered a priority. It is important to take measures in terms of prevention and control to improve care. In addition, these results can be used to conduct more in-depth studies on obesity.

Data availability: To clarify the conclusion of this study, the data are available from the corresponding author.

Conflicts of interest: The authors state that there is no conflict of interest regarding this article.

Ethical consideration: This project has been approved by the Ethics Council of the Higher Institute of Physical and Sports Education (Marien Ngouabi University). Information about the study was provided in writing to each parent of the participant prior to data collection. All participants gave their informed consent.

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