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Prevalence and Factors Associated with Obesity and Overweight Among Primary Schoolchildren in Three Municipalities of Conakry, Guinea: A Cross-Sectional Study

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Abstract: *Background:* Childhood obesity is a growing phenomenon in the world. Few studies have been conducted to investigate its risk factors in Guinea. The objective of this study was to estimate the prevalence of overweight and obesity, and to identify their associated factors among primary schoolchildren of Conakry city, Guinea. *Methods:* It was a cross-sectional study conducted in March 2016 among the 5th grade primary schoolchildren from three municipalities (communes) of Conakry (capital city), Guinea. Children were selected by using the multi-stage random sampling. Multivariate logistic regression was used to identify associated factors with obesity and overweight. *Results:* The prevalence of obesity was 2.5% (95% CI: 1.9-3.1) and of overweightness was 9.0% (95% CI: 7.9-10.3). Female gender (AOR = 1.78, p = 0.04), non-consumption of fruits (AOR = 2.38, p = 0.005) and traveling to school in car or bus (AOR = 2.26, p = 0,005) were risk the factors of obesity. Multivariate analysis also showed that students of Matoto primary schools (AOR = 1.68, p = 0.003), girls (AOR = 1.36, p = 0.003), children who go to school by car or bus (AOR = 3.40, p = 0.001), those who make between 15-30 minutes go to school (AOR = 8.36, p = 0.03), and children with sedentary lifestyle (i.e. spending their free time watching TV) (AOR = 1.66, p = 0.04) were independently associated with being overweight. *Conclusions:* Obesity and overweightness are frequent in primary schools of Conakry. This study suggests the need to develop prevention programs and policies focused on the monitoring of individual and collective nutritional status and early detection of obesity or overweightness among pupils, to contribute to the prevention of the occurrence of future chronic diseases in the Guinean population (diabetes, arterial hypertension, cerebrovascular accidents, etc.), which are in full expansion alongside epidemic communicable diseases.

Keywords: Prevalence, Associated Factors, Obesity, Overweight, Primary School, Guinea

1. Introduction

The association of obesity and overweight represents a serious public health problem. Globally, the trend of obesity prevalence and its impact has been increasing in society, especially in recent times [1] with an increasing prevalence in the world, not only in developed countries, but also in resources-limited countries [2].

The World Health Organization (WHO) has identified an increase in childhood obesity in developed countries and a high prevalence of childhood obesity has been reported in resources-limited regions such as in Latin America [3]. The prevalence of obesity among children in primary school has increased from 6.5% in 1980 to 19.6%, while among children in secondary school it's increased from 5.0% to 18.1% in 2008 [4]. The estimated prevalence of childhood obesity in Africa in 2010 was 8.5% and is expected to reach 12.7% in 2020, with North Africa as the region with highest prevalence of childhood obesity in Africa [5]. According to the latest WHO estimates, the worldwide prevalence of obesity nearly tripled between 1975 to 2016. In addition, the prevalence of overweight and obesity among children and adolescents aged 5-19 has risen dramatically from just 4% in 1975 to just over 18% in 2016 [6]. The rising prevalence of childhood obesity in developing countries is attributed to the growing urbanization, transition towards high caloric western diet of refined and fast foods, and sedentary lifestyle [5]. Additionally, globalization, improving economic conditions and changing dietary habits in developing countries are responsible risk factor for the rapid increase of obesity [1]. The literature also indicates that some risk factors for childhood overweight and obesity include those concerning the family and the sedentary lifestyle of the child, the socio-economic status of the family, number of siblings, rates of physical activity, and high levels of television viewing are associated with childhood overweightness and obesity [7, 8]. Overweightness and obesity can affect physical and psychosocial health [9].

Obesity and overweightness were considered an important risk factor in occurrence non-communicable diseases such as: cardiovascular diseases, which were the leading cause of death in 2012; diabetes; musculoskeletal disorders; and some cancers [6]. Children who are obese at preschool age are more likely to be obese in adolescence and adult age and develop diabetes, hypertension, hyperlipidemia, asthma, and sleep apnea [10]. Nevertheless, some researchers have investigated obesity or overweightness of school age children in certain countries of West-Africa. These studies have focused on different age groups ranging from 5 to 17 years and used different ways of measuring obesity or overweight. Thus, the prevalence of obesity and overweight ranged between 0.8% to 10.3% and 1.5 to 17.0%, respectively [10–18].

In Guinea, according to our knowledge, prevalence, risk factors and consequences of overweight or obesity are poorly documented. All of the few studies conducted have been focused only on children under five. One of these studies was highly disseminated through the Multiple Indicator Cluster Survey 2016 (MICS 2016). This study reported 4% of obesity or overweight among children of five of which 3.7% in Conakry [19]. However, prevalence and determinants of obesity or overweight of school aged children remain poorly documented. The aim of this study was to estimate the prevalence and analyze the risks factors both obesity and overweight in primary school children aged 8 to 19 into three communes of Conakry, Guinea.

2. Methods

2.1. Study Setting, Design, Population, Sample, and Anthropometrics Measures

It was a cross-sectional study concerned children in private and public primaries schools in three municipalities of Conakry city, namely, Dixinn, Matam and Matoto. A sample of 2,408 schoolchildren aged 8 to 19 was interviewed during the course by survey agents trained for the study. The technique of sampling, collecting, the schoolchildren inclusion flowchart and anthropometric measurement have been described elsewhere [20].

2.2. Data Collection

Data were collected by using a standardized questionnaire including: sociodemographic characteristics of both the children and their parents (i.e., age, sex, weight, height, education level, marital status, type of school attended, and food habits), food habits including the food consumed (i.e., fruits, vegetables, meat, fish, liver, sweets and sweetened beverages) by the children during the last 7 days preceding the survey, as well as the foods regularly eaten by the parents and children's friends. Data on physical activities (i.e., mode of transport to and from school, time to go to school, time spent in front of the television after school, sport practices, time spent watching television on weekends) were also collected.

2.3. Measurement of Obesity and Overweight

One anthropometric index: the z-score of the body mass index calculated according to the references of growth of the WHO 2007 for 5-19 years.

2.4. Statistical Analysis

Descriptive statistics were used to analyze quantitative (Means, SDs) and categorical (percentages) variables. Prevalence of obesity and overweight children was examined by using frequency and percentage distributions with their confidence interval (95% IC). Bivariate analysis has been used to identify significant differences between obesity and non-obesity, or overweight and non-overweight cases. The results of quantitative variables were compared by the Student T test. The chi-square test or Fisher's exact test has

been used to compare categorical variables results. Multivariate logistic regression model has been used to identify factors associated with obesity or overweight. All potential risk factors significant at the 0.2 level in bivariate analysis was entered into the model. Multivariate analysis was performed with models that were judged a priori to be sound. This was prospectively determined to be necessary to avoid producing spuriously significant results with multiple comparisons. The goodness-of-fit was assessed by the Hosmer-Lemeshow test. For all tests performed, 2-tailed P values< 0.05 were regarded as denoting statistical significance. Children who had a z-score of body mass index (BMI)> +1 and < or = +2 specifically for sex were considered to be overweight and those with a z-score of body mass index > +2 specifically at age and sex were considered obese [21]. Z scores BMI-for-age was generated using SPSS macro developed by WHO for the analysis of anthropometric data for children aged 5-19 years [21]. The data was coded to Epi Data software version 3.1 and analyzed by using statistical software for the social sciences (version 21.0 for Windows, SPSS, Inc.).

2.5. Ethics Approval and Consent to Participate

Ethical approval for the study was obtained from the Ethics and Research committee of the Public Health Department, Faculty of Health Sciences and Techniques, Gamal Abdel Nasser University of Conakry (N° 0211/SR/CVDR/2016). Permission was obtained from the municipalities directorates of education (Ministry of Education) in the three communes and the directors of the schools selected for the study. To obtain informed consent for participation from the students and their parents, we gave each of the pre-selected children a sealed envelope containing two documents. The first document was the parental consent form for their own participation in the study, but also for the participation of their children. The second document was the questionnaire to collect data on the characteristics of the pupils' parents and the characteristics of their households. Informed consent was obtained from the parents of all children included in this study through the signing of a consent form for participation. Also, all parents included in this study had signed an informed consent form for participation. The guidelines on research involving the use of human subjects were strictly adhered to according to the Helsinki Declaration.

3. Results

3.1. Socio-demographic Characteristics of Primary School Children and Their Parents and Food Habits

School children had an average age of 12 years and 53.4% were the girls. The study sample consisted of 35.3%, 32.0% and 32.6% of schoolchildren from Dixinn, Matam and Matoto respectively. About 42% of fathers of children engaged in informal activities (41.6%), 31% were public or private officers. 56% of fathers had attended a school. As for the mothers of schoolchildren, they were mostly traders (32.5%) and housewives (30.9%). Nearly 52% of them had been to school. Regarding schoolchildren's eating habits, the majority of them had at least two meals a day. Fish (98.9%), beverages (98.1%), sweets (97.3%), fruits (87%), meat (80.7%) and vegetables (69.4%) were consumed by schoolchildren in the last seven days prior to the survey.

3.2. Physical Activities of Schoolchildren

Physical activities of schoolchildren were documented during the investigation. The results showed that 80.4% of children walked to school, 17.7% by car or bus. Most children traveled 15-30 minutes (86.8%) and 30-45 minutes (10.0%) for school. Nearly 54.0% of children watched TV about 1 to 4 hours a day during the week and 56.6% over 5 to 8 hours on weekends. The children practiced the sport on average 2.93 ± 2.11 days. Most of the school children (92.0%) claimed to practice sport and 8% schoolchildren did not practice sports.

3.3. Obesity

Table 1 and Table 2 show the characteristics of obese and non-obese children, as well as their parents their eating habits. The proportion of obesity of primary schoolchildren was 2.5% (95% CI: 1.9-3.1). The prevalence of obesity was very different among the municipalities (p = 0.006): Matoto (4.1%), Dixinn (1.8%) and Matam (1.8%). It was higher in girls than in boys (3.1% vs 1.8%, p = 0.03). In addition, the proportion of obesity was different among schoolchildren who traveled to school by car or bus (4.5%), other transportation (2.9%) and foot (2.0%), p = 0.009. Moreover, it was very different between the times children travel to school (p = 0.003): 45-60 min (8.0%), 30-45 min (4.2%) and 15-30 min (2.1%). The prevalence of obesity was very different between 45-60 minutes (8.0%), 30-45 minutes (4.2%) and 15-30 minutes (2.1%) to get to school, p = 0.003. It was low among school children who regularly consume fruits (73.3% vs. 87.3%, p = 0.001) and fish (95.0% vs. 99.1%, p = 0.01). However, marginal difference (36.45±7.45 vs 34.43±8.39, p = 0.05) was found in average age of mother among obese and non-obese children.

3.4. Overweight

Table 3 and Table 4 show the characteristics of overweight and non-overweight children, as well as those of their parents eating habits and physical activities. The prevalence of overweight children was 9.0% (95% CI: 7.9-10.3). The prevalence of overweightness was very different among the communes (p <0.001): Matam (13.0%), Matoto (8.2%) and Dixinn (6.3%). The prevalence of overweightness was higher among boys than girls (10.2% vs. 7.7%, p = 0.03). Furthermore, the frequency of overweightness was very different among means of transportation/travel to school (p = 0.003): others mode of transportation (23.9%), Car or bus (10.2%) and walking (8.4%). It was also different among pocket money (p = 0.03): no money (12.4%), sometimes (7.9%), and always (10.2%). The frequency of

overweightness is different among time spent watching television on weekend (p = 0.02): 1-4 hours (7.7%), 5 to 8 hours (9.1%), do not watch TV (14.1%). It was very different between time to go to school (p = 0.01): 15-30 min (9.5%), 30-45 min (7.1%) and 45-60 min (1.3%).

3.5. Factors Associated with Obesity and Overweight

The results of the multivariate analysis showed that children who go to school by car or bus (AOR = 2.26, 95% CI: 1.27-4.01) and girls (AOR = 1.76, 95% CI: 1.01-3.12) were almost twice as likely to be obese as those who went to school with other modes of transportation and those who were boys (Table 5). The results also showed that, children who don't consume fruit (AOR = 2.38, 95% CI: 1.30-4.33) were twice as likely to be obese. Those who consume fish were 86.0% less likely to be obese (AOR = 0.14, 95% CI: 0.04-0.53).

We also found that children from Matoto primary school were almost two times more likely to be overweight as compared to those from Dixinn and Matam primary schools (AOR = 1.68, 95% CI: 1.20-2.36). Children who got to school through other modes of transportation (i.e., motorcycle, bicycle) were almost four times more likely to be overweight as compared to those got to school in walking and car or bus (AOR = 3.40, 95% CI: 1.67-6.94). Children who got to school between 15-30 minutes were almost eight times more likely to be overweight as compared to those got to school between 30-45 minutes and 45-60 minutes (AOR = 8.36, 95% CI: 1.14-60.94). In addition, female gender (AOR = 1.36, 95% CI: 1.02-1.82) and children who spent their time by watching television five to more than eight hours on weekends (AOR = 1.66, 95% CI: 1.02-2.70) were also associated factors for being overweight.

Table 1. Prevalence of Obesity among schoolchildren characteristics in three municipalities of Conakry city, Guinea, 2016.

Schoolchildren characteristics	Obesity n = 60	Non-Obesity n = 2338	p-value
age ± SD	12.33± 1.90	12.49 ± 1.78	0.50
Gender			0.03
Boys	20 (1.8)	1098 (98.2)	
Girls	40 (3.1)	1240 (96.9)	
Pocket money			0.37
No money	3 (4.3)	67 (95.7)	
Sometimes	29 (2.8)	666 (97.2)	
Always	28 (2.1)	1280 (97.9)	
Type of school			0.95
Publics school	25 (2.5)	965 (97.5)	
Privates school	35 (2.5)	1373 (97.5)	
Eating habits			
Fruits	44 (2.1)	2042 (97.9)	0.001
Vegetables	43 (2.6)	1628 (97.4)	0.73
Candies	50 (2.5)	1973 (97.5)	0.82
Beverages	55 (2.5)	2153 (97.5)	0.80
Fish	57 (2.4)	2318 (97.6)	0.01
Meat	51 (2.6)	1882 (97.4)	0.38
Number of meals by day	2.48 ± 0.62	2.49 ± 0.68	0.92
Physical Activities			
Mode of transport to and from school			0.009
Walking	39 (2.0)	1890 (98.0)	
Car/bus	19 (4.5)	404 (95.5)	
Others transportations*	2 (4.3)	44 (95.7)	
Time to go to school			0.003
15-30 min	44 (2.1)	2041 (97.9)	
30-45 min	10 (4.2)	228 (95.8)	
45-60 min	6 (8.0)	69 (92.0)	
Time spent in front of the television after school (in hours)			0.07
1-4	31 (2.4)	1263 (97.6)	
5-8+	16 (4.1)	376 (95.9)	
do not watch TV	13 (1.8)	699 (98.2)	
Time spent watching television on weekends (in hours)			0.18
1-4	15 (1.8)	821 (98.2)	
5-8+	41 (3.0)	1315 (97.0)	
do not watch TV	4 (1.9)	202 (98.1)	
Sport Practices			0.14
Yes	8 (4.1)	185 (95.9)	
No	52 (2.4)	2153 (97.6)	
Municipalities			0.006
Dixinn	15 (1.8)	836 (98.2)	
Matam	31 (4.1)	732 (95.9)	
Matoto	14 (1.8)	770 (98.2)	

* Others transportations: motorbike, bicycle.

Table 2. *Characteristics parents of Obesity and non-Obesity schoolchildren in three municipalities of Conakry city, Guinea, 2016.*

Parents characteristics	Obesity n = 60	Non- Obesity n = 2338	p-value
Average age of mother	36.45±7.45	34.43±8.39	0.05
Father profession			0.74
Trader	10 (2.9)	337 (97.1)	
Civil servant	17 (2.3)	722 (97.7)	
Informal sector**	28 (2.8)	968 (97.2)	
Unemployed	0 (0.0)	56 (100.0)	
Others professions	0 (0.0)	9 (100.0)	
Mother profession			0.95
Trader	17 (2.2)	755 (97.8)	
Civil servant	5 (2.0)	241 (98.0)	
Housewife	19 (2.6)	718 (97.4)	
Informal sector***	9 (2.5)	358 (97.5)	
Unemployed	4 (2.5)	157 (97.5)	
Student	2 (3.6)	54 (96.4)	
Father education			0.40
Illiterate	5 (4.1)	117 (95.9)	
Arabic school	12 (2.2)	538 (97.8)	
Primary/ Secondary/ Grammar/ University	43 (2.5)	1644 (97.5)	
Mother education			0.98
Illiterate	14 (2.4)	578 (97.6)	
Arabic school	12 (2.4)	482 (97.6)	
Primary/ Secondary/ Grammar/ University	32 (2.5)	1259 (97.5)	
Matrimonial situation of father			0.10
Not Married	4 (3.9)	98 (96.1)	
Married	25 (1.7)	1471 (98.3)	
Matrimonial situation of mother			0.33
Not Married	3 (1.5)	203 (98.5)	
Married	55 (2.5)	2105 (97.5)	

**Informal sector (Father): bricklayer, driver, plumber, couturier etc.…
***Informal sector (Mother): seamstress, hairdresser.

Table 3. *Prevalence of overweight among schoolchildren characteristics in three communes of Conakry, Guinea, 2016.*

Schoolchildren characteristics	Overweight n = 217	Non-Overweight n = 2181	p-value
Average age of schoolchildren	12.50±1.751	12.48±1.790	0.91
Gender			0.03
Boys	86 (7.7)	1032 (92.3)	
Girls	131 (10.2)	1149 (89.8)	
Pocket money			0.03
No money	9 (12.9)	61 (87.1)	
Sometimes	75 (7.4)	945 (92.6)	
Always	133 (10.2)	1175 (89.8)	
Type of school			0.22
Publics school	98 (9.9)	892 (90.1)	
Privates school	119 (8.5)	1289 (91.5)	
Eating habits			
Fruits	195 (9.3)	1891 (90.7)	0.18
Vegetables	157 (9.4)	1514 (90.6)	0.37
Candies	187 (9.2)	1836 (90.8)	0.44
Beverages	196 (8.9)	2012 (91.1)	0.31
Fish	214 (9.0)	2161 (91.0)	0.45
Meat	179 (9.3)	1754 (90.7)	0.46
Number of meals by day	2.52±0.61	2.49±0.68	0.51
Physical Activities			
Mode of transport to and from school			0.003
Walking	163 (8.4)	1766 (91.6)	
Car/bus	43 (10.2)	380 (89.8)	
Others transportations*	11 (23.9)	35 (76.1)	
Time to go to school			0.01
15 min-30 min	199 (9.5)	1886 (90.5)	
30-45 min	17 (7.1)	221 (92.9)	
45-60 min	1 (1.3)	74 (98.7)	
Time spent in front of the television after school (in hours)			0.09
1-4	105 (8.1)	1189 (91.9)	
5-8+	46 (11.7)	346 (88.3)	

Schoolchildren characteristics	Overweight n = 217	Non-Overweight n = 2181	p-value
do not watch TV	66 (9.3)	646 (90.7)	
Time spent watching television on weekends (in hours)			0.02
1-4	64 (7.7)	772 (92.3)	
5-8+	124 (9.1)	1232 (90.9)	
do not watch TV	29 (14.1)	177 (85.9)	
Sport Practices			0.35
Yes	21 (10.9)	172 (89.1)	
No	196 (8.9)	2009 (91.1)	
Commune housing school			< 0.001
Dixinn	54 (6.3)	797 (93.7)	
Matam	99 (13.0)	664 (87.0)	
Matoto	64 (8.2)	720 (91.8)	

*others transportation: motorcycle, bicycle.

***Table 4.** Characteristics parents of overweight and non- overweight schoolchildren in three communes of Conakry, Guinea, 2016.*

Parent' characteristics	Overweight n = 217	Non-Overweight n = 2181	p-value
Average age of mother	36.48±8.26	36.39±7.72	0.87
Father profession			0.40
Trader	27 (7.8)	320 (92.2)	
Civil servant	82 (11.1)	657 (88.9)	
Informal sector	91 (9.1)	905 (90.9)	
unemployed	5 (8.9)	51 (91.1)	
Student	1 (11.1)	8 (88.9)	
Mother profession			0.88
Trader	64 (8.3)	708 (91.7)	
Civil servant	23 (9.3)	223 (90.7)	
Housewife	73 (9.9)	664 (90.1)	
Informal sector	31 (8.4)	336 (91.6)	
Student	6 (10.7)	50 (89.3)	
Unemployed	16 (9.9)	145 (90.1)	
Father education			0.35
Illiterate	10 (8.2)	112 (91.8)	
Arabic school	42 (7.6)	508 (92.4)	
Primary/ Secondary/ Grammar/ University	163 (9.7)	1524 (90.3)	
Mother education			0.32
Illiterate	50 (8.4)	542 (91.6)	
Arabic school	38 (7.7)	456 (92.3)	
Primary/ Secondary/ Grammar/ University	127 (9.8)	1164 (90.2)	
Matrimonial situation of father			0.08
Not Married	3 (2.9)	99 (97.1)	
Married	113 (7.6)	1383 (92.4)	
Matrimonial situation of mother			0.14
Not Married	13 (6.3)	193 (93.7)	
Married	202 (9.4)	1958 (90.6)	

***Table 5.** Multivariate analysis determinants of obesity and overweight among schoolchildren in three communes of Conakry, Guinea, 2016.*

	Factors	Adjusted OR	IC95%	p-value
	Gender			
	Boys	1		
	Girls	1.78	1.01-3.12	0.04
	Fruits			
	no	2.38	1.30-4.33	0.005
	yes	1		
	Fish			
	no	1		
	yes	0.14	0.04-0.53	0.003
Obesity	Mode of transport to and from school			
	Walking	1		
	Car/ Bus	2.26	1.27-4.01	0.005
	Others transportations*	2.17	0.49-9.55	0.30
	Sport practice			
	no	1		
	yes	1.41	0.64-3.11	0.39
	Time spent in front of the TV every day (in hours)			
	1-4	1		

Factors	Adjusted OR	IC95%	p-value
5-8+	1.18	0.60-2.32	0.61
do not watch TV	0.64	0.33-1.25	0.63
Municipalities			
Dixinn	1		
Matam	1.09	0.51-2.31	0.81
Matoto	1.95	1.00-3.77	0.04
Gender			
Boys	1		
Girls	1.36	1.02-1.82	0.03
Fruits			
no	1		
yes	1.42	0.89-2.26	0.13
Mode of transport to and from school			
Walking	1		
Car/ Bus	1.21	0.84-1.73	0.30
Others transportations*	3.40	1.67-6.94	0.001
Time to go to school			
15-30 min	8.36	1.14-60.94	0.03
30-45 min	5.93	0.77-45.65	0.08
45-60 min	1		
Time spent watching television on weekends (in hours)			
1-4	1.07	0.77-1.48	0.66
5-8+	1.66	1.02-2.70	0.04
do not watch TV	1		
Municipalities			
Dixinn	1		
Matam	0.80	0.54-1.18	0.27
Matoto	1.68	1.20-2.36	0.003
Age of mother	1.00	0.98-1.02	0.68

(The "Overweight" label spans the rows in the first column.)

4. Discussion

The main aim of this cross-sectional study was to analyze the prevalence and determinants of obesity and overweight among school-aged children of Conakry. Data of children from 36 public and private schools were analyzed. The results showed that the prevalence of obesity was 2.5% and overweightness was 9.0%. These frequencies observed in our study show the real presence of these nutritional imbalances in the primary schools of Conakry. This could be explained by changes in children's eating habits through the consumption of fatty and sugary foods, but also the lack of physical activity. Some studies in West Africa [11, 16, 22] and elsewhere [1, 4, 5, 15, 23–25] have reported various frequencies regarding obesity and overweight. In Europe, a study in seven countries among primary school children revealed proportions of 15.6% overweightness and 4.9% obesity [7]. These differences in prevalence could be explained by changes in dietary habits including the consumption of foods rich in fat and carbohydrates, but also the cultural differences between these populations. These figures show the extent and dynamics of obesity and overweight in primary schools around the world in recent years. Otherwise, the difference in prevalence could be explained by the difference in population, sampling, the definition of obesity and the overweightness indicators, the tools, and the techniques used to measure weight and height.

We found statistically significant differences by common school attendance. The commune of Matam recorded the highest frequencies of obesity and overweightness. While the communes of Matoto and Dixinn have recorded common frequencies for obesity and different prevalence of being overweight. This study found that girls were more obese and overweight than boys. These results could be explained by the consumption of sugars, sweets, cakes but also sedentary lifestyle and physical inactivity of young girls. In addition, the fact that girls have a higher prevalence of obesity could be explained by the role of puberty in the development of body fat and its impact on the over estimation of body weight in girls at this time [26]. Studies in Africa [4, 5, 10, 11, 15, 18, 23, 27–29] and elsewhere [30–32] have shown similar results. However, other authors have reported that young boys were more obese [1, 33–39] and overweight [33, 34] than girls.

This current study reveals obesity was more frequently among children who got to school by car or by bus than children who took other means of transportation (i.e., motorcycle, bicycle) or walking. This result could hide the standard of living of some of the pupils' parents. Furthermore, the prevalence of obesity was higher among pupils who needed 45-60 minutes to get to school than among those who needed 30-45 minutes and 15-30 minutes to get to school. This result implies the distance travelled or the traffic difficulties faced by schoolchildren during their journey to school. Nevertheless, the prevalence of overweight was higher among pupils who needed 15-30 minutes to get to school than among those who took 30-45 minutes and 45-60 minutes. In addition, obesity was low among schoolchildren who have environment rich in fruits and fish. The prevalence of overweight was higher among children who did not watch TV on weekends than children

who spend 1-4 hours and 5 to 8 hours of their time watching TV on weekends. The frequency of overweight children who didn't watch TV on weekends may imply that they spend most of the weekend sleeping or doing sedentary activities (video games, social networks, and computers). Authors in Ethiopia revealed that preschool children who watched television more than 2 hours a day had 4 times more likely chance of being overweight/obese [33]. One study showed that children skipping breakfast, eating fast food and snacks more than or equal to once a week, and being involved in sedentary lifestyle more than one hour a day were significantly more likely to be overweight and obese while those participating in physical activity more than twice a week were significantly less likely to be overweight and obese [40].

In the present study, the results of the multivariate analyses showed that school children who got to school by car or by bus, and female gender were risk factors associated with obesity. Our findings showed that consumption fruits and fish were protective factors of obesity. As for overweightness, children who got to school in others mode of transportation (i.e., motorcycle, bicycle), who study in the primary schools at Matoto commune, and who get to school between 15-30 minutes were independently at risk of being overweight. The study also reveals association between children who spent their time by watching television five to more than eight hours on weekends, and overweightness. This could be explained by the lack of light in the neighbourhoods of Conakry. Previous studies have reported that public school learning, high parental socio-economic class, preference for sugary foods, physical inactivity or not exercising, sedentary lifestyle such as spending free time watching TV and playing computer games, sleeping in the afternoon and not having close friends were significantly associated with overweight and obesity in children [1].

This study has limitations. The cross-sectional and retrospective nature of our study implies a memory bias that can relate both to information about eating habits and physical activities (i.e., mode of transport to and from school, time to go to school, time spent watching television on weekends or each day) reported by children and their parents. This memory bias, a source of informational bias, can lead to an underestimation or overestimation of the strength of the relationship between obesity/overweightness, and the dietary habits and physical activities of children. Data on the eating habits, physical activities (i.e., transportation of travel for the school, time to go to school, time spent watching television on weekends or each day) of school children would been useful if they were collected prospectively.

However, to our knowledge, this study is one of the few studies to address the problem of obesity and overweight in primary schools in the of Conakry city, or even in Guinea. In addition, our study could be one of the first to include so many school children (i.e., about two thousand four hundred school children). The findings show the need to set up a monitoring and nutritional education program in schools to prevent possible health consequences for these school children as denoted by WHO [6] in the medium and long term (adulthood). Furthermore, the establishment of regular physical education and sports activities in primary schools could be a solution to these phenomena.

5. Conclusion and Recommendations

In this study the prevalence of obesity was 2.5% and overweightness was 9.0% among school children of three communes of Conakry. Getting to school in car or bus, female gender, and non-consumption of fruit were positively associated with obesity, while consumption fish were preventive factors for being obese. In addition, getting to school in other modes of transportation (i.e., motorcycle), studying in the primary schools at Matoto commune, female gender, getting to school between 15-30 minutes, and having a sedentary lifestyle were associated with being overweight. Therefore, in the absence of national data, these results reflect the importance of this phenomenon in our context. Hence, we the need to develop prevention programs and policies focused on the monitoring of individual and collective nutritional status and early detection of obesity or overweight before the problem spreads nationally.

Authors' Summary

Why Was This Study Done:
1) Obesity and overweight are a public health problem in both developed and resource-poor countries.
2) The World Health Organisation (WHO) reports that obesity among children is increasing in all countries. Its prevalence among primary schoolchildren increased from 6.5% in 1980 to 19.6%, while among secondary school children it increased from 5.0% to 18.1% in 2008.
3) In Guinea, according to our knowledge, prevalence, risk factors and consequences of overweight or obesity are poorly documented. Of the few studies conducted, focus has been only on children under five.
4) The aim of this study was to estimate the prevalence and analyse the risks factors for both obesity and overweight in primary school children aged 8 to 19 into three communes of Conakry, Guinea.

What Did the Researchers Do and Find:
1) We conducted a cross-sectional study of 2,408 pupils aged 8 to 19 in primary schools in three communes of the city of Conakry. These pupils were interviewed during class by interviewers trained for the study.
2) The proportion of obesity of primary schoolchildren was 2.5% (95% CI: 1.9-3.1). The prevalence of overweight children was 9.0% (95% CI: 7.9-10.3).
3) By using the multivariate logistic regression model, we found that going to school by car or bus and being a girl were the associated factors with obesity. The results also showed that, minus fruit consumption, municipalities (communes), spent more time by watching television were the associated factors with the

overweight among the primary schoolboys of Conakry, Guinea.

What Do These Findings Mean:

1) The prevalence's of obesity and overweight found among the children in this study are high. Eating habits, physical inactivity, female gender and geographical location (municipalities) were the main factors associated with obesity and overweight among the pupils in this study.

2) These results support the hypotheses that there is an epidemiological transmission in resource-limited countries. That is, chronic diseases (obesity, overweight, diabetes, etc.) once considered as diseases of developed countries are on the rise in poor countries.

3) This burden of chronic diseases, plus that of epidemic communicable diseases, which are commonplace in Guinea, could have a lasting effect on the Guinean population in the years to come. The recent high urbanisation of large African cities, such as Conakry (linked to rural-urban migration), the low inclusion of physical education in the school curriculum and the low-quality control of staple foods in Guinea could explain the results found in this study.

4) Hence, we the need to develop prevention programs and policies focused on the monitoring of individual and collective nutritional status and early detection of obesity or overweight before the problem spreads nationally.

List of Abbreviations

CEA-PCMT, African Center of Excellence for Prevention and Control of Communicable Diseases; NGO, Non-Governmental Organization; AIDS, Acquired Immunodeficiency Syndrome; CI, Confidence Interval; WHO, Word Health Organization; MICS, Multiple Indicator Cluster Survey; SD, Standard Deviation.

Declarations

Ethics Approval and Consent to Participate

Ethical approval for the study was obtained from the Ethics and Research committee of the Public Health Department, Faculty of Health Sciences and Techniques, Gamal Abdel Nasser University of Conakry (N° 0211/SR/CVDR/2016). Permission was obtained from the municipalities directorates of education (Ministry of Education) in the three communes and the directors of the schools selected for the study. To obtain informed consent for participation from the students and their parents, we gave each of the pre-selected children a sealed envelope containing two documents. The first document was the parental consent form for their own participation in the study, but also for the participation of their children. The second document was the questionnaire to collect data on the characteristics of the pupils' parents and the characteristics of

their households. Informed consent was obtained from the parents of all children included in this study through the signing of a consent form for participation. Also, all parents included in this study had signed an informed consent form for participation. The guidelines on research involving the use of human subjects were strictly adhered to according to the Helsinki Declaration.

Availability of Data and Materials

Authorisation to conduct the study and to disseminate its results was obtained from the directors of the school of the three municipalities included in the study. However, the data used in the study are not publicly available. Anyone interested in obtaining the data for scientific purposes can make a request to the authors.

Competing Interests

The authors stated that there is no competing interest.

Authors' Contributions

Kadio Jean-Jacques Olivier Kadio: Study design, supervision of students in charge of data collection, data cleaning and validation, data analysis and manuscript drafting; Niouma Nestor Leno: Study design, data cleaning and validation, data analysis and manuscript drafting; Cisse Diao and Adrien Fapeingou Tounkara: Supervision of students in charge of data collection and data analysis; Foromo Guilavogui: Manuscript reviewing; Guede Kogbo Zohonon Elsa Stephanie, Yao Emmanuel Kotchi and Koffi Jean-Charles Koidjane: Data collection; Sidikiba Sidibe, Alexandre Delamou and Alioune Camara: Study design, manuscript reviewin; Abdoulaye Toure: Study design, supervision data analysis and manuscript reviewing.

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