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Original Article

Physical Fitness and Its Associated Factors Among Children and Teenagers in Urban and Semi-Urban Settings in Two Localities of the Littoral Province, Cameroon

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Abstract

Background: Physical fitness in Cameroonian students has been assessed previously, but most have focused on urban areas. This study aimed to objectively evaluate two components of physical fitness and factors associated with it among urban and semi-urban secondary school students in two municipalities in the Littoral province, Cameroon.
Methods: A cross-sectional study was conducted between January and April 2021 in three randomly selected secondary schools in the Littoral Province. The study included 459 students aged 10 to 15 years, comprising 252 students from urban areas (UA) and 207 from semi-urban areas (SUA). Each student's height, weight, and blood pressure were assessed, and two field tests (20-m shuttle test and 4x10-m test) were performed to estimate maximal oxygen uptake (VO2max) and measure agility. Descriptive and inferential statistics were used for data analysis.
Results: The overall prevalence of overweight/obesity was 21.4%, with a higher prevalence of overweight/obesity among boys in semi-urban areas and an equal prevalence of overweight among urban and semi-urban girls. SUA students performed significantly better in the speed test (4x10-m) and VO2max ($P<0.001$ and $P=0.01$, respectively) compared to UA students. A comparison of age groups [(10-12 yrs) and (13-15 yrs)] showed no significant difference in VO2max values between urban and semi-urban dwellers ($P=0.06$ and $P=0.29$, respectively). VO2max values were above the threshold values associated with the risk of developing cardiovascular diseases.
Conclusions: Urban students were less physically active than semi-urban students, but the prevalence of overweight/obesity was similar in both settings.

Keywords: Physical fitness, Schoolchildren, Urban, Rural, Cameroon

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1. Introduction

Physical fitness can be considered an integrated measure of the body's various functions, such as skeletomuscular, cardiorespiratory, hematocirculatory, psychoneurological, and endocrine-metabolic, which are essential for daily physical activities and exercise (1). Better physical fitness is associated with a decreased risk of cardiometabolic conditions, improved bone health, cognitive function, body composition, and psychosocial factors (2-4). However, physical fitness in school-aged children and teenagers declines over time and is often associated with high blood pressure, coronary disease, and stroke (5).

In Cameroon, studies have found a link between sedentary lifestyles, high levels of overweight/obesity, and hypertension in children and teenagers, who increasingly engage in recreational activities such as video games, television, laptops, and smartphones at the expense of physical activities (6, 7). Moreover, recreational facilities such as football stadiums or sports complexes are often occupied by the government, leaving children and teenagers with only school-time physical education sessions, which are considered insufficient by some researchers (8). With the proliferation of schools in Cameroonian cities, children no longer cover long distances to get to school, and this situation is also superimposed on rural areas (6).

In rural areas, the structure of certain areas in Cameroon is undergoing a major transformation towards modernization, with the availability of water points, construction of roads and schools, and electrification. These changes have led to a deep lifestyle modification in favor of a poor physical fitness. Additionally, there is a higher representation of wealthier populations in these areas in search of land, which is becoming scarce in urban areas, and some Cameroonian researchers have reported that a high socioeconomic status is associated with a higher prevalence of overweight/obesity and physical inactivity (6, 9, 10).

Differences in physical fitness among children and teenagers mostly depend on geographical location, level of development, and environmental factors (11-14). In Africa, comparative studies on physical fitness have generally shown that children and teenagers from urban areas are less physically active than their rural counterparts (13-15). However, the level of discrepancy observed may depend on the socio-cultural context, as shown by Gerber and colleagues (16) in a comparative study of physical fitness among rural and urban children from three African countries, namely Ivory Coast, Tanzania, and South Africa. The study found that the fitness levels of Tanzanian children were better compared to those of Ivorian and South African children, indicating that the socio-cultural context plays a role. It is also important to consider age-related factors when interpreting the observed differences in physical fitness among children and teenagers (16). Physical fitness generally decreases with age, especially for children above 12 years old, as shown in the aforementioned study (16), where children below 12 years old showed high physical fitness levels regardless of the setting. Gender-based differences are also critical in these comparisons, with girls often showing greater sedentarism than boys regardless of the setting (17).

Cameroon is one of the middle-income countries where nutritional transition and physical activity coexist. Therefore, it is imperative to collect data on the physical fitness of children and teenagers, as poor physiological values acquired earlier in life tend to stabilize in adulthood (18).

Most studies that have examined physical fitness among Cameroonian students have been conducted mainly in urban areas, particularly in major cities (19, 20). The relationship between socioeconomic status and physical fitness is closely correlated. Moreover, these studies have exclusively focused on primary school pupils, whereas the transition from primary to secondary education is often accompanied by a decrease in physical activity among students.

The general objective of this study was to objectively assess two components of physical fitness and factors associated with them among urban and semi-urban secondary school students in two municipalities in the Littoral Province, Cameroon.

2. Methods

2.1. Study Design and Implementation

We conducted a cross-sectional study for four months from November 28, 2020, to February 27, 2021, in selected secondary schools located in urban and semi-urban areas of the city of Douala, Cameroon. In the Wouri division, we chose the New Bell locality in the Douala II sub-division as the urban area and the PK-21 locality in the Douala V sub-division as the semi-urban area. In the Moungo division, we chose the Bekoko village in the Dibombari municipality as the semi-urban area.

2.2. Study Population

After obtaining ethical clearance from the Institutional Ethical Review Board for Human Health Research of the University of Douala (IERB-UDo: 2492 IERB-Udo/12/2020/M) and administrative authorizations from the school authorities, we recruited every eligible and consenting student. Data collection was carried out in accordance with the recommendations of the Helsinki Declaration (revised in 1989). The inclusion criteria were as follows: ability to participate in regular daily physical activity and physical education and written informed consent was obtained from parents or guardians. Students with any physical, physiological, or other health issues, as well as those who were absent on the data collection day or presented with tachycardia or bradycardia before the test onset or any abnormal and unusual clinical sign, were excluded from the study.

2.3. Sample Size Calculation

For this cross-sectional study, we selected two

secondary schools from the urban area (Douala) and one secondary school from the semi-urban area (Dibombari), Littoral Province, Cameroon. Two of the four classes from each grade were chosen randomly from the semi-urban secondary schools, while all classes were chosen from the two urban secondary schools. As the population of students aged 9 to 16 years was minimal, we excluded these students from the study. A total of 459 students (124 urban boys, 128 urban girls, 98 semi-urban boys, and 109 semi-urban girls) aged 10-15 years were included in the study, which was conducted from January to April 2021.

2.4. Phase of Vital Signs Measurement

Participants were seated and rested for approximately 10 to 15 minutes. We then measured vital signs at rest, including systolic blood pressure (SBP), diastolic blood pressure (DBP), and heart rate at rest (HRr), using a DBP-1359b Arm-Type Automatic Digital Blood Pressure Monitor. We also took anthropometric measurements, such as weight, height, waist circumference (WC), and hip circumference (HC), using a graduated wooden scale and a measuring tape. Other body composition data, including % fatty mass, % body water, % muscle mass, and bone mass, were obtained using a Terraillon bio-impedancemetry analyzer.

2.5. Testing Phase

After the first two phases, the students were directed to a well-furnished space prepared for the performance tests, particularly the 4×10-m speed test and 20-m shuttle run test. The students were randomly taken to the two experimental stations created for this purpose: one for the 4×10-m speed test and the other for the 20-m shuttle run test. After conducting one of the two field tests, the second test was performed after 48 hours of recovery. During the 20-m shuttle run test, which provides an estimate of maximal oxygen uptake (VO2max), students ran in groups of 3 or 4 and wore a Polar A370 heart rate monitor (Kempele, Finland) to record their heart rate throughout the exercise. This test was conducted on a 20-meter track limited by visual landmarks (plots). Immediately after the 20-m shuttle run test, post-exertion vital signs (SBP, DBP, and HRr) were measured, starting from the first minute after the end of the test. Five minutes later, these physiological and body composition data were measured again. VO2max was estimated using the formula of Léger and colleagues at the end of the cardiorespiratory endurance test (the 20-m shuttle run test) (21).

2.6. Statistical Analysis

Data were entered into Microsoft Office Excel 2016 spreadsheet software and analyzed using StatView 5.0 software for statistical analysis. Qualitative and quantitative variables were expressed as percentages (%) and means±standard deviation (SD), respectively. Pearson's chi-square test for independence was used to compare percentages, while student's t-test was used to compare means on unpaired series. The significance level was set at $P<0.05$ for all statistical tests.

3. Results

Five hundred and eighty students were registered, but only 459 were eventually included, comprising 252 in urban areas and 207 in semi-urban areas. Ninety-six participants were not included due to a lack of parental consent, and 25 participants were excluded for incomplete information.

3.1. Sample Characteristics

The study population principally consisted of 12-year-old students (24.8%), with a greater representation of students (54.9%) from urban areas. The majority of recruited students (54.9%) attended the New-Bell Evangelical College. The sociodemographic features of the participants are shown in Table 1.

3.2. Comparison of the Students' Anthropometric and Body Composition Data According to Area and Gender

The values for height, weight, and bone mass in girls and boys from urban areas were significantly higher ($P<0.05$) compared to those of boys and girls from semi-urban areas. The waist circumference (WC) and hip circumference (HC) of boys from urban areas were significantly greater ($P<0.05$) than those of boys from semi-urban areas. The prevalence of overweight and obesity in our study population was 19.2% and 2.2%, respectively, giving us an overweight/obesity ratio of 21.4%. This prevalence increased with age

Table 1: Socio-demographic features of participants

Variables	Count	Percentage (%)
Age (yrs)		
10	10	2.2
11	44	9.6
12	114	24.8
13	112	24.4
14	100	21.8
15	79	17.2
School		
New Bell Evangelical college	252	54.9
Government High School of PK 21	30	38.6
Government Bilingual High school of Bekoko	177	6.5
Area		
Semi-Urban	207	45.1
Urban	252	54.9

Table 2: Distribution of anthropometric and body composition data according to area and gender

Variables	Total (n=459)	Boys			Girls		
		Urban (n=124)	Semi-Urban (n=98)	P value	Urban (n=128)	Semi-Urban (n=109)	P value
Anthropometric data							
Height (m)	1.5 (0.1)	1.56 (0.10)	1.44 (0.10)	<0.001	1.55 (0.10)	1.48 (0.10)	<0.001
Weight (kg)	45.86 (9.7)	46.36 (9.8)	39.92 (7.8)	<0.001	51.23 (10.7)	45.55 (9.2)	<0.001
BMI (kg/m^2)	19.9 (3.4)	18.81 (2.4)	19.07 (2.7)	0.43	21.3 (3.8)	20.70 (3.7)	0.27
WC (cm)	68.2 (6.6)	67.47 (5.78)	65.32 (5.16)	0.004	70 (7.89)	69.39 (6.26)	0.50
HC (cm)	72.5 (7.1)	70.5 (5.81)	68.64 (4.95)	0.01	76.07 (7.97)	74.28 (6.58)	0.06
WC/HC ratio	0.94 (0.04)	0.96 (0.04)	0.95 (0.05)	0.28	0.92 (0.04)	0.94 (0.04)	0.008
WC/H ratio	0.45 (0.04)	0.43 (0.04)	0.45 (0.04)	<0.001	0.45 (0.05)	0.47 (0.05)	0.003
Body Composition data							
% Fatty Mass	14.5 (7.8)	7.93 (3.1)	8.36 (3.6)	0.33	21±5.8	19.93 (5.6)	0.17
% Body Water	60 (6.9)	66.31 (2.7)	65.86 (3.2)	0.26	53.90±4.1	54.72 (4.2)	0.12
% Muscle Mass	46.5 (8.2)	54.61 (2.5)	54.25 (2.7)	0.31	38.82±2.9	39.73 (3.4)	0.07
Bone Mass (kg)	2.5 (0.5)	2.58 (0.5)	2.24 (0.4)	<0.001	2.70±0.4	2.45 (0.4)	<0.001
Body Mass Index							
Normal	356 (77.6%)	112 (90.3%)	81 (82.7)	0.009	90 (70.3%)	73 (67%)	0.47
Overweight	88 (19.2%)	7 (5.7%)	15 (15.3%)		33 (30.3%)	33 (30.3%)	
Obese	10 (2.2%)	1 (0.8%)	2 (2%)		4 (3.2%)	3 (2.7%)	
Underweight	5 (1.1%)	4 (3.2%)	0 (0%)		1 (0.8%)	0 (0%)	

H: Height; WC: Waist Circumference; HC: Hip Circumference; BMI: Body Mass Index; n: Sample Size

in urban dwellers and had a bell-shaped pattern in semi-urban dwellers. The percentage of overweight and obese girls from urban areas (30.3% and 3.2%, respectively) and semi-urban areas (30.3% and 2.7%, respectively) was significantly higher than that of boys from the same areas (Table 2). A trend towards increasing overweight/obesity with age was observed in urban dwellers until they reach the age of 14. Among semi-urban dwellers, overweight/obesity followed a bell-shaped pattern with peaks at 12 and 15 years (Table 3 and Figure 1). There was no significant difference (P>0.05) between urban girls and semi-urban girls and between urban boys and semi-urban boys.

3.3. Characterization of the Physical Fitness Components

Overall, the VO2max values were significantly higher (P<0.01) in semi-urban participants (46.02±6.5 mL/kg/min) compared to those of urban participants (44.46±6.7 mL/kg/min), and performance in the 4x10-m speed test was significantly (P<0.001) better in semi-urban areas (12.44±1.4 sec) compared to that in urban areas (12.66±1.4 sec) (Table 4).

Table 3: Weight status according to area and age group among students

Age (yrs)	Underweight (n=5)		Normal weight (n=356)		Overweight/Obese (n=98)	
	Urban n=5 (%)	Semi-Urban n=0 (%)	Urban n=202 (%)	Semi-Urban n=154 (%)	Urban n=45 (%)	Semi-Urban n=53 (%)
10	0 (0%)	0 (0%)	1 (100%)	7 (77.8%)	0 (0%)	2 (22.2%)
11	0 (0%)	0 (0%)	11 (91.7%)	28 (84.8%)	1 (8.3%)	5 (15.2%)
12	3 (7.3%)	0 (0%)	33 (80.5%)	49 (68.1%)	5 (12.2%)	23 (31.9%)
13	2 (4.3%)	0 (0%)	35 (74.4%)	53 (81.5%)	10 (21.3%)	12 (18.5%)
14	0 (0%)	0 (0%)	64 (78.1%)	13 (72.2%)	18 (21.9%)	5 (27.8%)
15	0 (0%)	0 (0%)	58 (84.1%)	4 (40%)	11 (15.9%)	6 (60%)

n: Sample size; %: Percentage

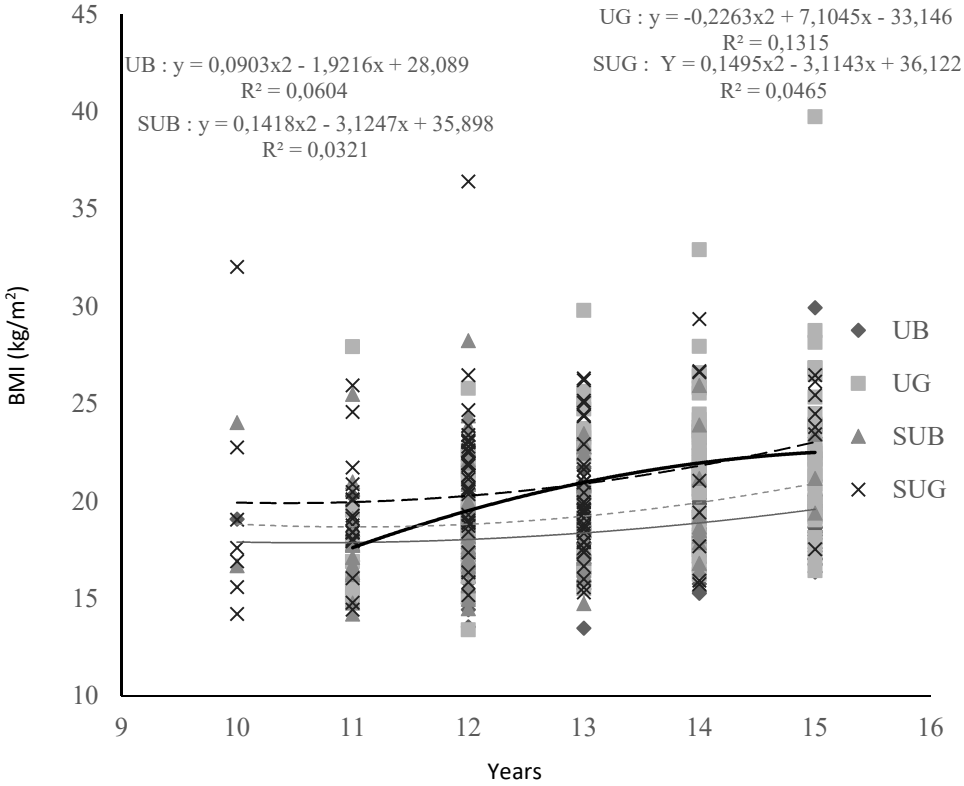

Figure 1: The figure shows the variation in body mass index (BMI) according to living area. BMI: Body Mass Index, UB: Urban Boys, UG: Urban Girls, SUB: Semi-Urban Boys, SUG: Semi-Urban Girls

Table 4: Overview of physical fitness indicators in the study population

Variables	Total (n=459)	Urban Area (n=252)	Semi-Urban Area (n=207)	P value
4x10-m (seconds)	12.66 (1.4)	12.89 (1.4)	12.44 (1.4)	<0.001
VO_{2max} (ml/kg/min)	45.16 (6.6)	44.46 (6.7)	46.02 (6.5)	0.01

VO_{2max}: Maximal Oxygen Uptake; n: Sample Size

The performance in the 4×10-m speed test and the 20-m shuttle run test (VO2max) was significantly better in girls (P<0.01 and P<0.001, respectively) and boys (P<0.001 and P<0.001, respectively) from semi-urban areas compared to those of girls and boys from urban areas (Table 5).

The performance of overweight/obese students at the various exertion tests (4×10-m speed test and 20-m shuttle run tests: VO2max) was significantly poorer (P<0.05) compared to that of their normal weight counterparts, regardless of the area (urban or semi-urban). Additionally, normal weight and overweight/obese students from SUA had significantly higher values of HR1, SBP1, DBP1, and VO2max (P<0.05) than those of normal weight and overweight/obese students from UA. Furthermore, physical performance in the 4x10-m speed test among normal weight and overweight/obese students from SUA was better (P<0.05) than that

Table 5: Gender-based physical fitness features

Variables	Girls			Boys		
	Urban (n=124)	Semi-Urban (n=98)	P value	Urban (n=128)	Semi-Urban (n=109)	P value
4×10-m (seconds)	13.54 (1.3)	13.16 (1.1)	<0.001	12.2 (1.2)	11.63 (1.2)	0.01
VO_{2max} (ml/kg/min)	38.9 (3.9)	40.75 (3.4)	<0.001	50.21 (3.4)	51.87 (3.3)	<0.001

VO_{2max}: Maximal Oxygen Uptake; n: Sample Size

Table 6: Physiological and physical fitness data according to weight status

Variables	Normal weight (n=356)			Overweight/obese (n=98)		
	Urban (n=202)	Semi-Urban (n=154)	P value	Urban (n=45)	Semi-Urban (n=53)	P value
Physiological data – Heart Rate						
HRr (bpm)	86 (11)	90 (9)	<0.001	89 (12)	90 (11)	0.50
HRa (bpm)	157 (20)	152 (12)	0.93	162 (20)	160 (11)	0.64
HRmax (bpm)	185 (18)	183 (17)	0.59	189 (22)	186 (14)	0.60
HR1 (bpm)	123 (16)	128 (14)	0.002	125 (14)	131 (14)	0.02
HRrecov1 (bpm)	109 (11)	111 (11)	0.18	111 (9)	111 (11)	0.99
HRres (bpm)	99 (20)	93 (19)	0.08	99 (20)	98 (16)	0.90
Physiological data – Blood Pressure						
SBP (mmHg)	106 (13)	107 (12)	0.37	115 (12)	116 (8)	0.40
DBP (mmHg)	65 (9)	65 (8)	0.71	72 (8)	68 (8)	0.001
SBP1 (mmHg)	129 (17)	133 (16)	0.01	138 (20)	146 (14)	0.02
DBP1 (mmHg)	70 (10)	76 (9)	<0.001	74 (11)	80 (9)	0.001
SBPrecov1 (mmHg)	105 (12)	107 (12)	0.28	117 (9)	116 (12)	0.58
DBPrecov1 (mmHg)	64 (8)	65 (9)	0.44	70 (8)	68 (7)	0.33
Physical Fitness data						
4×10-m (seconds)	12.7 (1.8)	12.4 (1.4)	0.03	13.7 (1.4)	12.5 (1.4)	<0.001
VO_{2max} (ml/kg/min)	45.94 (5.9)	47.34 (6.1)	0.03	37.11 (4.8)	42.25 (6.3)	<0.001

HRa: Average heart rate, HRres (HRmax-HRr : reserve heart rate); HR1: Post-exertion heart rate; HRrecov 1: Recovery heart rate; SBP 1: Post-exertion systolic blood pressure; DBP 1: Post-exertion diastolic blood pressure; SBPrecov 1: Recovery systolic blood pressure; DBPrecov 1: Recovery diastolic blood pressure; VO_{2max}: Maximal Oxygen Uptake

of normal weight and overweight/obese students from UA (as shown in Table 6). A comparison of VO2max values between urban and semi-urban dwellers according to age groups [(10-12 years) and (13-15 years)] showed no significant difference (P>0.05). However, performance in the 4×10-m speed test was significantly better (P<0.001) in semi-urban dwellers compared to that of urban dwellers.

4. Discussion

The objective of this study was to assess two physical fitness components and some of their associated factors among students living in urban and semi-urban areas of the Littoral province of Cameroon. We conducted an analytical cross-sectional study and found that students from urban areas (UA) were less physically active compared to their counterparts from semi-urban areas (SUA). However, an age group-based comparison [(10-12 years) and (13-15 years)] showed no significant difference (P>0.05) in the Maximal Oxygen Uptake values (VO2max) between urban and semi-urban dwellers. The prevalence of overweight/obesity was 21.4% (overweight: 19.2% and obese: 2.2%) with a predominance among semi-urban boys (17.3%; 15.3% overweight and 2% obese) and similar overweight values among urban and semi-urban girls (30.3%). The prevalence of overweight/obesity found in the present study was higher than those found in the studies of Choukem and colleagues (10) and Navti and co-workers (9), which were 12.5% and 18%, respectively. This increasing trend over the years is consistent with the conclusion of the meta-analysis published by Choukem and colleagues (6) on the prevalence of overweight/obesity and associated cardiovascular risk factors among children and teenagers in sub-Saharan Africa. Indeed, some factors such as physical inactivity or an unbalanced diet, which are classically recognized causal agents for this

disproportionate increase in overweight/obesity among children and teenagers of UA, are already superimposed in rural or semi-urban areas. Our study revealed that the proportion of overweight girls was identical in both areas (urban and semi-urban) and that paradoxically, among boys, the prevalence of overweight/obesity was higher in semi-urban areas. These results attest to the growing urbanization of rural areas as well as an economic transition marked by an increase in sedentarism (transport by motor vehicles) and the availability of high caloric index foods (6).

Anthropometrically, the weight and height of the students from urban areas were greater than those of students from semi-urban areas. However, this height-weight superiority in favor of urban dwellers had no influence on the estimated VO2max values and their best time record in the 4×10-m speed test, for it is known that tall and weighty children can be very performant in strength, speed, power, and endurance compared to their short and light counterparts (14).

When considering only the BMI criterion, we noted that the performance of overweight/obese students in the various exertion tests (the 20-m shuttle run test and the 4x10-m speed test) was poorer than that of their normal-weight counterparts. This result agrees with that of some researchers who found that obese teenagers had lower aerobic capacity compared to their non-obese counterparts (14).

We also observed in the age-based analysis that overweight/obesity increased with age in urban dwellers, and the pattern of overweight/obesity in semi-urban dwellers over the years followed a bell-shaped curve. This result could be related not only to more or less rigorous food planning among urban dwellers but also to a gradual loss of interest in the practice of physical activities and sports over the years (6). On the other hand, semi-urban dwellers, mindful of their precarity, would eat according to the availability of food. Indeed, with the existence of several forms of entertainment due to rapid urbanization, urban children have replaced active leisure activities such as racing games, playing football, and rope skipping with passive leisure activities such as computer, television, and board games, while those from semi-urban areas, despite the modernization trend observed, have all the same kept certain rural area features such as trekking, cycling, agricultural work, and some active hobbies such as playing football or rope skipping (6).

Performance in the 4×10-m speed test and the 20-meter shuttle run test (VO2max) among students in SUA was significantly better compared to that of students in UA. This result is, on the one hand, in line with those of other researchers who had observed that the physical fitness of children and teenagers living in rural areas was better compared to that of those living in urban areas (13, 15, 16). However, an age group-based comparison [(10-12 yrs) and (13-15 yrs)] showed no significant difference in the estimated maximal oxygen uptake values (VO2max) between urban and semi-urban dwellers. This advocates for age group-based comparisons just as certain reseachers (16) have shown that the performances of children are very high till the age of 12 and only decline afterward. Furthermore, the absence of difference in the estimated VO2max values among urban and semi-urban dwellers emphasizes the nutritional transition and physical activity context observed for several years in sub-Saharan Africa (6).

The VO2max values obtained from this study showed that the girls and boys were not at risk of developing cardiovascular diseases; their mean values were above the thresholds defined by Ruiz and co-workers (18) in 2016 (34.6 ml/kg/min in girls and 41.8 ml/kg/min in boys). Even an age group-based comparison reveals nothing other than a health risk related to VO2max values. Our VO2max values were similar to those found in other African children and teenagers (16).

4.1. Limitations

As the semi-urban area is considered a transition between the rural and urban setting, this study would have provided more information on the discrepancy observed in cardiovascular risk factors (obesity, overweight) and physical activity levels among rural and urban dwellers if some rural localities were included in the study. The cross-sectional nature of the study is also another limitation because it does not allow for a better follow-up of overweight/obesity and physical inactivity among students over time. Lipid profile and blood glucose levels would also have permitted a better assessment of the differences in the risk of developing cardiometabolic diseases among

normal-weight students and overweight/obese students, especially given that cardiorespiratory fitness is now considered a powerful health status indicator.

5. Conclusions

This study has shown that students from semi-urban areas now exhibit similar weight status features to their peers in urban areas, with a negative impact on their physical fitness. More attention should be paid to this target population, whose prevalence of overweight/obesity and inactivity is increasing at an alarming rate. One solution would be to increase the number of school-time physical education sessions to three per week (currently two per week) and the duration of each session to one hour (currently 45 minutes per session).

Ethical Approval

This study was approved by the institutional ethical review board for human health research of the University of Douala with the ethical approval code of 2492 IERB-Udo/12/2020/M. Also, written informed consent was obtained from the participants.

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Conflict of Interest: None declared.

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