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Physical Fitness, Hemodynamic Parameters and Body Fat Percentage in Urban Cameroonian Adolescents with Normal Weight and Overweight/Obese

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Abstract: *This study aims to assess the effects of overweight/obesity on the physical fitness and hemodynamic parameters in urban Cameroonian adolescents aged 11 to 18. Thus, a sample of 804 participants, namely: 282 boys and 532 girls was taken and divided into two groups according to their Body Mass Index. The first group consisted of 534 normal-weighted participants (66.42%) and the second of 270 overweight participants (33.58%). Individual cards were used to collect anthropometric, hemodynamic and physical fitness data from adolescents. Results shown significant difference in systolic blood pressure, diastolic blood pressure and resting heart rate between normal-weighted and overweight participants (P>0.05). Moreover, significant increase (p<0.05) in Hand grip strength and Sit-ups for 30 sec associated with a decrease in 10×5-m shuttle run test and Standing broad jump test were observed in overweight adolescents of both sexes at all age groups. In addition, aerobic endurance results showed a significant decrease (P>0.05) in maximal oxygen uptake in overweight participants compared to normal-weighted. The results of this study show that being overweight imposes abnormal mechanics on body movements that can lead to a deterioration of cardiovascular system and physical fitness of adolescents.*

Keywords: *Physical Fitness, hemodynamic parameters, overweight, obese, adolescent.*

1. INTRODUCTION

Obesity and overweight result from accumulation of body fats that may impair health [1]. They occur when the energy intake exceeds energy requirements. This could occur as a result of many factors including increased food intake, physical inactivity, and genetic factors [2]. Obesity and overweight are considered to be epidemics of the 21st century [3]. They affect 1.4 billion people aged 18 and over worldwide [4]. By 2030, the number of overweight people is expected to reach 3.3 billion [4]. In industrialized countries, the prevalence of overweight and obesity is up to almost 40% [5]. This prevalence is now rapidly increasing in Low and Middle Income Countries (LMICs), so in Africa it has exceeded the threshold of 30% for both men and women [6]. Finucane et al. [7], noted that the increase in prevalence is observed in all age groups of the population, including adults and children. The number of obese children and adolescents (aged 5-19) has increased tenfold over the past four decades globally [4]. The number of obese and overweight children in Africa has almost doubled in 20 years. According to Youfa and Hyunjung [8], the prevalence of obesity in children aged 7 to 11 has practically doubled in two decades, from 4% to 7%.

High Income Countries (HICs) were the first to experience this phenomenon. More recently, Low and Middle Income Countries (LMICs) have been facing a similar, but faster, nutrition transition process, so that in Africa, the prevalence of obesity may exceed that found in some HICs [9]. This phenomenon of nutrition transition is due to changing dietary habits and sedentary lifestyles related to a rapid development of urban industrial environments involving processed high-calorie food, easy access to transports, sedentary occupational and leisure time activities at home [10, 3]. These urban components make the modern city as a built environment physically obesogenic [11], and therefore associated with increasing rates of non-communicable diseases (NCDs), such as hypertension, type 2 diabetes, heart disease and some cancers [12]. The risk increases with increase in the level of obesity. They are also strongly associated with mental health and eating disorders [13]. Obesity may start in childhood and continue until adulthood. Severely obese children have complications such as diabetes, hypercholesterolemia, hypertension and atherosclerosis [14].

In Cameroon, obesity has become one of the most common public health problems affecting people of both sexes. According to the Ministry of Public Health, the prevalence of obesity in the general population increased from 11% in 1994 to 20.3% in 2010 [15]. In the same way, Fouda et al. [16] found a prevalence of obesity of 23.4% among workers in Douala. The most recent population level estimates for adult overweight and obesity in Cameroon are from a study conducted by Ayina et al.

[17] in an urban setting. Those authors found that the prevalence of obesity was higher in women compared to men, and central obesity is more prevalent particularly in women.

Over the recent decades the fitness of children and adolescents has significantly declined [18]. Rostan et al. [19] revealed that the physical fitness of the youth aged 9-16 years worldwide decreased by approximately 40% in past decades. In fact, in occidental and African countries, children were more engaged in indoor physical activities (media, video game, and computer) compared with outdoor physical activities (running, football, volleyball, and handball) [20]. Furthermore, with the economic development and the increase in urbanization and communication technologies, children are increasingly using cars or buses instead of cycling or walking to school [20]. This leads to sedentary behaviours, reduced physical activity and chronic diseases such as obesity and overweight. Children in Cameroon are an understudied group for chronic diseases in general and obesity/overweight in particular. Therefore, it is necessary to examine the effects of overweight/obesity on physical fitness and hemodynamic parameters in urban Cameroonian adolescents.

2. MATERIALS AND METHODS

Participants

Study was conducted according to the principles of the Helsinki Convention (1974). Participants were selected from the Government Bilingual Practising High School (GBPHS) in Yaoundé (Cameroon) following the authorization of the school principal. Written informed consent was obtained from the children and adolescents involved in the study and their parents or guardians. Using a non-probability sampling method of convenience, we enrolled 804 school children (73.70% females and 26.30% males) with an age range of 11 to 18 years. They were divided into two groups based on their Body Mass Index (BMI): group 1 made up of 534 normal-weight adolescents and group 2 made up of 270 overweight/obese adolescents. Were excluded from the study, those who did not complete the various physical tests, those who are underweight, those having musculoskeletal, those with clinical evidence of debilitating diseases and those engaged in extracurricular competitive sports activities. Measurements were performed from November to December (2021) under standard school conditions during the regular physical education classes between 7:30 AM and 11:30 AM.

Anthropometric Measurements

Body weight and body height were recorded with participants dressed in light clothing, after overnight fasting, without shoes and having washed their feet with an alcoholic disinfectant. Body weight was measured with a bio-impedance meter scale Tanita BC-532 (Tanita Corp., Tokyo, Japon). Body height was measured using a precision stadiometer (Seca 220, Seca) to the nearest 0.1 cm. Body mass index (BMI) was calculated as body weight in kilograms divided by height in meters squared (kg/m2).

Using the skinfolds method (the measurement of subcutaneous fat folds), we estimated the body fat percentage of participants. The first step was to measure four skin folds: biceps skinfold (front side middle upperarm); triceps skinfold (back side middle upperarm); subscapular skinfold (under the lowest point of the shoulder blade) and suprailiac skinfold (above the upper bone of the hip). Using the method of Durnin and Womersley [21], we calculated the Body Density (BD) of students according to sex and age. The results obtained made it possible to calculate the body fat percentage from the equation of Lohman [22].

Hemodynamic Parameters

Systolic blood pressure (SBP), diastolic blood pressure (DBP) and resting heart rate (RHR) measurements have been taken from the left arm, after a 15 min-period at sitting position, using an automatic oscillometric instrument (Omron HEM 742-E, Bannockburn, USA).

Physical Fitness Assessment

Validated and standardized by the European Council, the test battery comprised five tests integrated in the EUROFIT battery. All tests were performed twice (with the best score retained for analysis) except for the sit-up tests and the 10×5-m shuttle run test which were performed only once. These tests were applied in the following order:

Standing Broad Jump (SBJ)

The subjects made a jump as far as possible, landing on both feet without falling backwards. The maximum horizontal distance attained was measured in centimetres. This test measures the explosive leg power.

Handgrip Strength (HGS)

By use of a electronical model EH 101 dynamometer (range, 90 kg / 200Lbs), the maximum grip strength was measured for the dominant hand. The dynamometer was held firmly with the right hand at a 30° body angle between the arm and body. This measures the static arm strength.

Sit-Ups for 30 Sec (SU)

The test was performed with a knee angle of 90° and the feet fixed to the floor. We recorded the number of completed sit-ups (from a complete horizontal position on the floor to the position where the elbows touched the knees) during a 30 s period. This test measures trunk strength.

10×5-M Shuttle Run Test (10×5-Msrt)

This test provides an integral evaluation of the movement speed, agility, and coordination. Marker cones were positioned 5 m apart. When instructed by the timer, the subject ran to the opposite marker, turned, and returned to the starting line. This was repeated five times without stopping (covering 50 meters total), and time in seconds was used as the outcome.

20m Endurance Shuttle-Run (Bleep Test)

The test measures cardio respiratory endurance and was administered in a sports hall (temperature 20-25°C). It involved running between two lines set 20 m apart at a pace dictated by a recording emitting tones at appropriate intervals. Velocity was 8.5 $km \cdot h^{-1}$ for the first minute, which increased by 0.5 $km \cdot h^{-1}$ every minute thereafter. The test score achieved by the subject was the number of 20 m shuttles completed before the subject either withdrew voluntarily from the test, or failed to be within 3 m of the end lines on two consecutive tones. Afterwards, the last level shuttle was scored on the performance recording sheet. The maximum oxygen consumption (VO_2max) was estimated as per the regression equation developed by Leger et al. [23].

Data Analysis

Data were analysed using the SPSS statistical package version 21. Continuous variables are expressed as mean ± standard deviation (SD), and categorical variables are expressed as percentages. The normality of distribution for continuous measurements was verified with the Kolmogorov Smirnov test. The Mann-Whitney U test is used for the comparison of hemodynamic, body fat percentage and physical fitness variables between Normal Weight and Overweight/Obese group. The level of significance is set at < 0.05.

3. Results

A total of 804 Cameroonian adolescents (282 boys and 532 girls) aged 11-18 years were enrolled into the study. The overall prevalence of overweight/obesity was 33.58% (**Table 1**). This prevalence is

38.12% and 25.18% among girls and boys respectively. The proportions of overweight and obesity is higher in girls compared to boys. Moreover, this prevalence is 31.82%, 31.85% and 35.75% for the age groups of 11-13 years, 14-15 years and 16-18 years respectively, indicating an increase in this prevalence with the age of adolescents. Among boys, the prevalence of overweight is 17.78%, 23.15% and 28.35% for the age groups of 11-13 years, 14-15 years and 16-18 years respectively. Among girls, this prevalence is 37.65%, 36.41% and 39.83% for the age groups of 11-13 years, 14-15 years and 16-18 years respectively. In both sexes, the prevalence of overweight increases with the age of adolescents.

Table 2 shows the hemodynamic parameters, body fat percentage and the physical fitness of adolescents in general on the one hand and on the other hand, according to gender. Overall, analysis of these data shows that body fat percentage, trunk strength, coordinating speed, SBP, DBP and RHR in overweight adolescents are significantly higher than in normal-weighted adolescents ($p<0.05$). In contrast, the explosive leg power and cardiorespiratory endurance of overweight adolescents were significantly lower ($p<0.05$) compared to normal-weighted. Static arm strength did not show a significant difference ($p>0.05$) between the two groups. The same situation is observed among girls. Indeed, the body fat percentage, trunk strength, coordinating speed and hemodynamic parameters (SBP, DBP and RHR) are significantly ($p<0.01$) higher in overweight girls compared to normal weight girls. In addition, significantly low cardiorespiratory endurance ($p<0.001$) was observed in overweight girls (35.83 ± 8.19 ml / kg / min) compared to normal-weighted girls (43.10 ± 8.80 ml / kg / min). Explosive leg power and static arm strength showed no significant difference ($p>0.05$) in girls. Analysis of parameters in boys showed that body fat percentage, static arm strength, coordinating speed and hemodynamic parameters (SBP, DBP and RHR) were significantly higher ($p<0.01$) in overweight boys compared to normal-weight boys. Explosive leg power and cardiorespiratory endurance in overweight boys were significantly lower ($p<0.001$) compared to normal-weighted boys. Trunk strength was not significantly different ($p>0.05$) in boys.

Table 3 shows the hemodynamic parameters and the body fat percentage of adolescents according to gender and age groups. Analysis of the data shows that the hemodynamic parameters (SBP, DBP and RHR) were significantly higher in Overweight/Obese adolescents, at all age groups in both girls and boys, compared to normal-weighted adolescents ($p<0.05$). In terms of body fat percentage, significantly ($p<0.001$) higher values in overweight adolescents of all age groups, regardless of gender, were observed.

Table 4 shows the physical fitness of adolescents by gender and age group. The static arm strength of overweight boys aged 11 to 13 (32.55 ± 6.49 kg) and 16 to 18 (38.13 ± 10.33 kg) is significantly higher ($p <0.05$) compared to those with normal weight in the same age groups (27.94 ± 4.65 kg and 35.06 ± 19.43 kg respectively for 11 to 13 and 16 to 18 years). The coordinating speed of overweight adolescents is significantly higher ($p <0.01$) at all age groups, regardless of gender, compared to normal weight adolescents. Trunk strength was significantly higher ($p <0.05$) in overweight girls (16-18 years) and in overweight boys (14 to 15 years) in comparison to the corresponding normo-weighted groups. In contrast to previous parameters of physical fitness, explosive leg power is significantly low ($p <0.01$) in overweight girls (16-18 years) and in overweight boys (14-15 and 16 - 18 years) in comparison to the corresponding normo-weighted groups. Cardiorespiratory endurance of overweight adolescent boys and girls, of all age groups, was also significantly reduced ($p <0.05$) compared to the corresponding normal-weight groups.

Table1. *Gender and age groups of adolescents according to weight status*

Gender	Weight status	Age groups			Total
		11-13 years	14-15 years	16-18 years	
Girls	Normal Weight	53 (62.35%)	131(63.59%)	139 (60.17%)	323 (61.88%)
	Overweight/Obese	32 (37.65%)	75 (36.41%)	92 (39.83%)	199 (38.12%)
	Total	85 (100%)	206 (100%)	231 (100%)	522 (100%)
Boys	Normal Weight	37 (82.22%)	83 (76.85%)	91 (71.65%)	211 (74.82%)
	Overweight/Obese	10 (17.78%)	25 (23.15%)	36 (28.35%)	71 (25.18%)
	Total	47 (100%)	108 (100%)	127 (100%)	282 (100%)
Total	Normal Weight	90 (68.18%)	214 (68.15%)	230 (64.25%)	534 (66.42%)
	Overweight/Obese	42 (31.82%)	100 (31.85%)	128 (35.75%)	270 (33.58%)
	Total	132 (100%)	314 (100%)	358 (100%)	804 (100%)

Table2. *Adolescents hemodynamic parameters, body fat percentage and physical fitness in total and by gender*

	Total		Girls		Boys	
	Normal Weight (N=534)	**Overweight/ Obese (N=270)**	**Normal Weight (n=323)**	**Overweight/Obese (n=199)**	**Normal Weight (n=211)**	**Overweight/Obese (n=71)**
SBP (mmHg)	10.27±1.32	10.91±1.34***	10.67±1.33	10.97±1.35*	10.48±1.30	10.84±1.29*
DBP (mmHg)	6.27±1.02	7.17±1.00***	6.25±0.97	6.46±1.01*	7.29±1.06***	7.27±0.96***
RHR (bpm)	82.07±13.05	84.82 ±14.38**	82.01±12.62	84.76±14.35*	82.17±13.71	85.86±14.55*
Body fat percentage (%)	14.20±4.54	20.35±4.68***	16.52±3.64	21.85±4.17***	10.64±3.32	16.15±3.25***
HGC (kg)	32.14±11.63	32.44±9.56	32.27±9.76	31.42±8.87	31.94±14.04	35.28±10.83**
SBJ (m)	177.24±26.33	164.02±21.97**	165.19±22.16	160.08±21.20	195.68±21.01	175.06±20.41***
SU (number/30 sec)	17.96±4.79	18.69±5.59*	17.66±4.64	18.82±5.92**	18.42±4.98	18.34±4.56
10×5-Msrt (sec)	15.64±4.42	17.21±2.18***	15.47±1.36	17.07±2.14***	15.89±6.84	17.60±2.25***
VO2max (ml/kg/min)	44.09±9.47	35.89±8.47***	43.10±8.80	35.83±8.19***	45.60±10.24	36.07±9.28***

Source: *Values are presented as mean ± standard deviation. RHR, Resting Heart Rate; SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; HGC, Handgrip Strength; SBJ, Standing Broad Jump; SU, Sit-ups for 30 sec; 10×5-mSRT, 10×5-m Shuttle Run Test;* VO_2max*, Maximum Oxygen Consumption. *Difference between Normal Weight and Overweight/Obese. *P<0.05. **P<0.01. ***P<0.001.*

Table3. *Adolescents hemodynamic parameters and body fat percentage by gender and age group*

Girls						
Age groups	**Weight status**	**n**	**SBP (mmHg)**	**DBP (mmHg)**	**RHR (bpm)**	**Body fat percentage (%)**
11-13 years	Normal Weight	53	9.96±1.40	6.04±1.02	82.25±12.31	18.08±1.92
	Overweight/Obese	32	10.63±1.47*	6.52±1.10*	88.09±13.15*	24.33±3.23***
14-15 years	Normal Weight	131	10.57±1.23	6.24±0.96	81.79±12.74	20.45±1.66
	Overweight/Obese	75	11.72±1.16***	6.71±0.96***	85.21±51.80*	25.96±2.62***
16-18 years	Normal Weight	139	10.02±1.29	6.11±0.95	80.97±12.51	21.35±1.92
	Overweight/Obese	92	11.83±1.41***	6.50±1.02***	85.35±13.81*	27.49±3.47***
Boys						
Age groups	**Weight status**	**n**	**SBP (mmHg)**	**DBP (mmHg)**	**HRr (bpm)**	**Body fat percentage (%)**
11-13 years	Normal Weight	37	10.46±1.52	6.02±1.25	81.49± 10.27	17.82±1.44
	Overweight/Obese	10	11.60±1.07*	6.80±0.57**	88.80 ±8.70*	24.42±3.22***
14-15 years	Normal Weight	83	10.58±1.21	6.37±0.91	82.70±12.70	19.25±1.74
	Overweight/Obese	25	11.72±1.46**	7.16±1.07**	86.88±15.79	25.90±3.37***
16-18 years	Normal Weight	91	10.86±1.27	6.05±1.11	80.15±14.42	20.92±1.89
	Overweight/Obese	36	11.80±1.24***	6.86±0.94***	87.42±15.36*	26.23±2.18***

Source: *Values are presented as mean ± standard deviation. SBP, Systolic Blood Pressure; DBP, Diastolic Blood Pressure; HGC, Handgrip Strength. *Difference between Normal Weight and Overweight/Obese. *P<0.05. **P<0.01. ***P<0.001.*

Table4. *Adolescents physical fitness by gender and age group*

Girls							
Age groups	**Weight status**	**n**	**HGS (kg)**	**SBJ (m)**	**SU (number/30sec)**	**10×5-Msrt (sec)**	**VO_2max (ml/kg/min)**
11-13 years	Normal Weight	53	26.36±6.86	159.30±18.00	17.89±5.26	15.96±1.20	41.19±7.04
	Overweight/Obese	32	27.49±6.76	156.10±17.25	17.81±4.45	17.82±3.10**	37.62±5.58*

14-15 years	Normal Weight	131	29.85±7.01	160.60±19.47	16.80±4.06	15.92±1.15	39.86±7.65
	Overweight/Obese	75	29.68±7.43	157.40±24.33	18.03±7.79	17.11±1.94***	33.94±8.54***
16-18 years	Normal Weight	139	36.80±10.91	171.70±24.30	18.38±4.81	14.86±1.37	46.88±9.02
	Overweight/Obese	92	34.21±9.74	163.70±19.24**	19.82±4.27**	16.78±1.84***	36.75±8.44***
Boys							
Age groups	**Weight status**	**n**	**HGS (kg)**	**SBJ (m)**	**SU (number/30sec)**	**10×5-Msrt (sec)**	**VO2max (ml/kg/min)**
11-13 years	Normal Weight	37	27.94±4.65	171.10±12.71	16.57±4.72	16.04±0.98	41.28±6.85
	Overweight/Obese	10	32.55±6.49*	166.90±13.76	16.30±5.03	17.90±1.96**	32.65±7.77**
14-15 years	Normal Weight	83	30.31±7.75	198.50±18.94	17.46±4.88	15.51±1.16	43.18±9.49
	Overweight/Obese	25	32.29±12.08	169.30±19.26***	19.08±4.63*	17.86±2.48***	32.77±9.88***
16-18 years	Normal Weight	91	35.06±19.43	203.10±18.05	20.04±4.74	15.08±1.22	49.56±10.73
	Overweight/Obese	36	38.13±10.33*	181.30±21.13***	18.39±4.34*	17.34±2.19***	39.32±8.22***

Source: *Values are presented as mean ± standard deviation. HGC, Handgrip Strength; SBJ, Standing Broad Jump; SU, Sit-ups for 30 sec ; 10×5-mSRT, 10×5-m Shuttle Run Test; VO2max, Maximum Oxygen Consumption. *Difference between Normal Weight and Overweight/Obese. *P<0.05. **P<0.01. ***P<0.001.*

4. DISCUSSION

The aim of this study is to assess the effects of overweight/obesity on the physical fitness and hemodynamic parameters in urban Cameroonian adolescents aged 11 to 18. Our study revealed that the overall prevalence of overweight/obesity was 33.58%. This prevalence is 38.12% and 25.18% among girls and boys respectively. The proportions of overweight and obesity is higher in girls compared to boys. In both sexes, the prevalence of overweight increases with the age of adolescents. These results are in accordance with previous studies provided by Xie et al. [24] and Graff et al. [25] who shown that BMI increased during puberty, with boys mostly gaining muscle mass and girls mostly gaining fatty tissue. Higher proportions of overweight/obesity in Cameroonian girls may also be related to differences in gender roles particularly those requiring higher physical exertion (e.g., boys participating in higher energy expending roles/activities) and cultural desirability whereby being overweight is an admired trait and seen as a sign of wealth and prestige, particularly in girls.

Our results revealed that the overweight and obese adolescents performed worse in Standing broad jump, 10×5-m Shuttle Run Test and 20m endurance shuttle-run compared with normal weight children. In terms of body fat percentage, higher values in overweight adolescents of all age groups, regardless of gender, were observed. These results are in agreement with those obtained by He et al.

[26] and Lopes et al. [27] who reported that physical fitness decreases with increasing fat proportion. They have shown that obese subjects have lower performances on all tests requiring propulsion or lifting of body mass (runs and jumps) compared to normal weighted ones. From a biomechanical point of view, excess fat represents an inert load (dead weight) that must be moved. Xu et al. [28] has shown that overweight imposes abnormal mechanics on body movements, which could explain the high incidence of musculoskeletal disorders in overweight people. Osteoarthritis and the resulting joint pain are often, according to Singh et al. [29] correlated with overweight, in particular in the knee, hip and the spine. Gilleard and Smith [30] has shown that the spine has limited flexibility and increased back stiffness in obese patients, affecting the performance of movements that involve the trunk. Greater mechanical loads were measured at the knee, resulting in a decrease in the strength of the extensor and flexor muscles of the knee. Thus, overweight children exhibit impaired functional movement due to excess weight, which can interfere with daily physical activity level and limit motor performance [31].

The results of this study also showed that overweight and obesity adolescents performed better than those with normal weight in Handgrip strength and Sit-ups for 30 sec tests. According to some authors, overweight and obese adolescents can perform equally well or even better than children with normal weight in those muscular fitness tests where their body does not have to be transported, such as handgrip strength and Sit-ups for 30 sec test [32, 33]. This may be due to higher fat-free mass in obese and overweight adolescents.

Regardless of gender and age group, results showed that overweight and obese adolescents had lower cardiorespiratory fitness as compared to normal weight, which is in accordance with the previous study [34]. The biological mechanism of obesity and overweight has shown that overweight and excess body fat reduces an individual's exercise tolerance and aerobic capacity compared to normal-

weight children [35]. In addition, cardiovascular and respiratory demands are important in overweight children and adolescents, with higher heart rates and ventilation rates. Thus, in obese people, the dynamics of breathing may be affected and put pressure on the diaphragm resulting in reduced pulmonary comfort. This leads to a reduction in lung volumes and a change in respiratory mechanics both at rest and during physical activity. The effects of obesity and overweight on the cardiovascular system are marked by an increase in blood volume with hypertrophy of the left ventricle affecting its volume and relaxation (diastolic compliance). Impaired ventricular relaxation is an active energy-consuming phenomenon. Due to this failure of the cardiovascular system, overweight young people have greater energy demands [36]. On an emotional level, being overweight and obese made the children lose their self-confidence and motivation to participate in physical exercise, resulting in a poorer performance in physical fitness than their peers [37, 38].

From a hemodynamic point of view, the studied variables indicated differences between the overweight/obese and normal weight groups. Overall, analysis of these data shows that the systolic (10.91±1.34 vs. 10.27±1.32) and diastolic (7.17±1.00 vs. 6.27±1.02) BP were higher in the Overweight/obese group compared to normal weight group. The same situation is observed among girls and boys at all age groups. Many studies [39, 40, 41] support current results. They showed that at the start of turning overweight, the effect of adiposity on BP increases fourfold. This may be attributed in part to arterial stiffness, which increases MAP [41]. Chronic inflammation is also often cited as a key etiologic factor in the development of hypertension [42]. Higher SBP and DBP levels may reflect the progressive stiffening of the arterial wall, changes in the vascular structure, and the development of atherosclerosis [43]. The adipose tissue-derived hormone leptin has been implicated in mediating obesity-induced increases in BP [44].

Regarding HR values, the results of the overweight/obese group were also elevated compared to normal weight group (84.82 ±14.38 vs. 82.07±13.05), which corroborates with pre-existing findings in the literature [45]. This could be attributed to sympathetic nervous system hyperactivity [46].

Our study had several limitations. First, the results completely excluded participants who may be identified as underweight. Second, this study does not discuss the correlation of weight status with physical fitness and hemodynamic parameters of participants. Third, we did not obtain data about other cardiovascular risk factors, such as serum lipids and blood sugar. Adding these data may strengthen our data and will be the task for the future.

5. CONCLUSIONS

The present study showed that the overweight and obese adolescents have lower performances on all tests requiring propulsion or lifting of body mass (runs and jumps) compared to normal weighted ones. In addition, our results suggested that overweight and obese adolescents can perform equally well or even better than children with normal weight in those muscular fitness tests where their body does not have to be transported, such as handgrip strength and Sit-ups for 30 sec test. This could be attributed to elevated hemodynamic parameters (SBP, DBP and RHR) and body fat percentage found in Overweight/Obese adolescents, at all age groups in both girls and boys, compared to normal-weighted adolescents.

6. AUTHOR'S CONTRIBUTION & STATEMENT

Conceptualization, methodology and writing original draft preparation were made by Drs Bonoy Lamou, André Hamadou and Pascale Mibo'o. Formal analysis was made by Dr William Richard Guessogo and Mr Hugues Djofang. Writing and editing were made by Pr Paul Vernyuy Tan and Dr Bonoy Lamou. Dr Jean-Pierre Mbame, Mr Youssouf Adoum and Dr William Bian Mbang have been involved in Data collection and curation. All authors have read and agreed to the published version of the manuscript.

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ETHICS APPROVAL STATEMENT

The Study was conducted according to the principles of the Helsinki Convention (1974) and approvedby the Cameroun National Ethics committee (Reg. No FWAIRB00001954).

INFORMED CONSENT

Informed consent was obtained from all subjects involved in the study.

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