Original Article

Physical and cardiorespiratory profiles of urban schoolchildren aged 10-14 years in Douala, Cameroon

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ABSTRACT

Little information is known concerning the no-self-reported measures of physical activity among African schoolchildren despite alarming prevalence of the cardiometabolic risk factors such as overweight and obesity. This study aims to evaluate some physical and cardiorespiratory profiles among schoolchildren from two government high schools (S1, S2) in Douala, Cameroon. One hundred and seventy-six (176) schoolchildren (114 boys and 62 girls) aged 10-14 years underwent a 9 minutes run test. At the end of the test, distance covered (D), peak and recovery heart rates (Peak HR, HRR) were determined. Prior to testing session, anthropometric data (i.e. height and weight) were taken using a standard protocol and the body max index (BMI) was also calculated. The rating of perceived exertion (RPE) was estimated at the end of the test. Most of schoolchildren (97%) have normal weight. But D (m) was higher compared to some of those observed in Caucasians. D for girls was significantly ($p<0.0001$) lower than that of the boys. No significant ($p>0.05$) variation was found in BMI, Peak HR and HRR among the schoolchildren. However, significant ($p<0.05$) variation was detected in D for girls in S2 on a reduced track (278m) as compared to that of D for girls in S1 on a larger track (400m). Negative correlation was found between D and RPE ($r = -0.220$, $p=0.003$). These results present some differences on body composition, physical and cardiorespiratory profiles among Cameroonian schoolchildren in accordance with gender and space perception. **Keywords:** Physical activity; Physical fitness; Sports performance; Cardiorespiratory fitness.

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INTRODUCTION

Physical fitness of children and adolescents has become a critical issue in the world. Children and adolescents are an important target because of the progression of obesity and overweight, which are potential precursors of non-communicable diseases such as cardiovascular diseases, diabetes, and high blood pressure (Castillo-Garzon et al., 2007; Kvaavik et al., 2009). In addition, the onset of these diseases at an early age greatly compromises the future of these young people. Several scientific findings indeed reveal that most of the determinants of these diseases in adults are acquired in childhood and adolescence (Castillo-Garzon et al., 2007; Ortega et al., 2008; Kvaavik et al., 2009).

Several fitness assessment tools for children and adolescents have been put in place; the best-known being FITNESS-GRAM battery, ALPHA-FIT battery test, FUPRECOL health related fitness battery (Ramos-Sepulveda et al., 2016). These tools have a multicomponent approach to physical fitness: morphological, cardiorespiratory, and muscular among others. Cardiorespiratory component (maximum oxygen consumption or VO_2max) has been widely studied in a number of researches that aimed at evaluating the levels of physical profiles in children and adolescents (Castro-Piñero et al., 2009; Ramos-Sepulveda et al., 2016; Ruiz et al., 2016).

Direct VO_2max determination requires cost and sophisticated equipment beside highly skilled personnel. In order to overcome such limitations, an efficient and cost effective field tests (i.e. 12-minute run test, multistage shuttle run test, nine minute run-test, 2km and 6min walk test) were developed as an alternative to direct measurement (Castro-Piñero et al., 2009; Ruiz et al., 2016). These tests are very suitable in an environment with faulty equipment such as African countries. But the finding of their weak use is very surprising. Regular physical activity is often recommended to reduce the alarming prevalence of obesity and overweight in most epidemiological studies conducted in Africa (Assah et al., 2011; Fetuga et al., 2011; Muthuri et al., 2014). In some cases, this activity is evaluated only by self-reported measures.

In Cameroon, epidemiological findings on obesity and overweight in some schools indicated up to 18% prevalence (Wamba et al., 2013; Navti et al., 2014; Navti et al., 2015; Navti et al., 2017; Choukem et al., 2017). Standard factors including socio-economic status, stature, and physical activity have been identified as the key contributors of overweight and obesity in such studies. Navti et al. (2007) highlighted the importance of the objectively assessment of physical activity in and out of schools among Cameroonian children in view of the reported inverse relationship between physical activity and BMI-defined overweight/obesity and triceps skinfold thickness. Up till now, only self-reported measures have been screened in these studies. Few researchers have addressed the problem of collection of true measures of physical activity in our school context and until now, only two studies have investigated the electrocardiographic profiles of Cameroonian schoolchildren in response to the tests of physical education and sport (PES) practiced during the official exams (Mekoulou et al., 2017; Bika et al., 2018).

Moreover, information regarding the no-self-reported measures of physical activity is scarce particularly among African schoolchildren. Taking into account the significance of physical fitness and anthropometric indices in health policies interventions, this study was therefore designed to evaluate the physical and cardiorespiratory profiles of schoolchildren aged 10-14 years from two different schools in Douala, Cameroon.

MATERIALS AND METHODS

Participants

The present research is a cross-sectional study that investigated 176 children (114 boys and 62 girls), aged 10 to 14 years, students of two public schools from Douala, Cameroon. The initial enrolment was 315 students but only 176 students were selected as part of the final sample. This sample reduction was mainly due to the difficulty in managing other students, coupled with inability to familiarize the 09-minute race test, and the refusal of some girls to volunteer themselves for use of heart rate monitor belt by the experimenters (men or women). It is also important to note that several schools were solicited as part of this study through letters addressed to the heads of these institutions. However, only the two institutions mentioned above had given their agreement. All children were familiar with the 09-minute race test a week before the start of the experiment.

Ethical considerations

One month prior to the starting of the tests, the heads of institutions were contacted through motivated letter to develop a strong collaboration that will allow us to interact with the student for familiarization of the test. At the same time, administrative duties related to ethical clearance were completed and the study was approved by the Institutional Research Ethics Committee for Human Health at the University of Douala (CEI-UDo) under the number CEI-UDo/814/03/2017/M.

Protocol

Tests were carried out with schoolchildren from two public schools (S1 and S2) in Douala, Cameroon. Students from S1 realised the nine minutes running test on a classical track of 400m. While those from S2 carried out this test on another track of 278m. Due to the proximity of their school to the university campus housing international standard sports facilities, students from S1 ran on an Olympic track (T1, 400 meters). Whereas those from S2 ran on their site, a track of 278 m (T2) surrounding the football stadium of their high school because of their distance with said campus. The period of the study was between November 2016 and February 2017. Tests were implemented in the afternoon between 02 p.m. and 5 p.m. Participation in the study was voluntary. A detailed protocol on the study was given to schoolchildren in order to receive the parent's approval. The Legal guardians of schoolchildren provided their written informed consent prior to study participation. Only children who submitted signed parental approval file were allowed to participate in the study. At the beginning of each session, students were learned in simple words about the objectives of the study, practical implementation of the 9-minute run test and the overall feelings of subjective sensation of effort and physical strain.

Experimental protocol consisted of performing a 09-minute run test. After a short warm-up of 5 minutes and the signal of the first whistle, subjects ran in groups of three or two for a duration of 09 minutes. As the 09th minute of the race approached, each of the experimenters went to meet each subject to raise the mark that helped in determining of the distance covered. This was calculated by the number of laps completed added to the additional distance. Subjects thus observed a recovery being seated and at the 10th minute, a new measurement of weight was made. The heart rate monitor belt and watch were removed from the subjects, cleaned with water and alcohol to prevent infections before the following measurements. According to the automatic heart rate recording function of the Polar V800 heart rate monitor, two frequency values were taken into account: a first one that allowed detecting the peak heart rate developed during the test and a second (one minute after the test) which made it possible to calculate the recovery heart rate. At the end of each test, the rate of perceived exertion (RPE) was determined using the Children's OMNI Scale of Perceived Exertion [17] Prior to performing of the test, baseline morphological assessments (weight and height) were made using an electronic scale with stadiometer with the subjects without shoes and wearing minimal clothes. BMI was calculated and BMI Z-scores (BMI_Z) were generated by referring to WHO growth standard.

A large majority of subjects walked after 02 minutes of running. Our sessions were easily conducted through the teachers of physical education and sports in these institutions. They help in sensitizing the students on the importance of the study besides reminding the students to put on their sportswear. Sessions planned were taking into account of certain academic constraints (evaluations, courses) and various events (cultural evenings); the usual days were Wednesday and Friday. An average of 10 to 15 students were enrolled at each session.

Statistical Analysis

Data are presented as absolute and frequencies, percentages, mean ± standard deviation. The data with non-parametric distribution was compared between groups (Boys and girls) by the test U of Mann-Whitney. The data with parametric distribution was compared between groups (boys and girls) by the non-paired Student's t tests. The significance was set at $p < 0.05$. The software Statview software version 5.0 (SAS Institute, Inc., USA) was used for statistical analyses.

RESULTS

A distribution by age and gender of the population is presented in Table 1.

Table 1. Age and gender distribution among study population.

Age (years)	Boys		Girls	
	N	*%*	*N*	*%*
10	17	14.9	14	22.6
11	31	27.2	23	37.1
12	31	27.2	14	22.6
13	22	19.3	4	6.5
14	13	11.4	7	11.3
Total	114	100	62	100

N: sample size

The analysis of BMI revealed that majority of students (97%) has normal weight, with only one student being underweight and four overweight. But no obese student was identified (Tables 2 and 3). No significant differences ($p<0.05$) were noticed between the girls' BMI and that of the boys. Similarly, age differences did not account for significant variation ($p>0.05$) in BMI among 11- and 14-years old students. Distance covered (D) and Predicted maximum oxygen uptake (PVO_2max) were significantly higher ($p<0.0001$) in boys compared to that of the girls. D and PVO_2max were statistically similar ($p>0.05$) between girls and boys belonging to 12, 13 and 14 age groups. Additionally, no gender specific differences were detected in the peak heart rate (Peak HR) and heart rate recovery (HRR). Numerically higher D and Hrmax were calculated for the boys from school 2 running in 278m track as compared to those from school 1 running in 400m track. On the other hand, significantly higher ($p<0.0001$) D, and Peak HR were calculated for the girls from School 2 (278m) as compared to those from school 1 (400m) (Table 5). In comparison with some normative values used in European and American countries, the absolute and relative distribution of health-related fitness variables in our study could be consider normal. No significance difference ($p>0.05$) was found for the RPE with respect to gender. Distance covered was negatively and significantly correlated to RPE ($r = -0.220$, $p=0.003$).

Table 2. Absolute and relative distribution of health-related fitness variables and RPE.

Parameters	Gender		Classification
	Boys (N=114)	Girls (N=62)	Good
BMI (kg/m^2)	17.26±1.70	17.72±1.91	Good
Distance (m)	1585.20±215.76	1412.06±163.22	Good
PVO_2max (mL/min/Kg)	50.58±2.18	44.57±2.24	Good
Peak HR(bpm)	199.16±11.43	199.48±12.58	Good
HRR (bpm)	32.33±19.10	29.35±17.22	Good
RPE (0-10 OMNI Scale)	3.75±1.61	3.48±1.20	

BMI : Body Mass Index ; PVO_2max : Predicted Maximum Oxygen Uptake ; PeakHR : Peak Heart Rate ; HRR : Herat Rate Recovery ; RPE : Rating of Perceived Exertion

Table 3. Body Mass Index (BMI) profile by age and gender.

Age (years)	BMI (kg/m^2)	
	Boys	Girls
10	16.48±1.50	17.39±1.80
11	17.19±1.74	17.49±1.45
12	17.09±1.97	16.75±1.08
13	17.75±1.21	17.90±2.01
14	18.05±1.44	20.99±1.62

Table 4. Performance (distance), physiological parameters (Peak HR, HRR) and RPE according to age and gender.

Age	D (m)		PeakHR (bpm)		HRR (bpm)		RPE	
(yrs.)	B	G	B	G	B	G	B	G
10	1618.21 ± 205.43	1349.50 ± 167.41	200.58 ± 12.96	202.78 ± 12.73	39.05 ± 24.02	26.92 ± 16.49	3.82 ± 1.28	3.14 ± 1.14
11	1580.36 ± 173.74	1429.25 ± 167.21	199.90 ± 12.18	199.73 ± 9.15	33.06 ± 16.29	30.34 ± 19.26	3.95 ± 1.65	3.52 ± 1.08
12	1552.04 ± 254.69	1458.12 ± 157.12	197.25 ± 10.78	197.14 ± 18.45	34.03 ± 20.90	23.28 ± 21.70	3.58 ± 1.40	3.20 ± 0.99
13	1653.27 ± 169.32	1464.40 ± 167.16	197.04 ± 10.65	196.25 ± 2.98	27.09 ± 16.72	33.00 ± 17.98	3.40 ± 1.53	5.00 ± 2.00
14	1538.84 ± 276.54	1358.71 ± 140.68	203.69 ± 10.16	198.57 ± 12.71	26.61 ± 16.19	28.71 ± 24.69	4.23 ± 2.38	3.50 ± 1.22

D: distance covered; PeakHR: Peak Heart Rate ; HRR : Herat Rate Recovery ; B: Boys; G; Girls

Table 5. Comparison of the distance covered, heart rate and RPE during the nine-minute run test (09-MRT) between girls and boys according to the track.

Parameters	School 1 (N=86, T1=400m)		School 2 (N=90, T2=278m)	
	G (n=32)	B (n=54)	G (n=30)	B (n=60)
Distance (m)	1389.68±173.33	1578.20±210.96	1435.94±150.93[a]	1596.13±221,28
PVO_2max (mL/min/Kg)	43.98±2.46	50.35±2.01	45.21±1.82	50.79±2.31
Peak HR (bpm)	194.59±13.44	197.92±10.37	204.700±9.22[b]	200.283 ±12.29
HRR (bpm)	24.38±16.52	29.36±12.55	34.67±16.59	31.95±11.74
RPE (0-10 OMNI Scale)	3.81±1.42	4.03±1.99	3.10±0.92	3.48±1.15

T: track; [a]: significance difference between D for Girls from T2 and D for Girls from T1 (p=0.04); [b]: significance difference between Peak HR for Girls from S2 and Peak HR for Girls from S1 (p<0.0009). B: Boys; G; Girls.

DISCUSSION

The main objective of this study was to evaluate the physical and cardiorespiratory responses of 10-14 years schoolchildren in Douala (Cameroon) during a 09-minute running test (09-MRT).

Concerning the body composition, there were no significant differences (p>0.05) between girls and boys in terms of BMI. Girls have only presented slightly higher BMI than boys in the overall studied population. Our results have a number of similarities with Pelicier et al. (2016)'s findings. Very few participants (4/176) were overweight, one case of underweight has found and no obese students were identified. However, these observations were not in accordance with the previous findings on overweight and obesity in children in rural and urban Cameroon (Navti et al., 2014; Navti et al., 2015; Navti et al., 2017). The low prevalence of overweight and obesity could be justified by the sample size of our study. Indeed, the prevalence of overweight and obesity found in previous studies were between 12.5% to 18.8% with a minimum sample size of 500 children.

Concerning the performance parameters (distance covered, predicted maximum oxygen consumption), distance covered in boys was significantly (p<0.05) higher than that of the girls. These findings correlate favourably with that of Paludo et al. (2012), Ramos Sepulveda et al. (2016), Pelicier et al. (2016) and further support the idea of gender aspect in the VO_2max prediction equations from the 9-MRT. We found much higher values for distance with respect to those reported by Coleman et al. (2004), Bergmann et al. (2005), Pelegrini et al. (2011) and Bergmann et al. (2015). The heterogeneity of the samples has been argued by some authors to strongly influence the distance covered during the 09-MRT (Ramos-Sepulveda et al., 2016). In addition, studies involving the 9-MRT have all been conducted in Caucasians. The increase in the average distance among the schoolchildren in our study compared to their Caucasian counterparts could be linked to a genetic difference, maturation, race economy and environmental factors among others.

Concerning predicted VO_2max which is a physiological parameter for assessing cardiorespiratory fitness of children from their distance covered, the results (44.57 ± 2.24 mL / kg / min for girls and 50.58 ± 2.18 mL / kg / min for boys) point to the likelihood that our participants would be protected from the risk of developing certain diseases associated with poorer performances (35mL / kg / min for girls and 42mL / kg / min for boys) (Ruiz et al., 2016).

Given that our findings are based on the predictive equations of VO_2max, the results from such analyses should thus be treated with considerable caution. One of the criticisms often addressed to these equations is their underprediction or overprediction compared to real values.

In another aspect, indirect evaluation of VO_2max in children uses a set of field tests (5-minute test, 1000-meter test, 6-minute walk test, multistage shuttle run test), the most reliable being the multistage shuttle run test (Pelegrini et al., 2011). The 09-MRT has been criticized for its low levels of correlation with direct measurement (Ortega et al., 2008; Paludo et al., 2012; Ramos-Sepulveda et al., 2016). Despite the limitations of this test, Bergmann et al. (2005)' study had recommended the consideration of some factors (BMI, gender) in assessing the validity of 09-MRT. Paludo et al. (2012) also have suggested that the 9-minute test appears to be a valid indicator of cardiorespiratory fitness in adolescents between the ages of 10 and 12.

We chose the 09-MRT because it is one of the most practical in terms of the leading position of continuous exercises during Physical Education and Sports (PES) sessions in schools in our context.

Concerning distance covered in particular, it should be important to noted that the fact that the students from the two schools used different tracks (T1, 400m vs T2, 278 m) led us to certain comparisons and observations. Unlike other research carried out in this area, we found a significant difference ($P<0.05$) between distance covered among T2 girls compared to T1 girls. No significant difference ($P> 0.05$) was found in boys. Due to the fact that the tracks are different, the motivation of the students would also be different. The results of our study do not support the previous research in this area (Assomo et al., 2012). In fact, contrary to what was previously thought concerning the inhibitory effects of reduced spaces on physical performances, we found that girls exhibited higher performances in reduced tracks (278m) compared to larger spaces (400m). Yet, reduced spaces, because of the increasing number of turns, thus implying a subsequent increase in the number of accelerations and decelerations have been described as negatively affecting physical performances (Assomo et al., 2012). The age could explain these observations because the participants in this study were 27 years old. This would appear to indicate that there is a lot of sources of variability of VO_2max predictive tests using continuous runs. Nevertheless, these data need to be interpreted with caution because the discrepancies have only found in girls.

Results of peak heart rate (Peak HR) and heart rate recovery (HRR) have a number of similarities of previous findings (Schulze-Neick et al., 1992; Nieminen et al., 2009). HRR is another health indicator. The results of our study seem to demonstrate a good cardiovascular adaptation for exercise in our subjects where critical thresholds defined values below 12 bpm and 18 bpm during maximum exercise on treadmill and ergocycle respectively. These measurements could be mistaken because of the sub-maximal nature of the 09-minute test, which only takes into account the peak heart rate and not the maximum heart rate.

It is plausible that a number of limitations may influenced the results obtained. First, the limited sample size did not allow us to better compare our results with previous studies (Navti et al., 2014; Navti et al., 2015; Navti et al., 2017). Another limitation is the lack of data on the socio-economic background of students because previous studies have highlighted the preponderance of overweight and obesity among students from high socioeconomic backgrounds. Thus, lower prevalence of these and the relatively good physical and cardiorespiratory performances of the schoolchildren in our study could be related to the geographic area of these schools. Likewise, the assessment of physical fitness was limited to the cardiorespiratory component while an extension to the analysis of others components (musculoskeletal: explosive force, vertical jump height, grip strength, speed tests, agility and flexibility; morphological: waistline) would have been more informative and allow for more interesting correlations.

CONCLUSIONS

This work contributes to broaden current knowledge of cardiorespiratory fitness in children. Our research underlined the importance of track in the assessing of cardiorespiratory fitness in children. However, given the small sample size, caution must be exercised. The findings may not be representative of schoolchildren in Cameroon. Further studies should be conducted to assess the efficiency of physical education and sports programs in our schools by using more reliable tools such as multistage shuttle run test.

AUTHOR CONTRIBUTIONS

Conception and design: PBAN, AT. Acquisition: CJMV, JMN. Analysis and interpretation of data: PBAN, AT, CJMV, JMN, WRG, SHM, LSEN. Drafting the manuscript: PBAN, AT, CJMV, JMN, WRG. Revising the manuscript for important intellectual content: SHM, LSEN. Final approval to the version to be published: PBAN, AT, JMN, CJMV, WRG, SHM, LSEN.

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