International Journal of Physical Education, Sports and Health 2020; 7(3): 20-25

P-ISSN: 2394-1685
E-ISSN: 2394-1693
Impact Factor (ISRA): 5.38
IJPESH 2020; 7(3): 20-25

www.kheljournal.com
Received: 13-03-2020
Accepted: 15-04-2020

Peguy Brice Assomo Ndemba
(1). Exercise and Sport Physiology Unit, Faculty of Sciences, University of Douala, Cameroon
(2). Department of Physiology, Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Cameroon

Abdou Temfemo
(1). Exercise and Sport Physiology Unit, Faculty of Sciences, University of Douala, Cameroon
(2). Department of Biological Sciences, Faculty of Medicine and Pharmaceutical Sciences, University of Douala, Douala, Cameroon

Clarisse Noel Ayina Ayina
Exercise and Sport Physiology Unit, Faculty of Sciences, University of Douala, Cameroon

Falone Deville Nya
Exercise and Sport Physiology Unit, Faculty of Sciences, University of Douala, Cameroon

Jerson Mekoulou Ndongo
Exercise and Sport Physiology Unit, Faculty of Sciences, University of Douala, Cameroon

Wiliam Richard Guessogo
National Institute of Youth and Sports of Yaounde, Cameroon

Samuel Honoré Mandengue
Exercise and Sport Physiology Unit, Faculty of Sciences, University of Douala, Cameroon

Laurent Serge Etoundi-Ngoa
Exercise and Sport Physiology Unit, Faculty of Sciences, University of Douala, Cameroon

Corresponding Author:
Peguy Brice Assomo Ndemba
(1). Exercise and Sport Physiology Unit, Faculty of Sciences, University of Douala, Cameroon
(2). Department of Physiology, Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Cameroon

Physiological and anthropometric parameters of Cameroonian schoolchildren (10 to 12 years) to physical education and sports (PES) sessions

Peguy Brice Assomo Ndemba, Abdou Temfemo, Clarisse Noel Ayina Ayina, Falone Deville Nya, Jerson Mekoulou Ndongo, Wiliam Richard Guessogo, Samuel Honoré Mandengue and Laurent Serge Etoundi-Ngoa

Abstract
Physical Education and Sports (PES) sessions are the only opportunities for many children to participate in physical activity and sport. The objective of this study was to evaluate changes in anthropometric parameters, blood pressure profile and cardiorespiratory fitness induced by PES sessions among Cameroonian schoolchildren. Participants were 80 students (age: 10–12 years; boys n = 45; girls n=35) who exercised only during physical education (2 × 45-min periods per week). Anthropometric (weight, height, waist circumference) and physiological parameters (systolic blood pressure: SBP, diastolic blood pressure: DBP, resting heart rate : HRr, cardiorespiratory fitness : VO_2max) assessments were conducted in two trials separated by three months. An investigation she*et al*lowed the collection of dietary habits. The prevalence of obesity remained constant throughout the study (1.25%). In boys and girls, weight and body mass index (BMI) increased significantly ($P<0.05$). For physiological parameters (DBP, HRr, VO_2max), no significant difference ($P>0.05$) was found after three months in the school children. PAS and PAD had significantly decreased ($P<0.05$) among girls. Regular breakfast was associated with lower weight status among students. In contrast, fruit consumption was associated with greater weight gain among students. PES sessions after three months do not have sufficient impact on the improvement of anthropometric, physiological and performance parameters in students; results that are linked to an imbalance between very high calorie dietary intakes and energy expenditure.

Keywords: School, physical activity, Cameroon

1. Introduction

Regular participation in physical activity of 30 or 60 minutes per day can lay the foundation for many health benefits in general, improving the quality of life and reducing the risk of developing chronic diseases such as diabetes, obesity and cardiovascular disease in adolescence and adulthood [1]. In children and adolescents, there is an increase in sedentary behaviors (time spent on television, video games) that explain the alarming prevalence of overweight and obesity observed in schools [2, 3]. Obesity and overweight are important risk factors for the onset of non-communicable diseases. In Cameroon, literature based on the epidemiology of obesity and overweight in some schools indicated prevalences up to 18% [4-8]. Standard factors including socio-economic status, stature, and physical activity have been identified as the key contributors of overweight and obesity by these studies. Navti *et al.* [7] 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.

Indeed, many studies in low and middle-income countries on physical fitness profiles in children and adolescents have consistently reported subjective data [9, 10]. However, this lack of objective data on physical fitness does not allow the development of effective control strategies to reverse the trend of insufficient overall physical activity observed in children and adolescents [11, 12].

Nearly 4 out of 5 children and adolescents do not reach the global recommendations for physical activity. The last few years have been marked by an unavoidable decline in the time

available for the practice of physical activities and sports among the youngest with potential negative consequences on health and quality of life parameters [13]. Therefore, physical education and sports (PES) sessions seem to be the only real option for many children and adolescents, in terms of participation in physical and sports activities. PES sessions aim to train, through school practice, physical, sporting and artistic activities, educated, lucid, autonomous, physically and socially educated citizens; they provide an excellent framework for physical activity and health promotion [14, 15]. Equivocal findings are reported in the literature on the efficiency of PES sessions in improving physiological parameters [14, 15]. It is generally reported an improvement in the physiological parameters and performance in the school children when the sessions of PES are associated with an extracurricular hourly volume of the physical activities and sports [16]. Recent cross-sectional studies have reported electrocardiographic changes in the risk of sudden cardiac death in cameroonian students participating in intermittent exercise sessions [17, 18]. The transversality of these studies cannot lead to reliable and lasting conclusions about the knowledge of the physical and electrocardiographic parameters of cameroonian students. In 2018, the cameroonian public authorities, through a decree of the Prime Minister, increased the value of PES courses by increasing their coefficient during official examinations from 1 to 2. Before these decisions, it was noted a great lack of interest in PES sessions, sometimes resulting in numerous false certificates of physical incapacity, low motivation of students during physical education and sport sessions. This political will should be reflected daily by a greater commitment of students during the practice of PES sessions. It can be suggested that children who engage in physical education (PE) classes will tend to be more physically active on different days (weekdays and weekend days) or vice versa [19].
In another plan, according to the "activity stat" hypothesis, it can be inferred that frequent participation in PE classes may help to reach an energy expenditure threshold on PE days, and reduce the amount of time spent on physical activity during the day [20].
The main objective of this study is to evaluate the changes in body composition, blood pressure profile and cardiorespiratory fitness induced by PES sessions in some schoolchidren aged 10 to 12 years, in the city of Douala, Cameroon.

2. Materials and Methods

2.1 Participants

This is a longitudinal study of anthropometric and physiologic indicators parameters measured in students for grades 5-6 attending public secondary schools in the city of Douala, Cameroon.
80 schoolchildren including 35 girls and 45 boys, were recruited from two schools. The enrollment was made up of 153 students after the first data collection (anthropometric, performance, physiological) but only 80 students could be selected as part of the final sample because having participated in the second collection of the same data after three months. The abandonment, the management difficulty of the other students, the longitudinal nature of the study were the main reasons for this reduction in the sample. The study was approved by the institutional ethics committee for human health research of the University of Douala (Ethics decision no. 1228 CEI-Udo/11/2017) and all procedures were performed in accordance with the ethical standards of the Helsinki Declaration as revised in 2013.
The study took place from November 2017 to February 2018. The students were generally summoned on Wednesday afternoons, after classes between 1pm and 4pm. We were helped in this task of communication by the head of department in charge of sports and physical activities of the school.

2.2 Procedure

Before the start of each session, two lines spaced 20 meters apart were materialized. Detailed explanations on the 20m-shuttle run test were given to the students. The students were then taken to the recording stations of the anthropometric and blood pressure parameters. Two positions were set up, one for weight, height, waist circumference and the other for systolic and diastolic blood pressure.
Height was measured with a standing graduated height, with the students wearing shorts and t-shirt, and with their shoes off. Body mass was measured using a portable analogue scale (Terraillon, Tokyo, Japan). Body mass index (BMI) was calculated from height and body mass (BMI = body weight/height^2 kg/m^2) to provide an index of obesity, according to the International Obesity Task Force [21].
Resting heart rate and blood pressure (BP) were evaluated using an oscillometric device (Omron HEM-742; Omron Corporation, Kyoto, Kansai, Japan) validated for adolescents. The participants sat silently in a room with their backs leaning against a chair and their arms flexed at an angle of 90 degrees. After 5 minutes of resting, the first evaluation of resting heart rate (RHR) was performed, and after 2 minutes the second measurement was taken. The average of the two evaluations was used to determine RHR. These procedures were adopted according to the American Heart Society standards. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured concomitantly with RHR. The mean value was used.
The student's cardiorespiratory fitness level was assessed with the 20-m shuttle run test, developed by Leger *et al.* [22]. All schoolchildren were asked to run back and forth between two parallel lines, 20 m apart at outdoor track, following the pace of an audio signal that began at a speed of 8.5 km/h and increased by 0.5 km/h at every 1-min interval. Participants were encouraged at all times to run a maximal effort test. The total number of laps (shuttles) completed was recorded for each participant and VO_2max in mL/kg per min was estimated by the regression equations given by Leger *et al*. [22]
A survey sheet was completed by our assisted care of the students concerned to collect food information (breakfast, fruit consumption, practice of extrasports physical and sport activities).

2.3. Statstical analysis

All statistical analyses were conducted using SAS 5.0 (SAS Institute, INC, Inc., Cary, North Carolina, USA USA). Descriptive characteristics for all variables were calculated as means and standard deviations. The unpaired Student's t-test was used to make comparisons of anthropometric and physiological parameters between the two periods and the Wilcoxon test was used to compare low-end parameters. The level of significance was set at $p<0.05$.

3. Results

The anthropometric characteristics, blood pressure profile and cardiorespiratory fitness of the schoolchildren at baseline and at the end of three months sessions of PES are shown in Table

1.
There was a significant BMI increase ($p<0.0001$) in the schoolchildren after the three months sessions of PES. In contrast, the waist circumference had significantly decreased ($p<0.0001$). No significant differences in SBP (p=0,0187), DBP (p=0,1226), HRr (p= 0,1376) and PVO_2max (p=0,5111) were observed in the schoolchidren. The prevalence of overweight dropped to 2.5% after three months. The prevalence of obesity remained constant throughout the study (1.25%).
With respect to gender, BMI and waist circumference had significantly increased ($p<0.05$) in both genders following three months sessions of PES. PAS and PAD had significantly decreased ($p<0.05$) in Girls. As expected, boys performed better 20m-shuttlte run test (PVO_2max) while PVO_2max and HRr remained statistically the same ($p>0.05$) between pre and post-sessions of PES in all the groups (Table 2).

Table 1: Anthropometric characteristics, blood pressure profile and cardiorespiratory fitness of the schoolchildren at baseline and at the end of three months sessions of PES

Variables	Pre	Post	P
Weight (kg)	38.80±7.58	39.66±7,72^s	<0.0001
Height (m)	1.48±0.08	1.48±0,08	
BMI (kg/m^2)	17.59 ±2.45	17.99±2,53^s	<0.0001
WC (cm)	69.03±7.63	65.09±6,84^s	<0.0001
SBP (mmHg)	110±16	105±12^n	0.0187
DBP (mmHg)	73±15	70±10^n	0.1226
HRr (bpm)	92±17	95±13^n	0.1376
PVO_2max (mL/kg/min)	45.54±6.53	45.74±6.46^n	0.5111

BMI: body mass index, WC: waist circumference, SBP: systolic blood pressure, DBP: diastolic blood pressure, HRr: resting herat rate, PVO_2max: predicted maximum oxygen uptake, Pre: month O (November); Post: month 3 (February). n: non significant; s: significant difference.

Table 2: Sex-related differences in Anthropometric characteristics, blood pressure profile and cardiorespiratory fitness of the schoolchildren at baseline and at the end of three months sessions of PES

Variables	Boys		Girls	
	Pre	Post	Pre	Post
Weight (kg)	37.18±5.53	37.86±5.87^s	40.89±9.27	41.97 ±9.17^s
BMI (m^2)	17.16±1.55	17.46 ±1.64^s	18.15 ±3.21	18.66 ±3.25^s
WC (cm)	67.09±5.24	63.33±5.30^s	71.51 ±9.40	67.34±7.94^s
SBP (mmHg)	110±19	106±12^n	109±11	104±11^s
DBP (mmHg)	74±17	72±12^n	72±10	67±7^s
HRr (bpm)	89 ±19	94±14^n	95±15	96±12^n
PVO_2max (mL/kg/min)	50.19±4.08	50.48±3.71^n	39.55 ±3.47	39.65±3.34^n

BMI: body mass index, WC: waist circumference, SBP: systolic blood pressure, DBP: diastolic blood pressure, HRr : resting herat rate, PVO_2max : predicted maximum oxygen uptake, Pre : month O (november) ; Post : month 3 (bebruary) ; n : non significant ; s : significant difference.
Taking or not having breakfast had a significant positive impact ($P<0.05$) on the body composition (weight, BMI, waist circumference) of the schoolchildren after three months. It was observed that among schoolchildren who did not eat breakfast and those who had eaten, the weight, BMI, and waist circumference of students increased significantly ($P<0.05$); these increases in weight and BMI were higher for students without breakfast. DBP for schoolchildren who had breakfast had significantly decreased ($P<0.05$) during three months sessions of PES. On the other hand, no significant difference ($P>0.05$) in DBP was observed among students who did not eat breakfast. There was no significant difference ($P>0.05$) in SBP, HRr, and PVO_2max in relation to whether or not breakfast was taken among schoolchildren after three months sessions of PES (Table 3).

Table 3: Influence of breakfast on EPS relationship and some parameters (anthropometric, blood pressure, cardiorespiratory fitness)

Variables	NO		YES	
	Pre	Post	Pre	Post
Weight (kg)	39.65±9.51	40.73±9.18^s	38.95±7.70	39.85±8.05^s
BMI (kg/m^2)	17.53±2.65	18.05 ±2.58^s	17.58±2.71	17.98±2.86^s
WC (cm)	68.4±8.31	64.27±6.58^s	68.96±8.16	65.62±7.45^s
SBP (mmHg)	107±13	105±18^n	109±16	104±10^n
DBP (mmHg)	70±8	72±17^n	74±17	68±8^s
HRr (bpm)	91±20	92±12^n	93±16	96±13^n
PVO_2max (mL/kg/min)	42.22±4.85	42.57±5.80^n	44.49±6.75	44.69±6.50^n

BMI : body mass index, WC : waist circumference, SBP : systolic blood pressure, DBP : diastolic blood pressure, HRr : resting herat rate, PVO_2max : predicted maximum oxygen uptake, Pre : month O (november) ; Post : month 3 (bebruary) ; n : non significant ; s : significant difference
Regular or unplanned physical activity among schoolchildren resulted in significant increases ($p<0.05$) in weight and BMI after three months sessions of PES. WC and SBP had significantly decreased ($p<0.05$) among students who exercised regularly; no significant difference ($p>0.05$) was observed in those who did not exercised regularly in terms of WC, DBP, HRr and PVO_2max (Table 4).

Table 4: Influence of regular physical activity on the PES relationship and some parameters (anthropometric, blood pressure, cardiorespiratory fitness)

Variables	Wilcoxon (NO)		T Student (YES)	
	Pre	Post	Pre	Post
Weight (kg)	36.07±11.27	37.44±11.39 s	39.50±7.65	40.40±7.86 s
BMI (kg/m²)	16.65±2.92	17.31±2.91 s	17.68±2.65	18.08±2.78 s
WC (cm)	66.14±9.60	64±7.23 n	69.16±7.97	65.46±7.27 s
SBP (mmHg)	108±10	110±22 n	108±16	104±10 s
DBP (mmHg)	74±5	73±18 n	73±16	68±9 n
HRr (bpm)	86±17	91±12 n	93±17	96±13 n
PVO₂max (mL/kg/min)	43.28±6.22	42.85±5.86 n	44.02±6.45	44.35±6.45 n

BMI: body mass index, WC: waist circumference, SBP: systolic blood pressure, DBP: diastolic blood pressure, HRr : resting herat rate, PVO_2max : predicted maximum oxygen uptake, Pre : month O (November) ; Post : month 3 (February) ; n : non significant ; s : significant difference

Regarding fruit consumption, weight and BMI significantly increased (p<0.05) among students who consumed fruit regardless of their daily frequency after three months sessions of PES. On the other hand, no significant difference (p>0.05) was found in those who have not consumed fruit for the same parameters. WC significantly decreased (p<0.05) among students who ate fruit. The consumption or not of fruit has no significant influence (p>0.05) on SBP, DBP, HRr and PVO_2max (Table 5).

Table 5: Influence of fruit consumption per day on the EPS relationship and parameters (anthropometric, blood pressure, cardiorespiratory fitness).

Variables	1/day		2/day		3/day		Never	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Weight (kg)	37.40±7.33	38.25±7.93 s	40.50±8.14	41.61±7.46 s	41.61±9.23	42.62±9.39 s	41.25±15.34	42.4±15.84 n
BMI (kg/m²)	17.11±2.24	17.51±2.62 s	17.89±3.07	18.36±2.79 s	18.40±2,80	18.84±2.83 s	17.83±5.85	18.33±6.04 n
WC (cm)	66.84±7.63	64.19±7.37 s	70.67±8.44	67.11±7.20 s	71.40±7,20	65.10±6.84 s	71±16.97	67.50±9.19 n
SBP (mmHg)	110±18	106±12 n	109±12	104±13 n	101±10	105±10 n	109±10	85±1 n
DBP (mmHg)	75±20	70±11 n	72±9	68±12 n	67±6	68±6 n	80±6	60±3 n
PVO₂max	45.09±6.12	45.04±6.43 n	42.67±6.04	43.32±6.01 n	43.86±7.66	44.06±6.89 n	37.35±4.20	38.72±6.56 n

BMI: body mass index, WC: waist circumference, SBP: systolic blood pressure, DBP: diastolic blood pressure, HRr : resting herat rate, PVO_2max : predicted maximum oxygen uptake, Pre : month O (November) ; Post : month 3 (February) ; n : non significant ; s : significant difference

4. Discussion

The objective of this study was to evaluate changes in anthropometric parameters, blood pressure profile and cardiorespiratory fitness induced by physical education and sports (PES) sessions among cameroonian schoolchildren aged 9 to 12 years. Regarding BMI, we observed a slight increase in the percentage of normal weight schoolchildren after three months, from 88.75% in February to 92.5% in November. The percentage of obese schoolchildren (1.25%) remained the same between the two periods of the study. Overweight students were more numerous (7.5%) at the beginning of the study (November) compared to February (5%). The prevalence of underweight was 2.5% in November and 1.25% in February. These figures for obesity and overweight in particular are significantly lower than those generally found in similar epidemiological studies in Cameroon. The work of Wamba *et al.* [4], Navti *et al.* [5], Navti, *et al.* [6], Navti, *et al.* [7], Choukem *et al.* [8] reported prevalence of overweight/obesity up to 18% among schoolchildren. The size of the sample could be the major reason for these differences because the above mentioned work had a minimum size of 500 children. On the other hand, low socio-economic status has often been associated with very high prevalence of obesity/overweight [5, 8], in some countries, such as Togo [23], the prevalence of overweight/obesity in urban areas was significantly lower (4.58%). The constant prevalence of obesity between the two periods of the study can be explained by the length of time between the two data collection (three months). Indeed, this duration appears to be insufficient for PES sessions to have a significant impact on the weight status of students. It can still be observed that weight and BMI evolved significantly (p<0.05) during both periods of study in girls and boys. This can be explained by a weight gain related to a significant food intake during the christmas holiday period (December). Thus, in the second data collection (February), the impact of the one-month PES sessions could not remedy this increase in weight. But the evolution has been more marked for girls than for boys. This may be due to the pubertal period when girls have an increase in fat mass (secretion of androgens) and a decrease in lean mass, whereas in boys, there is an increase in lean body mass (secretion of testosterone) and a decrease in body fat. These results may also be associated with an increase in out-of-school physical activity or out-of-class physical activity for boys compared to girls; boys are more likely to practice various sports such as football, volleyball, basketball. For both girls and boys, the HRr and VO_2max values remained stable during the study. Even the works of Aphamis *et al.* [14] and Ardoy *et al.* [24], which involved a more or less significant duration (3 months, 9 months) in children in relation to the impact of PES sessions on the physiological repercussions have not reported significant increase in aerobic capacity. Ardoy *et al.* [24] found that significant increases in aerobic capacity occurred when these PES sessions were doubled, ie four sessions per week and only after three months. The blood pressure parameters (systolic blood pressure, diastolic blood pressure) had significantly decreased (p<0.05) in girls after three months of PES; differences that were not found in boys. The study by Ortega *et al.* [25] found an inverse relationship between good muscle fitness and the risk factors for developing cardiovascular disease (triglycerides, cholesterol, glucose) in adolescents. The PES sessions with regard to the longitudinal stabilization of the VO_2max values found in the present study show that the content of these sessions does not allow for the development of aerobic capacities but rather a development of muscular strength. And some studies report that better muscle strength is associated with a drop in blood pressure among schoolchildren and girls [26, 27]. With respect to the food survey, weight, BMI and waist circumference, significant increase (p = 0.0061) in these parameters (weight, BMI and waist circumference) was notice in those students that have eaten their breakfast as compared to those who have not eaten, where only slight increase (p = 0.0022) was detected, and therefore, would be more predisposed to obesity. In fact, the breakfast is known to be the most important meal of the day, as it follows a fasting period of 8 to 12 hours. Some studies [3, 9] have demonstrated the harmful role of the absence or irregularity of breakfast intake on anthropometric and physiological parameters in school. Obesity, overweight and low aerobic capacity in school children are therefore very often associated with a lack of breakfast. Results on the link between regular physical activity outside physical education and sport and weight status showed that waist circumference significantly decreased ($p<0.0001$) from November to February among students who performed regular physical activity but no significance (p = 0.4375) in waist circumference was found in those who did not exercise regularly. These results indicate the importance of extracurricular physical activities on improving the health of schoolchildren in general; the volume of PES sessions that appears to be insufficient for some studies to improve students' physical abilities must be accompanied by sports activities for students outside these sessions [15,19,28]. Regarding fruit consumption, the weight and BMI parameters from November to February had significantly changed among students who consumed fruit; however, no significance changes in weight and BMI was found for students who have not eaten any fruit. This result may seem surprising when we know the benefits of fruit consumption on the reduction of overweight [29]. But the explanation for this observation comes from an increase in high-calorie fruit-free meals in this group of students. On the other hand, students who have not eat fruit would have meals that are less rich in calories, thus explaining the relative constant of their weight status. PES sessions alone cannot have a significant impact on health parameters in general. PES sessions should be associated with a diet appropriate to the age and gender of the students so that the energy balance is balanced to reduce the prevalence of obesity. Our study can serve as a roadmap for conducting a health intervention on students to prevent the onset of obesity and thereby improve school health. This could reverse the epidemiological trend and have a positive impact on public health among schoolchildren.

It is plausible that a number of limitations may influenced the results obtained. First, the limited sample size did not allow us a better comparison with previous studies [4-8]. 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 relative 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.

5. Conclusion

PES sessions after three months do not have sufficient impact on the improvement of anthropometric, physiological and performance parameters in students; results that are linked to an imbalance between very high calorie dietary intakes and energy expenditure.

6. Acknowledgements

The authors wish to acknowledge all the principals, teachers and parents of children who collaborated in this study. The authors declare that there is no conflict of interests.

7. References

1. World Health Organization. Global recommendations on physical activity for health, 2010.
2. Saunders TJ, Chaput JP, Tremblay MS. Sedentary behaviour as an emerging risk factor for cardiometabolic diseases in children and youth. Can J Diabetes. 2014; 38:53-61.
3. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer- Cheung AE *et al*. Sedentary Behavior Research Network (SBRN)-Terminology Consensus Project process and outcome. Int J Behav Nutr Phys Act. 2017; 14:75.
4. Wamba PC, Enyong Oben J, Cianflone K. Prevalence of overweight, obesity, and thinness in Cameroon urban children and adolescents. J Obes. 2013; 2013737592.
5. Navti LK, Ferrari U, Tange E, Parhofer KG, Bechtold-Dalla Pozza S, Parhofer KG. Contribution of socioeconomic status, stature and birth weight to obesity in Sub-Saharan Africa: cross-sectional data from primary school-age children in Cameroon. BMC Public Health. 2014; 14:320.
6. Navti LK, Ferrari U, Tange E, Parhofer KG, Bechtold-Dalla Pozza S. Height-obesity relationship in school children in Sub-Saharan Africa: results of a cross-sectional study in Cameroon. BMC Research Notes. 2015; 8:98.
7. Navti LK, Atanga MB, Niba LL. Associations of out of school physical activity, sedentary lifestyle and socioeconomic status with weight status and adiposity of Cameroon children. BMC Obes, 2017
8. Choukem SP, Kamdeu-Chedeu J, Leary SD, Mboue-Djieka Y, Nebongo DN, Akazong C *et al*. Overweight and obesity in children aged 3–13 years in urban Cameroon: a crosssectional study of prevalence and association with socio-economic status. BMC Obes. 2017; 4:7.
9. Santos SJ, Hardman CM, Barros SS, Franca CS, Barros MV. Association between physical activity, participation in physical education classes, and social isolation in adolescents. J Pediatr (Rio J). 2015; 91:543-50.
10. Tassitano RM, Barros MV, Tenorio MC, Bezerra J, Florindo AA, Reis RS. Enrollment in physical education is associated with health-related behavior among high school students. J Sch Health. 2010; 80:126-33.
11. Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 2012; 380:247-257.
12. World Health Organization. Report of the Commission

on Ending Childhood Obesity. Geneva, Switzerland: World Health Organization, 2016.
13. Andersen LB, Riddoch C, Kriemler S, Hills AP. Physical activity and cardiovascular risk factors in children. Br J Sports Med. 2011; 45:871-6.
14. Aphamis G, Ioannou Y, Giannaki CD. Physical fitness and obesity levels during an academic year followed by summer holidays: anissue of insuficient time for physicalactivity. IJAMH. 2017; 20160137.
15. Koutedakis Y, Bouziotas C. National physical education curriculum: motor and cardiovascular health related fitness in Greek adolescents. Br J Sports Med. 2003; 37:311-14.
16. Cho M, Kim JY. Changes in physical fitness and body composition according to the physical activities of Korean adolescents. J Exerc Rehabil. 2017; 13:568-572.
17. Bika Lele EC, Pepouomi MN, Temfemo A, Mekoulou J, Assomo Ndemba P, Mandengue SH. Effet d’un effort intermittent d’intensité variable sur la variation du QT et du risque de mort subite chez des élèves camerounais. Ann Cardiol Angeiol. 2018; 67:48-53.
18. Mekoulou Ndongo, Assomo Ndemba J, Temfemo PB, Dzudie Tamdja A, Abanda A, Bika Lele MH *et al*. Pre- and post-exercise electrocardiogram pattern modifications in apparently healthy school adolescents in Cameroon. IJAMH. 2017, 20170071.
19. Rowland TW. The biological basis of physical activity. Med Sci Sports Exerc. 1988; 30:392-9.
20. Wilkin TJ. Can we modulate physical activity in children? No. Int J Obes (Lond). 2011; 35:1270-6.
21. Cole TJ, Lobstein T. Extended international (IOTF) body mass index cut-offs for thinness, overweight and obesity. Pediatr Obes. 2012; 7:284-94
22. Leger LA, Mercier D, Gadoury C, Lambert J. The multistage 20 metre shuttle run test for aerobic fitness. J Sports Sci. 1988; 6:93-101.
23. Djadou KE, Sadzo-Hetsu K, Koffi KS, Tsolenyanu E, Douti K, Afia KD *et al*. Prévalence de l’obésité en milieu scolaire urbain (Togo). Journal de pédiatrie et de puériculture. 2010; 23:335-339.
24. Ardoy DN, Fernandez-Rodrıguez JM, Ruiz JR. Improving Physical Fitness in Adolescents through a School-Based Intervention: the EDUFIT Study. Rev Esp Cardiol. 2011; 64:484-491.
25. Ortega FB, Ruiz JR, Castillo MJ, Sjöström M. Physical fitness in childhood and adolescence: a powerful marker of health. Int J Obes. 2008; 32:1-11.
26. Cohen DD, López-Jaramillo P, Fernández-Santos JR, Castro-Piñero J, Sandercock G. Muscle strength is associated with lower diastolic blood pressure in schoolchildren. Prev Med. 2017; 95:1-6.
27. Rexen CT, Ersbøll AK, Wedderkopp N, Andersen LB. Longitudinal influence of musculo-skeletal injuries and extra physical education on physical fitness in schoolchildren. Scand J Med Sci Sports. 2016; 26:1470-1479.
28. Rexen CT, Ersbøll AK, Møller NC, Klakk H, Wedderkopp N, Andersen LB. Effects of extra school-based physical education on overall physical fitness development--the CHAMPS study DK. Scand J Med Sci Sports. 2015; 25:706-15.
29. Meisler JG, Sachiko St Jeor. Summary recommendations from the American Health Foundation's Expert Panel on Healthy Weight. Am J Clin Nutr. 1996; 63:474-477.