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The Effect of Nutritional Status on the Physical Aptitude and Cardiovascular Profiles of School Children in Urban and Rural Areas of the Center Region of Cameroon

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ABSTRACT
The purpose of this study was to evaluate the effect of nutritional status on the physical aptitude and cardiovascular profiles of school children in urban areas of the center region of Cameroon. The study design was that of experimental model. 747 children, 384 males (51.4%) and 363 females (48.6%) took part in the study. Data was collected by determining the Body Mass Index (BMI) to assess the nutritional status of the children. Systolic blood pressure (SBP), Diastolic blood pressure (DBP), Heart rate (HR) was obtained as cardiovascular parameters while some conventional physical tests were conducted for physical aptitudes of the children. Applying descriptive (mean scores and standard deviation) and inferential (Independent T-test) statistics to analyzed data, the results revealed the following: Firstly, in the normal nourished population, mean SBP, DBP and HR was higher and statistically significant in urban area than in rural area as shown in the student test (t=12.63, P<0.0001), (t=12.46, P<0.0001) and (t=7.981, P<0.0001) respectively. Secondly, with respect to age, we observed a significant difference (p<0.001) of SBP and DBP in the 6-10 years and >10years age group categories. The mean VO2 max (ml.g-1) in the >10 years age category was higher than that in the category of 6-10 years with a high statistical significance (t=8.059, P<0.001). Still in the same population, the mean 30m dash(s) was higher in rural areas than urban areas with a good significance difference (t=2.999, P=0.0030). Lastly, the mean broad jump was highly significantly (t=10.34, P<0.0001) higher in rural areas than in urban areas. In conclusion, we could deduce that nutritional status dan impact on the physical aptitude and cardiovascular profiles of school children in the urban and rural areas of the center Region of Cameroon. The fundamental recommendation was the need for the government to ensure a frequent systematic control of the cardiovascular profile of children in our school milieu in order to avoid sudden emergencies at adult ages.

1. Introduction

Few challenges facing the global community today match the scale of malnutrition, a condition that directly affects one in three people (Srivastava *et al*, 2016). Each country in the World today faces a serious public health challenge arising from malnutrition. According to UNICEF 2019, millions of children are eating less than what they require and million still consume more than what their system needs. The study further states that food and nutrition, Malnutrition remains a triple burden (under nutrition, hidden hunger and overweight) in the world today, with at least one in three children under five either stunted, wasted or overweight; one in two children under five suffering from hidden hunger; with an increasing prevalence of overweight children globally. Malnutrition is a phenomenon resulting from an inadequate or excess in the supply of energy and/or nutrients. Malnutrition can leave an entire nation unproductive (ghvanidze *et al*, 2016).

Malnutrition manifests itself in many different ways such as poor child growth and development, skinny individuals or people prone to infection, overweight or individuals whose blood contains too much sugar, salt, fat, or cholesterol; or those who are deficient in important vitamins or minerals (Chattopadhyay, 2016).

Components of physical fitness are determinants of the degree of the condition of everyone. Someone said to be fit if in carrying out daily activities without experiencing significant fatigue. Student activities such as playing games and watching television at home make them do not have much time to do activities that can improve physical fitness. This affects students' eating routines and movement activities and allows for underweight (thin) and obesity in students (Dollman, Norton, and Norton, 2005). The energy causes the thin body condition of the student expended higher than the amount of energy entered. Meanwhile, obesity in children occurs because of the imbalance between the incoming energy with the energy consumed (Speiser *et al*, 2005). This means that the student eats a lot but lacks physical activity.

Nutritional problems are caused by an imbalance between nutritional intake or adequacy needs (Meyers, Hellwig, and Otten, 2006). Nutritional status can be determined through laboratory and anthropometric tests. Anthropometry is the easiest and cheapest way to determine nutritional status. Body Mass Index (BMI) is recommended as a good indicator to assess the nutritional status of adolescents.

Global childhood obesity rates have considerably increased (Yanovski, 2018). From 1975 to 2016, the prevalence of obesity among children aged 5–19 increased from 0.7 to 5.6% in boys and from 0.9 to 7.6% in girls (Lima, 2021). In 2016, an estimated 12.4 million children were classified as obese (Lima, 2021).

Previous studies have found that poor physical fitness and obesity are important factors for high blood pressure, coronary heart disease, and stroke (Akil, Ahmad, 2011; VenckunasT, Emeljanovas, Mieziene, Volbekiene 2017). Although the symptoms usually manifest in midlife, these diseases develop progressively over time, with some signs appearing as early as childhood or adolescence (VenckunasT, Emeljanovas, Mieziene, Volbekiene 2017). It is important to establish high fitness potential and sustainable lifestyle habits during childhood and adolescence.

Poor physical fitness in children deserves further attention. According to a review of 137 studies conducted in 19 countries, cardiorespiratory fitness in children aged 9–17 decreased significantly in most countries between 1981 and 2014, as measured by the 20-m shuttle run test (Tomkinson, Lang, Tremblay, 2019).

Likewise, Nutritional status being a state of the body in relation to nutrition has clinical (marasmus and kwashiorkor, goiter), anthropometric (based on body measurement) and biochemical indicators. Its permit us to determine if an individual is overweight, underweight or normal weight. The consumption of a balance diet has a great impact on nutritional status. Age, gender, household characteristics, dietary intake and health status are some of the factors that determine the nutritional status of children (Dohbobga *et al*, 2015).

Some scientists have equally demonstrated that there exists a concrete link between nutritional profile, physical aptitude (a good marker of the health condition in children and adolescents), growth level, mental development, cardiovascular risk factors and school performance (Cole *et al*, 2000) with boys at different age groups being physically apt than girls and performing better in assessment tests (Chung *et al*, 2013; Ortega *et al*, 2010).

1.1. Focus of the study

In recent years there has been an increasing number of cases associated with cardiovascular disease (CVD) that, according to the World Health Organization (WHO), are the leading cause of death worldwide. Several studies have shown that the most important factors in the appearance of overweight and child obesity are inadequate eating habits and physical inactivity especially in urban areas. These prevalence of overweight (OW) and obesity (OB) in children has also increased, which is a cause for concern, not only for its short-term consequences, but also for their health condition in adulthood (Freedman, Dietz, Srinivasan, Berenson, 1999; Uscátegui Peñuela et al, 2003) as it is closely linked to the subsequent development of cardiovascular disease, increasing the risk of mortality at a young age. It has been reported that there is a link between the nutritional profile, level of growth, physical aptitude, mental development, cardiovascular risk factors and school performance (Cole, Bellizzi, Flegal, Dietz, 2000). In this context, the purpose of this study is to investigate on the effect of nutritional status on the physical aptitudes and cardiovascular profiles of school children in rural and urban areas of the center region of Cameroon.

1.2. Methodology

2.1. Participants

The research was carried out in the 2021-2022 school year in some rural and urban areas of the center region of Cameroon more precisely at Bikok and Plateau Atemengue of Yaounde city respectively. 747 children of both sexes schooling in Yaounde and Bikok participated in the study.

2.2. Procedure

The study was a cross-sectional survey on school children from January to March 2021. At each study site, a sensitization talk was organized with the school authorities to explain the purpose and potential benefits of the study (lessons on importance of good eating habits and physical exercises). Informed consent forms were sent to parents/guardians through the children stating the purpose of the study as well as the benefits. Only children who brought back signed informed consent forms were included in the study. However, children who were sick and also those whose ages were less than six or more than seventeen years were not included in the study. The permission to carry on the study was obtained from the regional delegations of Basic and Secondary education for the center region of Cameroon. And also, permissions from the school management, parents and the children were obtained. Investigative methods included a questionnaire approach as well as measurement of anthropometric, cardiovascular and physical aptitude parameters of the children.

2.3. Instruments

Age and gender of the children were recorded in a structured questionnaire. Interviews were done in French and exceptionally in the best understood language. The age of each child was calculated from date of birth and confirmed from the school registers as entered by parents based on the information in the birth certificate.

In relation to cardiovascular parameters, before physical exercise, each participant's blood pressure was measured on the right arm by a nurse using an Omron BP 742N 5 series upper arm Blood Pressure Monitor. The systolic and diastolic blood pressures as well as the heart rate were measured twice and the mean value was recorded.

As concerns anthropometric parameters, the children's heights were measured with an Accustat Ross stadiometer (Genentech, Inc South San Francisco, CA). Each participant was instructed to stand erect with the heels, buttocks, shoulders and occiput against the stadiometer, so that the external auditory meatus and lower border of the eye sockets were in the same horizontal plane. The headboard was brought down to touch the head, and the height was read off the stadiometer. The measurements were recorded to the nearest 0.1 cm. Body weight was measured while the child was in light clothing to the nearest 0.1 kg using a Seca 813 Robusta High Capacity Digital floor scale. The body mass index was calculated using the body weight in Kg divided by the square height in m^2.

In relation to the determination of nutritional status**,** anthropometric indices were expressed in relationship to the reference population in statistical terms of standard deviations from the median. Using the Z-scores as described by (Bundy et al,2006) we were able to describe how far a child's weight was from the median weight of a child at the same height in the reference value and further deduced whether a child was malnourished or normonourished. The nutritional status was assessed by the WHO growth reference for school-aged children and adolescents to monitor the nutritional status of children aged 6 to 17 years (De Onis, Onyango, Borghi, et al,2007)

The physical aptitude of the participants was assessed using the following tests: the six minutes' walk test (6 MWT) to estimate the aerobic capacity and a 30-meter track to assess the children's speed. The participants were instructed to walk to their pace as far as possible in six minutes without running and at the end of the six minutes, a whistle was blown for them to stop and the distance covered by each child was recorded. The 30 m shuttle test was done on a 30-meter track with cones placed at the beginning and the end of the 30m track. The children were asked to run at maximum speed and time was recorded with a stop watch.

The broad jump (BJ) test was used to quantify the explosive strength of the participants. Here, the child stood behind the starting line, with feet together, and pushed off vigorously and jumped forward as far as possible. The distance was measured from the take-off line to the point where the back of the heel nearest to the take-off line landed on the floor. The test was repeated twice, and the best score was recorded (in cm).

2.4. Analysis of Data

In this study, the data was first entered into an excel spread sheet and later it was analyzed using a graph pad prism. It was then summarized into mean ± standard deviation for age, weight, height, SBP, DBP, HR. Pearson's correlation coefficients were then used to study the correlation between BMI (z score) and cardiovascular parameters, physical parameters and comparison between these relationships in rural and urban areas. Differences that were significant were recorded at $p<0.05$ and insignificant values at $p>= 0.05$.

3. Findings

The purpose of this study is to research on the influence of nutritional status on the physical aptitudes and cardiovascular profiles of school children in the rural and urban areas.

Table 1. Nutritional status and cardiovascular parameters as affected by sex

Factor	Category	N	Mean Cardiovascular parameter					
			SBP (mmHg)		DBP (mmHg)		HR (pulse/min)	
			Value	Test	Value	Test	Value	Test
Wasted	Male	9	100.556±14.282	t=0.8073	63.333±15.902	t=1.289	88.889±9.562	t=0.1701
	Female	12	105.083±28.949	P=0.4428	59.833±16.627	P=0.2334	91.667±10.656	P=0.8692
Normal	Male	301	107.810±18.825	t=1.925	61.256±16.266	t=0.8616	83.443±13.380	t=0.6972
	Female	251	103.139±22.265	P=0.0591	58.215±17.551	P=0.3373	84.227±14.392	P=0.4863
Over-weight	Male	62	112.500±19.399	t=1.925	63.250±15.601	t=0.6732	84.650±13.860	t=2.198
	Female	88	113.144±22.321	P=0.0591	66.833±17.846	P=0.5034	89.467±14.439	P=0.0319
Obese	Male	12	121.500±23.052	t=0.4251	74.333±14.511	t=1.671	98.083±11.807	t=1.819
	Female	12	117.833±17.189	P=0.6790	63.167±18.721	P=0.1228	89.833±10.399	P=0.0962

Difference of mean between sex groups as determined by student test (t)

As shown on the table above, among the 21 wasted children, there were no significant differences between the males and the females in the SBP, DBP and HR as shown in the student test (t=0.8073, P=0.4428), (t=1.289, P=0.2334) and (t=0.1701, P=0.8692 respectively.

As for the 552 normal nourished children, the difference was insignificantly higher in the males than the females in the SBP, DBP and HR as shown in the student test (t=1.037, P=0.3007), (t=0.8616, P=0.3373) and (t=0.6972, P=0.4863) respectively.

As for the 150 overweight children, the difference was insignificant higher in the females than the males in the SBP and DBP as shown in the student test (t=1.925, p= 0.0591) and (t=0.8616, P=0.3373) and (t=0.6732, p=0.5034) respectively. With regards to the HR, the difference was statistically significant (t=2.198, p=0.0319).

Lastly in the 24 obese children, between the males and the females in the mean SBP, DBP and HR, there was no statistical significance as shown in the student test (t= 0.4251, p=0.6790), (t=1.671, p=0.1228) and (t=1.819, p=0.0962) respectively.

Table 2. Nutritional status and cardiovascular parameters as affected by age

Factor	Category	N	Mean Cardiovascular parameter					
			SBP (mmHg)		DBP (mmHg)		HR (pulse/min)	
			Value	Test	Value	Test	Value	Test
Wasted	6 – 10	11	94.091±16.239	t=0.1369	57.091±18.637	t=1.035	85.73±10.30	t=2.072
	> 10	10	113.100±26.842	P=1.633	66±11.916	P=0.3275	95.70±8.50	P=0.0681
Normal	6 – 10	246	96.984±20.446	t=7.816	54.565±18.540	t=5.295	84.30±13.95	t=0.65
	> 10	306	112.621±17.881	P<0.0001	64.098±14.136	P<0.0001	83.50±13.81	P=0.51
Overweight	6 – 10	69	104.721±18.918	t=3.061	59.603±16.413	t=1.964	89.426±13.495	t=1.349
	> 10	81	117.775±21.052	P=0.00321	67.838± 16.854	P=0.0537	86.475±13.963	P=0.1819
Obese	6 – 10	15	115.533±21.039	t=0.1216	67.733±117.620	t=0.2699	95.067±11.234	t=1.091
	> 10	9	126.556±17.257	P=0.9062	70.444± 17.582	P=0.7941	92.111± 12.635	P=0.57

Difference of mean between age groups as determined by the student test (t)

With regard to the wasted children, the difference was insignificantly higher in children >10 years compared to those of age 6-10 years in SDP, DBP and HR as shown in student test (t=1.633, p=0.13691), (t=1.035, P=0.3275) and (t=2.072, P=0.0681).

As for the cardiovascular profiles in the normal nourished children, there was a very high statistical significance in the children of age >10 years than the children of age 6-10 years in SDP and DBP as shown in the student test of t=7.816, P<0.0001 and t=5.295, P<0.0001 respectively. HR was insignificantly (t=1.349, P=0.1819) higher. the children of age 6-10 years as compared to that of age >10 years.

In the overweight children, the difference was very insignificantly higher in children > 10 years compare to that of age 6-10 years in SDP and DBP as determined by student test (t=3.061, P=0.0032) and (t=1.964, P=0.0537) respectively. HR on its part was statistically insignificantly higher (t=1.349, P=0.1819) in the children of age 6-10 years as compared to those age >10 years.

Lastly, in the obese children, the difference was very insignificantly higher in children > 10 years compare to that of age 6-10 years in SDP and DBP as determined by student test (t=0.1216, P=0.9062) and (t=0.2699, P=0.7941) respectively. HR on its part was statistically insignificantly higher (t=1.091, P=0.3069) in the children of age 6-10 years as compared to those age >10 years.

Table 3: Nutritional status and cardiovascular parameters in rural and urban areas

Factor	Category	N	Mean Cardiovascular parameter					
			SBP (mmHg)		DBP (mmHg)		HR (pulse/min)	
			Value	Test	Value	Test	Value	Test
Wasted	Rural	17	101.824± 25.942	t=2.124	59.412±17.412	t=0.4023	88.941±10.349	t=1.414
	Urban	4	108.750±10.034	P=0.1237	69.500±6.576	P=0.744	97.00±6.964	P=0.2522

Normal	Rural	245	93.976±17.140	t=12.63	49.996±13.138	t=12.46	78.935±10.912	t=7.981
	Urban	307	114.971±18.225	P<0.0001	67.713±15.424	P<0.0001	87.726±14.690	P<0.0001
Overweight	Rural	52	97.373±19.367	t=5.286	52.510±15.462	t=5.618	79.922±9.573	t=6.739
	Urban	98	119.351±17.814	P<0.0001	70.124±14.704	P<0.0001	91.990±13.907	P<0.0001
Obese	Rural	3	105.667±19.956	t=1.052	46.333±21.823	t=0.5128	92.667±19.737	t=0.5049
	Urban	21	121.667±19.684	P=0.4031	71.952±14.358	P=0.6591	94.143±10.246	P=0.6638

In the wasted population, the mean value of SBP, DBP and HR was higher and statistically insignificant in urban area as compared to rural area as shown in the student test (p=0.1237, t=2.124), (p=0.1237, t=2.124 and (P=0.2522, t=1.414) respectively

In the normal nourished population, mean SBP, DBP and HR was higher and statistically significant in urban area than in rural area as shown in the student test (t=12.63, P<0.0001), (t=12.46, P<0.0001) and (t=7.981, P<0.0001) respectively

With regard to the overweight children, the mean SBP, DBP and HR was higher and statistically significant in urban area than in rural area as shown in the student test (t=5.286, P<0.0001), (t=5.618, P<0.0001) and (t=6.739, P<0.0001) respectively

Lastly, in the obese children, the mean SBP, DBP and HR was higher and statistically insignificant in urban area than in rural area as shown in the student test (t=1,052, P=0.4031)., (t=0,5128, P=0.6591) and (t=0.5049, P=0.6638) respectively

Table 3: Nutritional status and physical aptitudes in relation to sex

Factor	Category	N	Mean Physical aptitude					
			VO2max (ml.g^{-1})		30m dash(s)		Broad jump(m)	
			Value	Test	Value	Test	Value	Test
Wasted	Male	9	24.119± 6.819	t=2.2590	6.379± 1.283	t=1.186	1.728± 0.289	t=0.4112
	Female	12	29.455± 2.613	P=0.0538	5.991±0.689	P=0.2697	1.563± 0.409	P=0.6917
Normal	Male	301	27.126± 4.816	t=0.8186	5.845± 1.174	t=5.122	1.784± 0.374	t=0.5698
	Female	251	26.567± 4.848	P=0.4138	6.423± 0.950	P<0.0001	1.723± 0.443	P=0.5694
Overweight	Male	62	26.048± 4.003	t=0.8429	5.949± 1.052	t=1.316	1.716± 0.328	t=1.441
	Female	88	26.009± 4.313	P=0.4027	6.140± 0.714	P=0.1902	1.652± 0.353	P=0.1548
Obese	Male	12	22.598± 2.277	t=2.160	6.635± 1.248	t=0.9490	1.566± 0.306	t=0.3074
	Female	24	24.818± 2.646	P=0.537	6.237± 0.677	P=0.3630	1.517± 0.426	P=0.7643

Student test (t) to determine the difference of mean between sex groups

Mean VO_2max was insignificantly (t=2.2590, P=0.0538) higher in the female wasted children as compared to the male wasted children. For the 30m dash test, its mean value was higher in males than in females even though not statistically significant as reviewed by the student test (t=1.186, P=0.2697). As for the broad jump test in the wasted children, its mean value was insignificantly (t=0.4112, P=0.6917) slightly higher in males than in females.

In the normal nourish children, the mean VO_2max was higher in males (27.126± 4.816) than in females with a difference statistically insignificant (t=0.8186, P=0.4138). As for the 30m dash test, its mean value was higher in females than in males with a high statistical significance of t=5.122, P<0.0001. Mean broad jump result was higher in male than in females but statistical insignificance (t=0.5698, P=0.5694).

In the overweight population, the males had an insignificantly (t=0.8429, P=0.4027) higher mean VO2max than the females; female had a statistically insignificant (t=5.122, P=0.1902) higher value of mean 30m dash test than males while for the Mean broad jump result, male had a higher mean value than female even though statistically still insignificant (t=1.441, P=0.1548).

Finally in the obese children, the mean value of VO2max was insignificantly (t=1.316, P=0.0537) higher in females than in males. With regard to the 30m dash test, its mean value was statistically insignificantly (t=0.9490, P=0.3630) higher in females than in males while for the broad jump text, its mean value was higher in males than in female with no statistical significance (t=0.3074, P=0.7643).

Table 4: Nutritional status and physical aptitude as affected by age

Factor	Category	N	Physical aptitude					
			VO2max(ml.g^{-1})		30m dash(s)		Broad jump(m)	
			Value	Test	Value	Test	Value	Test
Wasted	6 – 10	11	25.750± 6.938	t=1.248	6.526± 1.097	t=2.529	1.755± 0.389	t=1.449
	> 10	10	28.728± 2.664	P=0.32523	5.751± 0.698	P=0.0393	1.50± 0.299	P=0.1905
Normal	6 – 10	246	25.315± 5.510	t=8.059	6.752± 0.984	t=13.80	1.682± 0.480	t=2.916
	> 10	306	28.134± 3.776	P<0.001	5.587± 0.928	P<0.0001	1.815± 0.331	P=0.0039
Overweight	6 – 10	69	25.580± 4.726	t=2.137	6.336± 0.918	t=4.282	1.600± 0.389	t=1.496
	> 10	81	26.850± 3.738	P=0.0363	5.833± 0.752	P<0.0001	1.704± 0.283	P=0.1394
Obese	6 – 10	15	23.123± 2.893	t=2.049	6.715± 1.069	t=1.827	1.573± 0.409	t=0.2964
	> 10	9	24.683± 2.017	P=0.0746	5.97± 0.738	P=0.1051	1.488± 0.292	P=0.7745

Student test (t) to determine the difference of mean between age groups

The wasted children had a mean VO2 max (ml.g^{-1}) higher in the population of age > 10 years (28.728± 2.664) as compared to that of age 6-10 years with a difference not statistically significant (t=1.248, P=0.2523). The mean 30m dash(s) was rather insignificantly (t=2.529, P=0.0393) higher in children of age 6-10 years as compared to those of age >10 years. As for the broad jump (m), its mean value was higher in the category of 6-10 years as compared to the category of >10 years even though of no significance as determined by student test (t=1.449, P=0.1905).

For the normal nourished children, the mean VO2 max (ml.g^{-1}) in the >10 years age category was higher than that in the category of 6-10 years with a high statistical significance (t=8.059, P<0.001). The mean 30m dash(s) value was higher in the category of 6-10 years as compared to their >10 years counterpart with a high statistical significance (t=13.80, P<0.0001) while conversely, the mean value of Broad jump (m) was significantly (t=2.916, P=0.0039) higher in the >10 age category as compared to the 6-10 years category.

With regard to the overweight population, mean VO2 max (ml.g^{-1}) was significantly (t=2.137, P=0.0363) higher in the category of >10 years as compared to that of 6-10 years; mean 30m dash(s) was rather significantly (t=4.282, P<0.0001) higher in the 6-10 years category as regard the >10 years category while mean broad jump (m) was insignificantly (t=1.496, P=0.1394) higher in >10 years category than in 6-10 years category.

The obese children had a mean VO2 max (ml.g^{-1}) higher in the >10 years category as compared to 6-10 years category even though of no statistical significance (t=2.049, P=0.0746) while the mean 30m dash(s) was insignificantly (t=1.827, P=0.1051) higher in children of age 6-10years as compared to their counterpart. The mean Broad jump (m) on its part had an insignificantly (t=0.2964, P=0.7745) higher value in the 6-10 years category as compared to the >10 years category**.**

Table 4. Nutritional status and physical aptitude in rural and urban areas

Factor	**Category**	**N**	**Mean Physical aptitude**						
			VO2max(ml.g^{-1})			30m dash(s)		Broad jump(m)	
			Value	Test		Value	Test	Value	Test
Wasted	Rural	17	27.790± 5.909	t=0.0788 P=0.9422		6.06± 0.838	t=0.01944 P=0.9857	1.7058± 0.354	t=2.517 P=0.864
	Urban	4	24.526± 2.173			6.565± 1.459		1.325± 0.277	
Normal	Rural	245	28.676± 5.111	t=9.595 P<0.0001		6.325± 1.006	t=2.999 P=0.0030	1.906± 0.407	t=10.34 P<0.0001
	Urban	307	25.443± 4.071			5.932± 1.167		1.636± 0.370	
Overweight	Rural	52	29.564± 4.476	t=7.621 P<0.0001		6.020± 0.798	t=1.002 P=0.3213	1.860± 0.337	t=6.674 P<0.0001

	Urban	98	24.533± 2.922			6.088± 0.904		1.549± 0.289	
Obese	Rural	3	26.297± 3.091	t=0.5670 P=0.6279		5.74± 0.516	t=3.526 P=0.0719	1.73± 0.206	t=0.1022 P=0.9279
	Urban	21	23.338± 2.432			6.535± 1.040		1.514± 0.382	

Student test (t) to determine the difference of mean between level of urbanization group

In the wasted children, the Mean VO2max (ml.g^{-1}) was higher in rural areas (27.790± 5.909) than in urban area with a highly insignificant difference (t=0.0788, P=0.9422). As for the 30m dash(s), its mean value was insignificantly (t=0.0944, P=0.9857) higher in urban areas than in rural areas of the same population while the mean broad jump was also insignificantly (t=2.517, P=0.864) higher in rural areas than in urban areas.

With reference to the normal nourished population, the mean value of VO2max (ml.g^{-1}) was higher in rural areas than in urban areas and this difference was highly significant (t=9.595, P<0.0001). Still in the same population, the mean 30m dash(s) was higher in rural areas than urban areas with a good significance difference (t=2.999, P=0.0030). Mean broad jump was equally highly significantly (t=10.34, P<0.0001) higher in rural areas than in urban areas.

In the overweight population, mean VO2max (ml.g^{-1}) was highly significantly (t=7.621, P<0.0001) higher in rural areas than in urban areas, mean 30m dash(s) was insignificantly (t=1.0062, P=0.3213) higher in urban area than in rural area and the mean Broad jump(m) higher in rural areas than the urban areas with a high statistical significance (t=6.674, P<0.0001)

In the obese children mean VO2max (ml.g^{-1}) was insignificantly (t=0.5670, P=0.6279) higher in rural area than in urban area, mean 30m dash(s) higher in urban area than rural area even though the difference was not significant (t=3.526, P=0.0719) while mean broad jump was also insignificantly (t=0.1022, P=0.9279) higher in rural area than in urban area.

4. DISCUSSION

With regards to the influence of nutritional status on SBP, DBP and HR with respect to sex, even though there was no statistical significance, the SBP, DBP and HR of males in the overall population was higher than those of their female counterpart. This doesn't go in line with the findings Hussein et al, 2018 which demonstrated a strong effect of BMI on SBP and DBP. Our study however goes in line with that of Din- Dzietham et *al* 2007, Dasgupta et *al*, 2007; Martin et *al*, 2004 who stated that family history of hypertension or CVD, Male sex and maternal smoking during pregnancy are additional risk factors, whereas children who were breastfed have a reduced risk of hypertension. Research shows that overweight and obese adolescents have more body fat and high blood pressure than normal weight adolescents (Menacho et *al*, 2014) and a strong relationship between BMI and blood pressure is well established for both SBP and DBP (Nwachukwu et *al*, 2010).

With respect to age, we observed a significant difference (p<0.001) of SBP and DBP in the 6-10 years and >10years age group categories in the normonourished children. These results were almost similar to those obtained in the North region with a significance difference of p=0.001 in the >10years age group category (Dohbobga et *al*, 2015). This finding also goes in line with those obtained by Paradis et al, 2004 which stipulated that the nutritional status was consistently associated with increase in SBP and DBP in all age- gender groups.

In relation to level of urbanization, this study demonstrates that mean SBP, DBP and HR were higher in urban areas of the overall population than in rural areas, with significant differences in normonourished (p<0.0001) and overweight populations (p< 0.0001). This goes in line with the study of Dohbobga et al, 2015 on the influence of nutritional status on the physical aptitude and cardiovascular profiles of school children in rural and urban areas of North Cameroon and that of Armstead et *al*, 2010 on affects of urbanicity on blood pressure and HR reactivity to a speech stressor in Cameroon. Typically, urban areas are narked by challenges that needs coping spirit. Increase exposure in sub-cultures, financial stress, redefining of cultural identity and movement away from traditional coping mechanisms may lead to stress among inhabitants in the urban areas. Studies suggest that urban- rural differences may expose urban inhabitants to increase level of chronic stress thereby putting individuals at higher risks for deregulated sympathetic nervous activation (Majane et *al*, 2007; Fezeu et *al*,2007).

In relation to nutritional status and physical aptitude with respect to sex, Nhantumbo et al, 2010 stated that nutritional status is related to physical fitness. From our data and after statistical analysis, we observed that nutritional status is associated with physical fitness. Our statistical analysis shows that even though of no statistical significance differences in males and in females, males performed better in 6MWT and broad jump than their female counterparts. These results are almost similar to those obtained in the North of Cameroon (Dohbobga et al, 2015) even though their results showed a statistical significance. This better performance in males than in females can be explained by the fact that male have greater muscular mass, bone density, less body fat (Monyeki et al, 2008) and high ability to achieve better performance than females (Ortega et al, 2010). Research states that age, sex and health status have more influence on the 6MWT than height and weight (Maja et al, 2013) and that an increase in anaerobic and aerobic functional capacities are higher in boys than girls and this is necessary to achieve the oxygen demand for the higher amount of skeletal muscle mass in boys (Ursina et al, 2014). Pangrazi and Corbin, in 1990 indicated that boys perform better than girls in explosive strength, muscle endurance and speed. This could also be as a result of socio- cultural differences. Generally, girls are encouraged to carryout passive activities while boys are encouraged to carry out physical activities via sports that implicates physical competition (Castaneda-Abascal, 2007).several differences come into play during the period of adolescence as a result of the influence of gonadal steroid growth hormone necessary for sexual development and morphological differences in boys and girls which results in difference in physical activity and muscle strength during adolescent periods in boys and girls (Rogol et al, 2002)

With respect to age, this study revealed that normonourished children showed significant difference in the older and younger populations in 6MWT, Broad- jump and 30m dash. Similar results were also obtained with 6MWT and 30m dash in the overweight population. Generally, the older population performed better than their counterpart in the 6MWT and Broad jump. Contrarily, the younger population performed better in 30m dash test than their older counterpart. The better performance in the 30m dash can be explained by the fact that sprint speed is positively affected by age, especially after childhood. This is affected by the efficient energy transfer from the hip to the ankle joint and by other factors such as optimization of the stride length and frequency, muscle morphology and architecture, neuromuscular coordination, training and age (Kotzamanidis et al, 2005). Other factors that can better explain these differences in sprint speed can be maturation of the neuronal system, improved coordination between agonists and antagonists muscle (Morgan et al, 2004). The age difference in physical fitness can be explained by the fact that older children have greater bone densities and muscle mass than younger children (Monyeki et al, 2008). These differences in body composition become greater with increase in age, with a significance difference obtained within age groups >10years.

With respect to level of urbanization**,** from statistical analysis, mean VO_2 max and broad jump were higher in rural areas as compared to urban areas. In the normonourished and overweight population (except for 30m dash test in the overweight population), we obtained significant differences ($p<0.0001$) of VO_2 max, 30m dash and broad jump in rural and urban areas. Even though of no statistical significance, 30m dash was higher in urban areas than in rural areas in the overall population. Our results go in line with those obtained in the North of Cameroon (Dohbobga et al, 2015). This can be explained by the fact that urban children practice a more sedentary life, most of them go to school and back on cars or bikes, spent most of their time watching TV which turn to reduce their physical strength contrarily to rural children who mostly walk on foot to school and back, accompany their parents to long distance farms which render them more physically active hence better performance in physical fitness tests.

5. CONCLUSION

Nutritional status has an influence on the physical aptitude and cardiovascular parameters of school children living in rural and urban areas of the centre region and this influence slightly differ in rural and urban areas of the centre region of Cameroon.

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