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Parent's Adiposity, Better Predicts Their Child's Adiposity than Socio-economic Status in a Sample of 2689 Children Aged 8 to 15 Year in Urban Area in Cameroon: A Pilot Study

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Authors' contributions

This work was carried out in collaboration between all authors. Authors MCNS and PCFW were responsible for design of the project, direct collection of the data, data and statistical analysis, manuscript preparation. Authors JLN, KC and JO contributed to study design, and manuscript preparation. All authors read and approved the final manuscript.

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ABSTRACT

Background: Cameroon, as many Sub-Saharan African countries, is undergoing epidemiological transition. Parents as well as well their children are getting overweight and obese, mainly in large cities.
Aims: This was a pilot study to identify the relationship between parents, environment and children body size in urban Cameroon.
Study Design: This was a cross sectional study.
Place and Duration of Study: In year 2010, between February and May. 25 selected schools in urban areas.

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Methods: Over three thousand and three hundred school age children were selected during investigations, including about 51.8% girls. The questionnaire used was set as follows (i) identification, (ii) collection of parent's information as ethnicity (region of origin), education, occupation, income and (iii) detailed information on children and anthropometrics. Body sizes were defined using the International Obesity Task Force (IOTF). Finally, 2689 children (52.2% Girls) were pooled for further analysis.
Results: Positive correlation was observed between child adiposity and pocket money; as with BMI for girls (r=0.342, P<0.001) and boys (r=0.225, P<0.001). Boys adiposity was correlated to family size (BMI, r=0.181, P<0.05), with gestational age at birth (waist, r=0.214, P<0.05) and birth weight (waist, r=0.293, P<0.01). Girl's adiposity did not show such associations. Mothers' adiposity was more correlated to girl's adiposity (waist, r=0.184, P<0.01 and BMI, r=0.183, P<0.01) as compared to boys. While no significant relationship was observed between parents' education level, occupation, and income. Considering ethnicity, parents' of west region were up to 3.2 times more at risk of having heavy children (all P=0.01).
Conclusions: In Cameroon urban area, parent's ethnicity and body size are better predictors of their child's adiposity. This pilot study highlight that further investigations are required to evaluate the contribution of each factor.

Keywords: Thin; overweight; nutrition; environment; parents; Cameroon.

1. INTRODUCTION

There are several factors associated with child adiposity in the literature. These include geographic and socioeconomic gradients, children's lifestyle, factors related to parents, family and schools [1,2]. Body size defined with body mass index (BMI) and waist (WC) showed strong association with socioeconomic status in a recent study [3,4]. Exposition to urban rather than rural areas of Cameroon was also strongly associated with changes in prevalence of central obesity between 1994 and 2003 at up to +32% and+190% for women and men respectively [5]. The changes in diets from traditional rural to urban westernized diets rich in fat and carbohydrate are know well documented [6,7,8].

Cameroon as many sub-Saharan countries is facing rapid social changes due to economic push, this lead into a double burden of malnutrition with the co-existence of under-nutrition and obesity in the same social strata [9,10]. In fact, increases in childhood overweight and obesity have become major public health problems in the industrialized world as well as in many developing countries undergoing rapid social changes [11]. In childhood and adolescence, the prevalence of overweight and obesity has more than doubled in some countries [12]. According to previous studies, urban areas of Cameroon are characterized by increasing rate of overweight and obesity around 8% to 11% depending on the socioeconomic status [7]. At the other end, the prevalence of under-nutrition, especially in the lower social milieu is of particular importance [13]. Hunger is still being a problem in Cameroon due to socioeconomic disparities [14].

Cameroon, like many Sub-Saharan African countries, is undergoing epidemiological transition, characterized by an ageing population with increasing cardiovascular diseases and type 2 diabetes mellitus [15,16], coupled to over-nutrition [3,5,17] and adoption of westernized lifestyle [18]. Inappropriate nutrition in urban areas [19,20] and lifestyle with less physical activities [21], due to rapid and inadequate socio-economic changes, are the first targets in addressing body weight issues.

Preliminary prior studies in rural as well as urban children and adolescents have been conducted in Cameroon [7,9,19,22], but these were limited both in age range and sample size. Our hypothesis was that body size in children and adolescents of urban milieu may be influenced by environmental and socioeconomic factors. The objective of this pilot study was to identify the relationship between children and adolescents' body size and environmental factors in urban Cameroon in a large sample.

2. SUBJECTS AND METHODS

2.1 Sampling

A population-based cross-sectional study was conducted among primary and high school children aged 8 to 15 between February and May 2010. Large city in Cameroon can have up to 92.6% urbanization rate and more than 2 million

inhabitants with about 425573 children (212639 boys and 212934 girls) aged 6 to 14 years old [6].

A stratified, multistage cluster sample of 3239 children aged 8 to 15 in thirty primary and high schools was enrolled. Stratified sampling, based on the population and educational system characteristics, was used to have proportionate representation of gender, area of residence and socioeconomic status (SES). The list of all public and private primary and high schools was provided by the authorities of Education. The listed schools were classified according to the administrative sub-divisions and yearly fees of schools. Every stratum included private and public schools. In Cameroon, primary public school is free of charge, it supplies low SES urban and rural children while high SES and middle SES urban children are mostly educated in private schools. Overall 13 schools were selected at random from each stratum and contacted by the principal investigator. If the school administration refused to participate, the next school was selected randomly from the respective stratum. For each school, a list of all classes including pupils aged in the range of 8 to 15 years was obtained and one class in each grade was selected at random. Parents were then informed by the school administration; signed informed consent and information on child and parents was obtained from each parent prior to enrolment of children on data collection day. Children suffering from any known diseases were excluded.

Sample size was calculated using Lorentz equation with a confidence (1-a) of 95%, anticipated prevalence of 32.14 % and margin of error of ±1. The minimum sample size calculated was 2680. Out of 3239 selected children, 550 pupils were excluded from the study because their age was outside the target range (n=271) or because of lack of data (n=279), thus 2689 pupils from 8 to 15 years old completed the study (1404 girls and 1285 boys).

Data were collected in the school milieu by fieldworkers composed of the first author, trained enumerators and school nurses.

2.2 Background Questionnaire

The questionnaire was modified from the WHO stepwise approach [23] and the Cameroonian health and demographic survey [6]. Pre-testing of the questionnaire was conducted prior to investigations to assess the validity of questions (personal communication, 2008). The questionnaire was divided into three major sections so as to (i) obtain consent statement from parents, (ii) identify pupils and (iii) collect information about parents and children. Information was noted about school name, date of the interview, pupils' name, gender, age and neighbourhood. Information on parents (mother and father) was collected via the questionnaire filled by parents, they included region of origin, education level, occupation, income, age, height and weight. Parents were asked to complete information on their child including allowed pocket money, number of people per room, gestational age at birth, birth weight, breastfeeding, weaning, physical activities, and daily food frequency.

2.3 Environmental Factor

The region of origin was used to define ethnicity due to the geographic distribution of ethnic groups, the ethnic group of each parent was asked, then these were pooled together in terms of regions of origin according to the administrative map of Cameroon respectively as "west", "north" and "south". The parents of children and adolescent participants identified themselves in three educational levels, as equal or less to primary "<=primary", college, and university or more ">=University". The occupation of parents was assessed in five main categories, as "Government" for those working in the public sector, "Private" for those employed in the private sector, "Independent" for those working for their own benefits, "Home care" for those working at a home and "others" for those with occupational situations not well established. Income was assessed as the money earn monthly in XAF earn (1 USD = 500 XAF). Three groups were constituted: less than 100.000 XAF (<100.000), between 100.000 XAF and 200.000 XAF (100.000<> 200.000) and more than 200.000 XAF (> 200.000). Allowed pocket money was assessed as the weekly money allowance for transport and school food to children. Family size was assessed as the number of people per family, indicating the number of people per home including parents and children. Age at birth was provided by mother as the month at term for the children. Child birth weight was recalled by mothers in grams. Breastfeeding and weaning information was provided by mothers. Physical activity was examined as the weekly frequency of intense and moderate physical activities. The weekly frequency of intense and moderate leisure activities was also assessed as well as

the walking frequency of children. The daily food frequency was used to assess the number of meals each child receives per day.

2.4 Anthropometric Measures

Anthropometric variables were measured in the child by trained enumerators according to existing standards. Height was measured without shoes to the nearest 0.1 cm using a portable standiometer. Body weight was measured to the nearest 0.1 kg using an indoor weighing scale with the student's shoes, coats, and other heavy outerwear removed. Height and weight were used to calculate BMI as body weight (kg)/square of height (m^2). Waist circumference was measured midway between the lower rib margin and the iliac crest to the nearest 0.1 cm with non-stretchable plastic tape.

2.5 Anthropometric Indicators

To allow international comparison, International Obesity Task Force (IOTF) reference standards were used to define body size [24,25,26]. This included age and gender-specific BMI cut-offs that defined Thinness, Overweight, and Obesity and were set to correspond, respectively, to BMI values of 18.5, 25, and 30 kg/m² at 18 years old.

2.6 Statistics

Data were analyzed with SPSS 10.0 for Windows (SPSS Inc., 1999). The level of significance of P value was set at less than 0.05. The difference between thin, normal, overweight and obese was done using analysis of variance (ANOVA) with Bonferroni's post hoc test for across group differences, or Kruskal Wallis Test for non-normally distributed variables. Association between body size and some selected parental variables was performed using the $\chi 2$ test. Pearson correlations between anthropometrics variables and other variables were calculated. Quantitative data are presented as mean with standard error of the mean and frequency data are given as percentage. Pupils less than 8 years old or above 15 years old were excluded because of the small number of these subsamples.

3. RESULTS AND DISCUSSION

3.1 Results

This cross-sectional school-based study was set between February and May 2010 with the aim to assess children and adolescent body size and the influences of parents and socioeconomic environmental factors. The age range was from 8 to 15 years old and included both boys and girls. In the present study a total of 2689 children and adolescents (1404 boys and 1285 girls) out of 3239 registered pupils were pooled for further analysis. Thinness, overweight and obesity were defined according to International Obesity Task Force (IOTF) for children as well as for parents.

3.1.1 Anthropometric data in children

Table 1 summarizes anthropometric data of the 2689 pupils distributed according to gender and body size. There was no significant difference in the average age between thin, normal, overweight and obese boys or girls. Consistent with the BMI classification, weight, height and waist were significantly different between the various weight groups in boys and girls (all P<0.01).

Table 1a. Anthropometrics measures in boys according to body size

	Normal		Thin		Overweight †		ANOVA
	N(%)	Mean(±SEM)	N(%)	Mean(±SEM)	N(%)	Mean(±SEM)	P value
Age (years)	1056 (82.1)	11.8(±0.0)	121(9.4)	11.5(±0.2)	108(8.4)	12.0(±0.1)	NS
Height (cm)	1056 (82.1)	147.4(±0.4)	121(9.4)	143.3(±1.3)**	108(8.4)	149.5(±1.5)	0.002
Weight (kg)	1056 (82.1)	39.5(±0.3)	121(9.4)	30.3(±0.6)***	108(8.4)	54.0(±1.2)***	<0.001
BMI (kg/m²)	1056 (82.1)	17.8(±0.0)	121(9.4)	14.4(±0.1)***	108(8.4)	23.9(±0.3)***	<0.001
Waist (cm)	980 (83.9)	76.77(±0.2)	107(9.1)	70.4(±0.6)***	80(6.8)	88.77(±1.0)***	<0.001

*†Overweight including obesity; data are n with mean ± SEM; BMI, Body Mass Index; NS, not significant; significance was calculated by ANOVA with Bonferroni post-Hoc for inter group comparison with *P<0.05, **P<0.01 and ***P<0.001*

Table 1b. Anthropometrics measures in girls according to body size

	Normal		Thin		Overweight †		ANOVA
	N(%)	Mean(±SEM)	N(%)	Mean(±SEM)	N (%)	Mean(±SEM)	P value
Age (years)	1040 (74.0)	11.8(±0.0)	136 (9.6)	11.5(±0.1)	228 (16.2)	12.0(±0.1)	NS
Height (cm)	1040 (74.0)	149.2(±0.4)	136 (9.6)	144.3(±1.1)***	228 (16.2)	151.2(±0.7)	<0.001
Weight (kg)	1040 (74.0)	42.0(±0.3)	136 (9.6)	31.1(±0.6)***	228 (16.2)	56.3(±0.8)***	<0.001
BMI (kg/m²)	1040 (74.0)	18.5(±0.0)	136 (9.6)	14.6(±0.1)***	228 (16.2)	24.3(±0.2)***	<0.001
Waist (cm)	962 (74.5)	80.94(±0.3)	124 (9.6)	73.16(±0.7)***	204 (15.8)	92.57(±0.7)***	<0.001

*†Overweight including obesity; data are n with mean ± SEM; BMI, Body Mass Index; NS, not significant; significance was calculated by ANOVA with Bonferroni post-Hoc for inter group comparison with *P<0.05, **P<0.01 and ***P<0.001*

Selected variables were analysed in Table 2, among which, allowed pocket money was significantly increased with overweight and obesity and decreased with thinness in both boys and girls. No significant difference was observed with other variables including the number of study years, number of persons per house, birth rank, gestation age at birth, birth weight, age of weaning, daily food frequency and frequencies of physical activities as well as leisure activities.

In Table 3, correlations between anthropometric and other variables are shown. For example, allowed pocket money is positively correlated to markers of adiposity such as BMI and waist, in both boys and girls. Gestation age at birth and birth weight showed positive correlations with waist circumference, but only for boys. No significant correlations were observed between BMI and waist and other factors such as weaning age, daily food frequency, intense activity, moderate activity walking, and intense leisure activity.

3.1.2 Parental-child relationships

Anthropometric data of the parents are summarized in Tables 4a and 4b. No difference was noted in average maternal or paternal body size in either boys or girls.

Table 2a. Selected variables in boys according to body size

	Normal		Thin		Overweight †		ANOVA
	N	Mean(±SEM)	N	Mean(±SEM)	N	Mean(±SEM)	P Value
Pocket money (FCFA/week)	574	1130.2(±41.4)	73	1082.8(±110.5)	46	1389.6(±149.5)	0.043†
Study years (years)	96	8.0(±0.2)	12	8.0(±0.9)	20	8.6(±0.5)	NS
Family member (number)	131	6.3(±0.2)	20	6.0(±0.6)	28	6.6(±0.7)	NS
Birth rank	122	2.7(±0.2)	17	3.2(±0.7)	25	3.6(±0.5)	NS
Gestational age at birth (month)	123	8.8(±0.0)	16	8.8(±0.0)	26	9(±0.1)	NS
Birth weight (g)	95	3268.8(±62.8)	13	3361.8(±123.5)	20	3368.7(±163.5)	NS
Age of weaning (month)	112	10.3(±0.4)	16	9.0(±1.0)	22	9.3(±0.9)	NS
Daily food frequency	129	3.1(±0.0)	21	2.9(±0.1)	29	2.9(±0.2)	NS
Intense activity freq/week	54	2.4(±0.2)	9	2.0(±0.2)	14	3(±0.5)	NS
Moderate activity freq/week	97	3.0(±0.1)	16	3.5(±0.5)	21	2.1(±0.2)	NS
Walking freq/week	99	4.1(±0.2)	16	4.0(±0.4)	24	4.0(±0.4)	NS
Intense leisure freq/week	94	2.5(±0.1)	15	2.1(±0.2)	23	2.3(±0.3)	NS
Moderate leisure freq/week	86	2.6(±0.1)	11	2.9(±0.6)	23	2.7(±0.3)	NS

*†Overweight including obesity; data are n with mean ± SEM; BP, francs CFA; freq/week, frequency per week; NS, not significant; significance was calculated by ANOVA for normal distributed data with Bonferroni post-Hoc inter group comparison with *P<0.05, **P<0.01 and ***P<0.001. Non normal distributed data were marked with † and significance was calculated by Kruskal Wallis test, significance was set at P value < 0.05*

Table 2b. Selected variables in girls according to body size

	Normal		Thin		Overweight †		ANOVA
	N	Mean(±SEM)	N	Mean(±SEM)	N	Mean(±SEM)	P value
Pocket money (FCFA/week)	508	1177.4(±47.7)	83	981.9(±79.5)	98	1374.4(±115.0)	0.043
Study years (years)	104	7.8(±0.2)	22	7.2(±0.3)	36	8.1(±0.3)	NS
Family member (number)	140	6.6(±0.2)	27	5.7(±0.4)	50	6.6(±0.4)	NS
Birth rank	118	3.0(±0.2)	24	2.5(±0.3)	44	3.0(±0.4)	NS
Gestational age at birth (month)	135	8.9(±0.0)	27	8.8(±0.0)	43	9.0(±0.0)	NS
Birth weight (g)	97	3184.2(±68.2)	18	3103.2(±142.6)	32	3298.4(±78.2)	NS
Age of weaning (month)	124	9.5(±0.4)	25	8.9(±0.8)	38	10.4(±0.7)	NS
Daily food frequency	143	3.0(±0.0)	30	3.0(±0.1)	52	3.1(±0.1)	NS
Intense activity freq/week	54	2.3(±0.2)	9	2.8(±0.6)	19	1.7(±0.2)	NS
Moderate activity freq/week	95	3.3(±0.2)	19	3.8(±0.4)	36	3.3(±0.3)	NS
Walking freq/week	93	4.0(±0.2)	20	5.0(±0.4)	38	4.4(±0.3)	NS
Intense leisure freq/week	76	2.5(±0.2)	16	2.4(±0.4)	33	2.6(±0.3)	NS
Moderate leisure freq/week	80	2.6(±0.1)	16	2.3(±0.5)	27	2.6(±0.3)	NS

*†Overweight including obesity; data are n with mean ± SEM; BP, francs CFA; freq/week, frequency per week; NS, not significant; significance was calculated by ANOVA for normal distributed data with Bonferroni post-Hoc inter group comparison with *P<0.05, **P<0.01 and ***P<0.001. Non normal distributed data were marked with † and significance was calculated by Kruskal Wallis test, significance was set at P value < 0.05*

Table 3. Correlations between anthropometric variables and additional parameters in boys and girls

	Boys		Girls	
	BMI	Waist	BMI	Waist
Pocket money (FCFA/week)	0.225**	0.307**	0.342**	0.439**
Family size	0.181*	0.027	0.083	0.04
Birth rank	0.142	0.091	0.094	0.022
Gestational age at birth (month)	0.091	0.214*	0.013	-0.036
Birth weight (g)	0.04	0.293**	0.044	0.043
weaning age (month)	0.033	-0.01	0.071	0.118
Daily food frequency	-0.063	0.108	-0.003	-0.014
Intense activity freq/week	0.115	-0.079	-0.152	-0.05
Moderate activity freq/week	-0.079	-0.063	-0.065	-0.016
Walking freq/week	-0.031	-0.037	-0.016	0.013
Intense leisure freq/week	-0.033	-0.106	-0.04	-0.039

*Data are Pearson correlation; significance was set as * P < 0.05, **P <0.01, ***P <0.001; BMI, body mass index (kg/m^2); FCFA, francs CFA; freq/week, frequency per week.*

In Tables 5a and 5b, correlations between parental and children adiposity measures are presented. Both maternal and paternal weight and BMI were positively correlated to adiposity markers in both boys and girls, although stronger in girls.

For selected parental variables showed in Tables 6a and 6b, no significant association was observed between boys' body size and the mothers' region of origin, education level, occupation, income, and body size. Only mothers' region of origin showed significant association with respect to girls' body size (P=0.01). According to fathers' variables, fathers from the west region were three time more likely to have overweight girls (P=0.01), whereas overweight fathers were 8 times more likely to have overweight boys (P<0.001). Interestingly, while boys and girls' body size were related to their parents' body size, only girls' body size is affected by their parents' region of origin.

3.2 Discussion

This study was conducted in 2010 on urban Cameroonian children aged 8 to 15 years old, to our knowledge, this is the first study conducted on such a large sample with the aim of studying the relationship between parents, environmental

factors and children body size in urban Cameroon. Important findings here are; (i) the strong parent-to-child body size relationship, (ii) the high impact of the region of origin as a determinant of girl's but not boy's adiposity, (iii) the association of pocket money allowance and child adiposity (BMI and waist), and (iv) the relationship between boy's gestational age at birth and birth weight and waist circumference.

There are several limitations to our interpretations, this pilot study was cross-sectional and therefore no causal inferences can be made; the cut-offs used with parents self-reported height and weight may lead to underestimation or overweight and obesity; the lack of some socioeconomic indicators necessary for the comparison with prior data such as equipment at home was noted; and finally, there was limited data on Cameroonian child food habits and physical activities.

Table 4a. Mother's anthropometrics in boys and girls

	Girls		Boys	
Age (years)	244	37.7(±0.4)	207	38.4(±0.5)
Height (cm)	208	165.2(±0.7)	167	164.7(±0.7)
Weight (kg)	204	74.6(±0.9)	166	73.6(±0.8)
BMI (kg/m²)	201	27.5(±0.4)	166	27.3(±0.3)

Data are n with mean ± SEM; BMI, body mass index.

Table 4b. Father's anthropometrics in boys and girls

	Girls		Boys	
Age (years)	227	45.4(±0.4)	195	45.6(±0.5)
Height (cm)	184	175.5(±0.7)	145	174.0(±0.8)
Weight (kg)	178	84.3(±1.0)	145	83.0(±1.1)
BMI (kg/m²)	174	27.4(±0.3)	145	27.5(±0.3)

Data are n with mean ± SEM; BMI, body mass index.

Dapi et al. [9] showed concern regarding the appropriate anthropometric measures to assess nutrition status in urban Cameroonian adolescents. BMI is a quick and simple method for the evaluation of body size and nutritional status [24,25,26].

Overall, the parental-child correlations were higher in girls compared to boys. Heavier boys were characterized by significantly heavier fathers, but no such correlation was observed in girls or with mother-child correlations. These results suggested that heavier fathers may actually have sufficient incomes, as suggested in a previous study [3], while girls and women are more exposed to overweight because of their cultural role in the preparation of food as reported in a recent study in urban Cameroon [9]. Similar observations were made in China where family history of obesity was a risk factor for child obesity [27].

Table 5a. Correlation between Mother's anthropometrics and child BMI and waist

	Boys		Girls	
	BMI	Waist	BMI	Waist
Height (cm)	0.07	0.171*	-0.032	0.068
Weight (kg)	-0.063	0.135	0.184**	0.213**
BMI (kg/m²)	-0.084	-0.017	0.183**	0.158*

*Data are Pearson correlation; significance was set at * P < 0.05, **P <0.01, ***P <0.001; BMI, body mass index (kg/m^2).*

Table 5b. Correlation between father's anthropometrics and child BMI and waist

	Boys		Girls	
	BMI	Waist	BMI	Waist
Height (cm)	-0.202*	0	-0.043	0.077
Weight (kg)	0.116	0.08	0.145	0.274**
BMI (kg/m²)	0.278**	0.083	0.192*	0.237**

*Data are Pearson correlation; significance was set at * P < 0.05, **P <0.01, ***P <0.001; BMI, body mass index (kg/m^2).*

In the present study, the socio economic status (SES), as assessed based on pocket money allowance was significantly associated with markers of adiposity. Similar observations were made in a study on urban Cameroonian adolescents where SES was associated with nutritional status [9]. In the urban adult population of Cameroon, the education level increased the likelihood of overweight and obesity by more than twofold [3]. In general, it has been observed that boys were more likely to be malnourished and vulnerable to health inequalities in sub-Saharan populations, and these were more likely to be at the lower socioeconomic levels [13]. This contrasts with other studies, such as a study on young Finns in Helsinki which reported that children on low socioeconomic strata were more exposed to central obesity and other factors of cardiovascular diseases [28].

Table 6a. Association between mother's variables and child body size status

	All boys		Boys		All girls		Girls	
	n	Normal (%)	Overweight † (%)	rr	n	Normal (%)	Overweight † (%)	rr
Region of origin		**NS**				**0.01**		
North	10	90	10	1	21	80.9	14.2	1
South	195	81.0	7.1	0.8	225	75.1	9.3	0.7
West	501	82.2	8.5	0.9	488	69.8	18.6	1.5
Education level		**NS**				**NS**		
<=Primary	35	88.5	8.5	1	24	62.5	29.1	1
College	94	75.5	13.8	1.9	108	63.8	21.2	0.7
>= University	76	72.3	14.4	2.0	102	65.6	20.5	0.6
Occupation		**NS**				**NS**		
Government	64	76.5	7.8	1	69	73.9	18.8	1
Private	142	83.0	7.0	0.8	165	73.3	11.5	0.6
Independent	226	83.6	9.2	1.0	240	70.4	19.1	1.0
Home care	189	79.8	9.5	1.1	158	70.2	12.0	0.6
Income [FCFA]		**NS**				**NS**		
< 100 000	77	76.6	12.9	1	96	61.4	21.8	1
100 000 <> 200 000	45	75.5	8.8	0.7	46	69.5	23.9	0.9
> 200 000	34	70.5	14.7	1.2	42	66.6	19.0	0.8
Body size		**NS**				**NS**		
Normal	49	81.6	14.2	1	59	69.4	13.5	1
Overweight †	116	74.1	13.7	1.0	137	60.5	26.2	2.2

†Overweight including obesity; data are n with percentages; FCFA, francs CFA; NS, not significant; rr, relative risk; differences between Thin, Normal and Overwt/ob group was calculated by χ^2 test, and significance was set at P <0.05.

Table 6b. Association between father's variables and child body size status

	All boys		Boys		All girls		Girls	
	n	Normal (%)	Overweight † (%)	rr	n	Normal (%)	Overweight † (%)	rr
Region of origin		**NS**				**0.01**		
North	6	100	0	--	13	92.3	7.6	1
South	187	80.2	7.4	1	213	75.1	9.8	1.5
West	494	81.7	8.7	1.1	472	70.3	18.6	3.2
Education level		**NS**				**NS**		
<=Primary	11	72.7	9.0	1	20	70	15	1
College	56	80.3	12.0	1.2	61	60.6	21.3	1.6
>= University	123	71.5	15.4	1.7	139	64.7	23.0	1.6
Occupation		**NS**				**NS**		
Government	99	76.7	7.0	1	101	79.2	11.8	1
Private	284	80.2	8.8	1.2	293	72.3	14.3	1.3
Independent	165	84.2	10.3	1.3	171	68.4	19.2	1.8
Other's	26	84.6	7.6	0.9	21	61.9	28.5	3.0
Income [FCFA]		**NS**				**NS**		
< 100 000	51	74.5	21.56	1	51	56.8	27.4	1
100 000 <> 200 000	43	67.4	11.6	0.6	54	62.9	18.5	0.6
> 200 000	70	77.1	12.8	0.5	87	66.6	21.8	0.7
Body size		**0.0001**				**NS**		
normal	38	68.4	2.6	1	46	63.0	17.3	1
Overweight †	104	72.1	23.0	8.3	125	65.6	25.6	1.4

†Overweight including obesity; data are n with percentages; FCFA, francs CFA; NS, not significant; differences between Thin, Normal and Overwt/ob group was calculated by χ^2 test, and significance was set at P <0.05.r

The personal history of the children was assessed with birth and early life information (rank, age, weight and weaning); we observed strong associations with adiposity in boys only. In a review by Georges Xu [29], Dr Baker's theory and the Helsinki study reported that the early life environment could lead to permanent changes in the development of children that could, in turn, lead to adverse health effects. A recent study highlights the importance of breastfeeding and its duration early on, with benefits to child health and survival [30].

Food habits and physical activity indicators in children were weakly associated with body size. To date, there is little data available in either Cameroon or sub-Saharan populations, as previously noted [7]. The same study reported a lower food intake in poor households containing elevated numbers of people per house. Energy expenditure was shown to be higher in boys compared to girls, boys were more likely to be involved in heavy activities while girls were more involved in lighter activities, and more exposed to food due to their cultural role in food preparation in the urban and rural population [7]. Previous data support the fact that urban adolescents in Cameroon are less engaged in manual activities and more exposed to junk food and westernized energy-dense food [22], whereas this study lacks to show significant relationship between food frequency, physical activity and child body size in an urban milieu. These results seem controversial and may be due to confounding factors in urban environment.

The region of origin associated differences in body size can likely be explained by the background influence of ethnicity on food habits. Similar data were published in a separate study on the Cameroon population [30]. Studies in Australia and England showed that ethnicity was reported to be a major determinant in the distribution of overweight and childhood obesity, independently of social classes [31,32].

4. CONCLUSION

In conclusion, children and adolescents' body size in urban Cameroonians is influenced by parents' adiposity, region of origin, and pocket money allowance. This pilot study is set as a baseline data for further investigations to monitor changes in parent-child-environment relationship through nutrition transition and economic growth.

ETHICAL APPROVAL

All authors hereby declare that this study was performed in accordance with the ethical standards and approved by the School Administration and the National Ethics Committee (N°. 114/CNE/SE/2010). Parents or guardians of all participants provided written and signed informed consent prior to participation to the study. Personal identification numbers were assigned to each participant to maintain anonymity.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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