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Original article

Co-existence of maternal overweight and obesity with childhood undernutrition in rural and urban communities of Lagos State, Nigeria

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Summary. *Background:* The coexistence of over-nutrition and under-nutrition is emerging as a public health problem in many low and middle income countries. This study aimed at determining prevalence of coexisting maternal overweight and obesity with childhood stunting (MOCS) and the associated socio-demographic factors in rural and urban communities of Lagos State, Nigeria. *Methods:* This was a cross sectional survey conducted using the multistage random sampling technique. A total of 300 mother-child pairs were studied, consisting of 150 each from rural and urban communities. Maternal overweight and obesity and undernutrition in children were determined using standard criteria. *Results:* The prevalence of overweight and obesity among mothers was significantly higher in urban than rural areas (50.7% vs. 41.3%; p=0.022) while the prevalence of childhood stunting was significantly higher in rural than urban areas (43.3% 12.6%; p<0.001). Coexisting maternal overweight and obesity with childhood stunting was observed in 31 (10.3%) mother-child pair with a significantly higher prevalence in rural than urban areas (14.7% vs. 6.0%, p=0.014). In multivariate logistic regression, maternal short stature (OR 3.3, 95% CI=1.2-9.0, p=0.02) and living in rural area (OR 0.2, 95% CI=0.1-0.5, p=0.001) were the identified risk factors for coexisting maternal overweight and obesity with childhood stunting. *Conclusion:* The prevalence of coexisting MOCS is high especially in rural areas. Effort at reducing childhood malnutrition should focus on appropriate interventional measures aimed at improving maternal nutritional status. (www.actabiomedica.it)

Key words: coexistence, overweight; obesity, stunting, mothers, child, Lagos, Nigeria

Introduction

Under-nutrition persist as a significant health burden particularly in low and middle income countries such as those in Sub-Saharan Africa (1). However, as a result of urbanization and accompanying nutritional transition in many of these low and middle income countries, there are new incursions of increasing prevalence of overweight and obesity coexisting with under nutrition, a phenomenon referred to as "double burden" malnutrition (2, 3). Double burden malnutrition represents complex situation where under-nutrition, over-nutrition and their consequences such as micronutrient deficiencies, infectious diseases and non-communicable diseases coexist. Reports indicate that double burden malnutrition can occur at household or community levels or even within the same individual (4). In an international survey from 42 developing countries, about 16% of households were with underweight and overweight members. This is

worrisome in developing countries where health facilities to manage these conditions and its consequences are scarce.

In Nigeria, the prevalence of childhood stunting is one of the highest in the world while the prevalence of overweight and obesity in the general population is on the increase. According to the National Demographic and Health Survey (NDHS) conducted in 2013, the prevalence of stunting, underweight and wasting among the under-fives are 37%, 29% and 18% respectively (5). From the same survey, 17% of Nigerian women are overweight and 8% are obese. The prevalence of these nutritional indices varies according to the background characteristics and place of residence in Nigeria.

The persistence of child under nutrition in low income countries has been associated with coexistence of maternal obesity and childhood under-nutrition (MOCS) in the same household. It is hypothesized that adoption of energy-dense but nutrient-poor foods for household results in increased overweight in adults, and failure to meet linear growth potential in children (6). It is therefore important to explore and estimate magnitude of double burden malnutrition in populations and also determine associated contributory factors with a view of providing appropriate interventions aimed at reducing the burden of malnutrition.

Information on coexistence of childhood stunting and maternal obesity in Nigeria is limited. Therefore, the aim of this study was to determine the current nutritional status of mothers and their children, prevalence of coexisting maternal overweight and obesity with childhood stunting (MOCS) and the associated socio-demographic factors in rural and urban communities of Lagos State, Nigeria

Methods

Study area

This study was part of as larger study on maternal and child nutritional status in rural and urban communities in Lagos state, Nigeria.

The study was carried out in the Epe Local Government Area and the Alimosho Local Government Area in Lagos State, Nigeria, which were randomly selected from the 20 local governments in Lagos state officially recognized by the Federal government of Nigeria.

Lagos state is Nigeria's former capital city. The vegetation is that of the tropical rain forest. It has an annual rainfall of 180 centimeters and a mean temperature of 26°C. It is 200-500 meters above sea level. Lagos has a very diverse and fast-growing population, resulting from heavy and ongoing migration to the city from all parts of Nigeria as well as neighbouring countries. Though the Yoruba, an African people inhabiting southwest Nigeria, constitute the city's principal ethnic group, there are a significant proportion of other ethnic groups, particularly the Ibos, Ibibio and Hausa.

Study design

The study was a cross sectional survey of children aged zero to fifty-nine months in rural and urban communities located in randomly selected Local Government Areas of Lagos State, Nigeria.

Ethical statement

Ethical approval was obtained from the Lagos State University Teaching Hospital Research/ Ethics Committee with approval file number LREC/10/06/297; verbal informed consent was also obtained from the parents that were involved.

Method of sampling

A multistage random sampling technique was used to select subjects. Epe and Agbowa were randomly selected from the Epe LGA, representing urban and rural communities, respectively, while Akowonjo and Orisunbare were selected from the Alimosho LGA, representing urban and rural communities, respectively. From each communities, houses were selected randomly using the table of random numbers.

Complete data was collected from 300 subjects comprising 150 each for rural and urban communities.

In each household, the parents of children aged zero to fifty-nine months were identified, and informed consent was obtained prior to the beginning

of the study. The parents were interviewed according to the proforma specifically designed for the study. Information was obtained on demographic, socio-economic characteristics, breastfeeding practices and type of solid, semi-solid or soft foods taken by children. The families were assigned a socio-economic class using the method recommended by Ogunlesi et al (7). The parents' occupations and highest education attained were scored from 1 (highest) to 5 (lowest). The mean score for both parents gave the social class, falling within the 1 – 5 range. Those with mean scores of 1 and 2 were further classified as upper class, those with mean score of 3 were classified as middle class, while those with mean scores of 4 and 5 were classified as falling in the lower social class.

Anthropometry

The children were weighed using an electronic weighing scale calibrated in 100 g units (SECA/ UNICEF, Australia). Children who were too scared to stand on the scale were weighed together with the mother, and the mother's weight automatically deducted to obtain the weight of the child. All children were weighed naked and to the nearest 0.1 kg.

Length of children aged less than twenty-four months was measured using an infantiometer. This was done on a firm surface with assistance, usually by the mother. The knees were held down and the head held firmly against the headboard. These measurements were done to the nearest 0.1 cm. Height was measured using a height board for children aged twenty-four to fifty-nine months. This was done with the children standing erect without shoes, with eyes facing forward and the feet together on the horizontal plane.

Mother's weight was measured using the same weighing scale used for children.

The height of mothers was also measured using height board. This was done with the mothers standing erect without shoes and with the eyes looking horizontally and the feet together on a horizontal level.

Waist circumference was measured with a flexible inextensible tape (Butterfly, China) midway between the iliac crest and the lower most margins of the ribs with bare belly and at the end of normal expiration according to the WHO guidelines (8). Standardization checks on the on the tools for anthropometric measurements were done periodically.

Malnutrition in children was calculated from the degree of stunting (height-for-age), underweight (weight-for-age) and wasting (weight-for-height) following World Health Organization (8) guidelines and cut off points. In this study, a child was said to be underweight, wasted and stunted if the Weight-for-Age, Weight-for-Height and Height-for-Age were below minus two Standard Deviation (-2 SD) from the median of each international reference standard, respectively.

Maternal overweight and obesity was determined by calculating Body Mass Index (BMI) as follows; weight (kg)/height^2 (m) and based on WHO standard, mothers were classified into underweight, normal, overweight and obese (<18.5, 18.5-24.9, 25-29.9, ≥ 30 kg/m^2 respectively). Waist circumference was used as measure of central body fat distribution. According to international reference standard, those with cut off point >88 cm were considered centrally obese (8).

Statistical analysis

WHO Anthro 2007 was used to generate z-score values for weight-for-age, height-for-age and weight-for-height. All data were entered into and analysed using SPSS for windows software version 13. The means and standard deviations (SD) were calculated for continuous variables, while ratios and proportions were calculated for categorical variables. Independent t-test was used to calculate mean differences for continuous variables between urban and rural communities. Categorical variables were compared using the Pearson Chi square (χ^2) test. 'P' values less than 0.05 were accepted as statistically significant.

Results

Socio-demographic characteristics

A total of 300 mother-child pairs were studied, consisting of 150 each from rural and urban communities, and the results obtained were analysed. Table 1 shows the socio-demographic characteristics and

Table 1. Socio-demographic characteristics of study population according to place of residence

Parameters	Total (n = 300)	Rural (n = 150)	Urban (n = 150)	P Value
Mothers characteristics				
Age (years)*	30.0±5.6	29.6±6.1	30.4±5.6	0.186
Family setting				0.001
Monogamy	265 (88.3)	119 (79.3)	146 (97.3)	
Polygamy	35 (11.7)	31 20.7)	4 (2.7)	
Parity				0.001
1	83 (27.7)	24 (16.0)	59 (39.3)	
2	183 (61.0)	101 (67.3)	82 (54.7)	
5-7	34 (11.3)	25 (16.7)	9 (6.0)	
Age at first birth				0.001
15-19	29 (9.7)	22 (14.7)	7 (4.7)	
20-24	127 (42.3)	77 (51.3)	50 (33.6)	
25-29	96 (32.0)	41 (27.3)	55 (36.9)	
30-34	37 (12.3)	5 (3.3)	32 (21.3)	
35-39	8 (2.7)	3 (2.0)	5 (3.4)	
Educational level of mother				0.001
No formal education	4 (1.3)	3 (2.0)	1 (0.7)	
Primary	72 (24.0)	55 (36.7)	17 (11.3)	
Secondary	155 (51.7)	79 (52.7)	76 (50.7)	
Postsecondary	69 (23.0)	13 (8.7)	56 (37.3)	
Social class[#]				0.001
Upper	19 (6.3)	0 (0.0)	19 (12.7)	
Middle	50 (16.7)	15 (10.0)	35 (23.3)	
Lower	231 (77.0)	135 (90.0)	96 (64.0)	
Children characteristics				
Age (months)*	25.3±16.4	31.3±16.4	19.3±4.0	0.001
Sex				0.248
Male	142 (47.3)	66 (44.0)	76 (50.7)	
Female	158 (52.7)	84 (56.0)	74 (49.3)	
Birth order				0.000
1	118 (39.3)	39 (26.0)	79 (52.7)	
2-4	161 (53.6)	87 (64.7)	64 (42.7)	
5-7	21 (7.0)	14 (9.3)	7 (4.7)	

Values are number (%) unless otherwise stated; *values are mean ± SD. [#]Upper social class includes parents such as senior government employee, high scale traders, and professionals, middle class include junior government employee, teachers and technicians while lower social class are peasant farmers, artisans, security agents, messengers, apprentice, laborers and the unemployed.

nutritional status of the study population according to their place of residence.

Polygamous homes was siginificantly common in rural than uban communities (p<0.001) while the parity of mothers was higher in rural than urban communities (p<0.001). The educational level of mothers was significantly better in urban as opposed to rural areas (p<0.001) and a significant proportion of the mothers in rural compared with urban communities (90.0% vs. 60.4%, p<0.001) were from the lower social class.

The mean age of the children in the rural communities was significantly higher than that of children from urban communities (31.3 vs. 19.3 months; p<0.001). Gender distributions of the children were not statistically different, with a male: female ratio of 1:1.3 in rural areas and 1:1 in urban areas. Seventy-nine (52.7%) children in urban areas were the first born compared with 39 (26%) children in rural areas. This difference was statistically significant (p<0.001).

Anthropometrics, Nutritional Status of Mothers and their children

The anthropometric characteristics of mothers according to their place of residence is as shown in Table 2. The weight of mothers in urban areas was significantly higher than those from rural areas (p=0.042). The prevalence of overweight in rural and urban areas was 27.3% and 32% respectively while the prevalence of obesity in rural and urban areas was 14.0%% and 18.7% respectively. This difference was statistically significantly (p=0.022).

Using waist circumference, there was no significant difference in the prevalence of central obesity between mothers from rural and urban areas (p>0.05).

The mean weight and height were significantly higher among children from rural than urban areas (Table 3). Both weight and height increase with age in both sexes in children from rural and urban areas. However, the degree of association of weight and height with age were higher in urban children (r=0,894 and 0.946 respectively) than rural children (r=0.736 and 0.857 respectively).

The prevalences of underweight and stunting were significantly higher among children from rural than urban areas (19.4% vs. 9.3%, OR 3.8, 95% CI=1.8-8.1, p<0.001) and (43.3% vs. 12.6%, OR 7.4, 95% CI=3.8-14.1, p<0.001) respectively.

Prevalence of maternal overweight/obesity with child stunting

There were 31 (10.3%) mother-child pair with maternal overweight/obesity and child stunting with

Table 2. Anthropometrics and nutritional status of mothers and children according to place of residence

Anthropometry/Body composition	Total (n =300)	Rural (n = 150)	Urban (n = 150)	P value
Mothers				
Weight, kg	63.9 (13.5)	62.3 (13.2)	65.5 (13.7)	0.042
Height, cm	160.3 (6.6)	159.9 (6.5)	160.6 (6.7)	0.337
BMI				0.022
<18.5	20 (6.7)	16 (10.7)	4 (2.7)	
18.5-24.9	142 (47.3)	72 (48.0)	70 (46.7)	
25-29.9	89 (29.7)	41 (27.3)	48 (32.0)	
30-34.9	42 (14.0)	20 (13.3)	22 (14.7)	
35-39.9	7 (2.3)	1 (0.7)	6 (4.0)	
WC, cm				1.000
≤88	184 (61.3)	92 (61.3)	92 (61.3)	
Greater than 88	116 (38.7)	58 (38.7)	58 (38.7)	
Children				
Weight-for-age z score, < -2 SD	43 (14.3)	39 (26.0)	14 (9.3)	0.001
Height-for-Age z score, < -2 SD	84 (28.0)	87 (64.7)	19 (12.6)	0.001
Weight-for-height z score, <-2 SD	31 (8.3)	14 (9.3)	13 (8.7)	0.118
Coexisting MOCS	31 (10.3)	22 (14.7)	9 (6.0)	0.014
Coexisting centrally obese mother with childhood stunting	28 (9.4)	24 (16.2)	4 (2.7)	0.000

BMI=body mass index; WC=waist circumference; MOCS=maternal overweight and obesity with childhood stunting, cm=centimetre, kg = kilogram

Table 3. Factors associated with overweight/obese mother and stunted child

Parameters	Overweight/obese mother and stunted child		χ^2	P value
	Yes No (%)	No No (%)		
Mothers characteristics				
Age (years)			2.4	0.124
≤30	14 (8.0)	160 (92.0)		
>30	17 (13.5)	109 (86.5)		
Family setting			0.07	0.788
Monogamy	27 (10.3)	236 (89.7)		
Polygamy	4 (11.8)	30 (88.2)		
Parity			2.2	0.137
≤4	26 (9.8)	240 (91.2)		
>4	6 (2.0)	289 (92.0)		
Number of children in the family			8.3	0.004
≤4	21 (8.3)	232 (91,7)		
>4	10 (22.7)	34 (77.3)		
Level of education			4.3	0.227
No formal education	0 (0.0)	4 (100.0)		
Primary	11 (15.3)	61 (84.7)		
Secondary	16 (10.3)	139 (89.7)		
Tertiary	4 (6.2)	65 (94.2)		
Residence			6.1	0.014
Rural	22 (14.7)	128 (85.3)		
Urban	9 (6.0)	141 (94.0)		
Height (cm)			7.8	0.005
<152	7 (25.9)	20 (74.1)		
≥152	24 (8.8)	249 (91.2)		
Social class			1.03	0.597
Upper	1 (5.3)	18 (94.7)		
Middle	4 (8.0)	46 (92.0)		
Lower	26 (11.3)	205 (88.7)		
Children characteristics				
Age (months)			6.5	0.167
0-11	3 (4.9)	58 (95.1)		
12-23	13 (14.4)	77 (85.5)		
24-35	4 (6.6)	57 (93.4)		
36-47	4 (8.7)	42 (91.3)		
48-59	7 (16.7)	35 (83.3)		
Gender			0.781	0.377
Male	17 (12.0)	125 (88.0)		
Female	14 (8.9)	144 (91.1)		
Birth order			0.38	0.537
1-4	28 (10.0)	251 (90.0)		
≥5	3 (14.3)	18 (85.7)		

Table 4. Logistic regression analysis for determinants of coexistence of maternal overweight and obesity with childhood stunting

Independent variables	Odds ratio	95% CI	p value
Overweight/obese mother and childhood stunting*			
Parity	0.95	0.63-1.43	0.803
Number of children in the family	1.15	0.86-1.54	0.334
Area of residence	3.29	1.21-8.98	0.02
Mothers height	0.16	0.06-0.48	0.001

*Adjusted for age of mother, age of child and social class

a significantly higher prevalence in rural than urban areas. (14.7% vs. 6.0%, p=0.014). Twenty-eight (9.3%) mother-child pair had coexisting maternal central obesity and child stunting with a significantly higher prevalence in rural areas (16.2% vs. 2.7%, p<0.001).

Determinants of co-existence of maternal overweight/obesity with child stunting

Tables 4 shows the influence of various socio-demographic factors on co-existence of maternal overweight/obesity with child stunting. There was significant association between co-existing MOCS and increase number of children in the family, rural residence and low height of mothers. In a multiple regression analysis, after adjusting for potential confounders, only maternal short stature and rural residence were the significant determinant of coexisting MOCS.

Discussion

This study provided further evidence of the occurrence of coexisting MOCS both in rural and urban settings of a resource poor nation where inadequate energy intake is certainly the major macro-nutritional problem.

In this study, the prevalence of overweight (29.7%), obesity (16.3%) and central obesity (38.7%) observed in rural and urban women were high compared to the prevalence of 6.7% for under-nutrition among this same group of women. This same trend was reported in the country since early 2000s. In a study of three rural communities in southwest Nigeria, 20.8% and 8.4% were overweight and obese respectively (9). In Abeokuta, Southwest Nigeria, 58.6% of market women were overweight (10), and in Jos, Central Nigeria, 29.4% and 25.9% of women were overweight and obese respectively (11) while in Sokoto, Northern Nigeria, the prevalence of central obesity was 28% (12). These obviously attest to high prevalence of overweight and obesity even among those living in rural areas and of low socio-economic class. This is in contrast to the usual finding in developing countries where overweight and obesity are more common among the affluent and in people of high socio-economic class. This has a direct consequence of increase in the prevalence of non-communicable diseases such as hypertension diabetes and other metabolic disorders in this population. These could stretch the health system and government budget which are already inadequate to cater for the existing problem of infections and chronic energy deficiency.

Despite various national and state programs and policies aimed at reducing under-nutrition among under-fives, the prevalence of childhood stunting in this study remains high especially in rural areas. Our previous study demonstrated that the risk factors were mostly socio-economic factors which will translate to provision of adequate and appropriate diet and better caring practices for children (13).

Reports indicate that the prevalence of coexisting MOCS is high in Asia, Latin America and in countries that are in the middle range of Gross National product (GNP) while the prevalence is low in African countries (6, 14, 15). However, the prevalence of coexisting MOCS in this study was 10.3%. This is in contrast to less than 5% reported for most sub-Saharan African countries by Jehn and Brewis (16) and 1.81% reported for Nigeria using the year 2008 Demographic Health Statistics survey (15). Our prevalence was similar to 8.4% obtained in Mexico (17), 11% in rural Indonesia (14) and 16.2% in neighbouring Republic of Benin (18). The high prevalence is evidence that the country

is in nutritional transition that is similarly occurring in almost all low and middle income countries, whereby the consumption of energy dense and nutrients poor diet leads to overweight and obesity in mothers and stunting in children.

Similar to finding in other studies (14, 16), our study shows that increasing number of children in the family was significantly associated with coexisting MOCS. This can be ascribed to reduced amount of nutrient rich food reaching the children as the family size increases.

In this study, maternal short stature was a risk factor for high prevalence of coexisting MOCS and this is similar to findings in rural Indonesia and Bangladesh (14). There is a link between early childhood stunting and development of obesity later in life. Therefore, the significant association between maternal short stature and coexisting MOCS could represent an intergenerational effect perpetuating malnutrition from one generation to the next.

Many studies reported that coexisting MOCS is more prevalent in urban than rural areas of developing countries because overweight and obesity are commoner in urban areas (16, 19) while other studies reported higher prevalence in rural areas (14). Our study shows that both coexisting MOCS and coexisting centrally obese mother with childhood stunting were more prevalent in rural areas. Interestingly, the prevalence of maternal central obesity in rural and urban areas was similar. This implies that, coexisting MOCS may represent a defined entity and not statistical artefact as alluded to by Dieffenback and Stein (20).

The limitations of this study include involvement of only 2 local government areas of Lagos State. However, the findings can be generalized to the broader community. We recommend that further cross-sectional research work involving other communities and a larger sample frame is needed to better understand this dual burden of malnutrition and the associated risk factors.

In conclusion, this study has shown that the prevalence of maternal overweight and obesity and childhood stunting is high in Lagos, Nigeria. Moreover, the prevalence central obesity which is a better indicator of adverse consequence of accumulated body fat is also high both in rural and urban areas of Lagos State, Nigeria. In contrast to earlier report, the prevalence of coexisting MOCS is high in Nigeria and is similar to what obtains in Asia and Latin America. Notably, the prevalence of coexisting MOCS is higher in rural than urban areas despite higher prevalence of maternal overweight and obesity in urban areas. In this study, rural residence was also identified as a major risk factor of coexisting MOCS. This might indicate that coexisting MOCS is a distinct entity whose root could be related to the on-going nutritional transition. Therefore, in order to reduce the persistently high prevalence of stunting, efforts must be geared towards educating parents and guardians on appropriate family dietary practices that will support growth and development of their children. This may involve public health enlightenment campaign discouraging consumption of energy dense, nutrient poor food by mothers and their children and also regulation of the food industry such that unhealthy foods do not get advertised or found in stores.

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Author's contribution:
IOS concieved, designed, analyzed the data and wrote the first draft. COS participated in the design, data collection, analysis and interpretation of data. WAO and IOO participated in the design, supervised data collection and guided writing of the manuscript. All authors read and approved the final manuscript.

Supplementary Materials:
Relevant research materials such as raw data are available on request

Conflict of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article

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