Predictors of Stunting among Children Attending the National Nutrition Institute in Egypt

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Abstract

Back ground: Child malnutrition is a major public health problem in low income and middle income countries especially among marginalized populations. Stunting contributes to 14.5% of annual deaths and 12.6% of disability adjusted life years (DALYS) in under-5 years children. **Objective**: To identify factors contributing to stunting among a sample of children. **Methods**: A case control study was conducted at the National Nutrition Institute, Egypt. The study recruited 300 children aged 2-8 years, 148 stunted children as cases and 152 non-stunted as control. Anthropometric measurements were assessed, socio economic status was evaluated, dietary assessment was done using 24 hours recall and food frequency questionnaire, previous feeding practices, and morbidities in the last two weeks were assessed. **Results**: Four logistic regression models were developed to predict stunting based on the framework developed by the WHO. Mothers' education was the only socioeconomic predictor of stunting where low maternal education attainment was associated with stunting. Formula feeding during first six moth of life was associated with reduced stunting. Children with history of delayed milestones were 2.4 times more likely to be stunted (p=0.002) while children with history of rickets were four times more likely to be stunted (p=0.007). Both anemia and chest infection increased the risk of being stunting by two folds. Dietary predictors included milk, meat and calcium consumption where meeting milk and meat groups recommendation reduced risk of being stunted by 80% and 40% while reduced calcium intake by 1 mg increase risk of being stunting by 1%. **Conclusion**: maternal education, previous formula feeding, previous morbidities and decrease intake of milk and meat groups are significant predictors for stunting.

Keywords: *stunting, children, malnutrition*.
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Introduction

Child malnutrition is a major public health problem in low and middle income countries especially among marginalized populations[1] contributing to almost one third of child mortality all over the world. Stunting contributes to 14.5% of annual deaths and 12.6% of disability adjusted life years (DALYS) in under-5 year's children[2].

Egypt ranked 11 among the 14 countries with the largest number of stunted children all over the world[3]. According to the Egyptian Demographic and Health Surveys of the years 2000, 2005, 2008 and 2014, stunting rates were on the rise between

2000 to 2008 stunting increased from 23% to 25% and then to 29%. In 2014 this rate decreased to 23%[4]. However other studies conducted by the World Food Program (WFP) in collaboration with Information and Decision Support Center (IDSC) among poorest villages revealed high prevalence of stunting (31%) and estimated annual costs of child under-nutrition at 20.3 billion Egyptian pounds (EGP) or 1.9% of GDP[5]**.** Also they reported that child's mortality associated with under nutrition has reduced Egypt's workforce by one percent.

The World Health Organization conceptual framework published in 2013 showed the complex nature of the context, causes and consequences of stunted[6]**.** Poor nutrition in the form of inadequate breastfeeding and complementary feeding, house and family factors and infection are the main identified causes of stunting. With the resurge of stunting in Egypt, there is a need to reevaluate the contributing factors of stunting in Egypt within the WHO framework to develop sound public health intervention to overcome the problem of stunting and to reduce its economic and health consequences.

Methodology

Study setting and duration**:** The present study was carried out at the Short stature clinic at the National Nutrition Institute (NNI) in Egypt during the period from January till June 2014.

Study design: A case-control study design was implemented.

Sample size**:** The sample size was calculated by Open Epi sample size calculator. The calculation based on a confidence level of 95%, power 80%, ratio of control to cases is 1, and the least extreme Odds ratio to be detected is 2. The calculation revealed total of 268 subjects (134 cases and 134 controls).

Recruitment: A purposive sample of 300 children aged 2-8 years old was recruited where 148 stunted children from the short stature clinic were selected as cases where height- for- age was less than -2SD according to the WHO height for age Z-score released on (2005) for under five children and 2007 for the 5-8years old children). One hundred and twenty five non-stunted children were recruited from the relatives of the attendants of other clinics at the NNI as control group.

Children with short stature due to certain pathology like hormonal stunting, bone diseases, chronic diseases, genetic diseases, metabolic disorders, or who are on medication for growth promotion were excluded from the study.

Official approval was obtained from the Public Health department committee. Informed consents were obtained from the mothers or care givers.

Data collection: Parents/caregivers of all the children were subjected to an interview included socioeconomic, dietary, medical information and anthropometric measurements. An updated validated socio-economic questionnaire was used[7] addressing seven domains, education, occupation, family composition, house environment sanitation, economic status and health care services. The total score of the above questionnaire ranges from 0-84. Tertiles of the score was estimated and the socioeconomic status was classified to very low (score <36), low (score 36-46), middle (score 47-60) and high (score above 60).

To assess the dietary intake of the children, 24 hours recall was used where mothers or the care givers were asked to list all the foods and beverages the child consumed the day prior to the interview elaborating on amounts and cooking methods. Amounts were estimated using cups and household utensils commonly used. Data of the 24hour recall were analyzed using the ESHA program obtaining 14 nutrients including total calories, macro and some micronutrients. In addition, a food frequency questionnaire including a list of 77 food items commonly consumed by the Egyptian children was used. Response of the mothers or care givers were recorded of how frequent did the child consumed this item in the previous week. The 77 food items were classified according to their similarity in composition into Grains-pasta group, Legumes and meat group, Milk and dairy group, Fruits and vegetables group and finally Discretionary calories group[8].

Questions addressing breastfeeding initiation, duration and exclusive breastfeeding for the first six month of child's life were administered in addition to questions investigating adherence to recommended complementary feeding practices of exclusive breastfeeding, feeding the newborn within one hour and breastfeeding initiation.

History of Acute illness within the previous two weeks and past history of micronutrients deficiencies like iron deficiency, vitamin D and Calcium deficiency were obtained.

Weight and height were measured and BMI was calculated. The height was read and recorded to the nearest 0.1 cm and the weight was recorded to the nearest 0.1kg with children standing barefoot and wearing light clothes.

Statistical analysis:

For each numeric variable, the normality of distribution was preliminarily assessed by the Kolmogorov–Smirnov test. Normally distributed variables were generally expressed as mean and SD. Variables not normally distributed were expressed as median and interquartile range. Qualitative variables were presented as frequency and percentages. Distribution tables were developed to describe socioeconomic and nutritional status of stunted and non-stunted children. The relation of each variable to outcome categories was separately tested by the chi-square test for categorical variables, t- test or Mann-Whitney for continuous variables. Statistically significant variables were included when four logistic regression models were performed to detect predictors of stunting among the stunted and non-stunted children following the WHO framework. All p-values below 0.05 were considered significant. Data analysis was conducted using SPSS v.21.

Results

The basic characteristics of the studied sample are shown in table 1. The age ranged from 2-8 years with a mean age of 5.2 ± 1.97 years. Percent of children born in urban areas was 62.8% in case group and 78.3% in the control group. Thirty four percent of stunted children were the second born child while nearly thirty five percent were ordered the third child or more, while more children in the control group were the first born (55.3%).

Nearly half of both groups had a history of breast feeding initiation in the first hour after delivery. Small percentages of both groups continued exclusive breast feeding for six months (16.2% of the cases versus 19% of the control, p=0.22). About one third of the control group started formula feeding in first 6 months versus about one fourth of cases. (table 2)

History of vitamin D deficiency , manifestations of rickets and treatment with calcium and vitamin D supplements was significantly higher among stunted children P-value <0.01, same case regarding iron deficiency anemia it was significantly higher among stunted children P-value < 0.01. Cases significantly showed more attacks of chest infection than control (table 2)

The socio-demographic score showed significant difference between both groups in educational domain, occupational domain, family sanitation domain, health care domain and total domain as illustrated in table 3. As demonstrated in figure 1; the percent of families that lie in the very low and low categories were significantly higher among stunted children. Almost 75% of families of stunted children were very low or low socioeconomic class compared to 46.7% of families of non-stunted. Almost 50% of families of non-stunted children were middle or high class compared to only 26.4% of stunted children families (p=0.00). The results is demonstrated in figure 1.

Comparing the level of parent's education among cases and control mother's education was significantly higher in the control group 74.7% than the case group 50.7%. While one third of mothers of the case group were illiterate compared to 8.6% illiterate mothers in the control group. Correspondingly, father's education of non-stunted children was significantly higher compared to fathers of stunted children. The percentage of fathers who work as skilled worker or clerk (76.7 %) was significantly higher among control group (p value = 0.00) compared to case group (69.3%). As regards to home sanitation domain the different services were lower in the case group with significant difference in availability of municipal collection of solid wastes, flush latrine, and air conditioning (43.2% vs. 68.4%, 95.3% vs. 100%, and 87.2% vs. 94.1% respectively). The health care domain demonstrated significant difference between the two groups as regards source of receiving medical service. More than one third of the cases received medical services from public ones versus only 20% of the controls.

Analysis of 24 hour recall for total calories and different nutrients by age as shown in table 4 demonstrated that; there was no significant difference in intake of total calories, macronutrients, and micronutrients among stunted and non-stunted children younger than 3 years. Comparing the intake of the children aged 2-3 years of this study to the recommended daily allowance[8] **.**

, we found that both stunted and non-stunted children had high intake of total protein exceeding the RDA (16 grams/day). The stunted and non-stunted children had low intake of vitamin A, B1, B2 and C. Also the intake of both groups from calcium was almost 50% of the RDA and they had low intake of iron, magnesium, phosphorous and borderline intake of zinc.

In the age group 4-8; intake of total calories and macronutrients was significantly higher in non-stunted children P < 0.01. Vitamin A, and Vitamin C intake was significantly higher among non-stunted children, also intake of minerals like Iron, Zinc, calcium and Phosphorous was higher in non-stunted children, however only calcium intake showed significant difference between groups (P-value 0.03).

Comparing the intake of servings of different food groups to the recommendations of my plate as demonstrated in table 5 revealed that; there was no significant difference in the intake among the children aged 2-3 years, however both groups had low intake of different food groups. Regarding the intake of food groups of children aged 4-9 years of the studied groups, there was significantly higher intake of all food groups among non- stunted children. Generally more than half of the stunted children had less than the recommended servings of legumes and meat group, fruits and vegetables groups.

Both stunted and non-stunted children had very low intake of milk and dairy products.

Four logistic regression models were developed to predict stunting based on the framework developed by the WHO(6).

Mothers' education was the only socioeconomic predictor of stunting where low maternal education attainment was associated with stunting (OR= 0.87 and 95%CI= 0.80-0.94). Formula feeding during first six moth of life was associated with reduced stunting (OR 0.53 and 95%CI=0.31-0.9). Children with history of delayed milestones were 2.4 times more likely to be stunted (p=0.002) while children with history of rickets were four times more likely to be stunted (p=0.007). Both anemia and chest infection increased the risk of being stunting by two folds.

Dietary predictors included milk, meat and calcium consumption where meeting milk and meat groups recommendation reduced risk of being stunted by 80% and 40% while increase calcium intake by 1 mg reduces risk of being stunting by 1%.

Discussion

Children malnutrition is a major public health problem with short and long term effects on both the child and its community. Although inadequate dietary intake, feeding practices in infancy, and recurrent illness were found to be the major direct causes of malnutrition in children, socioeconomic level is another contributor associated with malnutrition. The current study showed that morbidity demonstrated in past history of delayed milestones, rickets, anemia and chest infection were the major predictors of stunting. Also meeting recommended servings of meat and milk groups as well as calcium intake had protective effect against stunting as well as high maternal education attainment.

In consistence with our findings previous work in Egypt reported low plasma level of calcium(9,10) **,** high prevalence of iron deficiency anemia**(9,10,11)** among stunted children compared to non-stunted children**.**

Also diarrhea and acute chest infection used to be the main acute illness of public health interest and their prevalence in a community is used as an indicator of children health status of this community[12]**.**

The Egyptian Demographic and Health survey (2014) stated that the mothers of 14% of children under 5 years of age reported that their children had diarrhea within the 2 weeks before the survey. In addition, about 14% of the children of the survey had symptoms of acute chest infection within the 2 weeks prior to the study[4]. Only 3.7% of children in the present study had diarrhea and 29.7% had symptoms of acute chest infection. The difference in prevalence of acute illness compared to the EDHS data could be due to the difference in the sample structure as EDHS described the prevalence among children under 5 years, while this study was conducted among children aged 2-8 years. Also this study was conducted in winter where chest infection is prevalent than diarrheal diseases. Also, Gosh et al. (2012)[13] found an association between stunting and acute chest illness in the weeks preceding their studies. On the other hand, Janevic et al. (2010)[1], Tiwari et al. (2011)[14] found no relationship between recent acute respiratory infection and stunting.

Parental education is influential to the child health and nutritional status .Educated mother is aware of good nutritional choices, the importance of immunization, family planning and breastfeeding promoting her child's health. In addition high maternal education means better chance of having educated partner, good income occupation and better living conditions[15]. The present study found that one third of the mothers of stunted children were illiterate or can only read and write compared to 9.2% of the mothers of non-stunted children and that stunting was associated with low maternal education attainment. These findings were consistent with previous studies[14-17] .

Breastfeeding promotes linear growth[18] and early feeding malpractices accounts for nearly one third of malnutrition worldwide[19]. After 2 years of age, it is very difficult to reverse stunting that has occurred earlier unless food security and dietary environment of the child showed significant improvement. The current study showed that almost all the children were breastfed and mothers initiated breastfeeding within one hour. However many mothers failed to exclusively breastfeed their children and introduced prelacteal fluids or supplementary foods before six month of age (84% among stunted and 79% among non stunted children). Prelacteal fluids included herbal drinks, formula and rice water .No association between early breastfeeding and stunting was established in support to previous study by Kuchenbecker et al. (2015)[20] and unlike findings by Alemayhu et al. (2014) who found that children who had initiated breastfeeding after 6 hours of birth were 4 times more likely to be stunted. Also a study conducted among Malawian children and another among Iranian children showed that children who were exclusively breastfed for the first 6 months were less likely to be stunted[20,21]. Interestingly children given formula with breast milk in the first 6 months were significantly less likely to be stunted. On the contrary to our findings , other studies proved a significant relationship between formula feeding and stunting[22].We cannot but speculate that early introduction of herbal drinks, a cultural norm, decreased breastmilk consumption and increased low nutritional value alternatives put children who received formula in better nutritional status.

Diet with adequate amounts of milk and milk products, fruits and vegetables was reported to be protective against stunting. There are some nutrients thought to be more important than the others for growth of stature like protein[23,24] iron[11], zinc and calcium[24]. In order to interpret the dietary data in the current study, children were grouped according to their age and dietary requirements into 2 groups, 2-3 years and 4-8 years of age. No significant differences in daily nutrient intakes or number of children who met recommended servings of different food groups were observed between stunted and non stunted children 2 -3 years of age (N=54). Previous studies conducted among younger children 12-24 months old supported the results with no difference in nutrients intake between stunted and non stunted children[26,27]. In addition, Theron et al. (2006)[27] conducted a similar study in South Africa among children and found no significant difference in the frequency of intake of different food groups in both stunted and non-stunted children. The authors concluded that meat and milk food groups were not associated with stunting. On the contrary, Marquis et al.,1997[18] and Krebs et al.,2011[28] studied the effect of animal source foods especially meat on growth of stature in children aged less than 2 years. They found that regular consumption of animal source food has positive effect on growth of stature and is negatively related to stunting.

Dietary intake of children aged 4-8 years in the present study showed that stunted children had significantly low mean intakes of total daily calories, macronutrients and vitamin A, C, calcium, magnesium, iron and zinc. These results are supported by another study conducted in Egypt on children aged 2-5 years[10]

Current study showed that meeting milk and meat group recommendations reduced risk of being stunted by 80% and 40% respectively. Moreover, more than half of the stunted children did not meet the recommended servings of all food groups except grain –pasta food group (42%). The milk-dairy group and meat group were food groups of special interest when studying growth of stature. Previous studies conducted in Egypt among 2-6 years old children and 5-19 year old school children found that stunted children had lower intake of dairy products, meat, sugar, fruits, vegetables and beverages, the percent of children who consumed small amounts of milk and dairy products was significantly higher in stunted children[16]. Our results confirm findings of studies from Iran and other developing countries where stunted children were found to consume less of different food groups[21] or that high consumption of meat or animal foods[29,30] or milk[31,32] .Interestingly an intervention study conducted in Kenya provided milk, meat, extra calories to three intervention groups. They reported that the milk group had the highest increase in height compared to the other groups and children of meat group gained weight but didn’t gain height[24]

Limitations to be considered when interpreting the results of the present study include the wide age range of the studied group and its retrospective nature which possibly results in recall bias specifically of complementary feeding practices although all interviews were collected by one researcher to ensure consistent technique and interpretation of the caregiver answers. It should be also noted that epidemiological studies of this kind do not establish causality but may suggest associations and results cannot be generalized because the sample was conveniently selected and sociodemographically homogenous being governmental service recipients.

In conclusion, implementing the WHO framework for causes of stunting among children in the present study assisted in identifying strong morbidity and dietary predictors of stunting among a convenient sample of Egyptian children however there is need to test the model in more diverse population among children under two years of age or to develop a cohort study of newborn to better explain onset of stunting its causes and consequences. Meat and milk groups as dietary predictors and repeated infection could be directed to identify children at risk of stunting by health care providers to reduce the prevalence of stunting. Maternal education an important social predictor indicates the urgent attention to girl education and requires the health systems to be more creative to deliver simple and effective messages to mothers encouraging healthy complementary feeding practices and complementary food from local market. It is also important to explore expansion of social net to develop a food nutrition program geared to mothers with children under two years of age to ensure healthy food choices and feeding practices.

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Table 1: Basic characteristics of the studied sample

Basic characters	Case (148) No (%)	Control (152) No (%)	P value
Age			
Mean ± SD	5.20±1.97	5.20±1.97	0.91*
Sex			
Male	74 (50.0)	80 (52.6)	0.36#
Female	74 (50.0)	72 (47.4)	
Birth place			
urban	93 (62.8)	119 (78.3)	<0.001#
rural	55 (37.2)	33 (21.7)	
Birth order			
1st	47 (31.8)	84 (55.3)	<0.001#
2nd	51 (34.5)	37 (24.3)	
3rd	24 (16.2)	23 (15.1)	
4th or more	26 (17.3)	9 (5.9)	
Anthropometric measurements (mean ± SD)			
Weight	14.33 ± 3.74	17.42 ± 1.39	<0.001*
Height	96 ± 11.79	107.65 ± 13.29	<0.001*
BMI	15.2 ± 1.98	14.7 ± 1.4	<0.001*

*T-test # chi square test

Table (2): Previous feeding and morbidity history of the studied groups

Clinical history	Case (148) No (%)	Control (152) No (%)	P value*
History of breast feeding			
Initiation within first one hour	84 (56.8)	84(55.3)	0.79
Exclusive breast feeding for 6 months	24(16.2)	57(19.0)	0.22
Fluids given during the first 6 months			
Water	15(10.1)	12(7.9)	0.49
Herbs	82(55.4)	66(43.4)	0.24
Formula	34(23.0)	50(32.9)	0.04
Rice water	6 (4.1)	6(3.9)	0.55
Introduced animal protein			
Before 12 months	15 (10.1)	22 (14.5)	
Between 12-18 months	81 (54.7)	74 (48.7)	0.42
After 18 months	52 (35.1)	56 (36.8)	
History of vitamin D deficiency			
Delayed milestone	64 (42.7)	28 (18.7)	<0.001
Bow legs	26 (17.3)	4 (2.7)	<0.001
Previous Calcium supplementation	87 (58.0)	61 (40.7)	<0.001
History of iron deficiency			
Previous diagnosis of anemia	95(63.3)	62 (41.3)	0.003
Iron supplementation	83(55.3)	68(45.3)	0.083
Morbidities within the last 2 weeks			
Chest infection	57 (38.5)	32 (21.1)	<0.001
GIT infection	7 (4.7)	4 (2.6)	0.33

*Chi-square test

Table (3): Mean and standard deviation of socioeconomic scores among the studied groups

Socio-demographic score	Case Mean ± SD	Control Mean ± SD	P value*
Educational domain score(0-30)	12.2± 6.1	17.1 ± 5.9	<0.001
Occupation domain score (0-10)	2.7 ± 1.6	3.5 ± 1.9	<0.001
Family domain score (0-10)	6.1± 1.5	6.2 ± 1.4	0.54
Home sanitation domain (0-12)	10.7 ±2.5	11.5 ± 2.7	0.01
Family possession domain (0-12)	5.4 ±1.5	5.8 ±1.3	0.37
Economic domain (0-5)	2.04 ± 1.1	2.3 ±0.9	0.72
Health care domain (0-5)	2.9 ± 1.1	3.3 ± 1.4	0.04
Total score (0-84)	47.5 ± 10.1	55.2 ± 11.1	<0.001

*t-test

Table 4: Groups comparison for 24 hours recall regarding total calories, macronutrient, micronutrient intakes by age group

Nutrients intake	Age group ≤ 3 years			Age group (4-8) years		
	Case (n=24) Median (IQR)	**Control (n=30) Median (IQR)**	**P Value***	**Case (n=124) Median (IQR)**	**Control (n=122) Median (IQR)**	**P value***
Calories (kcal/d)						
Male	558 (369-1008)	1012 (726-1425)	0.53	1052 (883-1422)	1389 (1054-1643.5)	<0.001
Female	878 (567-1195)	645 (529-967)	0.12	967.2 (762.8-1198.4)	1245.8 (942.4- 1598.1)	<0.001
Carbohydrates (g/d)	108 (71.8- 157)	114 (83.6-142.8)	0.84	137.3 (106.2-179.2)	173.5 (130.9-203.2)	<0.001
Protein (g/d)	24.6 (13.3- 38.7)	24.1 (17.9-45.8)	0.65	35.4 (26.3-45.8)	43.7 (37.3-57.8)	0.007
Fat (g/d)	29.5 (12.3-44.6)	29.3 (17.5-43.6)	0.63	36.4 (25.2-48)	47.5 (34.9-69.1	0.003
Retinol (RE)	83.1 (51.4-172.6)	56.5 (13.4-118.6)	0.11	88 (26.5-63.8)	143 (55.8-242.4)	0.002
Vitamin B1 (mg)	0.32 (0.17-0.45)	0.28 (0.17-0.49)	0.98	0.38 (0.24-0.64	0.38 (0.25-0.59)	0.88
Vitamin B2 (mg)	0.32 (0.16- 0.64)	0.39 (0.16- 0.96)	0.61	0.42 (0.25-0.88)	0.59 (0.38-0.91)	0.12
Vitamin C (mg)	21.1 (5.3-50.3)	12.5 (1.6-27.3)	0.12	10.5 (3.0-39.4)	20.6 (7-52.3)	0.01
Calcium(mg)	252 (125-464)	292 (94.2-488)	0.84	330.3 (194.4-527.6)	408.2 (264.3-608)	0.03
Phosphorous (mg)`	372 (242-511)	337 (237-602)	0.72	483.6 (3339.2-616.8)	541.6 (351 -746.8)	0.25
Iron (mg)	5.1 (3.3-6.7)	5.8 (3.5-7.3)	0.62	7.1 (4.9-9.9)	8.8 (7.5-10.9)	0.05
Magnesium(mg)	70.2 (36.2-107.1)	43.7 (32.2-107.1)	0.33	62.8 (41.9-93.9)	72.6 (47.1-117.4)	0.05
Zinc(mg)	3.1 (2.3-4.5)	3.5 (2.1-5.5)	0.90	4.5 (3.3-6.3)	5.5 (4.1-7.5)	0.05
Copper (mg)	0.48 (0.24-0.72)	0.49 (0.16-0.99)	0.99	0.42 (0.21-0.76)	0.46 (0.29-0.85)	0.65
Empty calories (%)						
Yes	18 (75)	16 (53.3)	0.08	70 (56.5)	62 (50.8)	0.23#
No	6 (25)	14 (46.7)		62 (43.5)	60 (49.2)	

*Mann-Whitney #Chi-square test

Table (5): Group comparison of different food group servings by age group

Food group servings	Age group ≤ 3 years		P*	Age group (4-8) years		P*
	Cases (24) No (%)	Control (30) No (%)		Cases (124) No (%)	Control (122) No (%)	
Grains-pasta servings						
Less than recommended	13 (54.2)	20 (66.7)		52 (41.9)	31 (25.4)	0.004
Met or exceed recommended	11(45.8)	10 (33.3)	0.26	72 (58.1)	91 (74.6)	
Legumes-meat servings						
Less than recommended	17 (70.8)	23 (76.7)		73 (58.9)	47 (38.5)	0.01
Met or exceed recommended	7 (29.2)	7 (23.3)	0.42	51 (41.1)	75 (61.5)	
Milk-dairy servings						
Less than recommended	23 (95.8)	24 (80)		117(94.4)	95 (77.9)	0.01
Met or exceed recommended	1 (4.2)	6 (20)	0.2	7(5.6)	27 (22.1)	
Fruit servings						
Less than recommended	16 (66.7)	20 (66.7)		83 (66.9)	65 (53.5)	0.02
Met or exceed recommended	8 (33.3)	10 (33.3)	0.61	41 (33.1)	57 (46.5)	
Vegetables servings						
Less than recommended	16 (66.7)	19 (63.3)		72 (58.1)	54 (44.3)	0.02
Met or exceed recommended	8 (33.3)	11(36.7)	0.51	52 (41.9)	68 (55.7)	

*Chi square test

Table (6): Simple binary regression for significant predictors associated with stunting

Variables	Exp (B)	Significance	95 % CI
Socio-demographic predictors			
Maternal education	-0.87	0.001	0.80-0.94
Constant	22.3	0.99	
Breast and complementary feeding practice predictors			
Formula fed in first 6 months	-0.53	0.01	0.31-0.9
constant	-0.42	0.12	
Previous morbidities predictors			
Delayed milestones	2.40	0.002	1.39 – 4.16
Rickets	4.09	0.007	1.47 - 11.38
Anemia	1.90	0.010	1.16 - 3.11
Chest infection	2.00	0.012	1.17 - 3.45
Constant	0.069	<0.001	
Dietary predictors			
Meet recommended serving of Milk group	-0.21	0.001	0.09 - 0.55
Meet recommended serving of Meat group	-0.59	0.045	0.37 - 0.99
Calcium intake (mg)	-0.99	0.02	0.99 - 1.00
Constant	2.01	0.27	

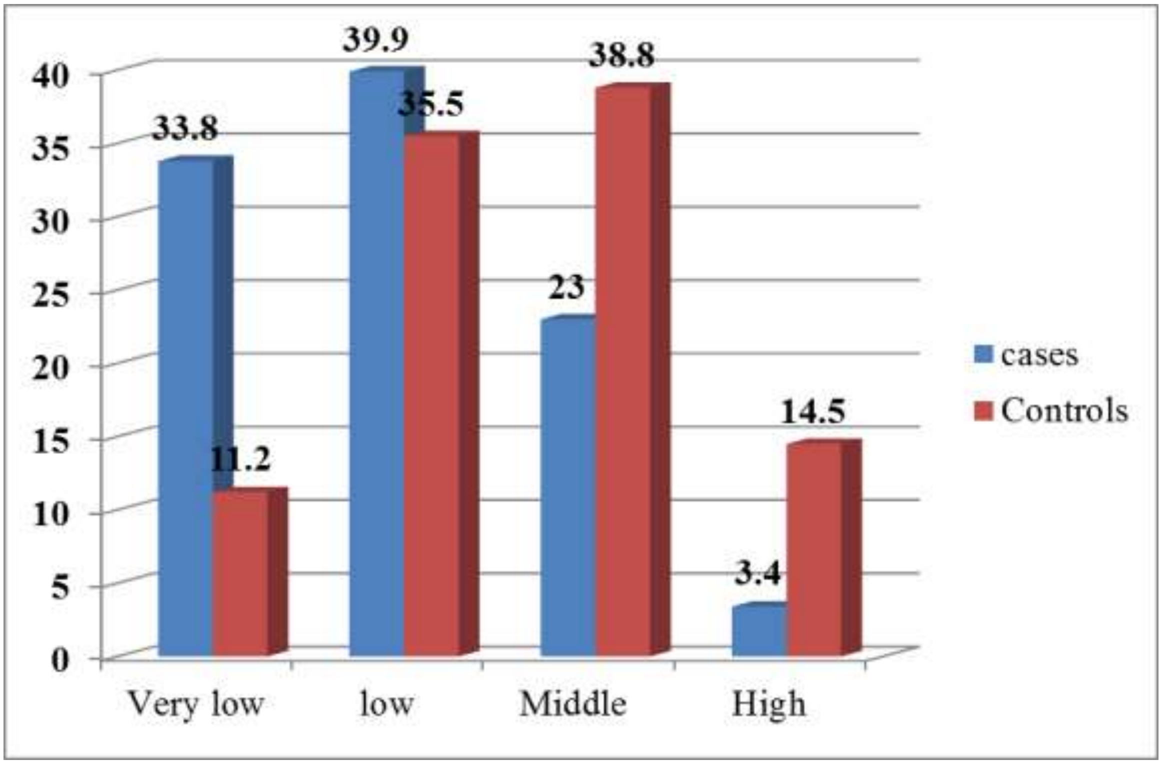

Figure 1: Socio-demographic levels among the studied groups