Prevalence of Malnutrition Detected by Anthropometric Assessment among Children Under Five Years of Age in Selected Rural Areas in Lower Egypt

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Abstract

Background: Malnourished children have a weakened immune system with a greater risk of developing preventable illnesses like pneumonia and diarrhea. Under nutrition is responsible directly or indirectly for 60% of the 10.9 million deaths occurring annually among children under five worldwide. On the other side, over nutrition (overweight and obesity), is a major contributor to the increased prevalence of non-communicable diseases in adulthood with its debilitating effects and increased cost of care between the elder population. **Objective:** To determine the prevalence of malnutrition detected by basic anthropometric assessment (weight and height) in children 0-60 month of age in selected rural areas of two districts in the governorates of Qalyubia and Gharbia and to explore the possible underlying factors of malnutrition in these areas. **Method:** A nutritional survey on 3871 children less than 5 years was conducted in rural health units in Kafr Shokr and Samanoud. Data was collected using an interviewed questionnaire with the mothers and anthropometric measurement sheet**.** **Results:** The study revealed that overweight and stunting were the most common forms of malnutrition prevalent within the study population at 15.2%, and 11.3% respectively and that some socio-demographic characteristics related to the children and their mothers were found to have their impact on the children's nutritional status. **Conclusion**: Nutritional status among Egyptian children needs due concern. Health education on promoting dietary pattern and importance of breast feeding will aid in promoting their health.

Key words: *Malnutrition – Under five years – Rural lower Egypt*

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Introduction

Malnutrition is a broad term that covers 2 broad groups of conditions. One is ‘undernutrition’—which includes stunting, wasting, underweight and micronutrient deficiencies or insufficiencies (a lack of important vitamins and minerals). The other is overweight, obesity and diet-related non-communicable diseases. People are malnourished if their diet does not provide adequate calories, protein, and micronutrients for growth and maintenance or they are unable to fully utilize the food they eat due to illness; this is what is known as undernutrition. Individuals are also considered malnourished if they consume too many calories than their daily requirement and in this case, individuals suffer from signs and symptoms of over-nutrition.[1]

Populations in numerous countries suffer from both these conditions in what is globally known as the double burden of malnutrition.[2]

The effects of undernutrition in infancy and early childhood are irreversible and affect the quality of life of individuals and nations. Undernutrition is responsible directly or indirectly for 60% of the 10.9 million deaths occurring annually among children under five worldwide. Over two-thirds of these deaths are often associated with inappropriate feeding practices, occurring during the first year of life. Malnourished children have a weakened immune system with a greater risk of developing preventable illnesses like pneumonia and diarrhea, they are more frequently sick and suffer the life-long consequences of impaired development both physical and cognitive.[3]

At the other end of the nutritional spectrum overnutrition presenting as overweight and obesity, is a rising pandemic worldwide and a major contributor to the increased prevalence of non-communicable diseases in adulthood with its debilitating effects and increased cost of care between the elder population.[4]

Anthropometry is defined as the study of the measurement of the human body, the WHO has identified it to provide the single most portable, universally applicable, inexpensive and non-invasive technique for assessing the size, proportions and composition of the human body. It reflects both health and nutritional status and can be used to predict performance, health and survival.[5]

The United Nations standing committee on nutrition endorsed the WHO Child Growth Standards in 2006. These standards were developed as a result of the WHO Multicenter Growth Reference Study (MGRS) conducted between 1997 and 2003 in six countries around the world (Brazil, Ghana, India, Norway, Oman, and the United States). The study followed a group of full term babies from birth to 2 years of age, and another group of children aged 18 to71 months was measured once, data from the two samples were combined to create the new WHO growth standards from birth to 5 years of age.[6]

A key characteristic of the new growth standards is that they explicitly identify breastfeeding as the biological norm and establish the breastfed child as the normative model for growth and development. The growth standards and curves establish guidelines for the healthy growth and development of all infants and young children in all countries around the world.[7]

The Government of Egypt and the Ministry of Health and Population (MOHP) have endorsed the WHO growth standards. The MOHP has also adopted the weight for age and height for age curves as the standard upon which the growth of its children is measured and monitored.

In the 2008 Lancet special series on maternal and child under nutrition[8], Egypt was identified as one of the 36 high burden countries suffering from stunting; stunting is one of the main indicators of chronic child malnutrition.

Egypt's DHS of 2008[9] found that 29% of children under five years of age were stunted and 14% were severely stunted, these levels are higher from those recorded in the 2000 and 2005 DHS surveys.

The results of the 2014 DHS survey shows a reversal in the levels of stunting nationwide, which fell to around 21%. A rising trend of child wasting has also been recorded to reach 8%.[10]

Prior to the Egyptian 2014 DHS report, none of the previous DHS reports covered the trends in overweight and obesity for under 5 children. The 2014 DHS reported a proportion of overweight children with weight-for-height above +2 SD to be 14.9% nationwide. This is less than the figures reported in the WHO Global Database concerning Egypt, which reported the prevalence of overweight at 20.5% all over Egypt in 2008.[11]

Based on this information, the MOHP has launched a Nutrition Unit within the Maternal and Child Health Department to combat this health threat. This unit has chosen two Governorates in Lower Egypt to set up a pilot of interventions to overcome the problems of malnutrition with a special emphasis on undernutrition.

This study aims to determine the prevalence of malnutrition detected by basic anthropometric assessment (weight and height) in children 0-60 month of age in selected rural areas of two districts in the governorates of Qalyubia and Gharbia and to explore the possible underlying factors of malnutrition in the selected areas.

Method

Study Setting: The MOHP selected the 2 Governorates Qualioubiya and Gharbia in Lower Egypt to conduct this study as part of a pilot phase for nutritional intervention to overcome the problem of malnutrition in Egypt.

The choice of districts to work in within each Governorate was based on the following criteria agreed upon with the MOHP:

I. Districts that have the majority of their facilities accredited were included in the selection process the logic behind selecting districts with a majority of accredited facilities was that they are more likely to be better equipped to implement the different interventions.

II. Facilities must be implementing the family health model with active patient files.

III. Districts with recently accredited facilities were favored.

IV. Districts with a majority of rural facilities were favored.

According to the above-mentioned criteria the two selected districts were

A. Samannoud in the Governorate of Gharbia.

B. Kafr Shokr in the Governorate of Qalyubia.

Within each district the pre-set target for the pilot study and interventions was 10 facilities per district, since Kafr Shokr only had 11 eligible facilities all the facilities were included in this assessment. Samannoud has a total of 20 primary care facilities of those only 13 are accredited 10 of these facilities were selected at random.

Sample Size and Sampling Technique: The sample size was estimated to be 1890 children in each district in accordance with the total population of under 5 children within each district determined from the birth registers of every selected health unit and expected frequency of stunting of 31.2% as seen in the 2014 Egyptian DHS.[10] The confidence level was set at 95%, with a sampling error of +/-3% and a design effect of 2. The sample size was rounded around 1900 children in each district. A systematic random sample was used to select eligible children in the current study.

The total number of children 0-59 months in Kafr Shokr was 12152 and in Sammanud was 17471. According to the sample size estimated, every 6th child was selected from Kafr Shokr and every 9th child was selected in Sammanud.

The selected child was enrolled by the health educator for examination in the health unit. If the selected child couldn't be reached or his caregiver refused, the next child in the list was selected.

Exclusion criteria: All children with chronic diseases that may affect the nutritional status and anthropometric measurements, e.g. cancer, endocrine diseases, chronic kidney diseases were excluded from the study. Children with severe acute diseases like diarrhea with dehydration and acute infections with toxemia were also excluded from the study.

Study Tools: 1-An interview questionnaire with the mothers of the children, including gender of child, date of birth, mother's age, mother education, income, number of siblings, child order of birth, child nutrition in the first 2 years of life. The questionnaire was pilot tested before implementation. 2- An anthropometric measurement sheet: The WHO guidelines for anthropometric measurements of children less than 5 years were followed[12] A. Measuring Weight: All the selected facilities have spring baby weight scales. A standard operating procedure (SOP) for the calibration of these scales was developed to make sure they are functioning properly. The scale is to be placed on a flat leveled surface and then calibrated according to the SOP. Once the calibration is complete, the nurse places the baby with the least amount of cloth possible on the scale while facing him directly. The weight of the child was then recorded in the data collection sheet to the nearest 0.01kg.

For older children, who can be directed to stand still on a scale, the normal adult scale was used. The same process of calibration was applied to the scale, and the child be placed with the least amount of clothing possible. B. Measuring Length or Height: According to the recommendations of the WHO, the recumbent length *(while child is lying down)* is used if a child is less than 2 years old, and the standing height is used if the child is aged 2 years or older.[12]

Measuring Length: To measure a child's length, the equipment needed is a length board (sometimes called an infantometer), which is part of the standard furnishings of the well-baby clinic in the primary health care facilities of the Ministry of Health and Population. The length board should be placed on a flat, stable surface such as a table before measuring the child.

Before commencing with the measurement, the nurse should check that the child's shoes and socks have been removed. If the child has hair braids that will interfere with the measurement of length/height they must also be removed. The child's mother must help in the process of measuring length/height to keep her infant calm. The child's head will be placed against the fixed headboard with his face facing up, the child must lie straight along the board with both shoulders touching the board, and his spine should not be arched. The child's legs are held down from the knees with gentle pressure with one hand and the nurse will move the footboard with the other so that the soles of the feet are flat against the footboard with toes pointing upwards. It is well known that it is not possible to straighten the knees of newborns to the same degree as older children, their knees are fragile and could be injured easily, and thus minimal pressure should be applied.

Measuring Height: To measure height, a wall height chart OR a height rod is used. The wall height chart is taped to the wall level to the floor; the height rod is incorporated into the adult weight scale. At the beginning, we check that the child's shoes and socks have been removed. If the child has hair braids that will interfere with the measurement of length/height they must also be removed. The child stands with his feet slightly apart, the back of the head, shoulder blades, buttocks, calves, and heels should all touch the height chart. The child's head is positioned so that a horizontal line from the ear canal to the lower border of the eye socket runs parallel to the ground. Keeping the head in position, use the other hand to put a straight object such as a ruler or hard cover book to rest firmly on top of the head and compress the hair. The measurement of the child's height in centimeters is read to the last complete 0.1 cm.

Data analysis:

Critical information for the calculation of nutritional status (child I.D, date of birth, date of visit, sex, height and weight) were uploaded onto the WHO-Anthro program version 3.2.2. The WHO-Anthro program has the capability to

Table 1: Distribution of the studied children by age & gender in Qualioubiya and Gharbia samples.

	Samanud District (Gharbiya)	Kafr Shokr District (Qalyobia)	Total
No. enrolled children	1941	1924	3871
Age (months) [No. (%)]*			
0-	312 (16)	261 (13.6)	573 (14.8)
12-	429 (22)	498 (25.9)	927 (23.9)
24-	415 (21.3)	421 (21.9)	836 (21.6)
36-	401 (20.6)	401 (20.8)	802 (20.7)
48-59	390 (20)	343 (17.8)	733 (18.9)
Gender [No. (%)]			
Male	1010 (51.9)	986 (51.2)	1996 (51.6)
Female	937 (48.1)	938 (48.8)	1875 (48.4)

**P = 0.013*

identify any extreme or potentially incorrect z-score values for each indicator, The lower and upper SD boundaries as per WHO recommendations are set to flag at -5SD & +5SD for WHZ (Weight for Height Z score) & BAZ (Body Mass index for Age Z-score), for the HAZ (Height for Age Z score) the limits are set at +/- 6SD, and at -6SD & +5SD for WAZ (Weight for Age Z score).

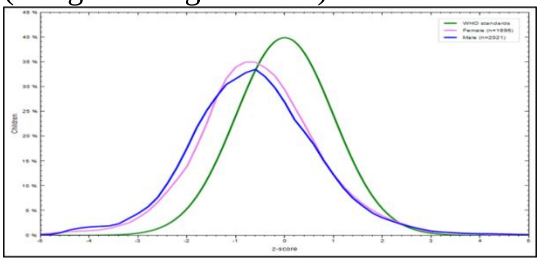

Figure 1: Deviation of study population disaggregated by sex from the reference WHO population, with regards to HAZ

Data were analyzed using SPSS program version 20. Since the sample was self-weighted, no adjustment for clustering was done. Data were presented in frequency and corresponding percentage. Comparison of qualitative variables was done using the Chi - square test. The Odds ratio was used to quantify risk with 95% confidence interval. All factors with P value <0.25 by univariate analysis were included in logistic regression analysis. The model was assessed for goodness of fit using log likelihood and Hosmer-Lemeshow test. No interaction between the predictors was examined in the logistic regression model. An adjusted Odds ratio with 95% confidence interval was estimated for significant predictors. A "P" value of 0.05 was used as the level of statistical significance.

Ethical considerations

Approval from Ain Shams Ethical Committee and administrative approvals were taken. An informed consent was obtained from mothers of children enrolled in the study. Confidentiality of data was ensured and data were used for research purpose only.

Results

A total of 3871 children were enrolled in this study from the two selected districts. males comprise 51.6% of the whole study sample. As for age distribution, no significant variability between the two study populations was observed as shown in table 1.

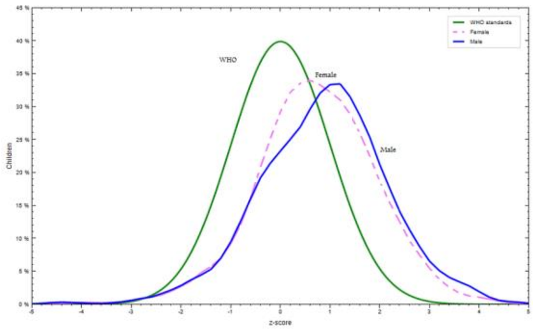

Figure 2: Distribution of sample Z scores of BMI of males and females children compared to WHO standards

As shown in table 2 overweight measured by the BAZ and stunting measured by the

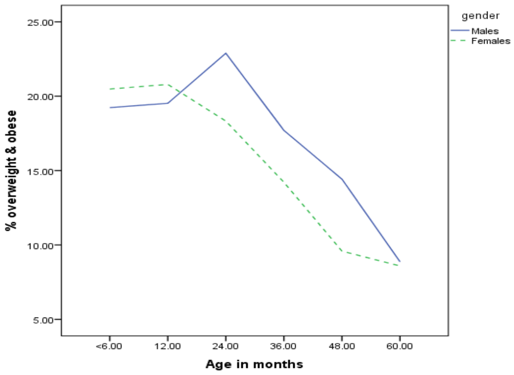

Figure 3: Prevalence of combined overweight and obesity across the different age groups in all children (upper graph) and among males and females of study sample

Table 2: Prevalence of The Different Forms of Malnutrition in The Study Groups.

Distribution of different forms of malnutrition by district		Samannoud Gharbeya (N=1975)		Kafr Shokr Qalyobia (N= 1942)		Total (N=3917)		P value
		N	%	N	%	N	%	
Stunting (HAZ)								
Moderate	< -2 SD to ≥ -3SD	172	8.7	158	8.1	330	8.4	0.765
Severe	< -3 SD	55	2.8	58	3.0	113	2.9	
Under weight (WAZ)								
Moderate	< -2 SD to ≥ -3SD	40	2.0	37	1.9	77	2.0	0.509
Severe	< -3 SD	8	0.4	4	0.2	12	0.3	
(WHZ) Overweight and Wasting								
Obese	> +3 SD	59	3.0	49	2.5	108	2.8	
Overweight	> +2 SD to ≤ +3SD	215	10.9	187	9.6	402	10.2	
Normal	≤ +2 SD to ≥ -2 SD	1665	84.3	1669	85.9	3334	85.1	.333
Moderate Wasting	< -2 SD to ≥ -3SD	24	1.2	30	1.5	54	1.4	
Severe Wasting	< -3 SD	12	0.6	7	0.4	19	0.5	
(BMZ) Overweight and Wasting								
Obese	> +3 SD	73	3.7	63	3.2	136	3.5	
Overweight	> +2 SD to ≤ +3SD	241	12.2	218	11.3	459	11.7	
Normal	≤ +2 SD to ≥ -2 SD	1625	82.3	1621	83.5	3246	82.9	.277
Moderate Wasting	< -2 SD to ≥ -3SD	22	1.1	32	1.6	54	1.3	
Severe Wasting	< -3 SD	14	0.7	8	0.4	22	0.6	

HAZ were the most common forms of malnutrition prevalent within the study population at 15.2%, and 11.3% respectively. Underweight measured by WAZ was observed in 2.3% of the study population while wasting measured by WHZ was only found in 1.9% of the study population.

Underweight was prevalent in 2.3% of the population and wasting was reported in 1.9% of the studied group. The prevalence of the different forms of malnutrition within the study population was not statistically different between the two districts

Figure 1 shows the distribution of Z scores of Height/Length for age of the study sample compared to the WHO reference growth chart for males and females. The curve of the study sample, although looks normally distributed, is shifted to the left compared to the WHO reference population curve due to higher levels of stunting with males showing a slightly higher shift than females. Stunting prevalence among male subjects was (12.3%) compared to (10.3%) among female subjects.

Figure 2 explains the distribution of Z scores of BMI for age of the study sample compared to the WHO reference growth chart for males and females. The curve of the study sample, although looks normally distributed, is shifted to the right compared to the WHO reference revealing higher BMI for age in males and females' subgroups than the WHO reference (The mean Z score of the study sample is 0.812). The prevalence of combined overweight and obesity (BMI higher than 2SD) across the different age groups is 15.2%. The prevalence is higher in the first 2 years of life around 20% and then starts to decrease gradually with age till reaching 8.7% by the age of 5. The distribution of Z scores in males and females shows similar phenomenon of gradual decrease by age, although Z scores start to tapper earlier in females before the age of 2. However, evidently, the Z scores show gender differential, especially by beginning of the 2nd year of life with males exhibiting higher prevalence of overweight. As shown in Figure 3, Mothers age showed a positive relation with the prevalence of stunting among the examined children; with siblings, order of birth as well as income were all found insignificantly related to overweight in such age group. For mothers in the extreme of age group (<20 and ≥35) showing an increased odds (OR 1.39) of having children, who were stunted. The education level of the mother had the highest statistically significant relation with the development of stunting in children with 13% of the children of non-educated mothers being stunted, while only 8.6% of the college educated mothers children were stunted. However, the child age and gender did not show a statistically significant relation to the development of stunting. Family size affects the nutritional status of children with higher rates of stunting being seen among families with more than 3 children (13.9%), with an odds ratio of 1.32 that a child will be stunted if he comes from a family with more than 3 children. The order of the child between his siblings also demonstrated how large families might affect the nutritional status with higher rates of stunting being seen as child order increased. A twin child was 2.5 times more likely to be stunted than a singleton child was. Monthly spending did not show any relation with the development of stunting The use of formula milk has no relation with the development of stunting among children, while the early or late introduction of complementary food showed a strong relation with stunting. The early introduction of complementary food seemed to have higher odds of developing stunting (OR 1.56) among our studied population as seen in table 3.

The determinants of combined overweight and obesity were shown in table 4. In children less than 24 months, in children within our study population. the only factor that was significantly associated with high BMI was milk formula as predominant feeding in this age group. Other socio-demographic factors: District residence, gender, mother's age and education, number of children 24 months or older, only boys exhibit significant relation with overweight with an odds ratio of 1.3. Other socio-demographic factors didn't show any significant relation to overweight.

Table 3: Determinants of Stunting among the studied participants in Qalyobia and Gharbia governorates.

		Normal N (%)	Stunted N (%)	P value	OR (95%CI)
Gender	Male	1773 (87.7)	248 (12.3)	0.050	1.22 (1-1.49)
	Female	1701 (89.7)	195 (10.3)		1
Child's age in month group	0-	509 (88.8)	64 (11.2)	0.057	1
	12-	821 (87.1)	122 (12.9)		1.18 (0.85-1.6)
	≥24	2144 (89.3)	257 (10.7)		0.95 (0.7-1.27)
Mothers age	20-34.99	3018 (89.2)	365 (10.8)	0.018	1
	<20 and ≥35	452 (85.6)	76 (14.4)		1.39 (1.06-1.8)
Mothers education	not educated or primary education	541 (87)	81 (13)	0.002	1.6 (1.16-2.17)
	secondary/ vocational education	1935 (87.9)	266 (12.1)		1.5 (1.14-1.9)
Number of children for each mother	1-3	3035 (89.1)	372 (10.9)	0.046	1
	> 3	439 (86.1)	71 (13.9)		1.32 (1.004-1.7)
Use of formula milk	Yes	780 (89.1)	96 (11)	0.71	0.95 (0.75-1.2)
	No	2694 (88.6)	347 (11.4)		1
Comple-mentary food intro.	<4 month	135 (84.4)	25 (15.6)	0.032	1.56 (1-2.42)
	4-7 month	2843 (89.4)	338 (10.6)		1
	> 7 month	429 (86.5)	67 (13.5)		1.3 (0.99-1.74)
Child order	First child	1260 (90.5)	132 (9.5)	0.003	1
	2nd or higher	2182 (87.8)	302 (12.2)		1.32 (1.06-1.64)
	Twin	30 (78.9)	8 (21.1)		2.5 (1.14-5.7)
Average monthly spending	≤ 1000	1289 (89)	159 (11)	0.207	
	1001 to 1500	312 (89.1)	38 (10.9)		
	>1500	214 (93)	16 (7)		

Even after adjustment for other potential confounding factors, Milk formula was the only predictor for overweight in children younger than 24 months and male gender was the only predictor of overweight in children from 2-5 years.

Discussion

The current study aimed to determine the prevalence of malnutrition by means of anthropometric assessment of children 0-60 month of age in rural areas of two districts in Lower Egypt in the Governorates of Qalyubia and Gharbia, and to explore possible underlying factors for malnutrition in the selected areas.

Concerning the demographic characteristics of the two study populations, no statistically significant difference was observed, regarding the prevalence of the different forms of malnutrition.

Results revealed by the BAZ or WHZ and stunting measured by the HAZ were the most common forms of malnutrition

Table 4: Determinants of combined overweight and obesity in Qalyobia and Gharbia study participants.

Variables	<24 months			≥ 24 months		
	No. (%)	P value	OR (95% CI)	No. (%)	P value	OR (95% CI)
District:					0.46	
Samanud	163 (22)	0.14	1	156 (12.9)		1
Kafr Shokr	144 (19)		0.99 (0.97-1.01)	139 (11.9)		0.99 (0.98-1.01)
Gender:					0.026	
Female	140 (19.3)	0.26	1	125 (10.9)		1
Male	167 (21.6)		1.16 (0.9-1.49)	170 (13.9)		1.3 (1.03-1.7)**
Mother's education:					0.25	
Illiterate /Read&Write	32 (20.3)	0.868	1	25 (9.4)		1
Primary-secondary	178 (20.1)		0.99(0.65-1.5)	193 (13)		1.45 (0.93-2.2)
University	97 (21.3)		1.07 (0.68-1.67)	76 (12.2)		1.4 (0.83-2.15)
Mother's age:					0.3	
<30	212 (19.7)	0.25	1	178 (13)		1
≥30	99 (22.3)		1.17 (0.89-1.5)	115 (11.6)		0.88 (0.68-1.12)
Birth order:					0.48	
First child	106 (20.2)	0.9	1	103 (11.8)		1
≥2nd order	200 (20.4)		0.98 (0.75-1.28)	190 (12.8)		1.09 (0.85 -1.41)
No. of siblings:					0.38	
1-2	266 (20.2)	0.42	1	257 (12.6)		1
≥3	41 (22.8)		1.17 (0.8-1.7)	36 (10.9)		0.85 (0.58-1.28)
Infant feeding:					0.79	
BF	200 (18.9)	0.01	1	223 (12.3)		1
Milk formula	107 (24.7)		1.4 (1.08-1.84)*	69 (12.7)		1.04 (0.78-1.39)
Family income:(LE)					0.22	
<1000	106 (19.6)	0.67	1	98 (11)		1
≥1000	42 (21.0)		1.09 (0.73 -1.63)	50 (13.5)		1.26 (0.87-1.8)

**The adjusted odds ratio after adjustment of gender, district, mother's age was 1.396 (1.06-1.8). Only infant feeding was significant. ** The adjusted odds ratio was 1.336 (1.04-1.710 after adjustment of income, mother education. Only gender was significant.*

prevalent within the study population at 15.2%, 13% and 11.3% respectively. Underweight measured by WAZ was observed in 2.3% of the population while wasting measured by WHZ and BAZ was only present in 1.9% of the study population.

These figures are lower than those reported in the Egyptian 2014 DHS for national and regional prevalence rates for the different forms of malnutrition. The national rates reported were; 14.9% for overweight measured by WHZ, 21.4% for stunting measured by HAZ, 5.5% for underweight measured by WAZ while wasting levels nationwide were 8.4%.[10]

A possible explanation for the difference between the results of the current study and those of the 2014 DHS can be attributed to different sample characteristics, as the study participants were recruited from only two rural districts in two governorates of Lower Egypt, which differs from the overall DHS sample characteristics. It should be noted that the study results are slightly closer for some of the indicators to those reported for rural lower Egypt in the 2014 DHS, where overweight measured by WHZ was 16.5%, stunting measured by HAZ was 17.9%, underweight measured by WAZ was 4.2% while wasting levels were 8.4%.[10]

Like many developing countries, and as evident from the prevalence of the different forms of malnutrition in the current study and in the Egyptian DHS of 2014 Egypt is suffering from the double burden of malnutrition. This means the coexistence of cases of over nutrition presenting as overweight and obesity and under nutrition presenting as stunting and to a lesser extent wasting and underweight.

In an attempt to identify the possible underlying factors of malnutrition, this study concentrated on the two indicators of malnutrition that showed a considerably high prevalence within the studied population. Stunting measured by (HAZ) index and overweight measured by (BMZ).

The bivariate analysis for identification of possible risk factors of stunting revealed a statistically significant relation between stunting and six examined factors.

Mothers education showed the strongest relation as a possible underlying factor for stunting (p<0.002) with mothers who were not educated or with only primary education having 13% of the identified cases of stunting while only 8.6% of those identified were to mothers with a higher education. The odds ratio of having a stunted child among the illiterate or with only primary education was 60% higher than between mothers with college education (OR with 95% CI 1.6 (1.16-2.17)). Similar relations can also be drawn from the 2014 DHS where 24.5% of identified cases of stunting were to mothers who were not educated while only 19.4% were to mothers with secondary or higher education.[10]

Syed Sanawar et al in 2005 also provided evidence that the literacy status of mothers strongly affects the nutritional state of their children where illiterate mothers present a risk for the development of malnutrition in children <3years of age especially underweight.[13]

Mothers age also showed a strong statistical relation (p<0.018) with the prevalence of child stunting. Mothers in the extremes of age (<20 and ≥35) showed a higher prevalence of having stunted children compared to those in the favorable child bearing ages (20-34.99 years) with incidence of stunting at 14.4% and 10.8% respectively. The odds of having a stunted child was 1.32 higher between mothers in the extreme age group compared to those in the favorable age group (OR 1.32 with 95% CI (1.06 - 1.64)). Gluckman in 2006, stated that, a mother who becomes pregnant at an early age, before she has completed her own growth, has a limited ability to nourish her Fetus thus affecting both pregnancy outcome and child wellbeing.[14] On the other hand, Roger and Yongyout, 2003 found a strong relation between child stunting and older mothers only. Unfortunately, the 2014 DHS did not consider the mothers age as one of the variables that might affect a child's nutritional status thus there is no local data to compare with.[15]

The study results revealed that stunting is also associated with the child order (p<0.003) with a higher prevalence of being stunting observed as birth order increased. Larger families with many children can effect negatively on household welfare and nutritional status. Victor in Nigeria 2009, demonstrated that the burden of care in term of parental time for care, nutrition and financing the care of the family would generally affect nutritional outcomes of children negatively, especially if all the children are under 5 years of age.[16]

The age of introduction of complementary food also had a significant effect on nutritional outcomes in our study population with children starting complementary food too early or too late having a higher incidence of being stunted (p<0.032). Those starting before the age of 4 month had the highest incidence of stunting between the three groups 15.6% with a 56% higher chance of being stunted (OR 1.56 with 95% CI (1-2.42)). The WHO guidelines on complementary feeding states that complementary food should be started when the baby can no longer get enough energy and nutrients from breast milk alone for most babies this is between 4 and 6 months of age.[17] When studying the effects of age of introduction of complementary foods on infant breast milk intake, total energy intake and growth in a randomized intervention study, Cohen et. al in 2003 found that breast fed infants self-regulate their total energy intake when other foods are introduced, thus there was no advantage to introducing complementary food before 6 months.[18]

We also found a statistically significant relationship between stunting and the gender of the child with males having a higher prevalence of being stunted than females ($p<0.050$) (OR 1.22 with 95% CI (1 - 1.49)). The incidence of stunting between male children was also higher in the 2014 Egyptian DHS (22.8% between male subjects and 19.9% between female subjects.[10] In a meta-analysis conducted using 16 demographic and health surveys for countries of sub-Saharan Africa Henry, 2007, concluded that male children under five years of age were more likely to become stunted than females with an odds ratio 1.16 (95% CI 1.12–1.20).[19]

As for overweight and obesity, the current study showed that the prevalence of combined overweight and obesity was highest in the first 2 years of life (around 20%) and starts to taper linearly till become 8.7% at age of 5. This phenomenon was previously noticed in other researches. Muller et al, in 2014 noticed a significant decrease in prevalence of obesity in Brazil from 13% in the first 2 years of life to 9% at age of 5 **[20].** Data for Egypt from DHS showed a similar trend where children from 4-5 years exhibit the least prevalence for overweight.[21] Possible explanation is that in the first two years of life, the child is dependent on his mother for feeding with less activity. Probable improper feeding at this stage may contribute to excess weight. Conversely, the toddler, is more active with less temptation towards food.

The results of the present research illustrated a significant relation of gender to excess weight (more than 2SD). Boys showed higher prevalence of excess BMI with age compared to girls. The gender differential was predominantly significant after the age of 2. The literature is controversial regarding the risk of overweight or obesity in relation to gender. While some studies have not found any gender-related differences[22] others have showed boys[23] or girls with higher rates.[24]

Association of milk formula to early childhood obesity was a widely accepted finding in the literature. Systematic reviews suggest that breastfeeding is associated with a reduction in the risk of later overweight and obesity.[25] Gibbs and Forste in 2014 reported that infants predominantly fed formula for the first 6 months were about 2.5 times more likely to be obese at 24 months of age relative to infants predominantly fed breast milk.[26] This agrees with our results where children predominantly fed with milk formula had 1.4 chances to develop overweight compared to those breast fed.

Conclusion

The study revealed that multiple risk factors are attributed to increased prevalence of malnutrition especially stunting among children under 5 years. The most important of which are, mother’s age, education and child order in the family.

Recommendations

Multidisciplinary approach is required to overcome the problem of malnutrition, the MOHP family planning department should enhance birth spacing , also Ministry of education must tackle the literacy problem among girls through programs that motivate enrollment of girls in schools in order to address underlying causes of malnutrition.

Study limitations

The current study was carried out only in two districts in 2 different governorates and not representing wider geographical areas in Lower Egypt as well missing other areas in Egypt, which limits generalizability of the findings. Another limitation of the study was inability to assess the feeding habits for children after weaning as the nutritional history from the mother would have been subjected to large recall bias jeopardizing its validity. Such limitation can be overcome by cohort follow up studies.

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