Nutritional Assessment of Preschool Children using Z-Score Analysis

Mostafa I. Waly¹,²*

¹Department of Food Science and Nutrition, College of Agricultural and Marine Sciences, Sultan Qaboos University, Muscat, Sultanate of Oman, ²Nutrition Department, High Institute of Public Health, Alexandria University, Egypt

*Corresponding Author: Dr. Mostafa I. Waly. Email: waly.mostafa@gmail.com

ABSTRACT

Background: Preschool years are characterized by striking changes in the physical development, language, cognitive and social behavior. Nutritional anthropometry is widely used for the assessment of the nutritional status of preschool children. Subjects: One hundred and twenty eight children (in the age group of 2-6 years) were recruited for this cross sectional study. We evaluated the underweight, wasting and stunting prevalence among this cohort using Z-Scores as compared to reference population. The middle upper arm circumference and body mass index (BMI) percentile were also evaluated. Results: Indicators of under nutrition were as follow; underweight (3.9%), wasting (3.1%), and stunting (2.3%) among the sampled preschool children. Conclusion: Stunting was the lowest among the examined preschool children. Overweight and obesity were not detected among the studied population. Conclusion: A nutrition intervention program should be developed and directed to this vulnerable group, preschool children, to combat these nutritional problems that might predispose children to under nutrition during adulthood.

Key words: Stunting, Underweight, Wasting, Preschool Children.


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INTRODUCTION

Environmental influences, mainly the diet, are directly involved in the normal preschool development. A good nutritional status (prenatal and postnatal) definitely reinforces normal childhood development, meanwhile, malnutrition problems reinforces abnormal growth development including underweight, stunting and wasting (1). The preschool years, are the years when children are switched from breast feeding or supplementary formula into a steady diet of semisolid foods. Preschool children are usually identified by health workers as being the vulnerable group within the community, i.e. the most affected
group for any malnutrition problem. Normal physical development, cognition and school performance among preschool children are greatly influenced by the amount of food, quality of the food and food habits (likes and dislikes) (2). Recent studies have shown that good postnatal nutrition is associated with a low risk of protein energy malnutrition (PEM), autism and leukemia.

The rapid rate of growth during infancy must be matched with adequate food intake, the child (two years to six years of age) is gaining weight of 1.8-2.7 Kg/year and stature is increasing by 7.6 cm/ year (3, 4). The recommended diet is the diet that includes a variety of foods with different textures and tastes provided throughout the day. Frequent and small meals are the best dietary habits that should be adopted by children, because the volume of the consumed food at one time is limited by the small stomach capacity. Most of the cross-sectional studies have shown that many children do not receive recommended amounts of fruits and vegetables; instead they consume foods that are rich in sugar, food additives, cholesterol and sodium.

Nutritional anthropometry is the most practical means for the assessment of the nutritional status of preschool children as well as for the identification of the extent of malnutrition problems among a particular community. Anthropometric measurements include physical measurements like body weight and height of children and based on the weight and height, a number of indices have been suggested such as weight for age, height for age and weight for height.

The US National Center of Health Statistics (NCHS) in 1975 has advocated expressing the deviation from anthropometric measurements of the reference median in terms of standard deviation or Z-scores. In 1978, the World Health Organization (WHO) urged the adoption of NCHS reference population data as normative value for international use (5-8). The NCHS/WHO growth reference curves were transformed to Z-score presentation and used as a tool to estimate the prevalence rate of malnutrition among preschool aged children. The Z-score (standard deviation scores) represents how far the data of a particular population are distributed (higher or lower) around the reference median (9-12). Following the classification of WHO database on child growth and using Z-scores
analysis; malnutrition problems among preschool children, have been categorized into three categories: Stunting, reflecting a long term growth faltering. A stunted child is defined as one whose height for age Z-score (HAZ) is less than -2 SD of the reference median. Wasting, reflecting acute or recent growth disturbances. A wasted child is defined as one with weight for height Z-score (WHZ) less than -2SD below the reference median. Underweight, reflecting a combination of disturbances in linear growth and body proportion, underweight child is defined as one with weight for age Z-score (WAZ) less than -2 SD of the reference median.

This study was designed to assess the nutritional status of a sample of preschool children in Muscat city, using the most commonly used indices as compared to the NCHS/WHO reference standards in order to identify stunting, wasting and underweight malnutrition problems if exist.

METHODS

Study subjects and setting: This cross-sectional study was study was implemented in private schools in Muscat city, Sultanate of Oman. The target population was preschool children in the age group 2-6 years. The total sample was 128 children, recruited on voluntary basis with the consent of their parents.

Socio-demographic data: The child’s birth certificates record was reviewed to collect child’s birth date (to calculate the age in months), residence and gender.

Anthropometric assessment: The following measurements were carried out for every child according to procedures described by Jelliffe (2). The measurements taken included: Weight, a calibrated scale was used and checked daily against a known weight prior use. Before use the balance was placed on hard flat surface and setting to zero. Shoes and heavy clothes were removed and children weighed with minimum possible clothes. Weight was recorded to the nearest 0.1-0.5 Kg. Stature, height was measured using a non-stretch tape fixed to the wall. After removing the shoes, each child was asked to stand on the floor; feet were together and with heels, buttocks, and back of the shoulders touching the wall adjacent to the tape. The child was asked to look forward so
that the line of vision was parallel to the floor with arms hanging on the sides. The height was measured to the nearest 0.1 cm.

Data analysis: The collected data were reviewed and entered into Excel sheets for analysis for computing for means, and standard deviation (SD). Statistical analysis was accomplished using statistical analysis software, GraphPad Prism, version 5 for unpaired t-test. Data were translated from Excel into EPI-info program to calculate Z-scores of anthropometric measurements, height for age, and weight for height and weight for age as compared with the National Center of Health Statistics (NCHS/WHO) reference values. Z scores (standard deviation scores): The Z-score represents how far the data are distributed (higher or lower) around the reference median. Following the classification of WHO database on child growth: Stunted child is defined as one whose height for age (HAZ) is less than -2 SD of the reference median, reflecting a long term growth faltering. Wasted child is defined as one with weight for height (WHZ) less than -2 SD below the reference median, which reflects acute or recent growth disturbances. Underweight child is defined as one with weight for age (WAZ) less than -2 SD of the reference median, reflecting a combination of disturbances in linear growth and body proportion.

RESULTS

The distribution of the study sample according to age and gender is presented in Table 1, which reveals that the sampled children were 71 boys (representing 55.5 % of the total population) and 57 girls (45% of the total population). The table also, reveals that the mean age of the boys was 35.5 ± 4 months meanwhile for girls it was 28.5 ± 3.55, and there is no statistical significance differences between the two means regarding age versus gender, P=0.204, t = 1.277.

Figure (1) displays the distribution of weight-for-height Z score (WHZ-score) of the children in relative to the reference population defined by (NCHS/WHO) (11). The figure shows that, the distribution of boys and girls is shifted to the left suggesting that the sampled children were slightly tended to be wasted indicating, acute malnutrition. The
overall percentages of acute malnutrition for all children (n=128) were 3.1%, 0.1 to 6.1 Confidence Intervals (C.I)*.

For boys (n=71) the percentage was 2.8% (-1.0 to 6.7 C.I*), meanwhile for girls (n=57) it was 3.5% (-1.3 to 8.3 C.I*) *C.I ≥ 95% Confidence Interval. The distribution of the weight-for-age Z score of the study sample relative to NCHS/WHO reference population is illustrated in Figure (2). The results show that the distribution of both boys and girls is slightly shifted to the left indicating a trend towards underweight. Prevalence of underweight for all children (n=128) is 3.9% (0.5 to 7.3 C.I*), and data analysis shows that underweight is more prevalent among boys (n=71) 5.6% (0.3 to 11.0 C.I*) than girls 1.8% (-1.7 to 5.2 C.I*). *C.I ≥ 95% Confidence Interval.

Figure (3) displays the height-for-age Z score (HAZ) as an indicator for stunting among the sampled children. Percentage of stunting for all sample (n=128) was 2.3% (-0.3 to 5.0 C.I*), for boys (n=71) it was 2.8% (-1.0 to 6.7 C.I*) and for girls (n= 57) it was 1.8% (-1.7 to 5.2 C.I*). *C.I ≥ 95% Confidence Interval.

The data on (figures 1, 2 and 3) were summarized in table 2 and it shows that WAZ (underweight indicator) was the highest, 3.9%, among both sexes followed by WHZ (wasting indicator), 3.1% and HAZ (stunting indicator) 2.3%. Sex differences were statistically significant among boys (5.6%) and girls (1.8%) in relative to WAZ (Figure 4).

DISCUSSION

In cross-sectional surveys, the use of appropriate anthropometric indicators allows the identification of the nature and extent of malnutrition among infants and young children in the community. Periodical assessments are useful for follow-up of populations, comparison between groups, evaluation of dietary intervention programs and statistical comparisons in nutritional epidemiological research. NHCS/WHO advocated three anthropometric indices as indicators for under-nutrition among preschool children. These indices are largely used on the international scale, and include: Height for age Z-score (HAZ) reflecting stunting, a long term growth faltering. Weight for height Z-score (WHZ) reflecting wasting, acute or recent growth disturbances. Weight for age Z-score
(WAZ) reflecting underweight, a combination of disturbances in linear growth and body proportion. Anthropometric indices, HAZ, WHZ and WAZ reflect child’s growth over time. Using these standards would allow the comparison of the results with those collected in other countries in the region as well as with data collected in surveys implemented by WHO.

A child’s growth responds to malnutrition in two ways that can be measured by anthropometry; (a) cessation of growth, stunting (short stature), results in low height-for-age and it reflects past under nutrition. (b) Wasting, short-term response to inadequate intakes and commonly assessed by weight relative to height. Unlike, weight for age reflects underweight and could be low because of stunting and/or wasting, thus children classified on the basis of weight for age criteria are a mixed group in terms of their nutritional status. The study results show that stunting indicator, HAZ, as well as underweight indicator, WAZ, was none significantly different among boys when compared with their girls’ counterpart. Such rates are remarkably lower than those reported in previous studies carried out in different parts Oman, suggesting an improvement in the nutritional status of preschool children and such improvement needs to be confirmed by a larger sample size and by evaluating the nutrient intake of the preschool children as well.

According to the findings of this study the following recommendations were formulated:

a. A more detailed study covering a large sample is needed to confirm the prevalence of malnutrition among preschool children in Muscat.

b. A nutrition intervention program should be developed and directed to preschool children to combat malnutrition problems which may predispose to malnutrition problems during adulthood.

**CONCLUSION**

In conclusion, the results of this study indicate that: Overweight and obesity are not prevalent among the studied sample; Underweight, stunting and wasting were limited in the sampled population; Underweight was generally more prevalent among boys; Different anthropometric indices are equally important in addressing malnutrition among preschool children.
REFERENCES


Table 1: Distribution of the study sample by age and gender

<table>
<thead>
<tr>
<th>Age (months)</th>
<th>Boys (n=71)</th>
<th>Girls (n=57)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>48 – 60</td>
<td>55</td>
<td>47</td>
<td>102</td>
</tr>
<tr>
<td>60-72</td>
<td>16</td>
<td>10</td>
<td>26</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>71</strong></td>
<td><strong>57</strong></td>
<td><strong>128</strong></td>
</tr>
</tbody>
</table>

Table 2: Distribution of the study sample by the WHZ, WHZ and HAZ scores

<table>
<thead>
<tr>
<th>Anthropometric Index</th>
<th>Both sexes</th>
<th>Boys</th>
<th>Girls</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHZ</td>
<td>3.1 %</td>
<td>2.8 %</td>
<td>3.5 %</td>
</tr>
<tr>
<td>(Wasting Indicator)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WAZ</td>
<td>3.9 %</td>
<td>5.6 %</td>
<td>1.8 %</td>
</tr>
<tr>
<td>(Underweight indicator)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HAZ</td>
<td>2.3 %</td>
<td>2.8 %</td>
<td>1.8 %</td>
</tr>
<tr>
<td>(Stunting Indicator)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Figure 1: Weight-for-age-Z score (WHZ) for children aged 48-72 months in relative to the reference population, NCHS/WHO

Figure 2: Weight-for-age Z score (WAZ) for children aged 48-72 months in comparison to the reference population, NCHS/WHO
Figure 3: Height for age Z-score (HAZ) for children aged 48-72 months in comparison to reference population, NCHS/WHO

Figure 4: Percentage of stunting, underweight, wasting among the sampled children