Assessment of Nutritional Status among Children Aged 1–under 5 years old in Aswan city, Egypt

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KEYWORDS
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ABSTRACT

Background: Malnutrition remains a significant public health issue in Egypt, affecting children under-five. This study assesses the nutritional status of children aged 12 to 59 months in Aswan City using WHO growth standards**. Methods:** A cross-sectional study was conducted on 1,104 children aged 12–59 months. Anthropometric measurements were collected, and Z-scores for weight-for-age (WAZ), height-for-age (HAZ), weight-for-height (WHZ), BMI-for-age (BAZ), and mid-upper arm circumference (MUACZ) were calculated based on WHO 2007 growth standards. **Results:** The mean Z-scores for WAZ and HAZ were negative across both sexes, indicating mild undernutrition, with males showing slightly lower values than females. WHZ and BAZ scores were comparable. MUACZ scores also indicated undernutrition in both sexes, with no statistically significant differences between them ($P > 0.05$). The prevalence of malnutrition among children was 11.5% for stunting, 8.1% for wasting, 4.3% for underweight, and 8.2% for low MUACZ scores. Overnutrition, including overweight and obesity, was observed in 11.3% of children. Overall, 24.1% (266 children) experienced undernutrition, with a 25% overlap among undernutrition categories, while 11.3% (125 children) were overnourished. **Conclusion:** The findings indicate a dual burden of malnutrition, with both undernutrition and overnutrition present among children under-five in Aswan City. Public health interventions should focus on addressing stunting and wasting while preventing overweight and obesity.

Introduction:

Malnutrition remains a critical global health concern, particularly among children under-five, as it significantly affects growth, development, and long-term well-being. It manifests in two major forms: undernutrition which includes stunting, underweight, and wasting—and overnutrition, characterized by overweight and obesity [1].

Undernutrition is often linked to inadequate dietary intake, poor maternal nutrition, recurrent infections, and socio-economic factors, leading to impaired physical and cognitive development. Conversely, overnutrition results from excessive calorie intake and sedentary lifestyles, increasing the risk of non-communicable diseases later in life [2], [3].

UNICEF (2021) [4] estimates that at least one in three children worldwide suffers from malnutrition. Egypt faces a growing double burden of malnutrition, with both undernutrition and overnutrition emerging as public health challenges [5].

Malnutrition is assessed through key indicators reflecting different aspects of nutritional status [6]. Stunting results from inadequate nutrition during pregnancy, poor early childhood diets, or repeated infections, leading to impaired growth and cognitive development. It is defined by a height-for-age Z-score below -2 standard deviations. Underweight, indicating both acute and chronic malnutrition, is classified as a weight-for-age Z-score below -2, with severe cases below -3 standard deviations. Wasting, or being too thin for height, arises from rapid weight loss or inadequate weight gain due to insufficient diet or illness, increasing the risk of disease and mortality. It is identified by a weight-for-height Z-score below -2, with severe cases below -3 standard deviations. Overweight results from excessive calorie intake and is linked to poor self-esteem and long-term health risks. It is defined as a weight-for-height Z-score above +2, while obesity is classified as above +3 standard deviations [7].

Anthropometric measurements are vital for evaluating the growth and nutritional status of children, and tackling both undernutrition and overnutrition, particularly among under-five children [8]. Understanding the prevalence and patterns of malnutrition through standardized anthropometric indicators is essential for designing effective public health interventions. This study aims to assess the nutritional status of children in Aswan City, Egypt, using WHO growth standards to provide insights into the burden of malnutrition and inform future nutritional policies.

Participants and Methods:

Study design; setting; and study population

A cross-sectional study was conducted on 1,104 children aged 12–59 months in Aswan City. in a number of nurseries randomly selected in Aswan City, the capital of Aswan Governorate. Located in the southernmost part of Upper Egypt. The selected nurseries provide care for children under 5 years of age.

Eligibility criteria

This study included apparently healthy children aged 12-59 months attending selected nurseries in Aswan City during the research period. Eligibility extended to both male and female children. Exclusion criteria encompassed children whose mothers had died or refused participation, those with a history of malnutrition, congenital anomalies, chronic disease, or clinical signs of growth hormone, thyroid, or sex steroid deficiencies, or skeletal dysplasia.

Sample size estimation

The sample size for this study was determined based on the estimated prevalence of malnutrition among children under- five in Egypt. According to the Egypt Demographic and Health Survey (EDHS), the prevalence of wasting among children under-five is approximately 8%, while stunting and underweight are 21% and 6%, respectively [9]. Using Cochran's formula for cross-sectional studies:

$$n = \frac{Z^2 \times p \times (1-p)}{d^2}$$

where n is the required sample size, Z is the standard normal variate (1.96 for a 95% confidence level), p is the estimated prevalence of wasting (0.08), and d is the margin of error (0.05). The calculated minimum sample size was 113 children. To account for potential non-response, clustering effects due to nursery-based sampling, and the need for subgroup analyses, the sample was expanded. Ultimately, 1,104 children aged 12–59 months were included in the study, ensuring greater statistical power and more precise estimates of malnutrition prevalence. This large sample size improves the representativeness and reliability of the study findings [10].

Data Collection Procedures

- Data collection took place in randomly selected nurseries in Aswan City from December 2022 to November 2023.
- The research team initiated the study process by obtaining an administrative access from the Directorate of Social Solidarity in Aswan.
- A pediatric consultant conducted a comprehensive physical examination to exclude children with systemic illnesses or health conditions affecting growth and nutrition.
- To ensure reliability, the researcher underwent specialized training in anthropometric measurement techniques following WHO standardized protocols [11], [12].

- Data were collected most days per week during nursery operational hours. The study's purpose, benefits, and confidentiality measures were explained, and written informed consent was obtained from all mothers/caregivers before enrollment.
- Anthropometric measurements were conducted using standardized protocols to assess the nutritional status of children. Data were collected to compute Z-scores for Weight-for-Age (WAZ), Height-for-Age (HAZ), Weight-for-Height (WHZ), BMI-for-Age (BMIZ), and Mid-Upper Arm Circumference-for-Age (MUACZ) based on the WHO (2007) Child Growth Standards [13] and CDC (2010) growth assessment guidelines [14]. These standards incorporate the National Center for Health Statistics (NCHS)/WHO reference data, ensuring methodological consistency and international comparability.
- Weight, height, BMI, and MUAC were measured and classified according to WHO Z-score classifications. Growth indicators were computed using the WHO Anthro software (v3.2.2) [15], adhering to established WHO (2007) [13] and CDC (2010) [14] protocols.

  - **Weight measurements** were conducted with precision, varying by age group. For children under 2 years, weight was measured to the nearest 0.1 kg using a calibrated UNICEF seca electronic scale (seca 881U), ensuring zero calibration before each measurement. Infants were weighed barefoot or in light clothing. For children aged 2 years and above, weight was measured to the nearest 100 g using a mechanical platform beam scale (Zt-160 – China Scale), with similar attire requirements.
  - **Length and height measurements** were also age specific. Children under 2 years (or those less than 85 cm in height) were measured in the recumbent position using an infant measuring board, with lengths recorded to the nearest 0.1 cm. Children aged 2 years and above were measured standing barefoot using a mobile stadiometer (Seca 214), with heights recorded to the nearest millimeter, ensuring proper posture.
- To ensure accuracy, each measurement was taken twice, and the average was used for analysis. If discrepancies were noted, a third measurement was taken, and the two closest values were averaged for precision and consistency [11].

Data management and statistical analysis

Data were reviewed, coded, and checked for accuracy. Descriptive statistics summarized categorical variables as percentages and frequencies. Continuous variables were reported as mean ± SD. Comparative analysis was performed using independent t-tests for continuous variables, depending on data distribution. A significance level of $P<0.05$ was considered statistically significant.

Ethics approval

This study was approved by the Research Ethical Committee of Aswan Faculty of Medicine before starting data collection (Approval number 309/December 2018).

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Results:

Anthropometric Z-Score Indices

Figure (1) illustrates the weight-for-age Z-score (WAZ) distribution among the studied children (12-59 months) compared to the WHO standard reference population. The distribution shows mild skewness to the left, suggesting a tendency toward lower weight-for-age levels.

Figure (2) presents the height-for-age Z-score (HAZ) distribution of the studied children against the WHO standard curve. The data indicate a left-skewed distribution with a sharp peak, suggesting a considerable prevalence of stunting.

Figure (3 compares the weight-for-height Z-score (WHZ) distribution of the examined children with the WHO reference distribution. The findings reveal varying degrees of malnutrition among the studied population.

Figure (4) displays the BMI-for-age Z-score (BAZ) distribution of the studied children, showing a comparable trend against the WHO standard reference population.

Figure (5) depicts the MUAC-for-age Z-score (MUACZ) distribution. The findings demonstrate a left-skewed distribution, highlighting undernutrition among the studied children.

Comparison of Anthropometric Z-Score Indices by child Sex

The WHO growth standards were applied to assess anthropometric measurements among 1,104 children aged 12 to 59 months. Table (1) presents the mean Z-scores and standard deviations for key anthropometric indices stratified by sex. The mean WAZ and HAZ scores were negative across both sexes, indicating mild undernutrition. Males had slightly lower values than females, suggesting a marginally higher risk of undernutrition. WHZ and BAZ scores were comparable between the two groups, reflecting similar overall body composition. MUACZ scores also indicated undernutrition in both sexes, with no statistically significant differences ($P > 0.05$). These findings suggest that sex does not significantly influence nutritional status variations within this sample ($P > 0.05$), although males exhibited slightly poorer growth indicators.

Nutritional Status Z-Score Categories

Table (2) summarizes the details nutritional status of under-five children based on anthropometric Z-scores. Most children fell within the normal range for weight-for-age (95.5%), height-for-age (88.5%), weight-for-height (80.7%), and mid-upper arm circumference (91.9%). However, undernutrition remains a notable concern, with 11.5% of children classified as stunted, 8.1% as wasted, 4.3% as underweight, and 8.2% exhibiting low MUACZ scores. Additionally, overnutrition was observed in 11.3% of children, with overweight (6.7%) and obesity (4.6%) contributing to the growing issue of dual malnutrition.

Overall Distribution of Nutritional Status

The pie chart (Figure 6) illustrates the overall distribution of nutritional status. Undernutrition affects 24.1% (266 children), including a 25% overlap within undernutrition categories, while 11.3% (125 children) are overnourished (overweight or obese), leaving 64.6% (713 children) in the well-nourished category.

Figure (1): Weight-for-age (WAZ) distribution by sex of the studied under-five children (12-59 months) compared to WHO standard reference population

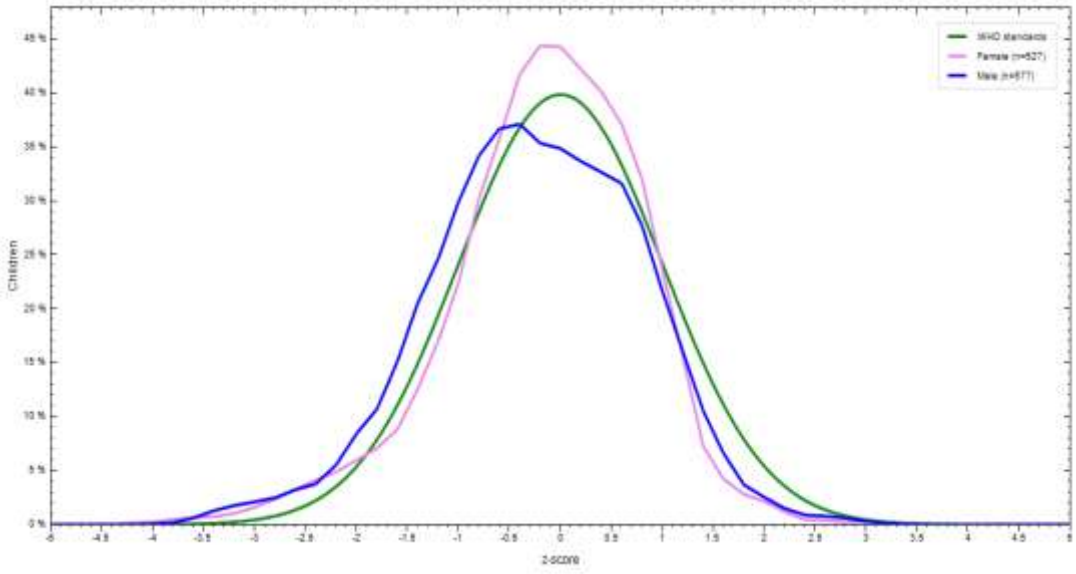


Figure (2): Height-for- age (HAZ) distribution by sex of the studied under-five children (12-59 months) compared to WHO standard reference population

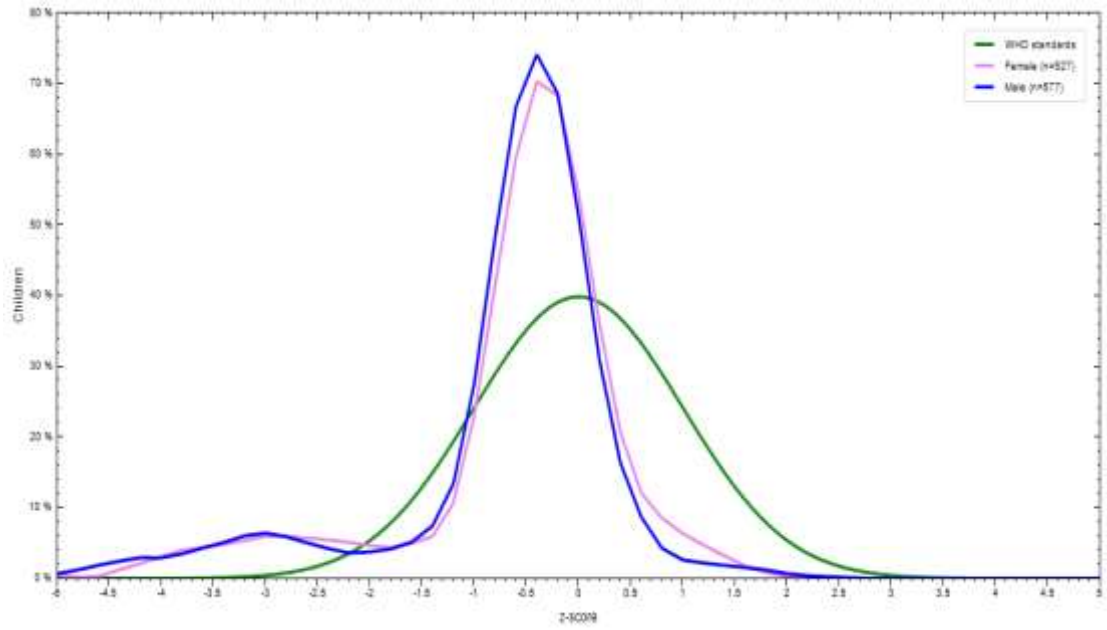


Figure (3): Weight-for-height (WHZ) distribution by sex of the studied under-five children (12-59 months) compared to WHO standard reference population

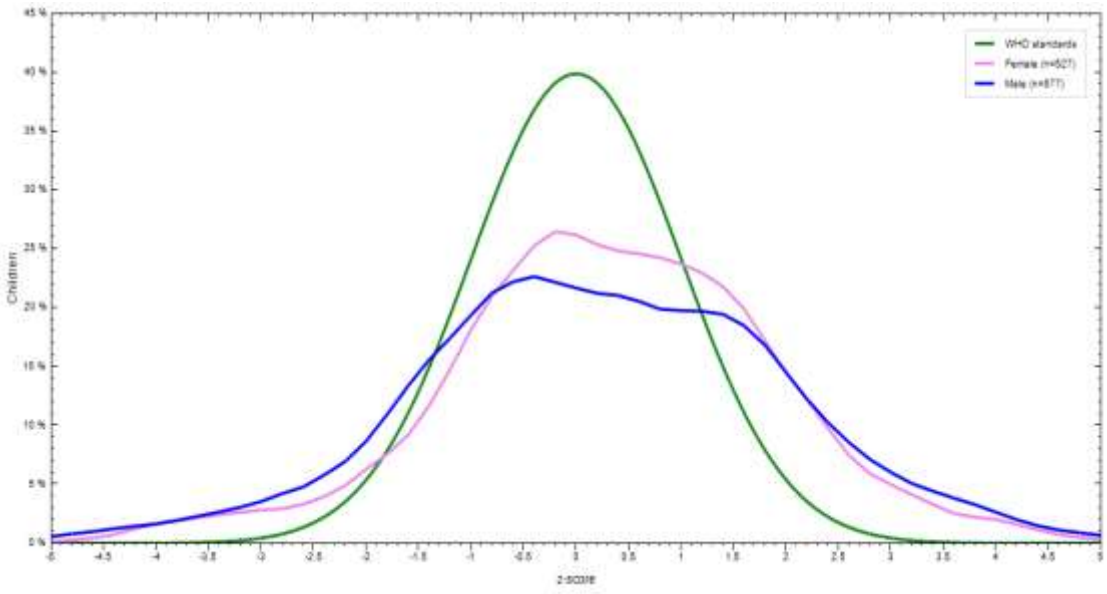


Figure (4): BMI-for-age (BAZ) distribution of the studied under-five children (12-59 months) compared to WHO standard reference population

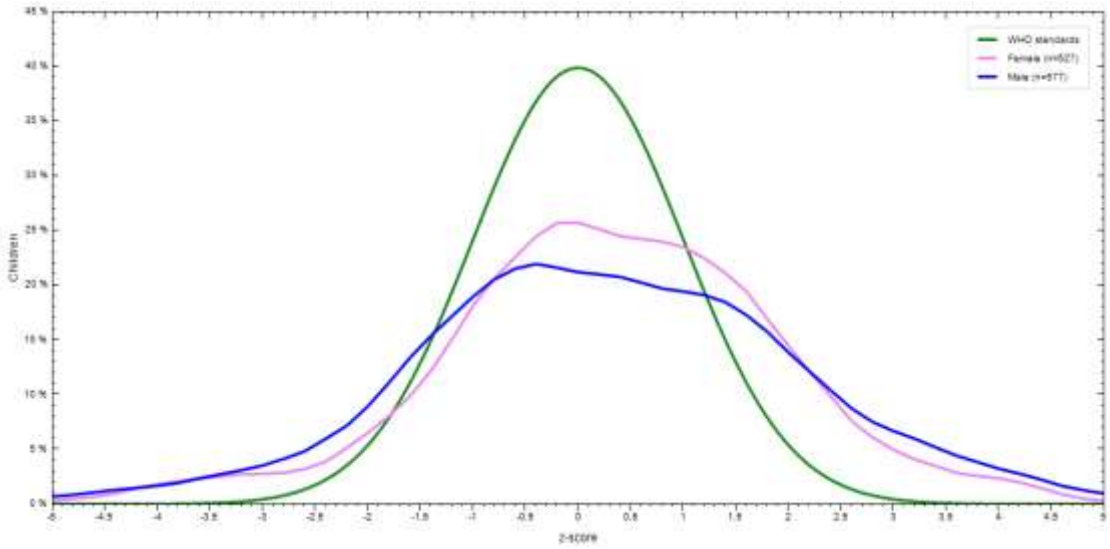


Figure (5): MUAC-for-age (MUACZ) distribution by sex of the studied under-five children (12-59 months) compared to WHO standard reference population

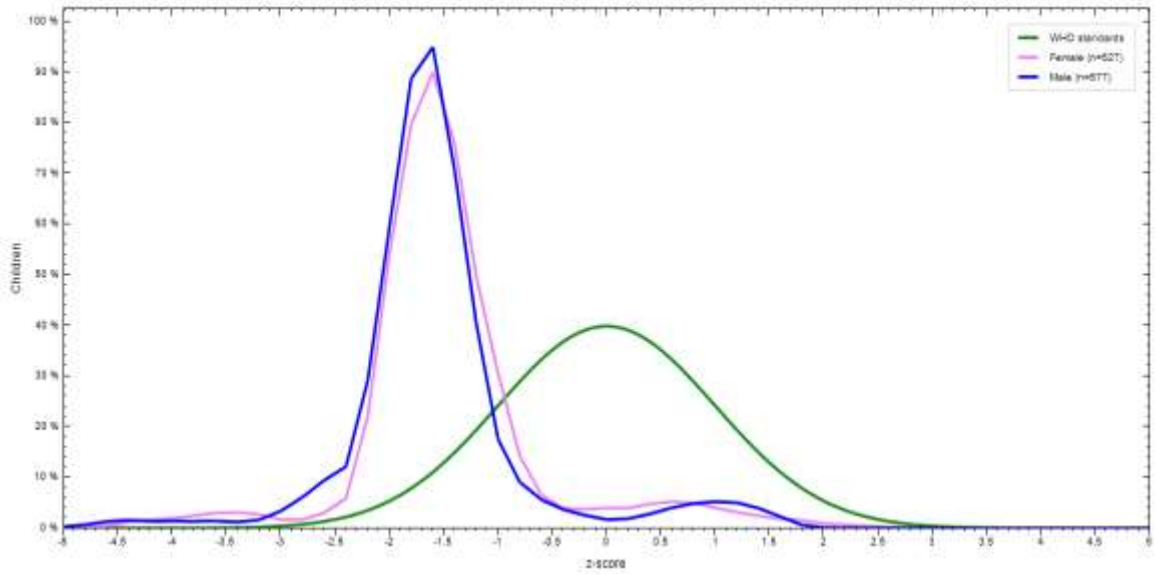


Table (1): Comparison of Anthropometric Z-Score Indices Among Under-Five Children (12-59 Months) by Child Sex

Z- sore	Total N= 1104		*P-value**
	Males (n=568, 51.5%)	Males (n=568, 51.5%)	
	Mean ± SD (Range)	Mean ± SD (Range)	
WAZ:	-0.22 ± 0.95 (-3.52 – 2.51)	-0.24 ± 0.98 (-3.19 – 2.93)	0.5991
HAZ:	-0.71 ± 1.10 (-5.04 – 1.56)	-0.64 ± 1.07 (-5.47 – 2.21)	0.1816
WHZ:	0.32 ± 1.53 (-4.60 – 4.48)	0.23 ± 1.63 (-4.70 – 4.77)	0.1632
BAZ:	0.34 ± 1.67 (-4.47 – 4.97)	0.24 ± 1.78 (-4.90 – 4.95)	0.1168
MUACZ:	-1.55 ± 0.76 (-4.68 – 1.58)	-1.54 ± 0.94 (-4.68 – 2.00)	0.5776

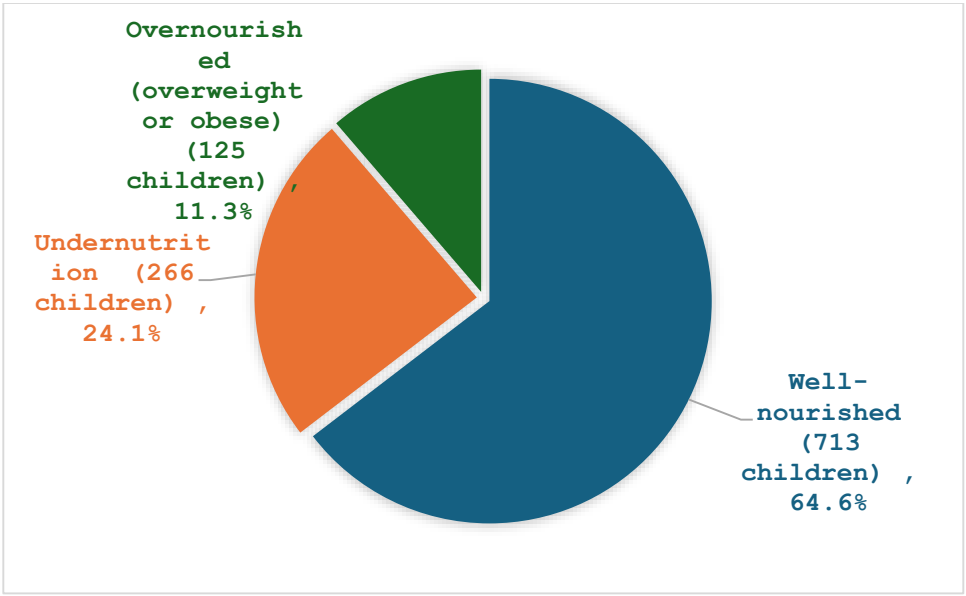
SD: Standard deviation; Anthropometric results (based on WHO standards 2007); * Sig. (2-tailed) for T-test analysis**.** WAZ: "Weight-for-age Z-score"; HAZ: "Height (or length)-for-age Z-score"; WHZ: "Weight-for-height (or length) Z-score"; BAZ: " Body Mass Index -for-age Z-score"; MUACZ: "Mid Upper Arm Circumference-for-age z-scores".

Table (2): Nutritional Status Z-Scores Categories for Under-Five Children (12-59 Months)

Anthropometric indices	Z score categories	Total (n=1104) N (%)
WAZ	Normal (≥ -2 WAZ score to ≤ 2)	1056 (95.5%)
	Moderate underweight (-3 ≤ WAZ score < -2)	36 (3.3%)
	Severe underweight (<-3 WAZ score)	12 (1.1%)
	Overall underweight (<-2 WAZ score)	**48 (4.3%)**
HAZ	Normal (≥ -2 HAZ score)	977 (88.5%)
	Moderate stunting (-3 ≤ HAZ score <-2)	61 (5.5%)
	Severe stunting (<-3 HAZ score)	66 (6.0%)
	Overall stunting (<-2 HAZ score)	***127 (11.5%)***
WHZ	Normal (≥-2 WHZ score to ≤2)	890 (80.7%)
	Moderate wasting (-3≤ WHZ score <-2)	54 (4.9%)
	Severe wasting (<-3 WHZ score)	35 (3.2%)
	Overall wasting (<-2 WHZ score)	**89 (8.1%)**
	Overweight >+2 z-scores	74 (6.7%)
	Obese >+3 z-scores	51 (4.6%)
	Overall overnutrition; Overweight& Obese (>+2 WHZ score)	**125 (11.3%)**
MUACZ	Normal (≥-2 MUACZ score to ≤ 2)	1014 (91.9%)
	Moderate undernutrition (-3 ≤ MUACZ score < -2)	59 (5.3%)
	Severe undernutrition (< -3 MUACZ score)	31 (2.8%)
	Overall undernutrition (<-2 MUACZ)	**90 (8.2%)**

.Anthropometric results (based on WHO standards 2007) WAZ: "Weight-for-age Z-score"; HAZ: "Height (or length)-for-age Z-score"; WHZ: "Weight-for-height (or length) Z-score"; BAZ: " Body Mass Index -for-age Z-score"; MUACZ: "Mid Upper Arm Circumference-for-age z-scores".

Figure (6): Overall Distribution of nutritional status among under-five children[*]



[*] some children may be counted in multiple categories (combined undernutrition)

Discussion:

Child malnutrition accounts for 45% of under-5 deaths globally, impairing physical growth, immunity, and cognitive development. It perpetuates poverty by affecting future health and productivity across generations [16]. The 2023 Global Hunger Index ranks Egypt 57th out of 125 countries, indicating moderate food insecurity. Challenges persist in food affordability, quality, and safety due to reliance on global markets for over half of its staples[9].

The findings of this study reveal that undernutrition remains a considerable public health concern among children aged 1–under 5 years in Aswan City, Egypt. The prevalence of stunting (11.5%), wasting (8.1%), and underweight (4.3%) aligns with global trends observed in low- and middle-income countries (LMICs), where chronic and acute malnutrition continue to be pressing issues UNICEF Egypt reports that malnutrition rates remain high, with stunting among under-five children at 21% in 2014, while child wasting and underweight stood at 8% and 6% respectively [9], [17]. The prevalence of wasting (8.1%) suggests acute malnutrition, which may be attributed to seasonal food shortages, infections, or inadequate healthcare access. These findings underscore the need for sustainable nutritional programs that emphasize both dietary diversity and early childhood healthcare services [16].

Stunting, a key indicator of chronic malnutrition, reflects prolonged inadequate dietary intake and recurrent infections during early childhood. A recent study in Upper Egypt reported comparable stunting rates, highlighting significant regional nutritional disparities that necessitate targeted interventions. Research by Gamal et al. (2023) [18].

further emphasized the impact of malnutrition on child health, revealing a high prevalence of undernutrition among under-five children with pneumonia, which worsened clinical outcomes and increased in-hospital mortality. Additionally, Elmighrabi et al. (2025) [19] reported stunting prevalence rates of 24.8% in children aged 0–23 months, 24.3% in children aged 24–59 months, and an overall rate of 24.5% in children aged 0–59 months, reinforcing the need for early nutritional interventions to mitigate long-term health consequences. The Global Nutrition Report (2022) [20] indicates that Egypt has made no progress towards achieving the target for stunting, with 22.3% of children under five affected, and 9.5% affected by wasting.

In contrast to undernutrition, this study also identified a notable prevalence of overnutrition, with 11.3% of children classified as overweight or obese. This trend aligns with broader shifts observed in Egypt and other low- and middle-income countries (LMICs), where increased consumption of energy-dense, nutrient-poor foods is driving childhood obesity [21].

The coexistence of undernutrition and overnutrition within the same population, known as the 'dual burden of malnutrition,' presents a critical public health challenge requiring urgent attention. Similar trends have been documented in Egypt where childhood obesity has been linked to higher intake of processed foods and reduced physical activity levels [22], [23]. Additionally, a growing body of evidence indicates that childhood overweight and obesity are rising more rapidly in North Africa, particularly in Egypt, compared to most Middle Eastern countries [24]. The 2022 Global Nutrition Report [20] further underscores this concern, revealing that 15.7% of Egyptian children under five are overweight, with projections indicating that this figure may continue to rise unless immediate preventive measures are taken.

A recent study on the prevalence and determinants of childhood obesity in Egypt reported that approximately one in six (17%) children under five were overweight or obese [24]. This alarming trend necessitates comprehensive, multi-sectoral interventions, including preschool-based nutrition education, regulatory policies restricting the marketing of unhealthy foods to children, and community-driven initiatives to promote physical activity. Addressing both undernutrition and the escalating obesity epidemic requires an integrated approach, combining public health strategies, policy reforms, and community engagement to foster sustainable improvements in child nutrition.

This study found no significant sex-based differences in anthropometric indices, although males exhibited slightly lower growth indicators than females. This is consistent with previous pooled analysis of data from 33 longitudinal cohorts from low- and middle-income countries suggesting that male children may be more vulnerable to growth faltering due to higher metabolic demands and differential care practices [25]. However, the lack of statistically significant differences suggests that broader environmental and socioeconomic factors likely have a more pronounced impact on child nutrition in this setting. Future research should explore gender-related feeding practices and access to healthcare services to further understand these subtle differences.

The findings of this study highlight the urgent need for targeted public health strategies to address both undernutrition and the childhood obesity. Government-led programs should focus on improving maternal nutrition, promoting breastfeeding and complementary feeding practices, and ensuring the availability of diverse, affordable, and nutrient-rich foods. Additionally, school-based interventions aimed at reducing childhood obesity through improved dietary education and increased physical activity should be prioritized. Collaborative efforts between policymakers, healthcare providers, and community organizations are essential to creating sustainable solutions for improving child nutrition in Egypt [9].

Study Strengths

- This study employed a year-round data collection approach, ensuring comprehensive assessment of seasonal variations in food availability and disease prevalence. Unlike single time-point studies, this methodology provides a more accurate reflection of nutritional status fluctuations. Additionally, Aswan City serves as a representative setting for Upper Egypt, with comparable socio-demographic and environmental conditions, enhancing the generalizability of findings to similar populations across the region.

Study Limitations

- Despite its strengths, this study has certain limitations. The cross-sectional design prevents establishing causal relationships between nutritional status and its determinants. Longitudinal studies would provide deeper insights into growth patterns and risk factors over time.
- While anthropometric measurements such as weight, height, BMI, and MUACZ effectively assess nutritional status, they do not capture micronutrient deficiencies or other underlying health conditions. Future research incorporating biochemical assessments of nutritional biomarkers would enhance the comprehensiveness of evaluations.
- Furthermore, socioeconomic factors, including household income, parental education, and healthcare access, were not extensively explored. Given their critical role in child nutrition, future studies should integrate these variables for a more holistic understanding.
- Despite these limitations, this study provides valuable data that can inform public health policies and targeted interventions aimed at improving childhood nutrition in Egypt.

Conclusion:

This study highlights the nutritional status of children aged 1–under 5 years in Aswan City, Egypt. While most children fall within normal anthropometric ranges, undernutrition remains a concern, and childhood obesity is on the rise. Addressing this dual burden requires integrated public health strategies, including policy reforms, community engagement, and evidence-based interventions. Future research should prioritize longitudinal studies to assess the impact of current nutritional programs and identify evolving trends and determinants of child malnutrition.

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Conflict of Interest Statement:

The authors declare no conflicts of interest related to this study.

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