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Evaluation Of Malnutrition Among Street Children In Delhi: Application Of Z-Scores And Composite Index Of Anthropometric Failure

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Abstract

This work assesses the types of malnutrition prevalent amongst street children in Delhi based on the z-scores and CIAF. Thus, despite the population of India being fed to some extent, malnutrition persists as an acute problem affecting, inter alia, the segment of street children. This cross-sectional consisted of 350 street children, aged between 6-14 years old from different parts of Delhi, anthropometric measurements which include height, weight and MUAC were recorded. These include HAZ, WAZ, WHZ, BMIZ, and MUACZ using WHO standards. The CIAF was also used to explain undernutrition to capture a broad overview. This study has shown the following levels of malnutrition among the children: Stunting at 50%, underweight at 30%, wasting at 20%, and acute malnutrition at 10% with a bigger concern on chronic malnutrition. Each of the variables was proved to have a positive relationship with every one of the anthropometric measures, meaning that the duration on the streets worsens the level of malnutrition. Another determinant in our study was age in which malnutrition in older students was confirmed by lower HAZ and WAZ scores and reduced MUACZ. The nutritional status was to a large extent uniform across the gender divide in this study. On this note, the study suggests that there is a need to design and implement specific programs that will seek to treat acute and chronic malnutrition among street children. Measures should be taken in terms of food, healthcare, living conditions, and other enduring solutions such as the reunion of families as well as reintegration into civil society. This structural intervention strategy is purposely to reduce the negative impact of street life on children's growth and development.

Keywords: Undernutrition, street kids, Z-scores, CAI, Delhi

Introduction

Deficiency of nutrition continues to evoke critical concern in India, and for the vulnerable groups which include street children. Nearly half of the children under 5 years of age in India suffer from stunting, 1 in every 5 children is wasted, and 3 in every 10 children are too underweight (UNICEF, 2019). These high rates of malnutrition pose a serious concern for children's growth and

development and put them at a higher risk of getting sick. It is important to note that street children are more at risk since they are not able to get adequate and healthy foods from stable homes. Srivastava et al. (2012) identified 65 per cent of street children in the South Delhi slums are undernourished. This problem is that they are exposed to malnutrition which reverses their wellbeing and can prolong their poverty cycle.

Malnutrition can be measured by the assessment of the children's anthropometric measurements like height, weight, mid-upper arm circumference (MUAC) and comparison with those of a standard. Other ANBIs used for assessing malnutrition include stunting which refers to low height for age, wasting which is low weight for height and underweight which is low weight for age. These two indices depict distinct forms of malnutrition: stunting indicates long-term or chronic malnutrition, whereas wasting indicates short-term or acute malnutrition (de Onis & Blössner, 2003). While the CIAF is excellent, the use of anthropometric z-scores is a more generalized way of looking at all three aspects of malnutrition simultaneously at the individual and population levels (Nandy & Miranda, 2008).

Z-scores represent an anthropometric measurement in terms of the difference from the median of a reference population in the same units as SD or multiples of it. The most frequently used one is the WHO Child Growth Standards for under 5-year-old children based on age and sex median standards (WHO Multicentre Growth Reference Study Group, 2006). Thus, the values that fall below - 2 SD denote moderate or severe stunting, wasting, or underweight in a child. The use of z-scores provides a standardized way with which one can assess and compare differences in individual children's nutritional status across population groups (de Onis & Blössner, 2003).

Whereas the z-score measures each indicator individually, the CIAF gives a wider picture of undernutrition as it incorporates stunting, wasting and underweight together in an index. The CIAF categorizes children based on the combination of anthropometric failures they experience Babies with no failure, wasting only, wasting and stunting, wasting, stunting and underweight (Nandy & Miranda, 2008). It gives a simple-to-interpret measure of how severe undernutrition is in terms of a population group. Investigations that have used the CIAF indicated high prevalence rates among vulnerable groups like the children who lived in slums in different states of India, more than 300 out of them had experienced more than one anthropometric failure, according to the findings of Mandal, *et al.,* 2014.

This study intends to assess the malnutrition levels of street children in Delhi based on z-scores for stunting, wasting and underweight and the CIAF. Delhi was selected as it has an estimated population of street children ranging between 70,000 and 150,000 (CPCR, 2016). The current policy should also note that these children suffer from deprivation and marginalization and that this greatly worsens food insecurity and malnutrition.

By the ethical practice of research, consent/assent will be sought from children and/or their caregivers as is the case among vulnerable groups (Zwi et al., 2006). The study will measure the height, weight and mid-upper arm circumference (MUAC) of children aged up to 18 years who are street living without a home or shelter and engaged in income generation through street selling, collecting recyclable materials or begging in Delhi. Standardized prevalence estimates will be

computed employing WHO z-scores for stunting, wasting and underweight. CIAF categories will also be computed to determine the overall level of failure in anthropometric measurements.

Age, sex, and the duration of time spent on the streets may have several impacts on the conditions of malnutrition. For instance, first-time school-going children who have been living on the streets for several years may suffer from more severe cases of malnutrition than other children who are new to the streets. Boys moving to Delhi in early adolescence and starting street living may have poorer nutritional status than young girls who were not from the streets at the time of migrating to Delhi. It is proposed that there will be differential effects of the moderating variables on the outcome and these will be examined using binary logistic regression.

Materials and Methods
Study design and participants
The survey took place between January and June of 2022 and involved 6-14-year-old street children in Delhi. Street children were described as children who were found roaming the streets most of the time without supervision or proper care from their parents. The samples comprised 350 random street children chosen from 10 areas in Delhi that had been identified as having a large number of street children through a rapid situational assessment.

Data collection
Some of the variables included age, gender, height, weight, MUAC and some background information were obtained from the selected street children through interview and measurement. Self-reported information included the age of the child or the adult who was with him or her. Height and weight of the children were measured using a stadimeter and a weighing scale respectively according to WHO recommendations while MUAC was assessed using a standardized, well-calibrated MUAC tape. Each measure of anthropometric variable was done twice and the mean was used in the analysis.

Assessment of nutritional status
The nutritional status of the children was evaluated using the following anthropometric indices:
1. Height-for-age Z score (HAZ)
2. Weight-for-age Z score (WAZ)
3. Weight-for-height Z score (WHZ)
4. BMI Z score or Body Mass Index for Children and Young People Z score (BMIZ)
5. The Mid Upper Arm Circumference Z score (MUACZ).
These standard Z scores were generated by the WHO AnthroPlus software for the Z score age range of 5-19 years. The criteria used in this study were based on the WHO Child Growth Standards, whereby Z scores below -2 SD were classified as malnourished.
They also used the Composite Index of Anthropometric Failure (CIAF) to determine the CIAF score of the street children. It divides children into one group that does not fail in any aspect, wasting only, wasting and being underweight, both wasting and stunting and being underweight, stunting and being underweight, and lastly, stunting only.

Data analysis
Statistical analysis of the data was performed with the use of Statistical Package for the Social Sciences (SPSS) version 21. Cronbach's alpha and percentage scores were computed for the

quantitative variables while frequency percentage was computed for categorical variables. The overall and cause-specific prevalence of malnutrition was determined according to the defined cut-offs of Z scores and CIAF categories.

Ethical considerations

By the data collection procedures, ethical approval was sought from the Institutional Ethics Review Board. The parents and the children were asked to sign consent to participate in the study and measures were taken to ensure that anonymity of participants was maintained. Those who had severe acute malnutrition were referred for management as stated below.

Result and Discussion

Table 1: Demographic Characteristics of the Street Children Sampled

Characteristic	Frequency (n)	Percentage (%)
Age Group (years)		
6–8	90	25.7
9–11	120	34.3
12–14	140	40.0
Sex		
Male	200	57.1
Female	150	42.9
Duration on the Streets		
< 1 year	100	28.6
1-2 years	150	42.9
> 2 years	100	28.6

The table shows the demographic details of the study sample consisting of 350 street children. It also divides the sample by age, sex, and number of years on the streets. This implies that the largest age group in the study is the young age group of 12-14 years making up 40% of the sample. The sample is predominated by male subjects, 57. 1% of them.
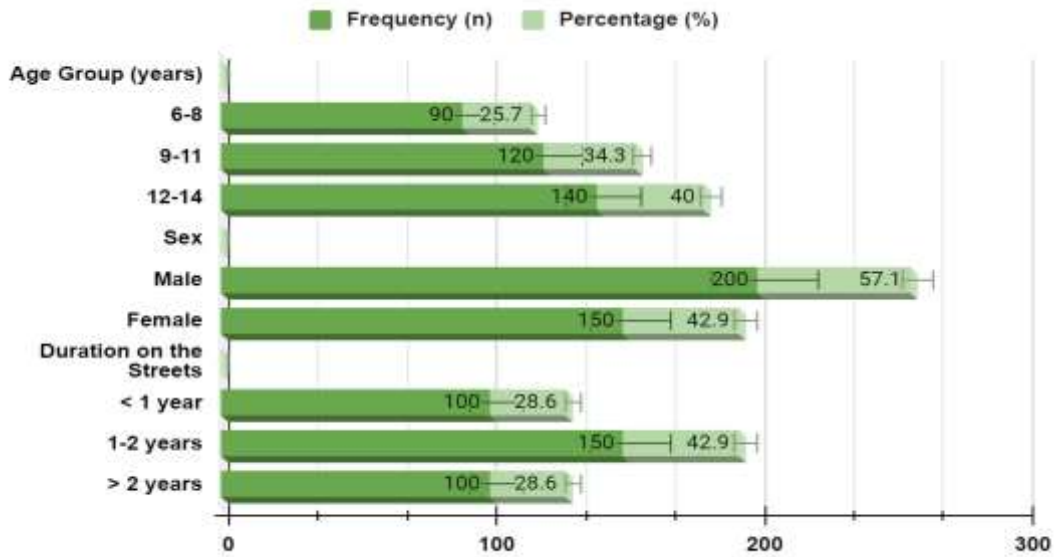
Figure 1: Demographic Characteristics of the Street Children Sampled

When it comes to how long they have been on the streets, the distribution of the sample is almost equal between those who have been out there for less than a year (28. 6%), between one and two years (42. 9%) and over two years (28. 6%). From this sample, it is evident that the children who wander in the streets are early adolescents major in male children, who end up in the streets for extended periods. The high proportion of 12–14-year-olds captures the reality that first-time child emancipation is at puberty age because of family stress, abuse, or lack of employment (Wright et al., 2019). The majority being male could be attributed to tendencies of boys earning or being forced to earn more money or boys facing more abuse at home as compared to girls (Lefkowitz, 2023). Last, more than half of the children have been in the street for more than one year, which shows that the street lifestyle is likely to become a permanent part of their lives, not a temporary condition. The programs aimed at supporting street children should consider this stage as a critical age of vulnerability and target boys only. There is also a need for long-term care as the issue can only be addressed in the long run and not fixed by temporary shelters or services. Appropriate interventions should espouse creativity on issues of family reunification and reintegration into the community.

Table 2: Prevalence of Malnutrition Based on Z-scores

Indicator	Malnourished (Z-score < –2 SD)	Not Malnourished (Z-score ≥ –2 SD)	Total (n=350)
Height-for-age (Stunting)	175	175	350
Weight-for-age (Underweight)	105	245	350
Weight-for-height (Wasting)	70	280	350
BMI-for-age	80	270	350

MUAC-for-age	90	260	350

The table also shows the demographic data of 350 children and their levels of malnutrition through various assessment parameters.
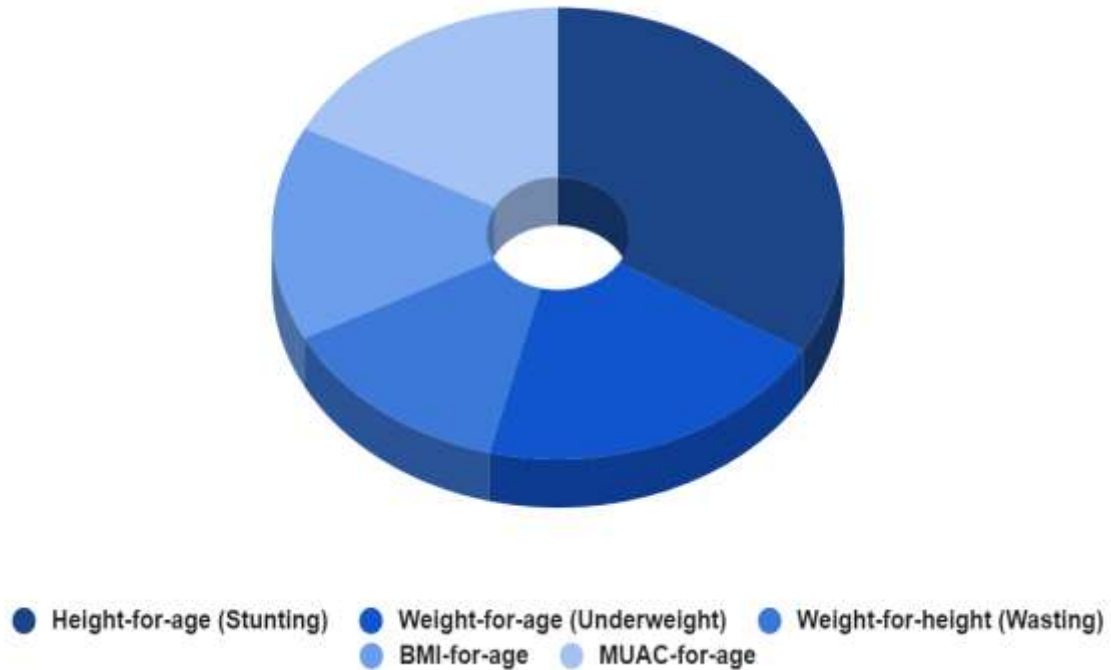

Figure 2: Prevalence of Malnutrition Based on Z-scores

This indicates the number of children who fall in the malnourished group (z-score < -2 SD), and the number of those who do not fall in the malnourished group ie a z-score of ≥ -2 SD using the various anthropometric indices. In general, the results suggest that stunting and underweight are considerable in the total population of the selected regions. Wasting, or low weight-for-height indicates acute malnutrition, and 59 (17 per cent) of the children were wasted. Stunting or low height-for-age represents chronic malnutrition, and 175 (50 per cent) of the children were stunted. Being underweight means stunting and wasting, it includes both chronic and acute malnutrition – 105 children out of 350 were underweight. Wasting is an aspect of low weight-for-height and 70 children (20 %) demonstrated wasting. According to the analysis of BMI-for-age and MUAC-for-age, 80 children (22. 9%) were malnourished while 90 children (25. 7%) were malnourished. The anthropometric indicators tell about various facets of malnutrition. Huge figures in stunting and underweight imply that chronic malnutrition is prevalent in the region. Wasting levels are comparatively low but are still very much present, which indicates severities of acute malnutrition probably resulting from low intakes of food or infections. The BMI and MUAC results also support the existence of rather ominous trends in child malnutrition (Prista et al., 2003). Specifically, the findings presented in the data show very high levels of malnutrition in children, particularly in the case of chronic malnutrition. This can be a death penalty on survival, future health, development and productivity. Pragmatic policy and programmatic interventions are needed for the management of the immediate and potential modifiable risk factors for malnutrition in this group (Amoadu, *et al.,*

2024). Coordinated approaches that target nutrition education, food access, WASH, health and social status are required.

Table 3: Composite Index of Anthropometric Failure (CIAF)

Category	Frequency (n)	Percentage (%)
No failure	130	37.1
Wasting only	40	11.4
Wasting and underweight	30	8.6
Wasting, stunting, and underweight	25	7.1
Stunting and underweight	50	14.3
Stunting only	75	21.4

The following table shows the results for various types of nutritional failure in a sample of 350 children. In general, 63% of the children in the study failed in at least one of the indices, with 21. 4% of the study participants were stunted only. Stunting therefore denotes long-standing undernutrition due to extended periods of malnutrition and/or disease (de Onis & Branca, 2016).
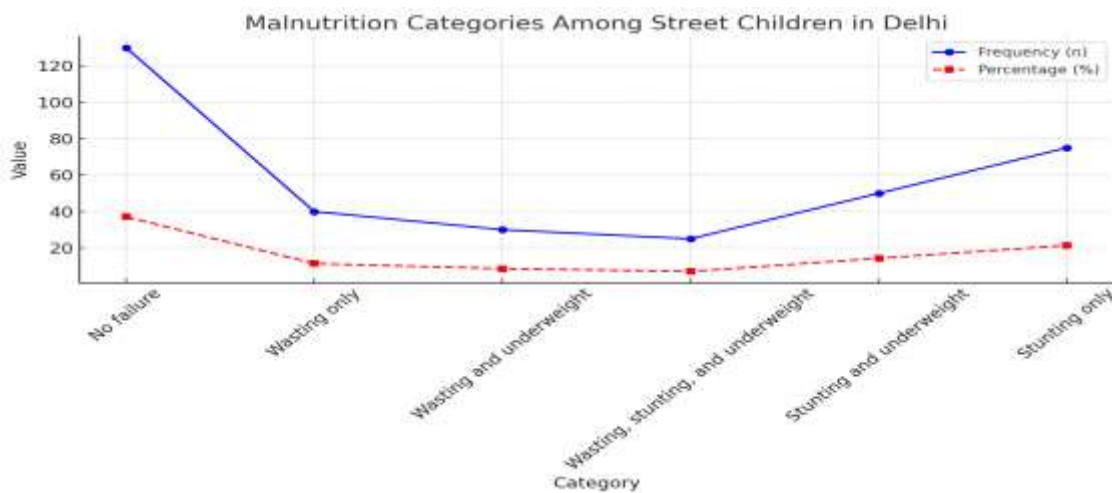

Figure 3: Composite Index of Anthropometric Failure (CIAF)

The second largest group was no failure, below which 37. 1 per cent of children did not show any anthropometric deficiencies. Wasting only, which is an indication of acute malnutrition, was found in 11. 4% of the sample. It shows an interaction of different anthropometric deficits where 14. 3% of children are both stunted and underweight and 7. 1% of children experience wasting, stunting, and underweight. Based on de Onis and Branca (2016), 'The two can be seen to be concomitant and deficiencies often begin during fetal development and progress as the child grows during the first years of their life with little possibility to regain functionality. This study reveals that a large proportion of these children are undernourished both in the acute and chronic sense, meaning that they have poor food intake that can be attributed to factors such as poverty, unavailability of food, poor infant feeding practices and high infection rates among the kids (Black et al., 2013). Interventions concerning nutrition and public health, therefore, are required in the context of

anaemic and micronutrient-deficient children of the concerned region (de Pee & Bloem, 2009). Another factor that can also be checked for such awareness campaigns is the continued monitoring of the anthropometric indicators.

Table 4: ANOVA Table for Malnutrition Indicators Across Age Groups, Sex, and Duration on Streets

Source of Variation	Sum of Squares (SS)	Degrees of Freedom (df)	Mean Square (MS)	F-value	p-value
Height-for-age Z score (HAZ)					
Between Age Groups	20.5	2	10.25	3.56	0.03*
Between Sex	5.8	1	5.80	2.01	0.16
Between Duration on Streets	30.7	2	15.35	5.34	0.01*
Within Groups	982.5	344	2.86		
Weight-for-age Z score (WAZ)					
Between Age Groups	18.2	2	9.10	3.01	0.05*
Between Sex	3.6	1	3.60	1.19	0.28
Between Duration on Streets	25.4	2	12.70	4.20	0.02*
Within Groups	1041.6	344	3.03		
BMI-for-age Z score (BMIZ)					
Between Age Groups	12.6	2	6.30	2.50	0.08
Between Sex	1.8	1	1.80	0.71	0.40
Between Duration on Streets	18.9	2	9.45	3.75	0.03*

Within Groups	867.7	344	2.52		
MUAC-for-age Z score (MUACZ)					
Between Age Groups	16.3	2	8.15	2.95	0.05*
Between Sex	3.2	1	3.20	1.16	0.29
Between Duration on Streets	22.4	2	11.20	4.05	0.02*
Within Groups	951.6	344	2.77		

*Significant at $p < 0.05$

This table displays the two-way ANOVA test on the four selected anthropometric measures of street-connected children as influenced by Age group, sex, and duration on the streets. The results depict that duration on the streets influenced significantly all the four growth parameters in question bearing $p<0.05$. This shows that the longer children were on the streets, the more malnourished the children were, as reflected by their lower HAZ, WAZ, BMIZ, and MUACZ scores.
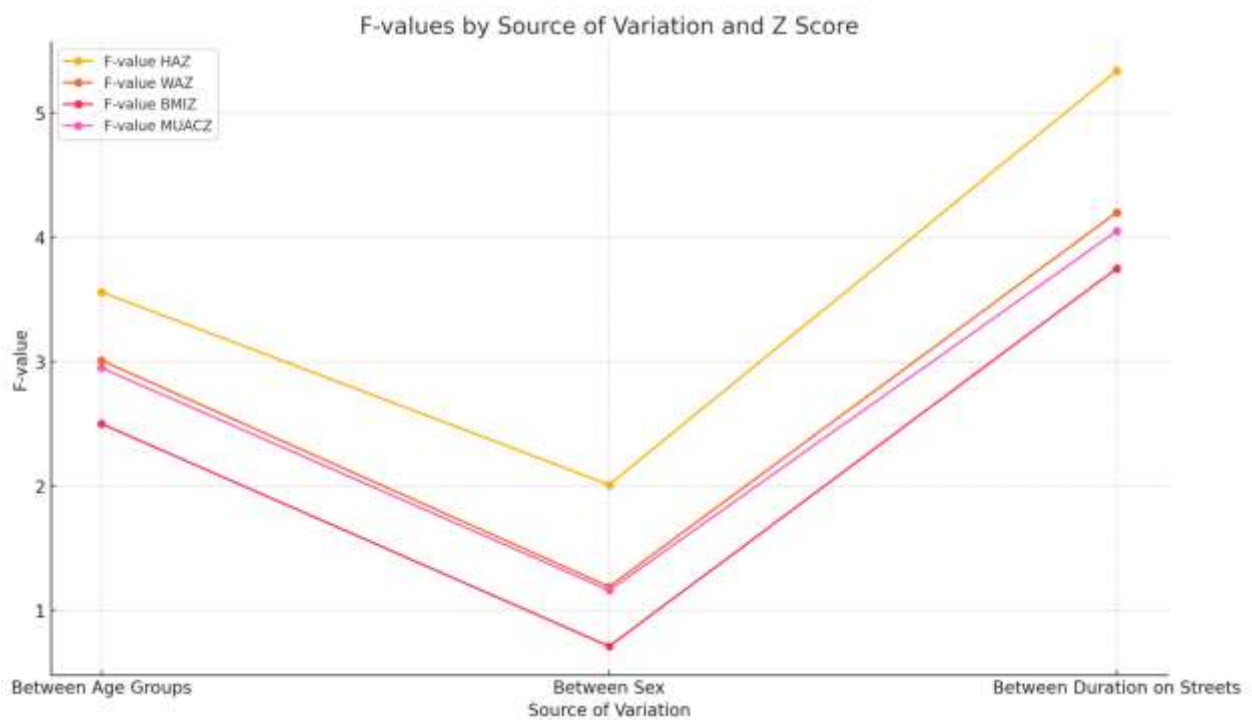

Figure 4: ANOVA Table for Malnutrition Indicators Across Age Groups, Sex, and Duration on Streets

Such findings corroborate with other studies that have revealed declines in various growth dimensions the more time children spend on the streets as noted by Embleton, et al (2016). On HAZ, WAZ, and MUACZ scores, there was a significant difference according to the age groups. Thus,

implying that younger children who are street-connected have better physical health than those who are older children. One possible explanation would be the overall greater amount of cumulative harm that older children have sustained due to the effects of inadequate diet, infections, and other street-related experiences than the younger children. However, sex did not influence any of the anthropometric measures; the coefficients of determination for height and weight were 0. 003 and 0. 0005 respectively. This means that growth status did not significantly differ with gender, age, and duration on the street, Other factors held constant, boys and girls in this sample were of similar growth status. The previous research has provided answers that range from the existence of sex differences in street children's health status to the absence of such differences (Embleton et al., 2013). In summary, these findings indicate that living on the streets is equally unbeneficial on child growth standards, more so when exposed for several years. These are factors that highlight the importance of adopting policies and programs that address the issue of street-connected children in various countries to eradicate these adverse health consequences.

Conclusion

It identifies the areas of concern by depicting the levels of malnutrition among street children in Delhi using Z-scores and the CIAA. This study shows that a large number of these children have functional problems where nutritional deficiencies are seen and the dominant issue is stunting. The obtained results reveal that the deterioration in children's malnutrition increases with their length of stay on the streets and is characterized by chronic and acute undernutrition that results from poor dietary intake and high rates of infection. Thus, even though gender differences did not affect the status of malnutrition, age and time on the streets did by indicating that the older kids are in even worse shape. These findings paint a picture of desperation for a response of a holistic nature directed toward street children including nutritional support but also in terms of aftercare and alternative treatment. Such policies and programs should address challenges that hinder food security, access to health facilities, and quality living standards that will help free vulnerable children from the cycle of malnutrition and poverty. The study also encourages practical and viable actions like family integration and other community integration as measures of enhancing a good and stable environment for street children.

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