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# Undernutrition and Household Environmental Quality among Urban and Rural Children in Nigeria

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**Abstract:** This study explored the association between child undernutrition and household environmental quality in urban and rural households. Anthropometric assessments were conducted on 370 preschool children in three urban communities (high, medium and low-density) and one rural community. A structured questionnaire for mothers and an observation checklist were used to collect sociodemographic and environmental data. An Environmental Quality Index (EQI) combining four composite indicators of household environment (water, sanitation, housing, waste disposal/drainage) was developed. Results Overall prevalence was 16.8% for wasting, 29.7% for stunting and 28.4% for underweight. There was a significant association between the EQI and stunting ($r = -0.437$, $p = 0.000$) and also, underweight ($r = -0.491$, $p = 0.000$) but not with wasting ($r = -0.152$, $p = 0.201$). Dissagregation of data into rural and urban revealed that the significant associations disappeared in the rural but persisted among the urban children. The findings reiterate the significance of environmental inadequacies to childhood undernutrition. However, environmental quality appears to be a more important determinant of undernutrition among urban than rural children.

**Key words:** Undernutrition, environment, urban, rural

## Introduction

The relationship between malnutrition and infection is well known and documented (Scrimshaw *et al.*, 1968; Smythe *et al.*, 1971; Chen and Scrimshaw, 1983; Biesel, 1984). Infections have adverse effects on nutritional status and conversely, malnutrition can lead to clinically significant immune deficiency and infections in children (Scrimshaw, 2003; Cunningham-Rundles *et al.*, 2005). Even in this decade, there is stronger evidence that the malnutrition-infection cycle or complex is the most prevalent public health problem in the world today (Allen and Gillespie, 2001).

A significant proportion of undernutrition seen in children is precipitated by infection due to the unhealthy state of their physical environment. Ddiarrhoea, respiratory infection and malaria are particularly important causes of child malnutrition (Tomkins and Watson, 1989) and these same infections are influenced by environmental quality. An array of environmental health variables has been associated with each of these infections (Stephens *et al.*, 1985; WHO, 1997), each of them has its own transmission route and these are related in some way to the environment. In spite of this, the malnutrition-infection complex is seldom seen in environmental terms, even though it is premised on the evidence that nutritional status is compromised by infection of environmental origin (Johns and Eyzaguirre, 2000). The United Nations Children Fund conceptual framework (UNICEF, 1998) underscores the position of an unhealthy environment as an underlying factor of child malnutrition, alongside household food insecurity and inadequate care for women and children. Food insecurity has been vastly researched, while as noted by Arimond and Ruel (2000), much of the research and policy work related to child nutrition prior to the 90s ignored the position of care. However, the role of an unhealthy environment has received even less attention. In Nigeria, there is a shortage of studies with an in-depth focus on environmental quality dimensions of childhood malnutrition especially with regard to location or rural-urban differentials. This study therefore examines the relationship between undernutrition in children and the quality of the environment in both urban and rural households from selected communities in Nigeria.

## Materials and Methods

**The study area:** The study was carried out in Oyo state, one of the 36 states in Nigeria, with a population of 3.8 million (National Population Commission, 1999). It is located between latitude $7^o$ and $9^o$ north of the equator and bounded by longitude $2^o$ and $4^o$ east of the Greenwich Meridian. Administratively, Oyo State is divided into 33 Local Government Areas (LGAs). For the purpose of this study, these were stratified into two: urban and rural, depending on the predominant settlement pattern existing in each of the LGAs. The next stage was the random selection (table of random numbers) of one LGA from each stratum, to ensure that all LGAs have equal chances of being picked. Consequently, Ibadan Southwest LGA was selected from urban and Kajola LGA from rural.

**Selection of study communities:** The study was community based. Due to the heterogeneity associated with urban areas, provision was made for the representation of the three different population density types (listed by the National Population Commission) in Ibadan Southwest LGA. A random selection of three communities, one from each population density group of low, medium and high was then made.

For the rural selection, in Kajola LGA, all the communities were listed, out of which one was randomly selected for study since there are no specific density groupings for the rural area, given that there is relative consistency existing in rural areas in terms of population density and socio-economic status.

**Subjects and sample size:** Children under the age of five years and their mothers were the subjects for study. Sample size was calculated at a confidence level of 95% according to FAO (1990).

$$N = \frac{Z\alpha^2 Pq}{d^2}$$

where N = minimum sample size desirable

$Z\alpha$ = 1.96

d = desired precision (0.05)

p = proportion of malnourished children under the age of five years in the population =38% (National Population Commission and ORC Macro, 2004)

q = 1-p = 1-0.38 = 0.62

$$\therefore \quad N = \frac{(1.96)^2 \times 0.38 \times 0.62}{(0.05)^2}$$

$$= 362$$

In order to cater for drop outs during the study, an allowance of 5% was made, thus the total sample size was 380. This was divided among the study communities using a simple percentage ratio based on the population of children under the age of five in each community. To select households within each community, a location map was used and every tenth house was selected for inclusion in the study. Where there was no child under the age of five, the immediate next household was selected in its place.

**Data collection:** The research procedure was reviewed and approved by the Department of Human Nutrition, University of Ibadan. Before the commencement of the study, introductory visits were made to seek access into the communities and to introduce the project and its objectives. Consent for the project was obtained from the community leaders, the health centre managers and the mothers and/ or fathers in the households selected for study.

Height of the children was measured using height measuring boards. Length boards were used to measure children younger than 24 months by laying them down on the board (recumbent length). Older children's height was measured standing erect against a flat wall, using chalk and the measuring tape. The height/length measurements were made to the nearest 0.5cm. Age in months was calculated from the date of birth to the date of the survey. Wasting, stunting and underweight were defined as low height-for-age at <-2 Standard Deviations (SD) of the median value of the National Center for Health Statistics/World Health Organization (NCHS/WHO) international growth reference. Sociodemographic and household environment data was collected using a pre-tested structured questionnaire for mothers and also, a household observation checklist.

**Development of the Environmental Quality Index (EQI):** Available literatures have only associated single aspects of the household environment (particularly water and sanitation) with children's nutritional status; however, this study combines several aspects and looks at them in relation to nutritional status. An Environmental Quality Index (EQI) was developed as a quantitative summary of the quality of the environment of each child's household. The index is based on four basic components, which represent household environmental dimensions or indicators:

a) A water indicator measuring safety, convenience and adequacy of household water supply
b) A sanitation indicator measuring access to adequate sanitation in the household
c) A housing indicator measuring availability and quality of the housing facility
d) A waste disposal indicator measuring adequacy and safety of waste disposal and drainage facility in the household.

First, each of the environmental indicators was operationally defined and measured by specific questions (Fig. 1). Responses to these were scored and summed up into each indicator. However, as questions with different number of response categories were combined into each indicator, it became necessary to make adjustments to standardize the scores, so that all variables will have an equal potential weight in the final scale score. The raw scores were therefore converted to z scores to adjust for the different distribution of each question in the constructs. The z-scores were subsequently transformed and expressed on a scale

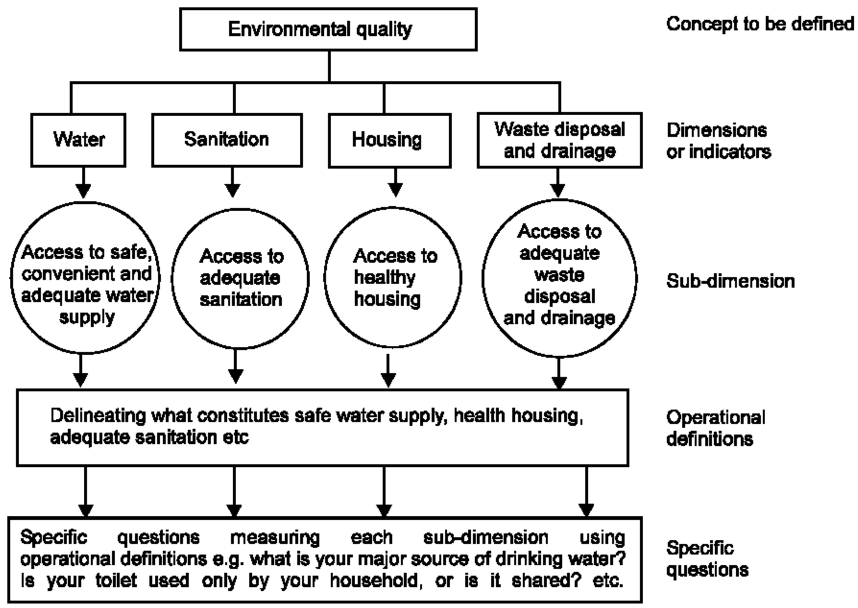


Fig. 1: Defining the concept of environmental quality

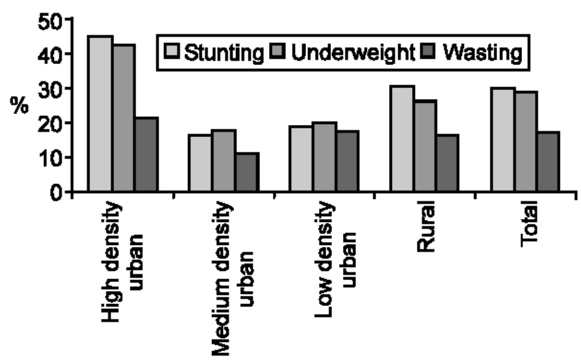


Fig. 2: Prevalence of undernutrition by community

between 0 and 100, like simple percentages, using the method described by de Vaus (1996), for ease of presentation. Finally, the EQI was obtained by adding all the four indicator percentages and dividing by four.

To ensure validity and reliability of the EQI, the following steps were taken:

a) It was ensured that all the questionnaire items or variables in each of the four components of the index belonged together conceptually. For example, 'type of toilet' does not belong to the water indicator, but sanitation indicator.
b) Each variable in the index was scored in the same direction to allow for fair comparison and combination. In other words, the variables were coded so that a high score indicated better environmental quality in that aspect and a low score represented a lesser quality.
c) Inter-item correlation among the four composite indicators was computed to provide a measure of the overall reliability of the EQI as measured by Cronbach alpha. This ranges between 0 and 1; the higher the figure, the more reliable the index and for reliability, it must be at least 0.7. For this study, the computed alpha was 0.7327, thus the EQI was adjudged to be reliable.

**Data analysis:** Data was analyzed using *Epi info* 6 statistical software package and the Statistical Package for Social Sciences (SPSS) Version 10.0. The dependent variable in this study was child's nutritional status as shown by height-for-age, weight-for-age and weight-for-height z-scores, while the independent variable was the EQI.

## Results

**Sample characteristics:** A total of 370 datasets were analyzed. The mean age of the children was 28.98±16.23 months, with the youngest cohort being from the high-density urban area (mean = 25.91±15.99) and the oldest from the low-density urban area (mean = 31.32±16.15months). The female children accounted for 51.9% as against 48.1% for the males. For the mothers, the lowest mean age of 28.40±6.70 years was that of the rural community, while the highest (30.58±4.37 years) was from the medium density urban community.

**Nutritional status of children:** The overall prevalence of undernutrition in the four communities was 29.7%, 28.4% and 16.8% for stunting, underweight and wasting respectively. There were noticeable differences in the

Table 1: Environmental indicators by community

| Household Environmental Indicators | High Density Urban | Medium Density Urban | Low Density Urban | Rural | Total |
|---|---|---|---|---|---|
| Mean scores (%) | | | | | |
| Sanitation | 61.4 | 85.1 | 90.5 | 32.1 | 63.9 |
| Water supply | 60.6 | 65.8 | 73.4 | 67.5 | 66.0 |
| Housing | 49.1 | 70.1 | 80.9 | 44.4 | 58.2 |
| Waste disposal/Drainage | 37.2 | 64.5 | 61.3 | 32.8 | 46.1 |

Table 2: Relationship between child undernutrition and household environmental quality

| | Stunting | Underweight | Wasting |
|---|---|---|---|
| Correlation coefficient | | | |
| Urban and rural (combined) | -0.437** | -0.491** | -0.152 |
| Urban sample (n = 270) | -0.564** | -0.593** | -0.174 |
| Rural sample (n = 100) | -0.084 | -0.065 | -0.256 |

**Significant at p<.001

nutritional status of children when each of the communities was considered (Fig. 2). Undernutrition was found to be most prevalent in the high density urban community, with very high figures of 44.4%, 41.9% and 21.0% for stunting, underweight and wasting respectively.

**Environmental quality index:** Table 1 shows the mean scores obtained in each community for the four environmental indicators. The low density urban community scored highest in three of the four composite environmental indicators, coming second only for waste disposal. The rural community scored lowest in all the indicators except in water supply, for which it scored second highest. Since the mean scores obtained for the indicators varied extensively across the communities studied, consequently, the mean EQI for each of the communities also differed widely. The rural community scored least (EQI = 44.1%±13.52), followed by the high density urban community, which scored 52.1%±14.55. The low and medium density urban communities had the highest scores (76.5%±17.76 and 71.3%±11.01 respectively). The overall EQI was 58.60%±18.39.

**Relationship between child undernutrition and household environmental quality:** The relationship between child undernutrition and household environmental quality as obtained through correlation analysis is presented in Table 2. There was a significant association between height-for-age and weight-for-age but not weight-for-height and the EQI. To test for the existence of urban-rural differences, the data was desegregated into urban and rural and correlation analysis repeated. It emerged that there was no significant association between EQI and any of the three indices of undernutrition in the rural sample, whereas, for the urban sample, the previously observed association remained.

For intra-community analysis, Schèffe multiple comparisons test was carried out on the urban sample. The result showed that within the same community (or population density group), children from households with a lower EQI tended to have lower height-for age and weight-for-age z-scores.

## Discussion

This study has demonstrated that there exists a significant relationship between children's nutritional status and the quality of the environment, even within similar population density settings or socioeconomic classification. This is in accord with the UNICEF conceptual framework for the determinants of undernutrition in children (UNICEF, 1998). Other studies (Smith and Haddad, 2000; Udipi *et al.*, 2004) have highlighted the contribution of environmental factors in the aetiology of child malnutrition. Growth faltering among developing country infants has been attributed to chronic or recurrent exposure to infection brought about by living in an unhygienic environment (Solomons, 2003).

This study further suggests that there exist urban-rural differences in the undernutrition-environmental quality association. In our rural sample, the observed relationship completely disappeared, but persisted and even increased in strength in the urban sample. Thus, it appears that undernutrition among the rural children was more associated with factors other than environmental quality, whereas it is a more important actor in the aetiology of undernutrition among urban children, principally the urban poor. That environmental deficits affect urban children more than rural children may be explained from the position of the difference in population densities; average population density in urban areas is far higher than in rural areas. More light is thrown on this when we consider sanitation, one of the four composite indicators of the EQI, as an example. The data indicates that sanitation was poorer in the rural community (32.1%) than in the high density urban community (61.4%). In reality, however, the latter's statistics are worse when population density is taken into account. Measuring 'access to adequate sanitation in the household' using questionnaire items such as 'type of toilet used by household' (among others) already places the rural community at a disadvantage while scoring the responses to this item. This is because in rural communities, community-designated open spaces such as rocks and bushes are more commonly used as toilet (which, in this study are scored low as a toilet facility), while in the high density urban community, flush toilets and pit latrines (which were scored higher) are more common. The salient issue that remains however, is the extent to which these flush or pit toilets are being shared by households in this densely populated urban community. When population density is high, there is crowding, bigger pressures on facilities and greater challenges for the maintenance of environmental quality. These are the living conditions that constantly expose children to the danger of infection and therefore the malnutrition-infection complex.

Similarly, Ellen Van de Poel *et al.* (2007) raised salient issues regarding the nature of rural-urban differences in child stunting and mortality in their analysis of Demographic and Health Surveys for 47 developing countries. They showed that although on the average, urban children are better nourished than their rural counterparts, the urban poor are often as disadvantaged as the rural poor with respect to nutrition and mortality because they are living in conditions that are equally bad (or even worse) as those in rural areas in terms of the impact on child health. This position supports previous studies (Menon *et al.*, 2000; Bitran *et al.*, 2005; Fotso, 2006).

In conclusion, there is a need for more attention to interventions involving environmental improvements at household and community levels, particularly in high density urban areas. This becomes more imperative as poverty and malnutrition have been increasing, both in absolute and in relative terms in several developing countries, Nigeria being one of them (Haddad *et al.*, 1999). As being currently advocated, innovative solutions for nutrition problems do require partnerships within and beyond nutrition science (Wahlqvist, 2006). Additional efforts to ensure an environment that supports the nutritional well-being of children will require increased collaborations with experts in several disciplines to develop and implement strategies to improve the quality of the living environment and hence, to reduce childhood undernutrition.

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