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*Research Article*

# The Relationship between Stunting and Some Demographic and Socioeconomic Factors among Yemeni Children and Adolescents

**Muhammed A. K. Al-Mansoob** [1] **and Muhammed S. A. Masood** [2]

[1] *Mathematics Department, Faculty of Science, Sana'a University, P.O. Box 12092, Yemen*
[2] *Mathematics Department, Faculty of Education and Language, Amran University, Yemen*

Correspondence should be addressed to Muhammed A. K. Al-Mansoob; darasan.ceo@gmail.com

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The purpose of this study is to evaluate the influence of sex, residence area, age group, school enrollment, poverty status, and income quintiles variables on the prevalence of stunting among Yemeni children and adolescents. The investigation was done on all children and adolescents (3004) aged 5-19 years and included in the last Yemeni Household Budget Survey (YHBS) data of 2005/2006. The data included a classification of the poverty status of surveyed households. The cutoff of -2 z scores of the height-for-age reference suggested by NCHS was used to calculate the prevalence rate of stunting. Descriptive, categorical testing, and logit modelling statistical analysis tools were used in the investigation. The statistical analysis shows the overall prevalence rate of stunting as 49.5% and the prevalence of stunting among males is higher than females. The prevalence of stunting among rural children and adolescents is higher than the urban children and adolescents, and it is higher among children and adolescents who were not enrolled than those enrolled. Children and adolescents of poor households were suffering from stunting (52.8%) as compared to children and adolescents of nonpoor households (47.7%). Children and adolescents living with the poorest, second, and middle-income households were 1.76, 1.73, and 1.46 times more likely to be stunted, respectively. The research provides an evidence that the childhood health situation in Yemen is chaotic and needs careful and effective cooperation and efforts both nationally and internationally to divert the foreseen danger looming.

## 1. Introduction

Stunting is defined as height-for-age z score (HAZ) of equal to or less than minus two standard deviation (-2 SD) below the median of a reference standard [1–3]. It means that any individual who is less than 2 SD below the reference median of HAZ is classified as chronically malnourished or stunted [1, 4]. HAZ score is one of the most recommended malnutrition indicators of stunting during adolescence [1–3, 5]. Height-for-age (HA) is a stunting indicator of chronic malnutrition based on the principle that an individual has an expected height for his age. It is an indicator of shortness/tallness and low score is evidence of chronic under nutrition [1, 4, 6]. It is an indicator measure of child health since it is believed to be a long-run measure of nutritional status [7]. It is also a well-established child-health indicator of chronic malnutrition, which reliably gives a picture of the past nutritional history and the prevailing environmental and socioeconomic circumstances [8].

As recommended by WHO, evaluating the malnutrition status is based on comparing the sample in the survey with a reference population of well-nourished children [1, 2].

Adolescence is a significant period of human growth that has unique changes occur during this period and an important stage in human development. In addition, the proximity of adolescence to biological maturity and adulthood may provide final opportunities for preventing adult health problems [9]. Therefore, assessing the growth and nutritional status of children and adolescents is an essential part of monitoring the health of a population or a community [10].

There is little anthropometric information available on adolescents in both developed and developing countries. One reason for this gap in knowledge is the lack of an

Table 1: Frequencies of the Variables.

| Variables | Categories | N | % |
|---|---|---|---|
| Sex | Male | 1607 | 53.5 |
| | Female | 1397 | 46.5 |
| Residence Area | Urban | 1819 | 60.6 |
| | Rural | 1185 | 39.4 |
| Stunting Status | Stunted | 1486 | 49.5 |
| | Not stunted | 1518 | 50.5 |
| School Enrollment | Yes | 2201 | 73.3 |
| | No | 803 | 26.7 |
| Age Groups in years | 5 - < 10 | 1081 | 36.0 |
| | 10 – 19 | 1923 | 64.0 |
| Poverty Status | | | |
| Poor | 5-<10 | 360 | 33.3 |
| | 10-19 | 667 | 34.7 |
| Non-poor | 5-<10 | 721 | 66.7 |
| | 10-19 | 1256 | 65.3 |
| Income Wealth Index Quintiles | Poorest | 350 | 11.7 |
| | Second | 377 | 12.5 |
| | Middle | 477 | 15.9 |
| | Fourth | 881 | 29.3 |
| | Richest | 919 | 30.6 |
| Total | | 3004 | 100.0 |

internationally agreed on nutritional status during this period of life. However, the assessment of malnutrition during adolescence is complicated by important changes in body composition, especially during the puberty or adolescence [3, 9].

There are few studies on adolescent that were conducted in Yemen. The first study was conducted by Jumaan in April 2007 on 114 girls aged 10-19 years [11]. She studied the impact of copper and zinc on stunting in a sample of adolescent Yemeni girls at Al-Wehda district, Sana'a, by using the Body Mass Index (BMI). She observed that 68.8% of the girls were below the normal stature-for-age percentile and 20% were stunted. Furthermore, there was a statistically significant effect of zinc levels on the heights of girls [11]. The second study was conducted by Al-Saqladi, Bin-Gadeen, and Brabin in 2010 on 102 children <16 years at Al-Wahda General Teaching Hospital, Aden [12]. The main purpose of the study was to describe the growth status of children and adolescents with Sickle Cell Disease (SCD) in Yemen using the new WHO reference values. It was found that there is an association of low height-for-age with males, low weight-for-age and weight-for-height with increasing age, and low weight-for-age with alkaline phosphatase levels [12].

The present study is aiming to investigate the effect of some socioeconomic factors on the prevalence of stunting among some school children and adolescents in Yemen.

## 2. Methods

*2.1. Definitions.* In this study, stunting was defined as HAZ equal to or below minus two standard deviation (-2 SD) of the mean of NCHS standard [3, 13].

Children were defined as aged 6-10 years and adolescents were aged 10-19 years [14].

*2.2. Data Source.* The sample of the study was all children and adolescents aged 5-19 years included in the last YHBS 2005/2006. The total sample was 3004 children and adolescents. Along with the stunting status, other factors such as sex, area of residence, school attendance, and age groups were taken into analysis.

*2.3. Analysis of Data.* The anthropometric measures convert information for individuals with height, sex, and age into z scores based on the NCHS recommended reference population [5] by using the Nutrition Procedure of Epi Info Computing Package Version 6.02 [15]. SPSS version (21) was used to analyze the data sample. The frequencies of the variables were calculated and both Pearson's Chi-Square ($\chi^2$) test and logit model were used to study the relationship between stunting and the other risk factors [16, 17]. The significance level $\boldsymbol{\alpha = 0.05}$ was established throughout the analysis.

## 3. Results

Statistically, it is plausible to explore first nature of the variables that will be used on the analysis. Therefore, Table 1 shows the frequencies of the variables in which 53.5% of the sample of children and adolescents are males and 60.6% are living in urban areas. 73.3% of the sample were found enrolled, 64% of them are on the age interval 10-19 years, and over one-third of the children (34.0%) are poor.

Table 2: The means and standard deviations (SD) of HAZ according to age groups.

| Variables | | 5 - 10 years | | 10 - 19 years | |
|---|---|---|---|---|---|
| | | Mean | SD | Mean | SD |
| School Enrollment | Yes | -1.6 | 1.7 | -2.1 | 1.4 |
| | No | -2.2 | 2.0 | -1.9 | 1.6 |
| Residence Area | Urban | -2.0 | 1.8 | -2.1 | 1.3 |
| | Rural | -1.8 | 0.9 | -2.1 | 0.7 |
| Sex | Male | -1.9 | 1.8 | -2.1 | 1.5 |
| | Female | -1.8 | 1.9 | -2.1 | 1.5 |
| Poverty Status | Poor | -2.0 | 1.8 | -2.1 | 1.6 |
| | Non-poor | -1.8 | 1.8 | -2.1 | 1.4 |
| Income Wealth Index Quintiles | Poorest | -2.0 | 2.1 | -2.3 | 1.4 |
| | Second | -2.2 | 1.8 | -2.3 | 1.6 |
| | Middle | -2.0 | 1.6 | -2.3 | 1.4 |
| | Fourth | -1.8 | 1.6 | -2.0 | 1.4 |
| | Richest | -1.7 | 2.1 | -1.9 | 1.5 |
| All | | -1.9 | 1.8 | -2.1 | 1.5 |

Table 3: The relationship between HAZ and other variables.

| Variables | | HAZ Status | | $\chi^2$ | P-value |
|---|---|---|---|---|---|
| | | Stunted | Not stunted | | |
| Sex | Male | 865 (58.2%) | 742 (48.9%) | 26.274 | 0.001 |
| | Female | 621 (41.8%) | 776 (51.5%) | | |
| Residence Area | Urban | 873 (58.2%) | 946 (62.3%) | 4.008 | 0.045 |
| | Rural | 613 (41.3%) | 572 (37.7%) | | |
| School Enrollment | Yes | 1051 (70.7%) | 1150 (75.8%) | 9.703 | 0.002 |
| | No | 435 (29.3%) | 368 (24.2%) | | |
| Age Groups in years | 5 - < 10 | 533 (35.9%) | 548 (36.1%) | 0.018 | 0.895 |
| | 10 – 19 | 953 (64.1%) | 970 (63.9%) | | |
| Poverty Status | Poor | 542 (36.5%) | 485 (31.9%) | 6.830 | 0.009 |
| | Non-poor | 944 (63.5) | 1033 (68.1%) | | |
| Income Wealth Index Quintiles | Poorest | 204 (13.7%) | 146 (9.6%) | 37.555 | 0.001 |
| | Second | 215 (14.5%) | 162 (10.7%) | | |
| | Middle | 252 (17.0%) | 225 (14.8%) | | |
| | Fourth | 418 (28.1%) | 463 (30.5%) | | |
| | Richest | 397 (26.7%) | 522 (34.4%) | | |

In general, Table 2 suggests that children aged 5-10 years that are not enrolled are more likely to be stunted. This result is reversely reported with the age group 10-19 years where those enrolled are more likely to be stunted. In both age groups, the children and adolescents of the urban areas are more likely to be severely stunted. Both males and females of the age group 10-19, poor, nonpoor, the poorest, second, and middle adolescents, are more likely to suffer from stunting.

The prevalence of stunting according to the categories of the variables is presented in Table 3. In this table, many important points can be noticed. For instance, the relationship between sex of children and stunting is highly significant ($\chi^2$ = 26.274, $P$ value = 0.001). The prevalence of stunting among males is higher than females. The relationship between residence area and stunting is significant ($\chi^2$ = 4.008, $P$ value = 0.045). The prevalence of stunting among rural children and adolescents is higher than the urban children and adolescents. The relationship between stunting and school enrollment is significant ($\chi^2$ = 9.703, $P$ value = 0.002) and the prevalence of stunting among those children and adolescents not enrolled is higher than those enrolled. The relationship between stunting and age groups is not significant ($\chi^2$ = 0.018, $P$ value = 0.895) and almost there is no difference in the prevalence of stunting between the two age groups. The prevalence among poor children and adolescents is higher than nonpoor (52.8% versus 47.7%) and the association is statistically significant ($\chi^2$ = 6.830, $P$ value = 0.009). Stunted children and adolescents were more likely to live with the poorest, second, and middle-income households ($\chi^2$ = 37.555, $P$ value = 0.001).

As the null hypothesis is to investigate the prevalence of stunting among Yemeni children and adolescents along

Table 4: Logit model analysis of prevalence of stunting.

| Independent Variables | B | Odds Ratio | 95% CI | P-value |
|---|---|---|---|---|
| Residence Area (rural) | -0.08 | 0.92 | 0.78 - 1.09 | 0.343 |
| Sex (male) | 0.41 | 1.50 | 1.30 - 1.74 | 0.001 |
| School Enrollment (yes) | -0.28 | 0.76 | 0.59 - 0.85 | 0.003 |
| Age Groups (10-19) | 0.13 | 1.14 | 0.97 - 1.34 | 0.116 |
| Poverty (non-poor) | -0.04 | 0.96 | 0.82 - 1.13 | 0.650 |
| Income Wealth Index Quintiles | | | | |
| (richest) | | | | 0.001 |
| Poorest | 0.56 | 1.76 | 1.32 - 2.34 | 0.001 |
| Second | 0.55 | 1.73 | 1.33 - 2.26 | 0.001 |
| Middle | 0.38 | 1.46 | 1.16 – 1.84 | 0.001 |
| Fourth | 0.18 | 1.19 | 0.99 – 1.44 | 0.067 |
| Constant | -0.31 | 0.74 | | 0.017 |

CI: Confidence Interval

with the variables sex, residence area, age groups, and current school attendance for children and adolescents, stunting of individuals was considered as the dependent variable and others as independent variables. For such a reason, logit or logistic regression is considered to be the most appropriate data analysis tool [16, 17]. Following this multivariate analysis (Table 4), the prevalence of stunting was found to be associated with sex, current school attendance, and quintiles variables. The prevalence of stunting among males was 1.53 times more than females. The prevalence of stunting among individuals who considered enrolled is about 0.71 times less than children not enrolled. The prevalence of stunting among children and adolescents who were living with the poorest, second, and middle-income households were 1.76, 1.73, and 1.46, respectively, times more than individuals who were living with the richest households.

## 4. Discussion

Although many studies have been conducted on the anthropometric assessment of nutritional status in preschool children [18, 19], much less information can be found about growth and nutritional status of school-age children and adolescents. Among the most important reasons for this lack of information are the difficulty of interpreting anthropometric data in these age groups [3, 9], the rapid changes in somatic growth, problems of dealing with variations in maturation, and difficulties in separating normal variations from those associated with health risks [20]. Furthermore, the use and interpretation of indicators such as height-for-age z scores (HAZs) for characterizing growth patterns have been a debated subject [19].

The results show that with using a cutoff of -2 z scores of the height-for-age NCHS reference, the overall prevalence of stunting is 49.5% which is in the range of 48-56% that is obtained in five countries, namely, Ghana, Tanzania, Indonesia, India, and Viet Nam [21]. This result is very high compared to some countries round the globe [10, 22–25] and low as compared to findings of a study done in South Africa (68.4%) of the obese group [26].

In the present study, the prevalence of stunting among males is higher than females. This result agrees with some studies conducted in Kenya and Nigeria [10, 23] but not with a study conducted in West Bengal [27]. This situation could be attributed to several factors: either the education syllabuses involving materials that raise awareness of the pupils to the health foods or the fact that they are naturally active and practicing some body exercises or both. On the other hand, generally, only families who can afford the education costs are sending their children to schools. Therefore, it seems logical to presume that these families live in, at least, reasonable living standards that could be reflected positively in their children's health. Furthermore, gender bias is still deeply rooted in the Yemeni society in favor of males, even in the urban areas. Usually, girls aged 10 years and over must reside at homes most of the time (early marriage is also common in the rural areas). Therefore, from this perspective girls are practically closer to food as culturally they should engage in the cooking process rather than boys.

It should be known that in Yemen, the food consumption patterns differ significantly from one area to another. These patterns are, in general, nutritionally unbalanced diets as they depend mainly on consuming very short list of food items especially grains and cereals. No doubt that the long term of poverty that is hitting the country is the main cause of these patterns and more specifically in the rural areas. In this regard, the poverty rate in the rural areas was 42.1% in 2004/2005, jumped into 59.2% in 2014, and is expected to be worse due to the ongoing devastated war that emerged in 2015 [28]. Therefore, it is not a surprising result to find the prevalence of stunting among rural children and adolescents to be higher than the urban children and adolescents. In fact, this result is in line with a study conducted in India [29] but not with another study conducted in South Africa [26].

The prevalence of stunting among children and adolescents who were not enrolled is higher than those enrolled. This result is in agreement with studies in Ghana and Tanzania where nonenrolled children were more malnourished than children enrolled [30, 31]. Children and adolescents belonging to poor households were significantly suffering

from stunting (52.8%) as compared to children and adolescents belonging to nonpoor households (47.7%) ($P$ value < 0.01). Similar findings to our study were found in a study conducted in India [32].

Children and adolescents living with the poorest, second, and middle-income households were 1.76, 1.73, and 1.46 times more likely to be stunted, respectively, compared to those living with the richest households ($P$ value < 0.01). Therefore, the prevalence of stunting is likely to be more among the poorest children and adolescents than the richest, which conforms to findings of a study conducted in Pakistan [33].

## 5. Conclusions

The main objective of the present research was to investigate the influence of sex, area of residence, age group, current school enrollment, poverty status, and income wealth index quintiles variables on the prevalence of stunting among Yemeni children and adolescents. The investigation was done on all children and adolescents aged 5-19 years involved in the last YHBS (2005/2006).

By using a cutoff of -2 z scores of the height-for-age NCHS reference, Epi Info package produced the overall prevalence of stunting as 49.5%.

All other statistical analyses have been done by SPSS (21) that included simple descriptive statistics, Chi-Square ($\chi^2$) testing, and the logit (logistic) regression. The results indicated a relatively high enrollment rate (73.3%) and showed that more than one-third (34.0%) of the investigated sample of children and adolescents are poor.

While stunting is common among 5-10 children that are not enrolled, 10-19 adolescents are commonly stunted. Stunting is common among 10-19 males and females, poor and nonpoor, and also in the first three income wealth index quintiles households.

The results of using Chi-Square ($\chi^2$) testing and the logit (logistic) regression have proved that the prevalence of stunting among males is significantly higher than females. The prevalence of stunting among those who were not enrolled is significantly higher than enrolled ones and also higher among those who were living with the poorest, second, and middle-income wealth index quintiles households than individuals who were living with the richest households.

The present research was built on analyzing a relatively old data (2005/2006), wherefore the results presented in this research do not reflect the actual terrible livelihood situations of the whole Yemeni people due to more than three years of miserable war and its disastrous consequences on children and adolescents.

## Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

## Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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