Original article

Nutritional Status of Adolescent Girls from Rural Communities of Tigray, Northern Ethiopia

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Abstract

Background: Addressing the nutritional needs of adolescents could be an important step towards breaking the vicious cycle of intergenerational malnutrition.
Objective: Assess nutritional status of rural adolescent girls.
Design: Cross-sectional.
Methods: Anthropometric and socio-demographic information from 211 adolescent girls representing 650 randomly selected households from thirteen communities in Tigray was used in data analysis. Height-for-age and BMI-for-age were compared to the 2007 WHO growth reference. Data were analyzed using SAS, Version 9.1.
Results: None of the households reported access to adolescent micronutrient supplementation. The girls were shorter and thinner than the 2007 WHO reference population. The cross-sectional prevalence of stunting and thinness were 26.5% and 58.3%, respectively. Lack of latrine facilities was significantly associated with stunting ($p = 0.0033$) and thinness ($p<0.0001$). Age was strong predictor of stunting ($r^2 = 0.8838$, $p<0.0001$) and thinness ($r^2 = 0.3324$, $p<0.0001$).
Conclusion: Undernutrition was prevalent among the girls. Strategies to improve the nutritional status of girls need to go beyond the conventional maternal and child health care programs to reach girls before conception to break the intergenerational cycle of malnutrition. Further, carefully designed longitudinal studies are needed to identify the reasons for poor growth throughout the period of adolescence in this population. [*Ethiop.J.Health Dev.* 2009;23(1):5-11]

Introduction

Adolescence is an intense anabolic period when requirements for all nutrients increase. During adolescence, 20% of final adult height and 50% of adult weight are attained, bone mass increases of 45% and dramatic bone remodeling occur and soft tissues, organs, and even red blood cell mass increase in size (1). This situation is further complicated when adolescents are often exposed to infections and parasites that can compromise nutritional status. Among those sexually active, there is also an increased risk of infection from sexually transmitted diseases.

Nutritional deficiencies have far reaching consequences, especially in adolescent girls. If their nutritional needs are not met, they are likely to give birth to undernourished children, thus transmitting undernutrition to future generations (2, 3, 4). One way to break the intergenerational cycle of malnutrition is to improve the nutrition of adolescent girls prior to conception. The vicious cycle of malnutrition, if not broken, will goes on resulting in more and more severe consequences.

Surprisingly, information regarding the nutritional status of adolescents from the developing world is lacking. Part of the reason for the lack of information has been the difficulty of interpreting anthropometric data in these age groups (5).

Limited studies conducted across a range of ecologic settings in the developing world demonstrate that children enter middle childhood having already accumulated significant deficits in nutritional status (6, 7, 8). However, adolescents have been considered a low risk group for poor health and nutrition and often receive scant attention. As a result, resources have traditionally been directed to children and mothers especially pregnant women. The relative omission of the nutritional needs of adolescent girls is surprising considering the fact that developmental processes of adolescence exert significantly increased demands on both micro and macronutrients (9, 10, 11).

Information both on absolute levels and on trends with respect to adolescent girls' malnutrition are of relevance for designing, initiating or modifying intervention programs. To the best of our knowledge, there are no research reports on adolescent nutritional status from Tigray. We believe that the paucity of available data on the nutritional status of adolescent girls has limited the development of intervention strategies aimed at improving the nutritional status of girls. Given the importance of integrating and coordinating interventions to optimize outcomes for adolescents, it is vital to arrive at a set of priority actions to guide program development and the implementation process. The process for priority

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setting should start with the assessment and analysis of the situation that adolescents face in their environment. The nutritional status of adolescent girls, however, has been under explored in Ethiopia. This study, therefore, is aimed at assessing the level of adolescent undernutrition and identifying the factors contributing to girls' malnutrition in Tigray, Northern Ethiopia. Information gathered from this survey will provide baseline data and will elicit support and promote cooperation among the different stakeholders towards the initiation of a sustainable nutrition and health promotion program for adolescents.

Methods

Thirteen study communities were selected from Central, Eastern, Northwestern and Southern zones of Tigray in 2004/2005, on the basis of their differences in agro-ecology and presence of water ponds and wells in the study communities. Fifty households (total of 650) were randomly selected from each of the 13 study communities from the project on "Water Harvesting for Poverty Reduction and Sustainable Resource Use, PREM". PREM was a multidisciplinary project with socioeconomic, agriculture, health and nutrition components. Excel software was used to generate the random numbers in addition to the roster of land registration from the local agriculture offices used as a frame for randomization of the households. Of the 650 households, 357 had one or more 10-19 year old adolescent family member(s). If a household had more than one adolescent girl, the younger one was included in the study to narrow the time gap for comparison of the nutrition situation of children and adolescents in the study communities. Two hundred and thirteen girls from the 357 households had complete anthropometric and socio-demographic information. Prior to the data collection, the PREM study team made a short visit to the study communities to meet local administrators and community leaders and brief them on the purpose and importance of the study. Before the start of the PREM study, a pilot survey was conducted in a similar community around the city of Mekelle. Problems highlighted during the pilot survey were resolved before the start of the actual survey. The interviewers and supervisors were trained to standardize the questionnaire administration and anthropometric measurements. All the interviewers and supervisors were at least high school graduates and able to communicate in the local language, Tigrigna.

This study was approved and supported by Mekelle University and Vrije Universiteit in the Netherlands. Before contacting any participants, the letter from the university was taken to local (woreda) authorities and to community leaders and they were briefed on the purpose of the study. Individual assent and parental consent were obtained from each participant before starting interviews or taking body measurements. Subsequently, clearance to use de-identified existing data was obtained from the Institutional Review Board of Oklahoma State University, USA.

Socio-demographic information

A household questionnaire was used to collect socio-demographic information. Daily close supervision (spot checks, re-interviewing and thorough scrutiny of filled-in questionnaires) was made by the field supervisors deployed with the data collectors. At the end of every community level data collection, a meeting was held between the data collectors, supervisors and the research team to discuss practical problems and issues of major concern. Respondents were re-interviewed by the supervisors when item non-responses were encountered. Either the key caregiver to the household or the father were interviewed when the mother was absent during data collection.

Anthropometry

Age, sex, weight and height were recorded. Locally made stadiometres with a sliding headpiece, and portable mechanical analog scales were used to measure height and weight, respectively. Height was measured to the nearest 0.1 cm and weight to the nearest 0.1 kg. Each subject was weighed with minimum clothing and no foot wear. The scales were carefully handled and periodically calibrated by placing standard calibration weights of 2 kg iron bars on the scale to ascertain accuracy. If the scale weight did not match the calibration weight, the scale was calibrated by adjusting its calibration screw while the calibration weight was on the scale. To avoid variability among the data collectors, the same measurers were employed for a given anthropometric measurement. Anthropometric measurements were converted to height-for-age and BMI-for-age z scores and percentiles. Girls with height-for-age below -2Z scores and BMI-for-age below the 5^{th} percentile of the 2007 WHO reference population were classified as stunted and undernourished, respectively (12, 13, 14). Girls with height-for-age z scores (HAZ) < -6 or > 6 were considered outliers. One outlier was removed from the data set. The z-scores were calculated using the Epi Info software, version 3.5.1, CDC, Atlanta, GA, USA.

Statistical analysis

Data were entered and de-identified at Mekelle University with additional data cleaning at Oklahoma State University, USA. Statistical Analysis Systems (SAS), Version 9.1(SAS Inc., Cary, NC, USA) was used for statistical analysis. Analysis of variance (ANOVA) and multiple regression analysis were also used for statistical analysis. Statistical significance was set at $p < 0.05$.

Results

The 650 households participating in the study were rural farming households. The average family size was five. Children under five years of age, adolescents and women were eligible to participate in the study. This report, however, has only focused on the anthropometric assessment of the nutritional status of adolescent girls. Only 211 adolescent girls had complete socio-demographic information and anthropometric data. The mean age, height, weight, height-for-age z scores (HAZ) and body mass index (BMI) of the adolescent girls were 14 years, 147 cm, 34.6 kg, -1.5 and 15.7 kg/m^2, respectively.

A large proportion of the households (75%) reported that food shortage was serious during the summer (June – August) season. The most important cause of food shortage to the households was shortage of rainfall (68%). Reduction in the quantity of food was the major impact of food shortage on adolescent girls (84%) and the households (79%). Cash/food for work/off farm activities (53%), selling of family assets (20%), and purchase of low cost foods (16%) were the three most important coping strategies against food insecurity in the study communities. Most households (75%) grew their own food and their source of water was river and/or unprotected well (95%). However, large proportions of the households (65%) had no access to fruit and vegetables. More than three quarters (83%) of the households had no latrine or safe waste disposal facilities. None of the households reported access to adolescent micronutrient supplementation; however, 98% of adolescents had access to visit the nearby health facilities for treatment and immunization services. We found no statistically significant association between the nutritional status of these girls and zones of residence (p=0.44), access to safe drinking water (p=0.19) and availability of home gardening (p=0.51). Lack of latrine facilities (open air defecation) was significantly associated with stunting (p<0.01) and thinness (p<0.01). Stepwise multiple regression analysis showed age to be the strongest predictor of stunting (r^2 = 0.88, p<0.01) and thinness (r^2 = 0.33, p<0.01). Lack of latrine facilities (open air defecation) was also a predictor of stunting (r^2 = 0.06, p=0.02) and thinness (r^2 = 0.07, p<0.01) in these adolescent girls.

Undernutrition was prevalent among adolescent girls from the study communities. Using the 2007 WHO growth reference, the cross sectional prevalence of stunting and thinness was 26.5% and 58.3%, respectively. The mean height-for-age of the study girls was below the -1SD curve of the 2007 WHO reference throughout the adolescent period (Figure 1), but above -2SD of the reference curve except at about 13 years of age.

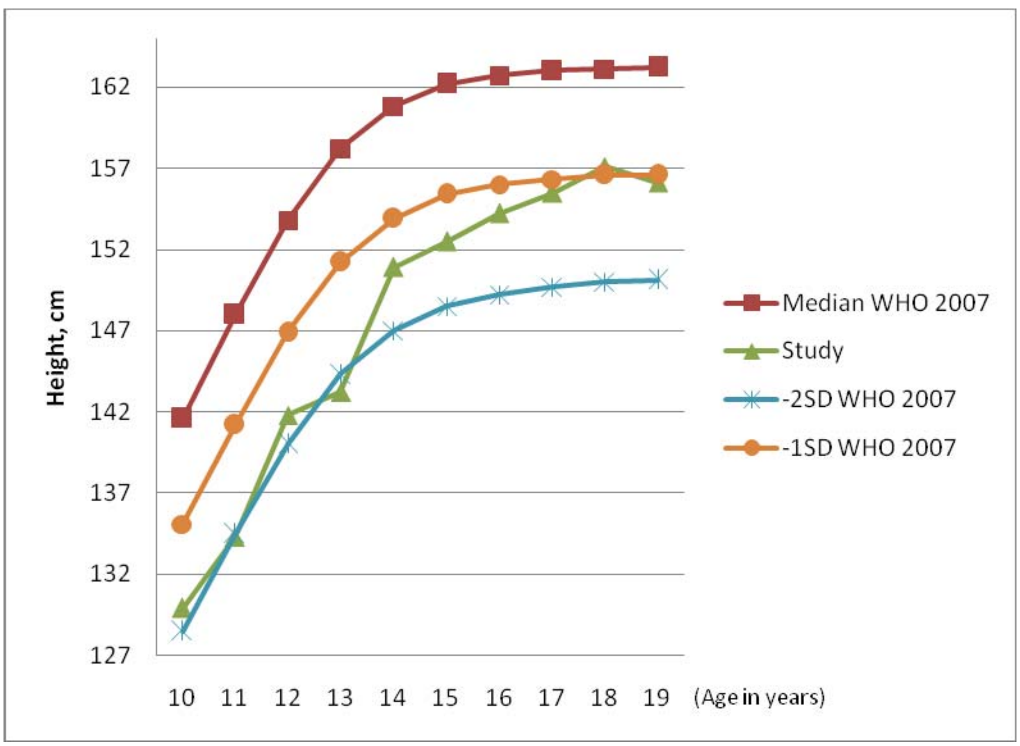

Figure 1: **Comparison of mean height-for-age of the study and 2007 WHO reference populations (n= 181).**

The age specific mean BMI-for-age for the study girls were also compared to the 2007 WHO reference population. The mean BMI-for-age of the study girls was below the 5th percentile of the reference until they reached 16 years of age. However, the mean BMI-for-age for the adolescents older than 16 years of age was above the 5th percentile but below the 25th percentile of the 2007 WHO reference (Figure 2).

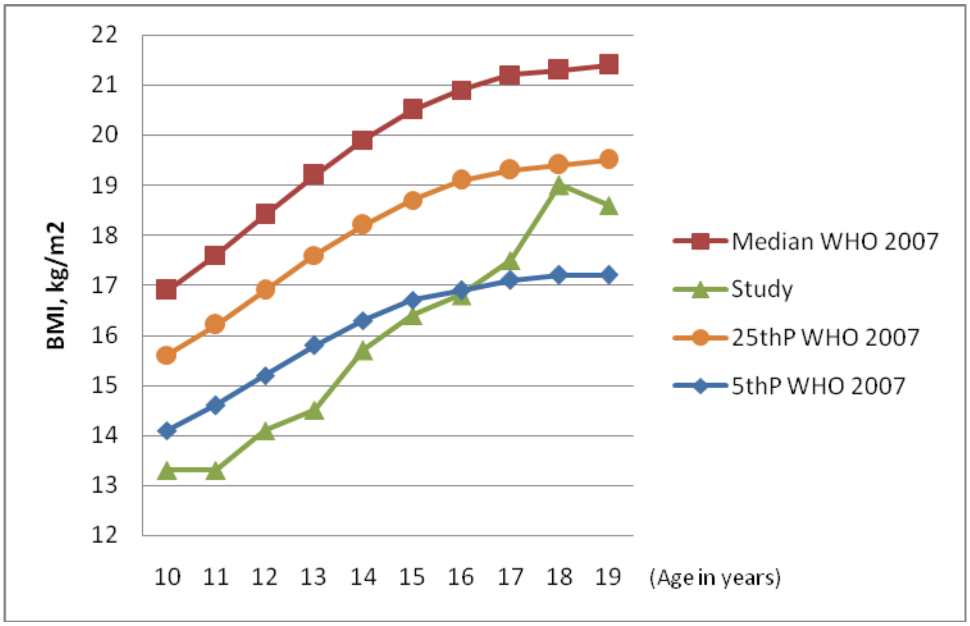

Figure 2**: Comparison of mean BMI-for-age of the study and 2007 WHO reference populations (n=211)**.

The mean height-for-age and BMI-for-age z scores were also compared to the NCHS/WHO reference population (Figure 3). Both z scores of the study girls were below -1Z scores of the NCHS/WHO reference population. The deviation of the height-for-age and BMI-for-age z scores of the study girls from that of the reference population was greater at 13 and 14 years of age, respectively.

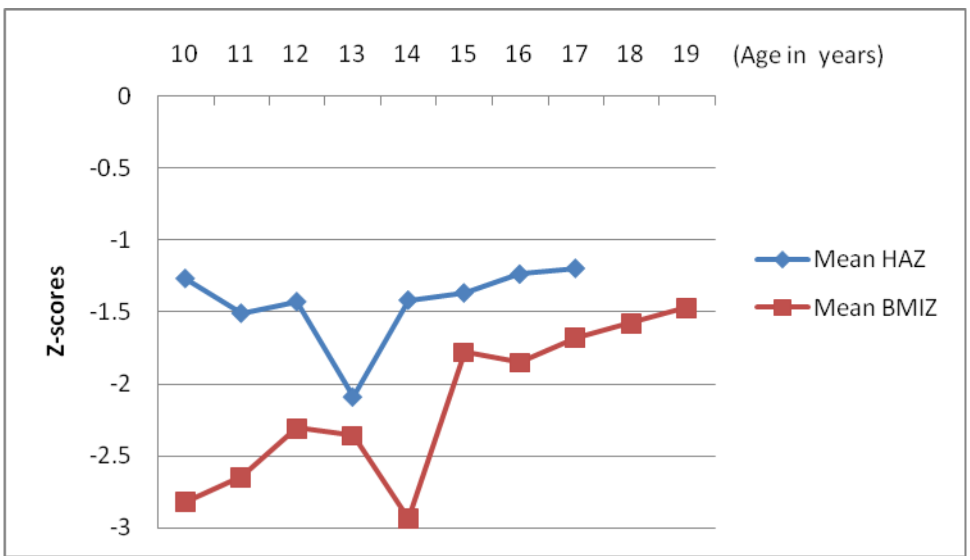

Figure 3: **Mean height-for-age (n=181) and BMI-for-age (n=211) z scores (calculated using the Epi info software based on the NCHS/WHO reference population) where "0" represents the median of the NCHS/WHO reference population.**

Discussion

There are no previous studies that characterize the nutritional status of adolescents from the study communities. To the best of our knowledge, this is the first report on anthropometric assessment of adolescents from Tigray. These adolescents demonstrate the vulnerability of those who have not received appropriate attention to ensure that their nutritional needs are met.

Ethiopia has made modest progress in reducing child malnutrition between 2000 and 2005. Forty-seven percent and 52% of under-five children were underweight and stunted in 2000 compared to 38% and 47% of children in 2005, respectively (15, 16, 17). While these achievements are encouraging, sustainable results are not expected if the nutritional status of adolescent girls is neglected. Regardless of the scientific reports of high rates of adolescent undernutrition from the developing world (6, 19-24), adolescents have been considered low risk groups for health and nutrition. This has further been complicated by the absence of local reference data and difficulty of interpreting anthropometric data in this age group.

Because of the recent availability of the 2007 WHO growth reference for adolescents, we compared our data using both the 1978 NCHS/WHO and 2007 WHO growth reference curves and observed a comparable prevalence of stunting. Compared to the 2007 WHO reference population, the cross sectional prevalence of stunting and thinness in these adolescent girls was 26.5% and 58%, respectively. The poor nutritional status of the girls remains uninterrupted throughout their adolescent life. This is substantiated by the fact that stunting, which is considered as index of chronic or long term duration of undernutrition, was observed during the entire period of adolescence. The study girls were considerably shorter than the reference population (figure 1), suggesting that they had not fully recuperated from childhood deficits. Although there are dangers in interpreting cross sectional data on growth and indices of growth in terms of longitudinal data, the most pronounced deviation of the mean height-for-age z scores from the reference population was observed at about 13 years of age (figure 3). For instance, the average height difference of about 15 cm seen at 13 years was reduced to about 6 cm by 18 years but still was substantially lower than the median 2007 WHO reference. The tendency of the average height differences to increase at early years and decrease in the later years suggests that younger adolescents were much more affected by undernutrition and also provides observational support for an opportunity for catch-up growth in these girls. Moreover, the apparent increase in the mean height-for-age and BMI-for-age at later years of adolescence (figures 1 and 2) might be a sign of secular trend of improved growth to correct childhood deficits. However, not as much seems to be achieved by this mechanism as the final achieved stature of these adolescent girls is still below the reference population (figure 1).

Significant association was observed between stunting and open air defecation ($p = 0.01$). Such an association was not surprising. In areas where there is scarcity of proper waste disposal facilities, bare foot walking may serve as a means of contracting parasitic infections. But, in contrast to our expectation, we found no significant association between stunting and access to safe drinking water ($p=0.19$) and home gardening ($p=0.51$). One possible explanation for the lack of association between stunting and access to safe drinking water could be lack of awareness, not of the importance of clean water but about what characterizes clean water. Unless the clean water from the source is utilized and stored under hygienic conditions, it may be contaminated very easily and serve as a vehicle for intestinal parasites which will have a dramatic impact on the nutritional status of the girls. Similarly, the irregular availability and use of vegetables as sources of family income could be some of the reasons for the lack of association between stunting and availability of home gardening in the households.

According to our stepwise multiple regression analysis, age was found to be strong predictor of stunting ($r^2 = 0.88$, $p<0.01$) and thinness ($r^2 = 0.33$, $p<0.01$). Lack of latrine facilities (open air defecation) was also a predictor of stunting ($r^2 = 0.06$, $p = 0.02$) and thinness ($r^2 = 0.07$, $p < 0.01$) in these adolescent girls. Those who defecate in the bush had a higher mean height-for-age z scores and BMI-for-age than those who defecate around the homestead ($p = 0.01$). Open air defecation around the backyard contributes to the poor nutritional status of these girls which calls for addressing environmental sanitation and the wearing of shoes when walking outside and working in the agriculture field. Place or zone of residence predicted growth in under-five children (16) but not ($r^2 = 0.02$, $p= 0.44$) in the adolescent girls from the same study communities.

A major strength of this study was the random selection of the households. Generalization may be made to the study communities as an attempt was made to identify randomized households and adolescents from the study communities. The major limitation of this study was the failure to collect information related to pubertal landmarks. Studies have shown that chronic under-nutrition can delay sexual maturity and the adolescent growth spurt. As a result, adjustments were not made for differences of ages of sexual maturation, which might confound comparisons between the survey and reference population (14, 25). Another limitation of the study was that the cross-sectional design makes any inference of growth pattern over time difficult. The cross-sectional nature of the study could only generate a hypothesis about the possible role of certain independent variables on the nutritional status of these adolescent girls but not their causal relationships.

In conclusion, until a reference growth curve for Ethiopian adolescents is established, we recommend the use of the 2007 WHO reference curve because of its improved curve fitting and inclusion of BMI-for-age reference curve for adolescents. Secondly, our results provide evidence that undernutrition is a persistent problem among these future mothers. Most adolescent girls in the survey area conceive soon after marriage making the period between marriage and first conception perhaps too short to be able to target this period effectively. Thus, the girls may start pregnancy at a great disadvantage. Moreover, they are at increased risk of problems in delivery due to cephalopelvic disproportion and of delivering low birth weight infants (26, 27, 28). So, programs to support adequate nutrition for adolescents could provide an opportunity for healthy transition from childhood to adulthood and could be an important step towards breaking the vicious cycle of intergenerational malnutrition.

Recognizing the intergenerational effect of malnutrition and high prevalence of adolescent undernutrition in the study communities, there is a clear need for carefully designed longitudinal study to definitively answer the reasons for poor growth throughout the period of adolescence. Strategies addressing the nutritional status of girls are needed in addition to the conventional approach of providing services to pregnant and lactating women through the traditional maternal and child health care programs.

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