Original article

Anthropometric status of Oromo women of childbearing age in rural south western Ethiopia

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Abstract: A community based, cross-sectional survey was undertaken on the anthropometric status of Oromo, non-pregnant women of childbearing age in the Kersa subdistrict of Southwestern Ethiopia. The main purpose of this investigation was to determine normative anthropometric standards in women of childbearing age. Interviews and anthropometric measurements were completed on 473 non-pregnant women randomly selected and stratified by five year age categories from eight peasant associations. The mean (SD) weight was found to be 46.9(5.3)kg, with 75% weighing less than 50 kg. Women's height averaged 155.5 cm with nearly 20% under 150 cm. The mean (SD) BMI was 19.4 (1.9) kg/m^2 and 35% of the women had a BMI lower than 18.5 kg/m^2. Means for all anthropometric measurements fell below the 10th percentile of the standard NCHS reference for black women. All anthropometric outcomes were stable across age categories. The relation between these anthropometric measures and adverse health outcomes will require validation. [*Ethiop. J. Health Dev.* 1997;11(3):1-7]

Introduction

Little information is available concerning the distribution of anthropometric indices and the nutritional status of women of child bearing age in Ethiopia or, more generally, in East Africa. These represent major deficits, given the high rates of maternal and infant mortality in the region (1) and the importance of maternal anthropometry as a predictor of these events (2,3). In Ethiopia estimates of maternal mortality range between 6 and 15 pregnancy related deaths per 1000 live births or in excess of 25,000 deaths per year (4,5).

Preventive maternal health programs in Ethiopia lack normative anthropometric data on women of childbearing age. Without this information it is difficulty to assess the health impact of maternal malnutrition in the population, nor is it feasible to accurately identify women at greatest nutritional risk for adverse health outcomes. With this in mind, the purpose of the study was to provide normative anthropometric standards in women of childbearing age and to identify important determinants. With these reference data validation of cut-off points for the identification of chronic energy deficiency and the predication of pregnancy outcomes is made possible.

Methods

Study design: A community based, cross-sectional survey of rural Oromo non-pregnant women of child bearing age residing in the Kersa subdistrict of Southwestern Ethiopia was undertaken during the months of November and December 1992. Anthropometric status was determined and information about potentially important determinant factors were recorded. The study was descriptive and analytic, with the latter exploring demographic, social, economic, health, behavioural, and environmental factors in relation to women's anthropometric status as measured by height, weight, body mass index (BMI), arm circumference (AC), and triceps skinfolds thickness (SFT).

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Population: the source population was any Oromo non-pregnant woman of child bearing age (15

49 years) residing in the 59 Kebele Peasant Associations (PA) of Kersa subdistrict. It was estimated that there were approximately 29,300 women meeting these criteria at the time of the study. Because of security problems and the limited availability of functional community health agents (CHAs) at the time of the study, subjects were selected from 21 of these PAs.

A stratified random sample of eight PAs was chosen; four from PAs within a 10 km radius of Serbo (the district capital) and three outside 10 km. Within each PA the population was stratified by five-year age categories between 15 and 49. Eligible for the study were all non-pregnant women, 15-49 years of age, of Oromo ethnicity and having resided in the study area for at least 6 months. Excluded from the study were all pregnant women, women less than two months postpartum, those with spinal deformity, and paraplegics. A census carried out at the time of the study identified 2,427 eligible women.

Twelve random numbers per age category were generated by SAS PC for each PA selected. Out of these twelve, the first nine who consented were included in the study. When a woman was not present the enumerator made several attempts to find. If she was not found she was replaced by the next randomly selected subject. Following these procedures, 504 were selected and all consented to participate, but only 473 completed the interview and measurements. The drop out rate was 6.6% (31 subjects), due to a reluctance to have their anthropometric measurements taken following the interview.

Sample size estimates: We assumed a BMI SD of 2 kg/m^2 in estimating the mean BMI in each age group. Taking 95% as the desired confidence level we calculated a sample size estimate of 62/age category. Allowing for a potential non-response rate of 15% in each age group, the study population included a sample size of 72/age category and a total sample size of 72x7=504.

Measurement: An interviewer-administered questionnaire was completed in Oromigna by a trained interviewer following the woman's consent. Information regarding 1) demographic, social and economic characteristics 2) medical and obstetric history, 3) life-style/health behaviours, and 4) nutritional practices were gathered using this questionnaire.

Measurements of height, weight, arm circumference and triceps skinfolds thickness were obtained. Weight was determined using a Detecto scale placed on a hard board over a flat surface, and checked for zero-balance before each measurement. Weight was recorded to the nearest 100 grams. For height, the subject was asked to stand on the Detecto scale with the head positioned to look straight ahead, feet together, knees straight, and heels, buttocks, and shoulder blades in contact with the vertical surface of the height scale. Arms were hanging at the sides in a relaxed manner with palms facing the thighs. Height was recorded to the nearest 0.10 centimeter with the examiner's eyes level with the horizontal bar to avoid parallax errors. The left mid-upper-arm circumference was measured to the nearest 0.10 centimeter with the arm hanging relaxed at the sides. For SFT, the arm was allowed to hung relaxed in its natural position; the measurer then grasped with his/her thumb and index figures the skin and the underlying fat parallel to the long axis just one cm above the mid arm. A Harpenden calliper was applied on 238 while a Haltain calliper was used on 235 subjects. Both the Haltain and Harpenden skinfold calipers were calibrated to the nearest 0.2 mm and were carefully reset to zero before each subject was measured. Before the study proper, two teams each made up of a supervisor, three interviewers, and a measurer completed one week of training followed by a one week pilot study. Inter-observer agreement between the two measurers and between the different measuring scales was assessed and results were not statistically significant. The interclass correlation coefficient (ICC) that quantifies the extent of the overall agreement on an individual subject result between the two measures was also assessed. The high correlation coefficient indicates high agreement between the two measures. The lowest correlation coefficient was found for skinfolds thickness (0.92) and the highest for weight (0.99). The agreement between the first and the second measure for skinfold thickness is slightly lower. This might be partly attributed to

different pinch positioning in the two measures. However, there was no concrete evidence of systematic error. Follow-up and prior adjustment provided the necessary quality control and minimized the occurrence of different types of errors.

Analysis: Data entry and analysis was carried out in the following sequence using the SAS PC statistical package (6). Range, mean, standard deviation and centiles were calculated for weight, height, BMI, arm circumference and triceps skinfold thickness by age category. The relation between potential determinants and anthropometric measurements, comparing upper with lower quartiles, were analyzed. Receiver operator characteristic (ROC) curves were also derived for arm circumference prediction of abnormally low weight (<45 kg).

Results

The socio-demographic and reproductive characteristics of the sample are shown in Table 1. The majority were married, illiterate and housewives. Those women who were classified as nonhomemakers were engaged in several activities ranging from government employment to school attendance.

Table 2 summarizes the mean anthropometric results by age category for height, weight, BMI, AC, and SFT. With the exception of SFT, these anthropometric outcomes were stable across all age categories (one-way ANOVA, P>0.05). Mean SFT's ranged from 7.8mm (youngest: 15-19 yrs.) to 6.2 mm (oldest: 45-49yrs.) and were significantly different (one-way ANOVA, P<0.01) across age categories.

Pearson's correlation coefficients were calculated to evaluate associations among the anthropometric indices in the sample (Table 3). All correlations were less than 0.75, the highest being between BMI and weight (0.74) and BMI and arm circumference (0.74). Positive and significant (P<0.01) association

Table 1: **Socio-demographic and reproductive characteristics of Oromo women in S.W Ethiopia, (n = 473)**

Characteristic	No. (%)	Mean (SD)	Median
Annual household income*	107 (102)	91	
Less than 50	118 (25.0)		
50 to < 90	17 (24.7)		
90 to <150	17 (24.7)		
150 or more	21 (25.6)		
Household size		5.7 (2.2)	5
2 - 3	79 (16.7)		
4 - 5	61 (34.0)		
6 - 7	44 (30.4)		
8 - 9	64 (13.5)		
10 or more	25 (5.3)		
Parity		4.5 (2.6)	4.0
0	94 (19.9)		
1 - 2	101 (21.9)		
3 - 4	95 (20.1)		
5 and above	183 (38.7)		
Average birth interval**		2.9 (1.6)	2.9 (1.6)
0 - 2 years	81 (27.4)		
>2 - 3 years	140 (42.2)		

>3 - 4 years	66 (19.9)		
> 4 years	35 (10.5)		
Marital status			
Never married	72 (15.2)		
Married	362 (76.5)		
Widowed	23 (4.6)		
Divorced/Separated	16 (3.4)		
Literacy***			
Illiterate	417 (88.2)		
Literate	56 (11.8)		
Occupation			
Housewife	392 (82..9)		
Other	81 (17.1)		

*$US

*n = 332, limited to women reporting two or more deliveries.

*** as assessed by reading and writing in any language

were found in all, while height was not associated with BMI, arm circumference and skinfold thickness. Table 4 summarizes the lower 5, 10, and 25 centile cut-off points for each anthropometric measure.

In order to assess the predictive validity of arm circumference for low (<45 kg) weight, a cut-off point for arm circumference was selected based on the receiver operator characteristic curve (ROC) shown in Figure 1. The selected cut-off point of 23 cm is at the 40th centile of the arm circumference distribution for the study sample. This resulted in a sensitivity of 70% and a specificity of 80%.

In Table 5, lower and upper quartiles for BMI, AC, and SFT are compared in terms of mean age, income, parity, and household size. No statistically significant (P>0.05) associations were found with BMI, AC or arm

Table 2: **Mean distribution of anthropometric measures of Oromo women S.W. Ethiopia, by age category.**

Age category	Height (cm)	Weight (kg)	BMI (kg/m^2)	ARM* (cm)	SFT** (mm)
15-19	153.6	46.6	19.8	24.2	7.8
20-24	155.8	47.7	19.7	23.9	7.2
25-29	156.0	47.0	19.3	23.7	6.7
30-34	154.7	46.1	19.2	23.5	6.4
35-39	156.3	46.9	19.2	23.3	6.7
40-44	155.7	46.8	19.2	23.6	6.4
45-49	155.9	46.9	19.3	23.7	6.2
All	155.5(5.9)	46.9(5.3)	9.4(1.9)	23.7(2.0)	6.8(2.2)

ARM*=Arm circumference, SFT**=skinfolds thickness, ( )=SD.

circumference. Those in the upper SFT quartile had a significantly lower mean age and parity (P<0.05), while mean household size was positively associated with skinfolds thickness (P<0.05). In a multiple linear regression model including age, household income, parity and household size, only household size was found to be a significant predictor of SFT (P=0.016).

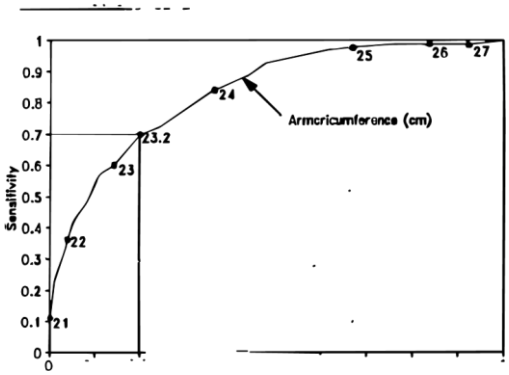

Figure 1: **Receiver operator characteristic (ROC) curve for detection of Oromo women less than 45 kg by arm circumference.**

Discussion

A major finding of this study is the strikingly lower mean height, weight, BMI, arm circumference and skinfolds thickness of rural residing, Oromo women relative to published international standards (7,8). Although all the anthropometric indices in this sample followed Gaussian distributions, their means were located in the lower centiles of international NCHS standards.

Relative to international standards, the majority of women in the sample were short. Nearly 20% were less than 150 cm in height, which has been used as a cut-off point for the prediction of cephalopelvic disproportion (CPD) (9,10). Varied cut-off points, ranging from 150 to 160 cm, have been used to define short stature and compute relative risks for CPD among African women (12,13). Using these cut-offs, the percentage of women in our study identified as at risk for obstructed labor would range from 20% to 75%. The low mean height can, in part, be explained by genetic predisposition. Alternatively, the fact that the prevalence of malnutrition in children in this area is about 10% (11) and has remained so for many years suggests that malnutrition prevented these women from reaching their maximum growth potential during their adolescent years. A third explanation is exposure to previous, acute food shortages and famine conditions. However, it should be noted that the study area was minimally affected by the Ethiopian famine of 1984-85 and no age cohort effects were observed.

Table 3: **Correlation matrix for the anthropometric measurements for Oromo women in S.W Ethiopia.**

Variable	Height	Weight	BMI	Arm circum ference	Skinfolds Thickness
Height	1.00	0.54**	-0.16	0.06	-0.07
Weight		1.00	0.74	0.67**	0.40**
IBM			1.00	0.74**	0.53**
Arm circumference				1.00	0.59**
Skinfolds thickness					1.00

**P<0.01

This survey was conducted following the main harvest, when weights are expected to be optimal because of better food availability and relatively lower energy expenditures. Despite these favourable conditions, the mean weight in this study sample was only 46.9 kg which falls below the NCHS 10th centile for Afro-American females. As with height, this may be due to the chronic, inadequate intake of good quality food. Yet another explanation for the observed weights is their small body frame and low height. The observed mean weight in our study is consistent with studies carried out in other ethnic groups in Ethiopia (14,15).

Table 4: **Cut off points for the anthropometric measurements of Oromo women.**

Centiles	Height (cm)	Weight (kg)	BMI (kg/m^2)	ARM* (cm)	SFT**(cm)
5%	146.5	39.2	16.4	20.5	3.8
10%	148.0	40.6	17.1	21.3	4.2
25%	151.5	43.0	18.3	22.5	5.2

BMIs are similarly low in this sample compared to international standards. Given that this measure adjusts for height differences between populations, the low mean BMI finding is of greater concern. The very low BMIs found in this study might be attributed to the women's cumulative inadequate food intake leading to lower fat storage. In addition, because of their high activity pattern, they may be subjected to energy expenditures that exceed their caloric intake. The mean BMI of 19.4 kg/m^2 in this study is comparable to studies in other parts of Ethiopia. Similar values were obtained in rural Northwestern Ethiopia by Zein and Assefa (15). In their study of an Amhara sample they found a mean BMI of 20.2 kg/m^2 among 322 women.

The mean arm circumference of 23.7 cm in our survey is consistent with the other measures and indicates that women on average are thin. The arm circumference distribution in this study is lower than similar populations in other less developed countries (16,17). It was found that the vast majority (85%) of this study's subjects had a skinfolds thickness below 9 mm which is at the tenth centile in the NCHS reference standard.

The relationship found between arm circumference and weight in this survey led us to consider its use as a predicator of surrogate measure for weight. Using 23 cm as a cutoff point, we find a sensitivity of 0.60 and specificity of 0.85 for detecting under-weight women. In this community where accessibility to health care services is poor, weight measurements are not available. The use of colored tapes by community health workers then becomes potentially feasible for targeting women at nutritional risk for adverse health outcomes.

As age and parity are related, most studies in affluent countries show a tendency for an increase in weight and BMI with parity. The experience in poor countries is the opposite, in part due to maternal depletion syndrome (18). In this study the identical mean weight across all the parity categories suggests factors in addition to maternal depletion are strongly influencing nutritional status. Further study is needed to correctly interpret it. In addition to repeated childbearing, chronic malnutrition may be explained by recurrent illness and excess energy expenditure across all parity categories.

Table 5: **Comparison of lower and upper quartiles selected measurements of Oromo women by potential socio-demographic determinants**

Measurement	Age (year)	Household income (birr)	Parity	Household Size
BMI				
Lower Quartile	31.61	499.42	3.59	5.70
Upper Quartile	29.58	554.95	3.16	5.65
Difference	2.03	55.55	0.43	0.05
t-value	1.38	0.72	1.04	0.17
Arm circumference				
Lower Quartile	31.31	513.23	3.80	5.66
Upper quartile	29.04	550.82	3.14	5.65
Difference	2.27	37.59	0.66	0.01
t-value	1.53	0.44	1.59	0.02
Skinfolds Thickness				
Lower Quartile	43.25	458.43	4.29	6.27
Upper Quartile	28.91	551.33	3.09	6.05
Difference	5.34	92.90	1.20	0.77
	3.44**	1.17	2.64**	2.47**

*p<0.05 **p<0.01.01

Larger household size in this study was found to be a contributing factor to increased skinfolds thickness. This tendency was also replicated in a Guatamalan study (19). As the number of individuals in the family increases, it maybe that their contribution in labor increases, hence resulting in greater food production, collection, and distribution to the family.

Over one-third of the women had a BMI lower than 18.5 kg/m^2, which suggests that a large proportion of women are likely to suffer from chronic energy deficiency (CED) (20).

In view of the much lower anthropometric distributions documented, the likelihood of adverse maternal and fetal outcomes may be greatly elevated.

The survey has certain methodological limitations. The study being cross-sectional, measurements were taken only once. Therefore, issues of seasonal variation that may occur in anthropometric measurements were not addressed. Women who were absent from home on several occasions during the survey were replaced by those who were present from among the list prepared for alternate subject selection. This could have introduced a potential selection bias since this is likely to exclude women who were mobile and engaged in an income earning job or attending school. If this is so, women of better socioeconomic status and more optimal nutrition are less represented in the study.

Recommendations

This data offers pre-pregnant anthropometric standards which need to be validated in terms of important pregnancy and non-pregnancy related outcomes. Although the results are quite similar to studies conducted in other Ethiopian ethnic groups, generalization can be recommended with caution only, because of diversities in genetic and environmental factors throughout the country. The ultimate implication of the observed low anthropometric standard in the study sample is then linked to adverse maternal outcomes, such as obstructed labour and Intruterine growth retardation (IUGR). If women at elevated risk for low brith weight (LBW) were identified before conception, preconception efforts made to improve nutritional status can be expected to reduce infant and neonatal mortality rates and the likelihood of better child health and development may follow. The validity of specified cut-off points for the detection of women at risk for adverse health outcomes are a priority in future anthropometric research.

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