

Nutritional status among the *Mising* tribal children of Northeast India with respect to their arm fat area and arm muscle area

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ABSTRACT

The study highlights the nutritional status of two thousand nine hundred and sixty five (2965) numbers of Mising (a scheduled tribe) children of Upper Assam with the help of two derived nutritional indices i.e. Arm Fat Area (AFA) and Arm Muscle Area (AMA). The mean values and their descriptive statistics of AFA as well as AMA are presented for each group of children starting from 6 to 20 years of age. A sexual variation has been found in terms of the mean values of both the indices and is more marked in the early childhood and late adolescent period. With respect to the United States standard the Arm Fat Area indicates that Mising girls suffer relatively more than the Mising boys. On the other hand with respect to Arm Muscle Area Mising boys are found to be more sufferer than the girls. The Mising boys shows higher mean values for AMA than those of the girls whereas an opposite trend of sexual variation is found with respect to AFA. The results indicate that the boys tend to accumulate more muscle and girls more fat in their growth period. With the present study it can be said that to delineate the nutritional status of a particular community several parameters should be taken into consideration at a time to come to a final conclusion.

Key words: Nutritional status, Arm Muscle Area, Arm Fat Area, Mising children

INTRODUCTION

Height-for-age and weight-for-age are two most effective ways to know the growth and nutritional status of children. But according to some scholars it may not provide accurate consistency where children are from moderately underweight range. In such cases arm circumference and triceps skinfold thickness are suggested to be another practical measurements for assessing the nutritional status of a community (Jelliffe, 1966). By using these two measurements we can calculate Arm Muscle Area (AMA) and Arm Fat Area (AFA) which is more logical to assess the status of calories and protein nutrition (Gurney, Jelliffe and Neill, 1972). In various recent studies upper arm muscle area and

upper arm fat area are regarded as reliable indices of growth and nutritional status among the children and adolescents of a community (Bolzan Guimarey and Frisancho 1999; Erfan *et al.* 2003; Cicek *et al.* 2009; Basu *et al.* 2010; Sen *et al.* 2011). It was reported that upper arm muscle area is linearly correlated with total body mass and it may be a good indicator of protein malnutrition (Heymsfield *et al.* 1982; Hall, 1990). But use of these indices to ascertain nutritional status of a community is a recent development and such study among the population groups of Northeast India is very meager in nature. Therefore the present study aims to evaluate the nutritional status of the *Mising* children of Upper Assam with the help of Arm Fat Area and Arm Muscle Area.

MATERIAL AND METHODS

The present study is based on a cross-sectional data of 2965 *Mising* children and of them 1459 are boys and 1506 are girls. The *Mising* constitute one of the major schedule tribe plain populations of Assam. They form the second largest plain tribe of Assam. According to 2001 census there are a total of 5,87,310 *Mising* individuals residing in Assam. They are mainly concentrated in the Districts of North Lakhimpur, Dhemaji, Jorhat, Dibrugarh, Sibsagar, Tinsukia, Golaghat, Darang and Sonitpur of Assam. The *Mising* are primarily agriculturalist but they also depend on fishing. Ethnically they belong to the Indo-Mongoloid group having Tibeto-Burman Linguistic family. Traditionally they are pile dwellers which give them protection from perennial flood in Assam.

The age of the children ranges from 6 to 20 years. The field work for the purpose was carried out in between December 2006 to January 2009 at different intervals. The subjects were recruited from few villages situated in Dibrugarh, Sibsagar, Lakhimpur and Dhemaji Districts of Upper Assam. The data were mainly collected from the schools those were located within the villages. Some socio-economic data were also collected by house to house survey. Only the apparently healthy looking children were included in the study. The measurements were taken following Weiner and Lourie (1981).

Arm muscle area (AMA) and arm fat area (AFA) were calculated to have the nutritional status of the studied children using the following formulae

$$AMA \text{ (cm}^2\text{)} = (\text{MUAC} - \pi\text{T SF})^2 / 4 \pi$$

$$AA \text{ (cm}^2\text{)} = \pi / 4 \times (\text{MUAC}/\pi)^2$$

$$\text{AFA (cm}^2\text{)} = \text{AA} - \text{AMA}$$

Where,

MUAC = Mid upper arm circumference

TSF = Triceps skinfold thickness

The mean values of the parameters were compared to the percentile reference values given by Frisancho (1981).

RESULTS AND DISCUSSION

The descriptive statistics of arm fat area (mm^2) among the *Mising* children from 6 to 20 years along with its graphical representation have been presented in Table 1 and

Table 1: Descriptive statistics of arm fat area (mm^2) among the *Mising* children

Age in years	Boys			Girls			t value
	Total	Mean (mm^2)	S.D.	Total	Mean (mm^2)	S.D.	
6	96	405.91	67.31	105	509.02	106.79	8.26*
7	93	433.90	70.00	102	564.06	145.87	8.05*
8	100	460.32	76.47	101	617.95	133.24	10.30*
9	96	515.26	114.54	100	660.02	162.74	7.22*
10	107	663.08	125.54	105	692.08	161.28	1.46
11	98	694.05	138.15	105	737.22	219.85	1.69
12	101	687.80	122.69	107	870.79	231.24	7.18*
13	103	808.87	131.20	92	932.88	197.99	5.09*
14	90	873.16	102.00	91	981.49	182.37	4.94*
15	90	820.36	140.58	97	962.24	210.83	5.45*
16	91	849.27	138.93	100	1031.08	179.96	7.85*
17	93	742.20	157.32	104	1064.72	193.53	12.89*
18	99	767.29	136.55	100	1129.32	210.35	14.41*
19	96	849.79	216.59	90	1163.33	215.63	9.89*
20	106	862.36	143.09	107	1198.25	223.84	13.06*

* Significant at 5% level, S.D. = Standard deviation

Figure 1. It has been found that girls are having higher Arm Fat Area than the boys in all the age groups and the differences are significant in most of the groups except in the age of 10 and 11 years.

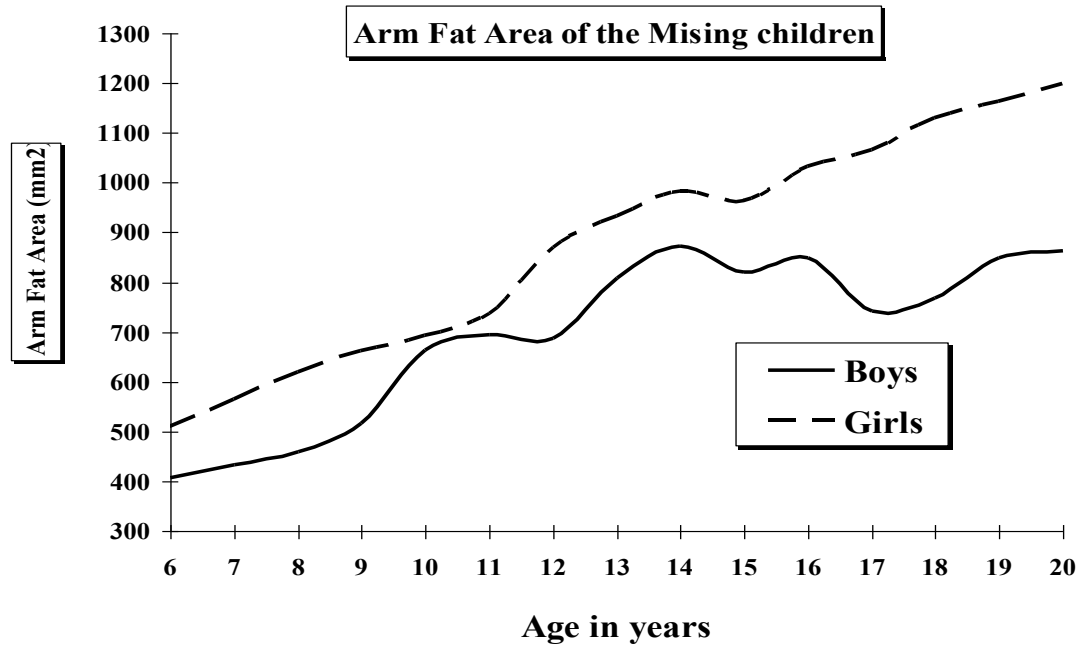


Figure 1: Arm Fat Area (mm²) among the *Mising* children with increasing age

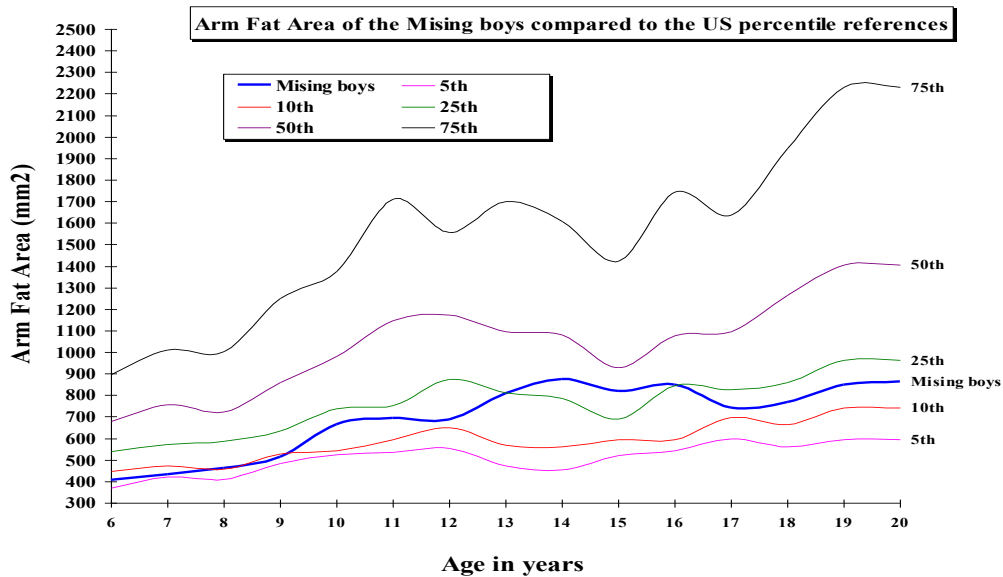


Figure 2: Arm Fat Area (mm²) of *Mising* boys compared to the US percentile reference (Frisancho, 1981)

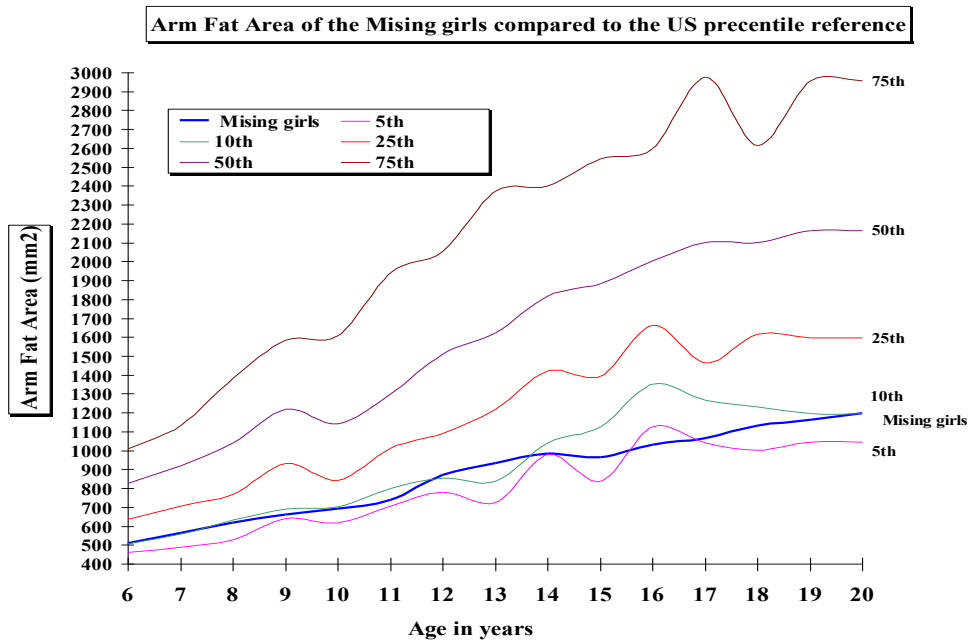


Figure 3: Arm Fat Area (mm²) of *Mising* girls compared to the US percentile reference (Frisancho, 1981)

The Arm Fat Area of the *Mising* children has been compared with the United States standards and it has been depicted in Figure 2 and 3.

With respect to Arm Fat Area it is found that *Mising* boys fall within 10th percentile of the US reference upto 9 years of age and it comes in between 10th and 25th percentile of the reference during 9 to 13 years. The mean values cross the 25th percentile of US reference in between 13 to 16 years. However it again falls back in between 10th and 25th percentile of the reference after 16 years.

The AFA of *Mising* girls of 6 to 12 years of age correspond to the 10th percentile of the US reference and cross that mark by 13 years of age. However it comes down to below 5th percentile of US reference at 16 years indicating relatively poor nutritional status at that age. The values again raise over 5th percentile and end up around 10th percentile of US reference after 17 years.

Thus with respect to the US standard the arm fat area indicates that *Mising* girls suffer relatively more than the boys. Table 2 shows the mean values of arm muscle area of the *Mising* boys and girls and the same has been shown in Figure 4. It is evident that the *Mising* boys have higher arm muscle area than the girls except 6 years and 13 years.

Table 2: Descriptive statistics of arm muscle area (mm²) among the *Misings*

Age in years	Boys			Girls			t value
	Total	Mean (mm ²)	S.D.	Total	Mean (mm ²)	S.D.	
6	96	1526.80	226.71	105	1528.37	184.97	0.05
7	93	1697.50	237.72	102	1633.66	199.19	2.02*
8	100	1786.74	249.15	101	1652.59	325.07	3.29*
9	96	1842.91	197.97	100	1748.55	355.32	2.31*
10	107	1931.56	276.40	105	1878.65	402.34	1.11
11	98	2124.30	315.24	105	1998.08	427.56	2.40*
12	101	2508.03	426.03	107	2476.91	600.91	0.43
13	103	2725.20	421.12	92	2843.68	609.98	1.56
14	90	3191.04	474.81	91	3046.13	584.70	1.83
15	90	3486.55	426.35	97	3226.55	687.72	3.13*
16	91	3625.74	508.10	100	3245.35	519.34	5.11*
17	93	3930.46	403.68	104	3332.91	510.75	9.15*
18	99	4040.24	574.17	100	3339.86	523.87	8.99*
19	96	4006.80	473.78	90	3344.55	414.23	10.16*
20	106	4076.51	596.26	107	3383.30	697.33	7.80*

* significant at 5% level, S.D. = Standard deviation

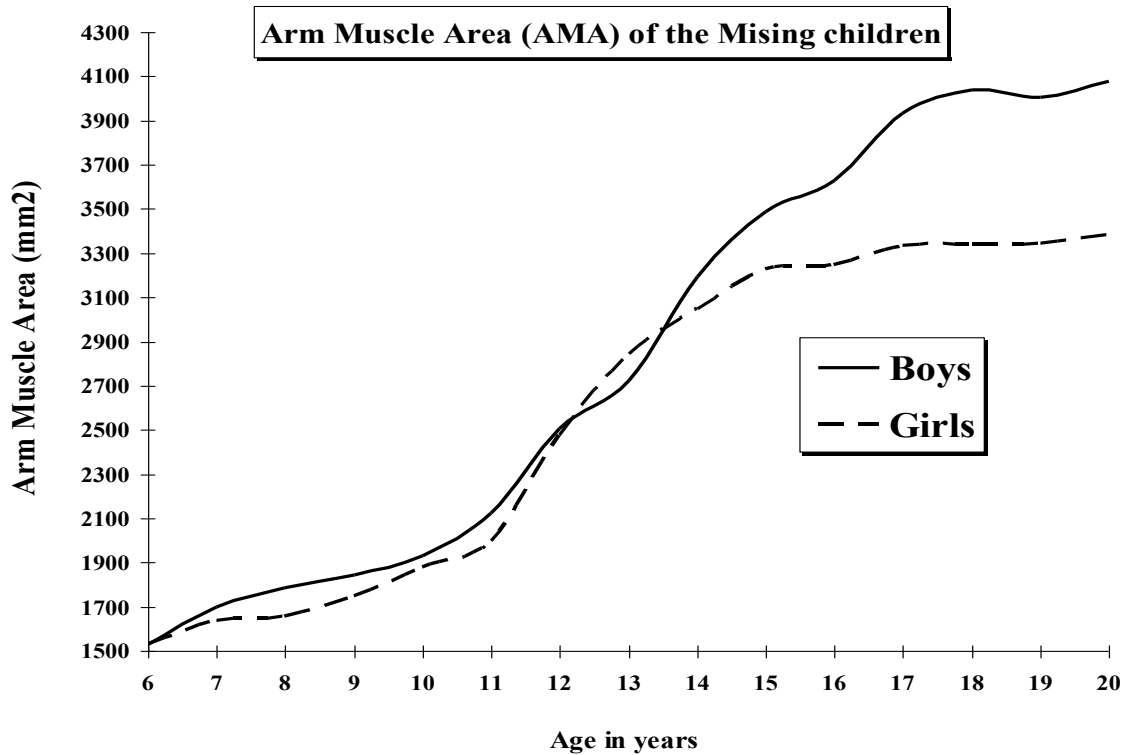


Figure 4: Arm muscle area of the *Mising* children with increasing age

The distribution of boys into percentile groups for arm muscle area against the US reference is shown in Figure 5. The boys almost upto 15 years of age group are above 10th percentile of US reference standard but after 15 years of age they falls below 5th percentile of US reference.

The distribution of girls into percentile groups for AMA has been presented in Figure 6. It is seen that the girls of 6 to 11 years age group are mainly fall in between 10th and 25th percentile of the US international reference standards. After 12 years onwards they are above the 25th percentile of US standard and after 15 years they correspond to the 50th percentile with slight fluctuation in between 17-18 years and 19-20 years.

Thus in terms of AMA *Mising* girls are in a better position than that of the *Mising* boys.

As a whole we can say that the *Mising* boys are showing higher mean values for AMA than those of the girls whereas the mean values of AFA are higher among the

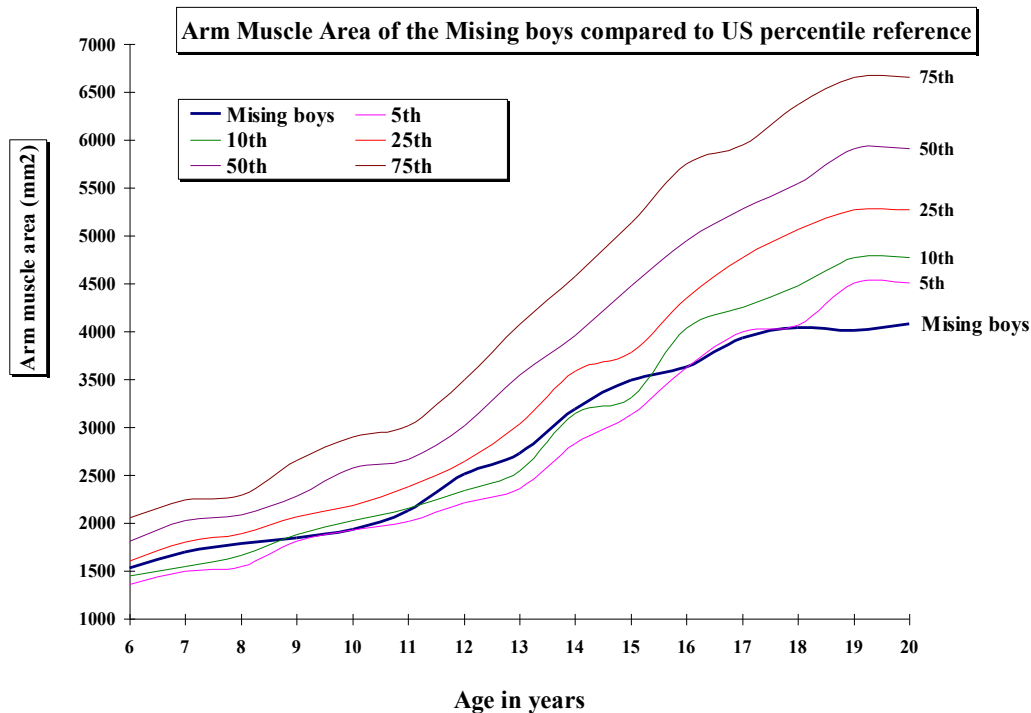


Figure 5: AMA of the *Mising* boys compared to the US percentile reference data (Frisancho, 1981)

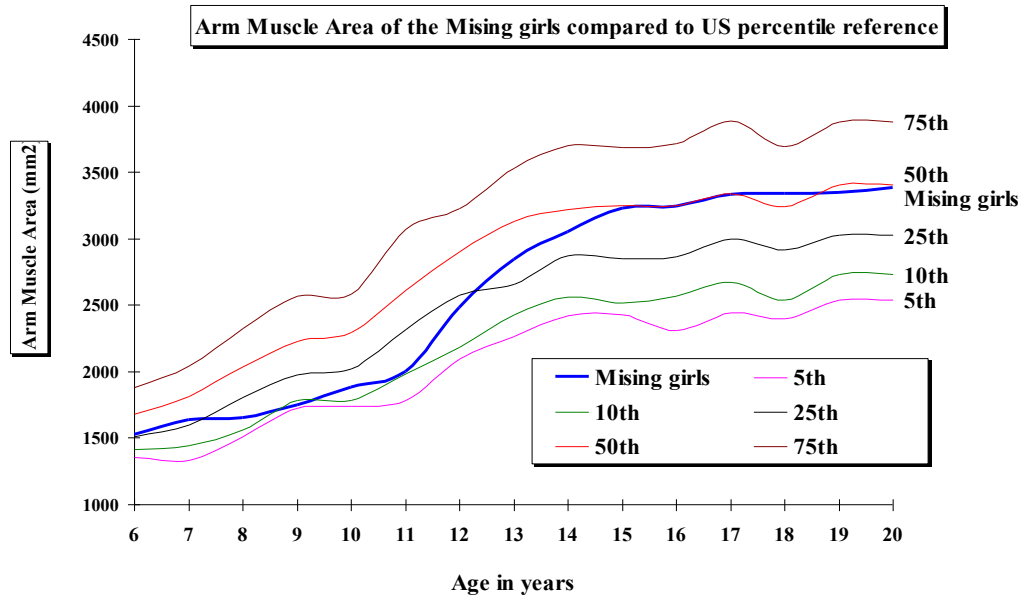


Figure 6. AMA of the *Mising* girls compared to the US percentile reference data (Frisancho, 1981)

Mising girls than the boys. It indicates that the boys tend to accumulate more muscle and girls more fat throughout the growth period. The higher physical activity among the boys than the girls may be the probable reason for this muscle accumulation (Reddy and Papa Rao, 1995; 2000), while Frisancho (1974) attributed accumulation of more fat throughout childhood and adolescent in the girls to be the cause of more AFA among them.

It has already been attempted to determine the nutritional status of the same subjects with the help of height-for-age, weight-for-age and BMI-for-age as per WHO 2007 criteria (Sikdar, 2010). Overall it has been found that in terms of height-for-age, weight-for-age and AFA-for-age girls are found to be more sufferer of undernourishment than the boys, whereas as per BMI-for-age and AMA-for-age, boys are found to be more sufferer than the girls. It is very difficult at this stage to provide a reasonable explanation for such sexual variation in nutritional status however studies on this particular topic on other population groups may provide some logical explanation in near future. On the other hand where some nutritional indices are showing cases of under nutrition among the *Mising* community some other indices are showing presence of overweight cases also (Sikdar 2012 a). All such out comings are associated with the ongoing demographic as well as nutritional transition prevalent in the present community as well as other tribal

communities of Northeast India (Sikdar 2008; Ahmed Das and Sikdar 2010; Sikdar 2012 b).

The study indicates that the different indices used for detecting prevalence of malnourishment do not give the same result. Therefore at this stage it becomes imperative for the academicians as well as physicians to derive such an index which can give us a clear picture of nutritional status of a community. Such index may identify the subjects who are vulnerable to nutritional deficiencies and calls for urgent attention from clinical point of view. The index may be developed taking into consideration the height, weight, skinfolds from several points and circumferential measurements at a time. Such an index can have population specific cut-off points in near future.

Conflict of interest: None declared

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