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Body mass index and chronic energy deficiency among the Jaunsari boys and girls of Jaunsar-Bawar, Uttarakhand: An anthropological study

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Abstract
Data on height and weight of 178 boys and 145 girls in the age group of 06- 12 years belonging to the Jaunsarese, a Scheduled Tribe residing in the Jaunsar-Bawar area of the state of Uttarakhand was taken applying anthropometric methods in order to analyze chronic energy deficiency of the population. The study was conducted on nine villages namely Burashwa, Bishdar, Paati, Mahrawana, Rawana, Shirwa, Maipawata/Mahpawata, Jogio and Kolho. Random sampling technique was applied for selecting the sample population during the study. It is revealed in the study that the BMI ranges from 12.63 to 21.33 among the Jaunsari boys and 11.96 to 20.24 in the girls. Mean BMI of males is found to be 14.88 (1.22) and in females it is found to be 14.52 (1.98). From the study it is found that 23% boys fall under CED-III and 33.1% girls fall under CED-III. 58.9% boys fall under CED-II, 15.16% under CED-I and 2.25% are categorized as normal. 0.56% are graded as obese. Similarly, 61.3% girls are categorized under CED-II and 5.52% under CED-I. No girl is found under normal category.

Keywords: Jaunsarese, jaunsar-bawar, BMI, chronic energy deficiency (CED)

Introduction

In the assessment of the nutritional status of individuals and communities, anthropometric measurements play an important role. Anthropometry is being most widely used method for estimating fat distribution (Goran *et al*, 1998 [13]; Moreno *et al*, 1997 [26]; McArdle *et al*, 1986 [24]; Bolzano *et al*, 1999 [4]; Musaiger *et al*, 2000 [27]; Gaur et.al. 2002 [10]; Urade et.al 2004 [40]; Ghosh and Bharati, 2006 [12]; Urade and Chakravarty, 2008 [41], 2012; (Urade and Mallick 2017) [44]. The nutritional assessment is done by observing the departure of the anthropometric measures from the normal standards. The basic causes of undernutrition in developing countries are poverty, poor hygienic conditions, and little access to preventive and health care (Mitra 1985 [25]; WHO 1990). In developing countries such as India, anthropometry, despite its inherent limitations, still remains the most practical tool for assessing the nutritional status in the community (Ghosh *et al.* 2001 [11]). Quetlet or body mass index (BMI) is widely accepted as one of the best indicators of nutritional status in adults by many pioneers of the area like James *et al*. (1988) [16] Ferro-Luzzi *et al*. (1992) [9]; Shetty and James (1994) [37]; Naidu (1994) [28]; Bailey and Ferro-Luzzi (1995) [2]. Rolland-Cachera (1993) [36] opined that BMI may be nutritionally rather than genetically related, despite wide variation in weight and height among human populations (Eveleth and Tanner 1990 [8]; Majumder *et al*, 1990). Khongsdier (2001) [20] advocates the use of BMI as an anthropometric indicator of nutritional status and further adds that this may be more appropriate to apply it in a country with diverse ethnic groups such as India. (cf. Adak *et al*, 2006) [1] Weight, height, and BMI are the most common indicators usually used to assess nutritional status of the children (Naidu and Rao, 1994 [28]; Reddy, 1998 [35]; Vishweswara Rao *et al*, 1991 [45]; Khongsdier, 2001 [20]; Gaur *et al*, 2002 [10]; Urade *et al*, 2004 [40]; Urade and Chakravarty, 2008 [41], 2012 [43]) (Urade and Mallick, 2017) [44]. Adak et.al. 2006 [1] in their research paper on BMI and CED of central Indian populations published in Human Biology extensively dealt with the issue on the basis of Cormic Index and BMI. The study reveals that

ANOVA on Cormic index and BMI suggested that the people within a population are more homogeneous than the people between populations. There is a positive but statistically insignificant correlation between Cormic index and BMI. The five social groups differ more in size distance than in shape distance. According to the dendrogram of generalized distance values, the Muslims and the general castes can be grouped into one cluster and the scheduled castes, scheduled tribes, and other backward castes can be grouped into another cluster (Adak et.al. 2006) [1].

Urade and Mallick (2017) [44] in a cross sectional study which was conducted on 1080 school going Namasudra boys aged 6 to 17 years in 24 Parganas (N) district of West Bengal. In this study from body mass index (BMI) different grades of chronic energy deficiency (CED) were assessed. The study revealed that the mean BMI ranges from 10.39 to 30.11 KgM^2 from lower to higher ages. Significantly high magnitude of CED was noticed wherein 83.05 % of the children suffered from malnutrition out of which more than 80 % of children of lower ages (6 – 10 years) had low BMI. There has been an increased trend in BMI from lower to higher age groups in this study.

Most of the studies on body mass index were carried out from South India and North-eastern region (Rao *et al*, 1990 [34]; Naidu and Rao, 1994 [28]; Bharati 1989 [3]; Khongsdier, 1997 [19], 2001; Urade and Mukherjee, 2009) [42] but very few from Central and Western India (Singhrol and Mitra, 1984 [38]; Urade *et al*, 2004 [40]; Urade and Chakravarty, 2008 [41], 2012, Adak *et al*, 2006 [1], Das and Bose, 2010) [6].

In an important community based cross-sectional study undertaken by Das and Bose (2010) [6] on Body Mass Index

and Chronic Energy Deficiency among Adult Santals of Purulia District, West Bengal, India, it is revealed that females were found to be more undernourished than their male counterparts (30.6%) & (63.4%). This sex difference was statistically highly significant ($x2 = 55.96$; $df = 4$; $p < 0.001$). Study also demonstrated that Santals of Purulia, both males as well as females, were under nutritional stress (Das and Bose, 2010) [6].

In this backdrop the present paper is an attempt to study the Body Mass Index and Chronic Energy Deficiency among the Jaunsari Boys and Girls of Jaunsar-Bawar area in Chakrata tehsil of Dehradun district of the state of Uttarakhand.

Material and Methods

Jaunsar-Bawar paragana is a hilly region full of lush green deciduous forests of Deodar, Pine (Chir) and Spruce in Garhwal division in north-west part of Dehradun district in the state of Uttarakhand. It is a valley comprising of rough terrain, deep gorges and turbulent rivers in which lower half part is known as 'Jaunsar' while upper half is known as 'Bawar'. It is located at 77^0 45' and 78^0 7' East to 30^0 31' and 31^0 33' North with an area of approximately 1002 square kilometers. The Jaunsar area is demarcated from Garhwal by the river Yamuna. Historically, it was a part of Sirmaur kingdom of the present day state of Himachal Pradesh. In 1829, this became part of Chakrata tehsil of Dehradun.

The native inhabitants of Jaunsar-Bawar region are known as the Khas/Khos/Khasa or the Jaunsarese. They were declared as Scheduled Tribe in the year 1967. With a total population of approximately 1,00,000 (Census 2011, they constitute to 30.4% of total population of the state of Uttarakhand) spread over 365 villages, they consider themselves as descendants of the mythological Pandavas of the Mahabharata and practice polygynandry. Their society is constituted by a stratified caste system wherein the highest rung is constituted by Rajputs and Brahmins (intermarriages are allowed between them) together known as the Khas/Khasa belong to Aryan stock. The intermediate rung is formed by the Bajgi, Badhai (Luhars), Sunars, Nath, Jagdi/Jogda etc. The lowest rung comprises of the autocthonous Koltas including Shilpkar, Chamars, Mochis and Doms who are mostly landless labourers and earlier treated as bonded labourers and untouchables are said to be of Austric stock. They live in extended joint family characterized with patrilineal descent, patriarchal authority and patrilocal residence (Majumdar, 1962; Hasnain 1982 [15]). Daichara system of kinship still prevails in the region and Sayanachari system and Khumri (village panchayat) are functioning in harmony with modern Panchayati Raj Institutions. Lord Mahasu is their principal and supreme deity. They speak Jaunsari (a dialect of western Pahari) and Hindi and their life looms larger around agriculture and animal husbandry.

Research Methodology

The present study applies both fieldwork methods and anthropometry. The study was conducted on subjects selected from nine villages namely Burashwa, Bishdar, Paati, Mahrawana, Rawana, Shirwa, Maipawata/ Mahpawata, Jogio and Kolho. Random sampling technique was applied for selecting the sample population during the study. Informed consent was received in prior from the participants of the study. The individuals included in the study apparently looked in good health. While taking height and weight, utmost care was taken to record height to the nearest of 0.1 cm and weight was recorded to the nearest of 0.5 kg. Errors in measurement were within acceptable limits.

Assessment of Nutritional Status

The assessment of nutritional status though is possible through several methods like clinical examination, anthropometry, bio-chemical evaluation, functional assessment, assessment of dietary intake, vital and health statistics and ecological studies, however, in the present study only anthropometric method is used. Anthropometric measurements such as height and weight and index *viz*. Body Mass Index (BMI) have been calculated. The Somatometric measurements regarding stature and body weight on each subject were taken using standard technique recommended by Weiner and Lourie (1981) [47]. Body weight of the subjects wearing minimum clothes was measured with weighing machine; however, there was little deviation in ideal condition of measurement of weight in tribal villages of Jaunsar-Bawar in case of girls. Stature was measured with Martin's anthropometer. BMI for each subject was calculated. Mean value and standard deviations were also calculated. The age of the children was determined from the school register, birth certificates and was also cross checked from elderly members of the family. Following method of calculating BMI is applied-

BMI (Kg/M$^{2)}$ = weight (Kg) / Height^2 (m^2)

Findings and Discussion

Assessment of Nutritional Status of Jaunsari Children through Anthropometric Measurements

It has now been well established by various reports that India has the distinction of having the largest member of malnourished children in the world. WHO has set the goal of attainment of highest level of health for all. Assessment of nutritional status is a vast subject (WHO 1995, 1999). According to Jelliffe (1966) [17] the study of nutritional status of any country is important from the mechanism of evolution and morphological character which bring about the change in the pattern of body development and its structure.

Malnutrition has been defined as a "pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients" (Jelliffe,1966) [17]. Malnutrition during infancy and early childhood is believed to have long- term repercussions on both physical growth and intellectual performance in later life (Cravioto and De Liecardy, 1966 [5]; Stoch and Smythe, 1976) [39]. The body mass index (BMI), weight deficit, height deficit are the best determinants of the nutritional status of individual and population. BMI is better indicator of current nutritional status than any measurement or index (Waterlow, 1973 [46]; Rao and Singh, 1970; Rao and Rao, 1975; Rao et.al. 1990 [34]; Dugdale, 1971) [7]. BMI ratio is also found to be reliable index for assessing malnutrition in growing children (Gupta *et al*., 1979 [14], 1981; Raman *et al*., 1989) [31]. In the light of above the following table represents the distribution of BMI among boys and girls in nine studied Jaunsari villages.

Table 1: Distribution of BMI of boys and girls in 09 different villages

BMI of boys and girls in 09 different villages						
Village	**No. of Boys**	**Mean Value of Boys**	**S.D.**	**No. of Girls**	**Mean Value of Girls**	**S.D.**
Burashwa & Bishdar	12	15.1	0.58	20	13.9	0.32
Mahrawana	32	13.9	0.62	21	12.7	1.52
Paati	22	13.6	0.92	18	14	0.22
Shirwa	27	14.5	0.02	18	14.2	0.02
Rawna	15	14.4	0.12	13	14.3	0.1
Maipawta	13	14.9	0.38	14	14.8	0.58
Jogio	38	15.1	0.58	26	14.9	0.68
Kolho	19	15	0.48	15	15.3	1.08
Total	178	14.52		145	14.22	

Table 2: Age-wise Distribution of Mean BMI among the Jaunsari children as per CED (after Urade et. al., 2004) [40]

Age-wise Distribution of Mean BMI among the Jaunsari children as per CED						
Age (in yrs)	**No.**	**Category Grade**				
		14 (CED-III)	**14-15.49 (CED-II)**	**15.5-16.49 (CED-I)**	**16.5-22.49 (Normal)**	**22.5 & above (obese)**
Boys						
6	30	08(4.49%)	19(10.6%)	03(1.68%)		
7	22	06(3.37%)	12(6.74%)	04(2.24%)		
8	21	03(1.68%)	16(8.98%)	02(1.12%)		
9	25	05(2.80%)	17(9.55%)	03(1.68%)		
10	30	08(4.49%)	18(10.11%)	04 (2.25%)		
11	28	07(3.93%)	13(7.30%)	07(3.93%)		01(0.56%)
12	22	04(2.24%)	08(4.49%)	06(3.37%)	03(1.68%)	01(0.56%)
Total	178	41(23.03%)	105(58.99%)	27(15.17%)	03(1.68%)	02(1.12%)
Girls						
6	22	10(6.9%)	12(8.2%)	0		
7	15	06(4.1%)	09(6.2%)	0		
8	19	09(6.2%)	10(6.9%)	0		
9	20	08(5.5%)	12(8.0%)	0		
10	25	07(4.8%)	17(11.7%)	01(0.69%)		
11	20	05(3.4%)	13(8.9%)	02(1.12%)		
12	24	03(2.0%)	16(11.0%)	05(2.81%)		
Total	145	48(33.1%)	89(61.3%)	08(5.52%)	00	00

Figures in parenthesis show the percentage.

The distribution of BMI and its categories resulting chronic energy deficiency (CED) is shown in table 2. The BMI ranges from 12.63 to 21.33 in boys and 11.96 to 20.24 in girls. Mean BMI of males is found to be 14.88 (1.22) and in females it is found to be 14.52(1.98). From the table 2 it appears that 23% boys fall under CED-III and 33.1% girls fall under CED-III. 58.9% boys fall under CED-II, 15.16% under CED-I and 1.68% are categorized as normal while 1.12% among the boys are graded as obese. Similarly, 61.3% girls are categorized under CED-II and 5.52% under CED-I. No girl is found under normal category as well as obese category.

The CED is a chronic imbalance between energy intake and expenditure (Jequier, 1987) [18]. The high level of energy expenditure is required for physical activities and playing. This impact of imbalance is seen on both sexes. Since BMI is a result of complex interaction between nutritional intake, health status and physical activity pattern (Parizkova, 1977), the lesser intake of fat and protein might he affected in gaining weight and height among the Khaire Kunbi children (Urade et.al. 2004) [40], the present study is among the Jaunsari children also reveals similar trend and such trends of malnutrition among the Jaunsarese children may be attributed to their low socio-economic status, non consumption of adequate food required as per their age as well as notions regarding food and dietary habits prevalent in the Jaunsar-Bawar area. This situation requires serious attention for attaining better health status among the Jaunsari children.

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