CO-EXISTENCE OF UNDERNUTRITION AND CENTRAL OBESITY AMONG UNIVERSITY STUDENTS OF PASCHIM MEDINIPUR, WEST BENGAL, INDIA

Sanjay Nayak[1], Ayushi Midya[2], Binoy Kumar Kuiti[3], Mahua Chanak[2], Kaushik Bose[2*]

[1]Cultural Research Institute, Kakurgachi, Kolkata
[2]Department of Anthropology, Vidyasagar University, Midnapore
[3]CoE in STMC, Utkal University, Bhubaneswar

[*]Corresponding author: kaushikbose@cantab.net

Abstract:

Objective: Undernutrition and obesity are gradually increasing in India. The discourse regarding the dual burden of undernutrition (UN) and central obesity (CO) has not yet been extensively explored among university students. The present study assessed the frequency of malnutrition based on mid-upper arm circumference [MUAC (cm)] as well as a waist-hip ratio (WHR) among the students of Vidyasagar University, Paschim Medinipur, West Bengal. **Methods:** University hostel-based cross-sectional data have consisted of 501 (300 females; 201 males) postgraduate students, aged above 20 to 24 years. MUAC (cm), Waist circumference [WC (cm)], hip circumference [HC (cm)]were measured using standard procedures. **Results:** The total rate of undernutrition was 32.70% where males (42.3%) were higher than females (26.3%) but the prevalence of CO was much higher in females (64.7%) compared to males (3.0%). Hence, the total frequency of combined abnormality (UN and CO) was 10.0%, where the prevalence of UN and CO were more among females (16.0%) than males (1.0%). **Conclusion:** The present study indicated that the prevalence of UN among male students was very high. The prevalence of CO was high among female students. Appropriate policies and interventions are necessary for the improvement of nutritional status of university students.

Key words: Undernutrition, central obesity, university students, dual burden, waist hip ratio

Running title: Undernutrition and central obesity among university students

INTRODUCTION

Undernutrition (UN) and central obesity (CO) are remaining serious health problems in developing countries of sub-Saharan Africa and Southern Asia (Agyemang et al., 2015; Kimokoti & Hamer, 2008). Last decade, these mal-physical characteristics are established a dual form burden of diseases at the community level (Dutta et al., 2019; Sharma & Mondal 2020; Wells et al., 2020) as well as in individual (Little et al., 2020; Barazzoni & Cappellari, 2020). The component of dual burden, the Chronic Energy Deficiency (CED) or undernutrition are more vulnerable to many diseases including Bitot's spot, Anemia, Night blindness, Goiter, Hypothyroidism and Xerophthalmia (WHO 2000). Like CED, obesity and CO are determinants of Global Burden of Diseases i.e. heart disease, diabetes, hypertension, osteoarthritis, and respiratory abnormalities (Poirier & Eckel, 2000; Despres, 2006). Inadequate food intake, junk food-related dietary habits, lack of proper food knowledge, alcohol consumption, stress, depression, and family history with a chronic health problem are main supporting factors for both mal-physical characteristics. According to World Health Organization (WHO), up to 2030 and beyond the prevalence of obesity may increase in low-income countries (WHO, 2012).

In order to assess the prevalence of UN and generalized adiposity, Body Mass Index (BMI) is a predictable indicator (Bose, 1996) for detection of the body height wise weight pattern. However, the usage of multiple instruments like stadiometers and weighing scales; and sometimes may lead to misleading estimates for participant's (edema, limb amputation abnormal curvature of the vertebral column and pregnant) measurement that causes limitations in the measurement of BMI (de-Onis, 2004; Ulijazek & Kerr, 1999; Schlegel-Pratt & Heizer, 1990).Accordingly, many research personnel favor to use MUAC (cm) as a realistic substitute measure for the detection of UN of all ages (children, adolescent and adult) and succeeding to identify individuals with morbidity and risk of mortality (WHO, 1986; Briend, 1987; Alam et al., 1989; Vella et al., 1994; Bose et al.,2019).Another assessing parameter for CO, WHR is the most convenient measurement than WC (cm), waist-height-ratio (WHtR), abdominal volume index and conicity index (Esmaillzadeh et al., 2004; Motamed et al., 2015).In the present scenario, few researchers reported that the prevalence of UN (Cutillas et al., 2013; Peltzer et al., 2014; Gopalkrishnan et al. 2012) and CO (Fagih & Egtesadi, 2005; Adnan et al., 2013; Amani et al., 2016; Chukwudi, 2016; Obirikorangetal., 2017) among the university students of different countries.

According to 'All India Survey on Higher Education' (AISHE), a total 3917156 (males = 1818443 and females = 2098713) students were enrolled in post graduate level at 774 universities in India and in

West Bengal, total 187171(males = 1818443 and females = 2098713) students enrolled in 46 universities (GOI, 2016). Hitherto, only few study reports are available on WHR based CO (Deepa et al., 2009; Bag et al., 2013; Pradeepa et al., 2015; Chanak & Bose, 2019) and MUAC based nutritional status (Bose et al., 2007; Bose et al., 2006; Bisai et al., 2009; Goswami et al., 2018; Garg et al., 2018; Bose et al., 2019; Singh et al., 2019) from different parts of India. Hence, the study on student hostellers in India, only one study (Khan et al., 2015) has been reported earlier. Our objective was to examine the pattern of CO and evaluate the MUAC based nutritional status among Vidyasagar University students, whose are living in the University hostels. The present study emphasizes on sex difference between MUAC based nutritional status and WHR based CO; and their co-existence among studied students.

METHODS

This study is based on a quantitative survey design. The present cross-sectional study was conducted among regular post-graduate students of Vidyasagar University, Paschim Medinipur, West Bengal. This university is a comprehensive, rural-based academic institution located in Medinipur town in Paschim Medinipur district, which is located in the South Western region of West Bengal state in India. Most of the students live in hostels on the university campus and outside the campus.

A total of 501 (males = 201 & females = 300) students aged 20 to 24 years residing in these hostels (both boys and girls hostel) were included for the study. Age(years) and anthropometric data were collected in a close-ended questionnaire schedule. Appropriate ethical clearance was obtained from Vidyasagar University authorities and the necessary permission was also obtained from local community leaders before the study commenced. For all the participants, the same measuring equipment was used, calibrated daily for standardization to reduce bias or error. All anthropometric measurements were collected by two trained research scholars (SN and AM)by using the standard techniques of Lohman et al. (1988). All circumference measurements (MUAC, WC and HC) were recorded to the nearest 0.1 cm. Technical errors of measurements (TEM) were computed and were found to be within acceptable limit (Ulijaszek & Kerr, 1999). Waist-Hip Ratio (WHR) was computed by using the following standard equation: WHR= waist circumference (cm) /hip circumference (cm).

Assessment of MUAC based nutritional status and CO (based on WHR) were detected by recently proposed MUAC cut off (Tang et al., 2017) and WHR cut off (WHO, 1989). Pregnant women and lactating mothers were not included in the study.

The following cut-off points were used: -

MUAC cut off points: Undernutrition: MUAC ≤ 24.0 cm; Normal: MUAC>24.0 cm

WHR cut off points: Normal: WHR<0.95 (Male), WHR<0.85 (Female); CO: WHR≥0.95 (Male), WHR≥0.85 (Female)

Some statistical explanation with means and standard deviations of all circumference variables and indices were computed for each sex separately. Chi-square test (χ^2) was utilized to compute sex differences in nutritional status. All statistical analyses were undertaken using the Statistical Package for Social Sciences (SPSS 16.0).

RESULTS

The sex specific anthropometric and derived characteristics among studied students are presented in Table 1. The mean age among female students (21.40±1.06 years) was significantly lower (t = -10.224, p<0.001) than males (22.83±1.32 years). Another observation from same table is that the mean MUAC, WC and HC among females (26.25±2.94 cm; 80.43±7.94 cm and 93.60±6.67 cm respectively) was significantly higher (t = 6.294, p<0.001; t = 10.912, p<0.001and t = 14.959, p<0.001 respectively) than males (24.65±2.57 cm; 72.45±8.14 cm and 84.14±7.32 cm respectively). However, WHR was not showed any significant differences between both sexes.

Table 1: Anthropometric and derived characteristics of the participants

Measurements	Sex		t
	Female (N=300) Mean ± SD	Male (N=201) Mean ± SD	
Age (year)	21.4±1.06	22.83±1.32	-10.224[***]
MUAC (cm)	26.25±2.94	24.65±2.57	6.294[***]
WC (cm)	80.43±7.94	72.45±8.14	10.912[***]
HC (cm)	93.60±6.67	84.14±7.32	14.959[***]
WHR	0.85±0.05	0.87±0.14	-0.665[ns]

*** = p < 0.001, ns = not significant

Table 2 presents the correlation between all anthropometric measurements among studied students. MUAC had significant correlation with WC (r = 0.577, p<.001), HC (r = 0.579, p<0.001) and WHR (r = 0.245, p<0.05) among females but in males, MUAC had significant correlation with WC (r = 0.154,

p<.05) and HC (r = 0.348, p<.001).Both in females (r = 0.809, p<0.001; r = 0.682, p<0.001 and r = 0.125, p<0.05 respectively) and males (r = 0.525, p<0.001; r = 0.532, p<0.001 and r = -0.382, p<0.001 respectively) WC, HC and WHR were significantly inter-correlated.

Table 2: Correlation between anthropometric measurements

Measurements	Sex	MUAC (cm)	WC (cm)	HC (cm)	WHR
Age (years)	Female	0.086^{ns}	0.047^{ns}	0.089^{ns}	-0.033^{ns}
	Male	0.013^{ns}	-0.044^{ns}	-0.059^{N}	-0.011^{N}
MUAC (cm)	Female		0.577^{***}	0.579^{***}	0.245^{***}
	Male		0.154^{*}	0.348^{***}	-0.099^{ns}
WC (cm)	Female			0.809^{***}	0.682^{***}
	Male			0.525^{***}	0.532^{***}
HC (cm)	Female				0.125^{*}
	Male				-0.382^{***}

$* = p < 0.05$, $*** = p < 0.001$, ns = not significant

The prevalence of UN and CO is presented in Table 3. Results revealed that total 32.7% university hostellers were belonged to UN category and males (42.3%) frequency was higher than females (26.3%) counterpart. Association between nutritional status and sex was highly significant (13.915, p<0.001). Hence, the association between CO and sex was highly significant (p<0.001). The prevalence of CO was much higher in females (64.7%) compared to males (3.0%).

Table 3: Prevalence of MUAC based undernutrition and WHR based CO

MUAC (cm)	Female		Male		Sex combined		Chi-square
	N	%	N	%	N	%	
UN	79	26.3	85	42.3	164	32.7	13.915^{***}
Normal	221	73.7	116	57.7	337	67.3	
WHR	Female		Male		Sex combined		Chi-square
	N	%	N	%	N	%	
Normal	106	35.3	195	97.0	301	60.1	190.928^{***}
CO	194	64.7	06	3.0	200	39.9	

$*** = p < 0.001$

Table 4 revealed the co-existence of UN and CO among studied university hostellers. Total 22.8% participants were belonged to 'UN only' and males (41.3%) were higher than females (10.3%). Therefore, the total frequencies of 'CO only' and 'UN and CO' were 29.9% (Females= 48.7%; Males= 2.0%) and 10.0% (Females= 16.0%; Males= 1.0%) where females were more prevalent than males in both cases. The significant differences between males and females were observed in all components of malnutrition, i.e. 'UN only', 'CO only' and 'UN and CO' (p<0.001; p<0.001 and p<0.001 respectively).

Table 4: Co-existence of both UN as well as CO among the participants

Malnutrition	Female		Male		Proportional difference	Sex combined	
	N	%	N	%		N	%
Normal	75	25.0	112	55.7	48.399[***]	187	37.3
UN only	31	10.3	83	41.3	65.710[***]	114	22.8
CO only	146	48.7	4	2.0	124.831[***]	150	29.9
UN and CO	48	16.0	2	1.0	30.078[***]	50	10.0

[***] = p < 0.001

DISCUSSION

The MUAC is a useful inexpensive and without complex formulated (like BMI, WHR, WHtR, CI etc.) instrument for detecting the prevalence of UN at a population level (Collins et al., 2000). Thus, it is most suitable for the documentation of adult UN in large scale of population surveys (Khadivzadeh, 2002; Tang et al., 2017).

Figure 1 shows that the prevalence of MUAC based UN among the university students of Paschim Medinipur district were experiencing lower nutritional stress (32.70%) than slum dwellers (43.5%) of Paschim Medinipur (Bose et al., 2007), Kora Mudis (51.2%) of Paschim Medinipur (Basu & Banik, 2009), Mahalis (57.73%) of Bankura (Bose et al., 2019)but Telegas (32.7%) of Paschim Medinipur (Banik, 2007) showed equal result and lastly coastal fishermen (27.02%) in Purba Medinipur district of West Bengal (Kuiti, 2018) also showed a lower prevalence.

In the present scenario of CO, studied university students were (39.9%) less centrally obese than Bengalee Kayastha (100.0%) of West Bengal (Sarkar et al., 2009) followed by Punjabi adults (83.2%) of Punjab (Kaur et al., 2013), rural adults (67.7%) of Kerala (Bindhu et al., 2014), rural Bengalee (78.6%) adults of West Bengal (Karmakar et al., 2019), rural Bengalee adults (61.6%) of West Bengal (Chanak & Bose, 2019), coastal fishermen (58.6%) of West Bengal (Kuiti, 2018), coastal adults

(57.0%) of Tamilnadu (Chauhan et al., 2015), working adults (53.5%)of Mumbai (Nalwade & Prabhu, 2012) and urban adults (41.2%) of Karnataka (Nagendra et al., 2017) as given in Figure 2.

Figure 1: Comparison of MUAC based nutritional status among different population
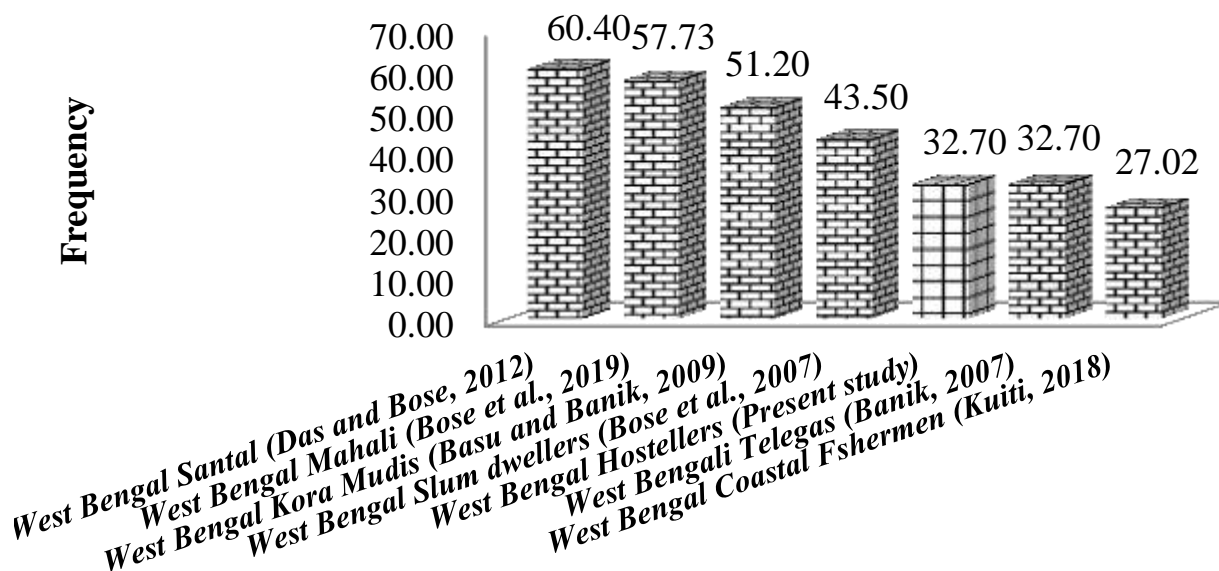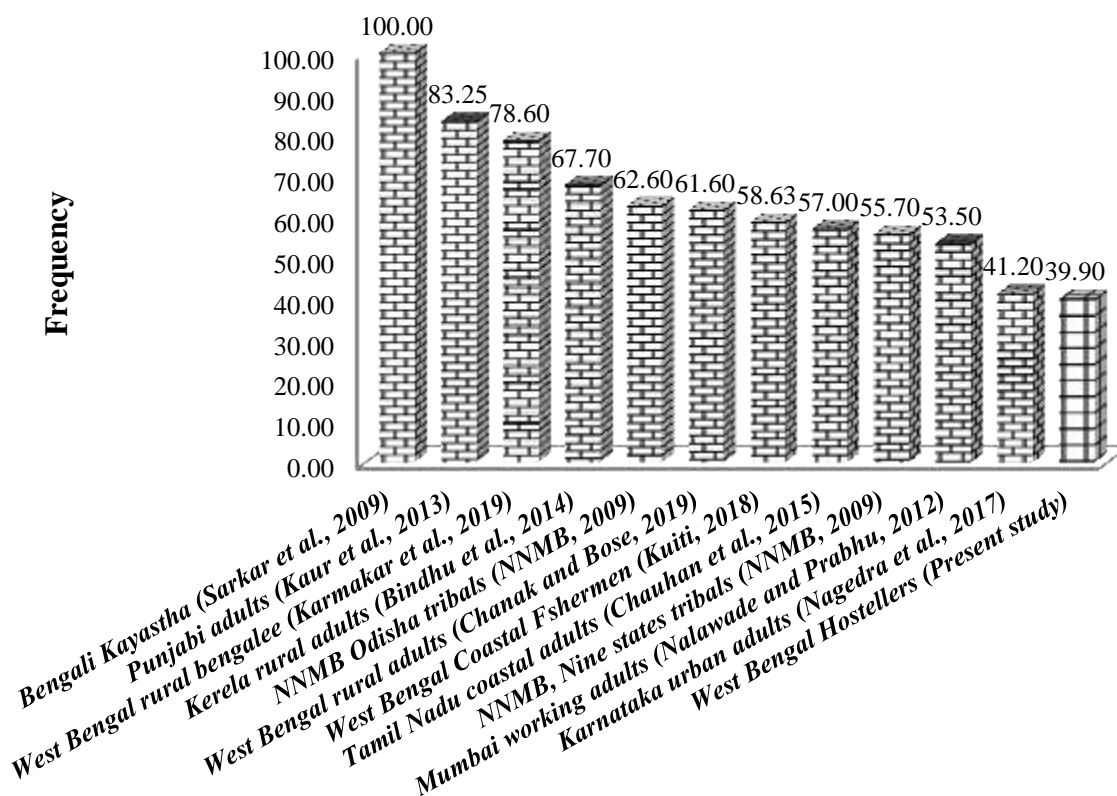

Figure 2: Comparison of WHR based CO among different population

Another aspect of this present study was sexual dimorphism with UN and CO, where the frequency of UN was higher in male than female but in the case of CO, females were more obese than male. These two findings are consistent with several other studies in India (Agrawal & Ebrahim, 2011; Misra et al., 2011; Pengpid & Peltzer, 2019).

Within the subject double burden of UN and CO exacerbates with gender inequalities, as combined conditions are more highly prevalent in female than in male, as shown in North and West Africa (Dalal et al., 2011).This mal-physical characteristics could be due to an alteration in body composition such as an escalation and relocation of body fat and hormonal changes following age augmentation, which are escorted by a less active lifestyle, leading to an increased risk of overweight and obesity among female (Han et al., 2011). Another conceptual clarification is that individuals with obesity may present with true malnutrition due to inability to preserve body composition and performance with loss of skeletal muscle loss and function that exert major negative influences on morbidity and survival (Barazzoni & Cappellari, 2020).

CONCLUSION

The present study indicated the presence of UN and CO among university boarders. Policies and intervention are necessary at the university level for healthy eating awareness among incoming students. The university administrators should try to encourage students, particularly females, to be more physically active. High rate of UN and CO among males and females, respectively, could have alarming health implications. Further studies are needed to ascertain the relationship between UN and CO related co-morbidity among this group. Appropriate health and nutritional programs can be initotaed based on the results of these studies.

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AUTHORS' CONTRIBUTIONS

SN and AM collected the data and undertook data entry. BKK analyzed the data and prepared the first draft. .MC and KB prepared and finalized the manuscript.

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