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CONTENTS

Comparative evaluation of nutritional anthropometry and dietary recall methods for assessing the nutritional status of population

ANURADHA DUTTA, ARCHANA KUSHWAHA, NEETU DOBHAL and JYOTI SINGH*

Department of Foods and Nutrition, College of Home Science, G. B. Pant University of Agriculture and Technology, Pantnagar-263145 (U.S. Nagar, Uttarakhand)
**Corresponding author's email id: 46182_jyotisingh@gbpuat-tech.ac.in*

ABSTRACT: Nutritional status is the balance between the intake of nutrients by an organism and the expenditure of these in growth, reproduction, and health maintenance. Nutritional anthropometry and dietary recall method were used to obtain information on the nutritional status of the people aged 18-65 years. The study was conducted in the month of March 2022 with the sample size of 266 adults. Information on age and gender was collected from the respondents. Stadiometer and weighing balance were used for measuring the height and weight of the subjects who were classified according to Asian BMI classification (WHO, 2000). To cross-check the data obtained from anthropometry, dietary intake of a representative sample of 28 women was collected using one day 24-hour dietary recall method. The average BMI for the total population was reported to be 23.9, indicating that the subjects fell in the category of overweight. The study of dietary intake of the selected respondents indicated that the intake of calories, protein, iron, calcium, and dietary fiber was below the recommended levels. In contrast, carbohydrate and fat intake were found to be above recommended daily nutrient intake. The results of the study indicate that on the basis of anthropometry, the nutritional status of the respondents emerges as overweight and the results of the dietary assessment show an imbalance in the nutritional intake. Thus, both nutritional assessment techniques are essential for evaluating the nutritional status of populations.

Key words: Anthropometric measurements, nutritional status assessment, nutrient intake, twenty-four-hour dietary recall.

The prevalence of overweight and obesity is rising in the developing world, according to recent evidence. By 2025, non-industrialized nations are expected to have three-quarters of the world's obese population (Onis *et al.,* 2010). In developing nations, undernutrition coexists with being overweight (Mukuddem *et al*., 2004). Growing public health concern is the incidence of non-communicable diseases such as type 2 diabetes, hypertension, and cardiovascular conditions. In this context, it is necessary to periodically examine nutritional status because dietary intake is linked to significant health effects.

There are various ways of measuring the nutritional status of the community and of which two methods are anthropometry and the dietary recall method. Measuring the human body at various ages and nutritional status levels can be done quickly, efficiently, and objectively using nutritional anthropometry. It is based on the belief that proper measurements should reflect any morphological difference brought on by a significant functional physiological change. It sometimes detects even subclinical alterations brought on by dietary changes (John *et al.,* 2020). One such measurement is Body Mass Index (BMI). BMI is a person's weight in kilograms (or pounds) divided by the square of height in meters. It is a low-cost and simple method for determining a person's nutritional status, categorized as underweight, healthy weight, overweight, and obese. Although BMI does not directly measure body fat (Garrow and Webster, 1985, Freedman *et al.,* 2013 and Wohlfahrt *et al*., 2014), it is somewhat linked with more precise measurements of obesity.

Furthermore, BMI appears to be as strongly correlated with various metabolic and disease outcomes as are these common outcomes of high body adiposity (Steinberger *et al*., 2005, Sun *et al*., 2010, Lawlor *et al*., 2010, Flegal and Graubard, 2009, Freedman *et al.,* 2009 and Willett *et al*., 2006). India currently has to deal with both undernutrition and overnutrition. In India, there are around 135 million obese people (Ahirwar and Mondal, 2019). Malnutrition is a common occurrence, and obesity can have adverse metabolic consequences. As body

mass index rises, so does the risk of diabetes and heart disease. An increase in BMI progressively increases the risk of heart disease and diabetes (Kalra and Unnikrishnan, 2012). These diseases, directly and indirectly, stress the nation's already underdeveloped healthcare system.

Diet is a major lifestyle-related risk factor for various chronic diseases. Both subjective assessment and objective observation can be used to evaluate dietary intake. Open-ended questionnaires can be used for subjective assessment, such as dietary recalls or records (Shim *et al*., 2014). The 24-hour recall method (questionnaire method) is one of the dietary assessment methods of nutritional status. It is a relatively easy method based on the recall capabilities of the individual over the past 24 hours and is reasonably accurate (John *et al*., 2020). These entirely open-ended surveys gather a range of details about the food ingested over a specified period. A single-day recall for the 24-hour typically takes 20 to 30 minutes to complete and is conducted in the manner of an in-depth interview. It may be necessary to provide specific information on food preparation methods, the materials included in mixed recipes, and the brand of any commercial goods (Shim *et al*., 2014).

Based on the above-mentioned facts the study was conducted to evaluate the efficacy of the two methods viz., BMI and dietary recall in predicting the nutritional status of a defined population.

MATERIALS AND METHODS

The study was conducted in March 2022. The sample for this study was selected from a population aged 18 to 65 years who attended Farmer's fair (*Kisan Mela*) organized by G. B. Pant University of Agriculture and Technology, Pant Nagar. BMI of 266 people was assessed, and for dietary recall, a subsample of 28 adult women were interviewed. The study was conducted in stall put by Department of Foods and Nutrition, College of Home Science.

Anthropometry is the most commonly used technique for determining the presence and severity of malnutrition among the population. The nutritional status of all the selected subjects was assessed by measuring their height (cm) and weight (kg) with the help of a portable weighing machine and stadiometer, respectively. The weighing balance was placed on a hard and flat surface. Before measuring weight, the weighing scale's zero error was tested and adjusted as needed. The respondent was asked to stand on a weighing balance without shoes and socks, and with the bare minimum of clothes, and the reading displayed on the screen was recorded. Height was measured keeping in mind the standard procedure. The subjects were asked to stand barefoot on the weighing machine in an erect position. Further, BMI was calculated using the weight and height of respondents by applying the formula, i.e., weight in kilograms divided by height in meter square, and then compared with Asian standards of BMI given by WHO (2000) (Table No.1). The dietary intake of the respondents was recorded by one-day 24-hour recall method. The respondents were asked about all food items eaten in the last 24 hours, from morning until night. Each respondent was asked about the type and quantity of food they consumed the previous day. that was further converted into raw ingredients and quantified raw food was reported in grams. The nutrient intake consumed by each respondent was calculated manually with the help of an Indian food composition table for different food items (Longvah *et al*., 2017). Nutrient adequacy was calculated by comparing average daily nutrient intake with the ICMR Recommended Dietary Allowances (ICMR, NIN, 2020).

RESULTS AND DISCUSSION

Basic Information of the subjects: The study conducted on a total of 266 populations included 176 males (66%) and 91 females (34%). The population was segregated into three age groups, i.e., young adults (18-45 years), older adults (45-65 years), and elderly (65+ years). Moreover, it was

Table 1: BMI Classification for Asian population (WHO, 2000)

Nutritional status	BMI (Kg/m^2)
Underweight	18.5
Normal	18.5–22.9
Overweight	23–24.9
Obese	$\geq$25

found that the maximum population belonged to the section of young adults while the elderly population were the least. Males were found to be in greater number than female among all the age groups (Figure No.1).

Anthropometric Measurements: The average weight and height for the population was 64.14 kg and 163.39 cm, respectively (Figure No. 2). The average height was 168.51cm in males and 153.44 cm in females, falling below the Indian average height of 177 cm and 162 cm, respectively (ICMR-NIN, 2020) (Figure No. 3). The average weight for males was 68.39 kg and for females was 56.13 kg, both of which are marginally above the Indian set standards of 65 kg and 55 kg, respectively (ICMR-NIN, 2020).

The average BMI was reported to be 23.9, which shows that the population belonged to the overweight category (Figure no. 2). The average BMI for males was 24.16, while that for females was 23.54. (Figure No. 3). Both of the gender groups were found to be overweight (Figure No.4). According to NFHS (2019-2021) data, it was found that the percentage of urban and rural women and men aged 15 to 49 years who were overweight or obese (BMI $\geq$25.0 kg/m^2) was 39.1, 25.4 per cent and 31.4, 25.0 per cent respectively. The percentage of overweight or obese (BMI $\geq$25.0 kg/m^2) women in district Udham Singh Nagar was 35.4 per cent (NFHS, 2022). To assess the prevalence of obesity among the adult population residing in hilly areas of Uttarakhand, Rautela *et al*. (2018) reported that the prevalence of overweight was 14.8 per cent and obesity was 55.5 per cent. Among all obese, BMI was $\geq$30 kg/m^2 for 20.7 per cent of the study participants. Yadav *et al*. (2016) in their cross-sectional study interviewed 130 medical students to assess BMI and found that the students' mean + SD for height was 1.67 + 0.09 m, while their average weight was 66.61 + 12.71 SD

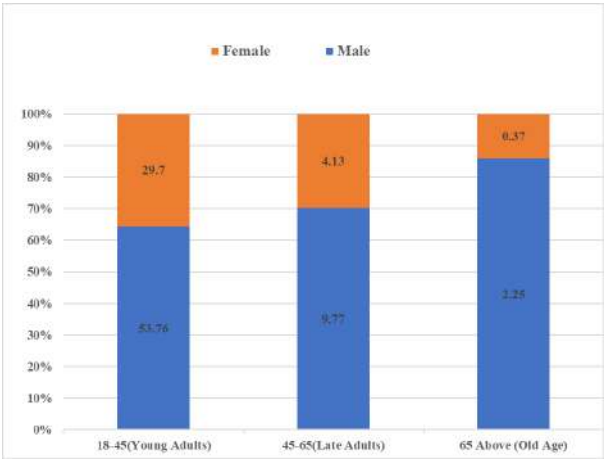

Fig. 1: Age distribution of the study sample

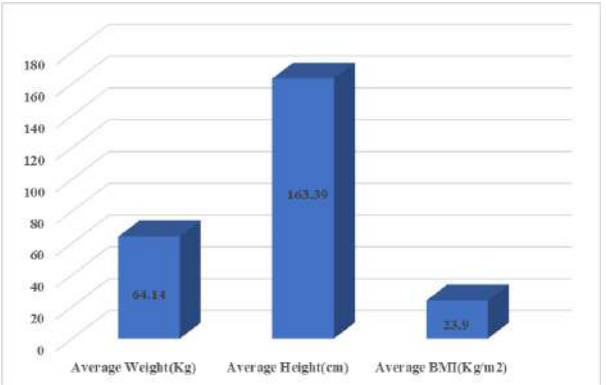

Fig. 2: Average weight, height, and BMI of the study sample

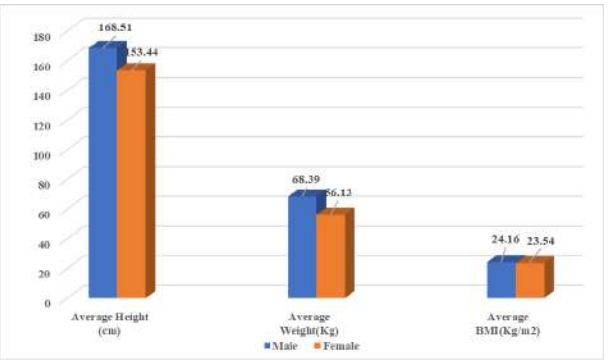

Fig. 3: Gender wise distribution of average height, weight and BMI of the study sample

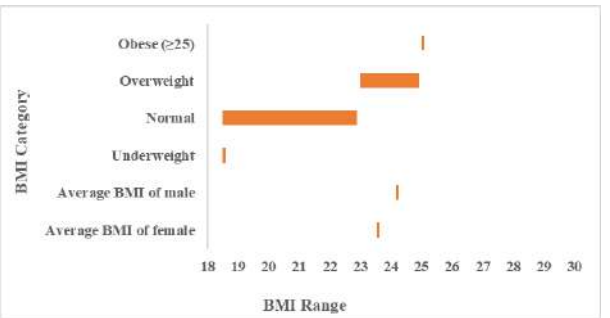

Fig. 4: Comparison of average BMI of the study sample with reference value (WHO, 2000)

Table 2: Comparison of mean nutrient intake of female subjects with reference Values (n=28)

	Energy (Kcal) [EAR]	Protein (g/d)	Carbohydrates (g/d)	Fats [EAR]	Iron (mg/d)	Calcium (mg/d)	Fiber (g/d)
RDA Value	2130	45.7	130	25	29	1000	25
Average Intake of nutrients/day	1009	45.4	168.6	64.3	73.7	632.7	6.6

EAR: Estimated average requirement

Table 3: Per cent of study sample falling under different levels of adequacy of daily nutrient intake as per RDA

Nutrients	Number of Respondents (%)		
	Below RDA/EAR	RDA/ EAR	Above RDA/EAR
Calorie (Kcal) [EAR]	100	-	-
Protein (g/d)	39	25	36
Carbohydrates (g/d)	39	3	58
Fats (g/d) [EAR]	11	7	82
Iron (mg/d)	43	14	43
Calcium (mg/d)	86	3	11
Fiber (g/d)	100	-	-

kg and their average BMI were 23.54 + 3.09 kg/m^2. About 73.1 per cent of the students had normal BMIs, compared to 22.3 per cent who were overweight, 3.1 per cent who were obese, and only 1.5 per cent who were underweight. Male students were much more likely than female students to be overweight or obese.

The overweight population was followed by normal body mass index among both gender groups. Assessment of BMI among young adults (n=1482) of Haryana reported that the majority of students (61.74%) were classified as usual or healthy weight, followed by underweight (23.11%) and overweight (12.35%), and only 43 (2.90%) were classified as obese. When comparing students by gender, 18.95 per cent of male and 26.17 per cent of female students were underweight, while 16.64 and 14.16 per cent of students were overweight or obese, respectively (Sindhu and Sangeeta, 2013). BMI ranging >18.5 kg/m^2- 22.5 kg/m^2 is followed by underweight which was found to be least among both the population. The average BMI was found to be 22.32 ± 3.58 kg/m^2. Nearly 50% of the study participants had BMIs within the normal range (51%). 18 per cent of the participants were undernourished, 20 per cent of the subjects were overweight, and 11 per cent of the subjects were underweight according to Asian BMI given by WHO (John *et al*., 2020).

By 2040, it is anticipated that India's general prevalence of overweight and obesity will have significantly increased, with significant increases seen in particular among older Indians and rural Indians. For the purpose of forecasting future non-communicable disease burdens and their economic impact, precise projections of excess weight are essential (Luhar *et al*., 2020).

24-Hour Dietary Recall: Analysis of 24-hour dietary recall data is provided in Table no. 2 and Table no. 3. As caregivers, mothers, and wage earners, women manage many responsibilities in the household. Their diet and health may be impacted by a lack of time and the demanding job and home demands (Tiwari and Tripathi, 2018). The energy intake for a moderate adult woman is 2130 kcal, whereas, in our study, the average intake for energy was reported to be 1009 kcal (Table no.2). Calorie intake was below the EAR for 100 per cent of the population (Table no. 3). The average daily protein intake was found to be 45.7 gm/day, and it is clear from Table no. 2 that 39 per cent of the woman fell below RDA, 25 per cent were normal, and 36 per cent population were above RDA. The recommended dietary allowance for carbohydrates given by ICMR 2020 is 130 gm/ day (Table no. 2). Our study reported that carbohydrate intake was 168.6 gm/day, and 39 per cent of women fell below RDA, 3 per cent were normal, and 58 per cent were above RDA (Table no. 3). The average value reported for fat intake was 64.3 gm/ day and 11 per cent of the women were below EAR, 7 per cent were normal, and 82 per cent were above EAR. The average value calculated for iron was found to be 73.7 mg/day, where 43 per cent of the women fell below RDA, 14 per cent were normal, and 43 per cent were above RDA. For calcium intake among women, the average value was

632.73 mg/day where 86 per cent of the women were below RDA, 3 per cent were normal, and 11 per cent were above RDA. The average fiber intake value among women was 6.689 gm/day, which was much below that of RDA 2020, and it was observed that 100 per cent of women fell in the category of below RDA for fiber intake (Table no. 2 and Table no. 3). A study reported that working women of Jabalpur city were taking significantly high energy, carbohydrate, and fat but lower calcium and fiber (Tiwari and Tripathi, 2018). When 152 sedentary adult women, comprised of students and faculty from Punjab Agricultural University, Ludhiana, were assessed for their nutrient intake, it was found that their calorie intake was below RDA and their intake was low in protein and high in fat (Kaur, 2012). Priyadarshini (2016), in her study on working mothers, stated that the consumption of calories, protein, and iron was much lower than RDA. In contrast, the intake of fat was more than recommended dietary allowances. Dobhal and Raghuvanshi (2012) in their study on nutrition and health status of urban and rural women of Garhwal region of Uttarakhand revealed that the per cent RDA intake of protein, fat, calcium, thiamine, riboflavin, niacin and ascorbic acid was more than 100 per cent. The intake of energy and iron was 86.8 and 80.5 per cent of RDA for all the subjects.

CONCLUSION

Assessment of nutritional status through BMI found that the average BMI for males was 24.16 while that for females was 23.54. Both of them were found to be overweight. The overall average value for BMI was found to be 23.9, which means that the population belongs to the overweight BMI category. Data on the 24-hour dietary recall method indicate that most women had nutrient intake lower than recommended dietary allowance (RDA). It emerges from the study that nutritional anthropometry alone does not give a clear picture of the nutritional status of a population. To identify nutritional deficiencies or excesses in a population, one should utilize the 24-hour recall method. To obtain accurate results for nutritional assessment studies, both techniques should be utilized together.

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