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ASSESSMENT OF NUTRITIONAL STATUS, ENERGY INTAKE AND ENERGY REQUIREMENT: A CROSS-SECTIONAL STUDY AMONG SABAR MALES OF WEST BENGAL, INDIA

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ABSTRACT

Malnutrition, particularly undernutrition, is a major problem for most low and middle-income countries. For several years, health professionals have recommended improving daily diets and continuous nutritional education as the solution to malnutrition and maximising a healthy life. More specifically, malnutrition is often reversible to a certain extent if the balance between energy intake (EI) and energy requirement (ER) can be measured accurately and maintained accordingly. The present study tries to assess the nutritional status and evaluate the EI and ER among the Sabar males living in the Purulia district of West Bengal, India. For this cross-sectional study, 400 Sabar men aged 18–60 years were selected. To assess their nutritional status, the anthropometric measurements of height (cm) and weight (kg) were taken following a standard procedure. Body mass index (BMI) was calculated, and the classification proposed by World Health Organization (WHO) for the South Asian population was considered. Body composition variables like Percent Body Fat (PBF), Fat Mass (FM), Fat-Free Mass (FFM), Fat Mass Index (FMI) and Fat-Free Mass Index (FFMI) were

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also calculated. The 24-hour dietary recall method was used to assess the nutrient intake (i.e., EI). ER was derived from the estimated total energy expenditure (TEE) calculated from the predictive equation proposed by the Indian Council of Medical Research (ICMR) for the Indian population. The study protocol was approved by the institutional ethical committee. Data were collected after getting consent from the study participants. The rate of undernutrition increased with age and was found to be highest (56.9%) among the aged individuals (41–50 years) with an overall prevalence of 48.5%. A gradual decrease in FFM, FFMI and a steady increase in PBF, FM, and FMI was seen with the increase in age. Differences were observed in EI and TEE across different age groups and nutritional categories. A negative energy flow was identified where TEE exceeded EI in each age and nutritional category. The high prevalence of undernutrition demands immediate nutritional intervention. This is probably the first report on the assessment of EI and TEE among any indigenous community living in West Bengal, so further studies are required among other communities living in similar or different ecological conditions for a better understanding and formulation of nutritional policies with special emphasis on elderly people.

Keywords: *Sabar; undernutrition; energy intake; energy expenditure; tribe, India*

INTRODUCTION

India is experiencing a nutrition transition where undernutrition has been prevalent, and the cases of overweight/obesity are gradually increasing [1–4]. This condition is recognised as the double burden of malnutrition (DBM) and is commonly found in most middle and low-income countries [5–7]. A recent study based on 2015–16 National Family Health Survey (NFHS) data reveals that, in India, the prevalence of underweight and overweight among adult men (15–54 years) are almost the same (19.7% and 19.6%) and among women (15–49 years) 22.9% and 20.6%, respectively [1]. Thus, researchers have opined that it is the prerequisite to develop appropriate nutrition strategies considering individualised nutritional needs to address undernutrition and overnutrition on an urgent basis [1, 8].

Malnutrition is associated with several factors like gender, marital status, family income, level of education, ageing, healthy lifestyle, physical activities, unemployment, poverty, changes in dietary practice, comorbidities, access to health care facilities, etc. and has become the most important factor for illness and death in recent years [9–17]. For several years, health professionals have made recommendations on improving daily diets and continuous nutritional education as the solution to malnutrition in the general population and maximising a healthy life [18, 19]. More specifically, malnutrition is often reversible to a certain extent if the balance between energy intake (EI) and energy requirement (ER) can be measured accurately and maintained accordingly [20–22]. The amount of EI mostly depends on the intake of carbohydrates (4 kcal/g), protein (4 kcal/g), and fat (9 kcal/g). Methods like weighing of food intake, laboratory analysis of foods, quantified 24-hour dietary recalls and food frequency questionnaires (FFQ) are widely used to assess EI [23]. Currently, it is recommended that ER must be assessed by total energy expenditure (TEE) instead of EI [24–26]. TEE consists of the energy required for vital life processes (resting energy expenditure (REE), i.e., basal metabolic rate – BMR), the energy expended during physical activities (energy expenditure of activity), and the energy utilised for digesting, absorbing, and metabolising food (diet-induced energy expenditure) [24, 25, 27–30]. Measuring TEE provides important data to clinical practitioners to determine the amount of calorie intake specifically for ill patients and particularly in the case of weight management after successful weight loss [20]. The doubly labelled water (DLW) technique is proven to be the gold standard to measure the daily TEE accurately, but this method is complex and time-consuming, requiring highly trained technical assistance, expensive instruments and a clinical setting [24, 30–32]. As an alternative, indirect calorimetry (IC) is a non-invasive technique and is considered best fitted under appropriate clinical conditions [21, 22]. However, the use of IC is also limited in daily practice as it is time-consuming and highly expensive [20, 21, 22, 33]. To solve this problem, several predictive equations are developed to determine TEE in malnourished individuals and used as an alternative to IC in clinical practice [21, 33]. Most of these predictive equations are used to estimate TEE among hospitalised patients with special reference to older adults [21, 22, 34–47]. Studies have also revealed that TEE varies due to several factors like age, gender, body composition, physical activity levels, climatic conditions, state of nutrition, ethnicity, etc. and maybe some other genetic influences [48–52]. Therefore, there is no universal consensus that any one predictive equation can be applicable to different populations with different categories of body mass index (BMI) [48, 50, 53–54]. Most of the studies are found to be conducted in the West particularly among white people [55–58], while studies on the Asian population are limited [50, 59–61]. In 1985, the expert committee of the Food and Agriculture Organization of the United Nations (FAO), the World Health Organization (WHO) and the United Nations University (UNU) gave a predictive equation relating to body weight and corresponding BMR [24]. Here, it is important to note that the level of physical activity (sedentary/moderate/heavy work) and the types of food consumed can significantly influence the

TEE, while certain factors like muscle mass, body composition, and hormonal factors can also affect BMR [28, 30]. Following FAO/WHO/UNU's (1985) recommendation, the Indian Council of Medical Research (ICMR) expert group proposed predictive equations for Indians incorporating the physical activity level with the BMR [24, 29].

As India is the homeland for several ethnic communities living in different geographical settings and unique for their cultural heritage, information on their EI and ER is very much needed for proper monitoring of the health conditions of such communities. In India, tribal people (8.6% of the total population) [62] are the most underprivileged section and are exposed to several kinds of malnutrition irrespective of age and gender [1, 9, 63, 64]. Sabar is one such tribal communities living mainly in the districts of Jhargram, Purulia, Bankura, Purba and Paschim Medinipur, etc. of the state of West Bengal, India. Traditionally, they have been forest dwellers, and their mode of subsistence is foraging [9, 63, 65–67]. However, due to deforestation and the implementation of forest protection and wildlife protection acts, they are forced to leave the jungle and settle close to the jungle areas [67]. Previous studies have reported a high prevalence of undernutrition [9, 63, 65, 66] and death incidents due to starvation in this community [67–69]. Even a recent study by Das et al. revealed a paradoxical result where a high prevalence of undernutrition (44.3%) is found among adult Sabar males despite balanced nutrient intake [63]. Such kind of findings demand further exploration. In this context, the present research was undertaken to evaluate the nutritional status through anthropometry and analyse the EI and ER among the adult Sabar male population living in the Purulia district of West Bengal, India. To the best of our knowledge, no such studies have been conducted in this community or any other tribal community living in West Bengal, India.

MATERIALS AND METHODS

In this cross-sectional study, 400 Sabar men aged 18–60 years were randomly selected from 24 villages under seven administrative blocks in the Purulia district of West Bengal, India. Purulia district is the westernmost district of the state with dense forests, rivers, variegated flora and fauna [9]. As a general exclusion criterion, individuals with any visible physical deformity or history of major illness were excluded. In addition, individuals practising any dietary restrictions or special dietary additions were also excluded from this study. Their participation in the study was purely voluntary. Informed consent was collected. Semi-structured schedules were administered to collect information on their food-related practices and dietary habits. The data were collected between September 2018 and October 2022. The study received approval from the Institutional Ethical Committee for Bio-Medical and Health Research involving Human Participants of the University of Calcutta, West Bengal, India (No. CUIEC/01/02/2022-23).

To evaluate their nutritional condition, anthropometric measurements of height (cm) and body weight (kg) were taken following a standardised operating procedure [70]. Height and body weight were measured to the nearest 0.1 cm and 0.1 kg using Martin's anthropometer rod and a calibrated electronic weighing machine (OMRON HN 289). These measurements were taken from the left side, with individuals dressed as little as possible. BMI was calculated following the standard formula: BMI = Weight (kg) / Height $(m)^2$. The classification based on BMI (undernutrition: BMI < 18.5 kg/m^2, normal: BMI 18.5–22.9 kg/m^2, overweight: BMI 23.0–24.9 kg/m^2, obesity: BMI ≥ 25.0 kg/m^2) proposed by WHO for the South Asian population was considered here to determine the nutritional status of the studied population [71]. Further, body composition variables like Percent Body Fat (PBF), Fat Mass (FM), Fat-Free Mass (FFM), Fat Mass Index (FMI) and Fat-Free Mass Index (FFMI) were also calculated [70, 72–74].

The nutrient intake was assessed by the 24-hour dietary recall method. All the food items and beverages consumed on the previous day by the individual were recorded in detail. An electronic digital kitchen weighing scale (SF-400) was used to weigh the raw ingredients of any preparation. Furthermore, 12 cups of different sizes (30–1400 ml) and 2 spoons (5 ml and 15 ml) were also used to measure the quantity of cooked food items following the protocol used by the National Institute of Nutrition, Hyderabad, India, in their national-level nutrition survey [75]. After assessing the total cooked quantity of any preparation, the portion consumed by the study participant was assessed in terms of cups, following the cup size and volume accordingly. For calculating the raw food equivalent from individual cooked intake, a conversion factor (CF) for any ingredient was used [CF = weight of the raw food used (g) / total cooked quantity of that preparation (ml)] at first, then, at the second stage, the individual intake of that ingredient (g) was recorded following the formula = CF (that ingredient) × volume of individual cooked food consumed (ml) [75]. Following the food composition table prepared by Gopalan et al., the nutritive values of different food items were calculated [76].

There is currently no recommended EI for Indian adults; ER was derived from the estimated TEE calculated and proposed by the ICMR for moderately active men as 2710 Kcal/day [26]. Strenuous activities such as cultivation or labour were considered as moderate work activities by ICMR [75]. As the study participants were found to be homogenous in their regular activities, including food habits and physical activities (primarily working in daily wage activities, such as cultivation or labour), the Sabar men were referred to as moderately active men in this study. It was already mentioned that the ICMR expert committee adopted the procedure of FAO/WHO/UNU expert consultation where factorial calculations were recommended to estimate the ER of the adults [24, 29]. At first, following ICMR, the BMR of an individual was predicted depending on body weight and age. As the study participants were male (18–60 years), the following equations proposed by ICMR for predicting BMR for males were considered:

a) 18–30 years: 14.5 × body weight (kg) + 645;
b) 31–60 years: 10.9 × body weight (kg) + 833 [29].

Then the energy cost was determined from different activities of an individual (including work activity, domestic/leisure time activities and sleep duration). From the ratio of the energy cost of an individual activity per minute to the cost of BMR per minute, the physical activity ratio (PAR) was determined [25, 29]. PAR value for activities performed in a day was aggregated over that period to yield the physical activity level (PAL) by the equation = total PAR-hours / total time (24 hours) [29]. Based on the PAL values, individuals were classified into three categories: sedentary work – 1.5, moderate work – 1.8 and heavy work – 2.3, respectively [25, 29]. Therefore, the final formula used to assess TEE was = predicted BMR × PAL [29].

Data were analysed using the Statistical Package for Social Sciences (SPSS, IBM) software version 26.0. Descriptive statistics were performed for all the studied variables, including mean with standard deviation (SD) and minimum and maximum values. The study participants were divided into four age groups: group I (18–28 years), group II (29–40 years), group III (41–50 years), and group IV (51–60 years) based on the 25^{th}, 50^{th} and 75^{th} percentile values of age. A one-way ANOVA test was used to examine the relationship of studied variables within/between different age groups and nutritional categories. A p-value of 0.05 was considered to be statistically significant.

RESULTS

Table 1 shows the characteristics of the studied population where the mean (± SD) age, height, weight, PBF, FM, FFM, FMI, FFMI, and BMI of the population were 39.37 ± 12.821 years, 162.08 ± 5.254 cm, 49.50 ± 6.321 kg, 15.45 ± 3.606%, 7.76 ± 2.552 kg, 41.74 ± 4.665 kg, 2.95 ± .986 kg/m^2, 15.87 ± 1.506 kg/m^2 and 18.84 ± 2.197 kg/m^2, respectively. A noticeable difference was observed in mean values between EI (1659.15 ± 194.887 Kcal/day) and TEE (2467.41 ± 138.123 Kcal/day) in this population.

Table 1. Descriptive statistics of studied variables

Variables	Mean	SD	Minimum	Maximum
Age (years)	39.37	12.821	18	60
Height (cm)	162.08	5.254	140.5	176.0
Weight (kg)	49.50	6.321	35.0	77.1
BMI (kg/m^2)	18.84	2.197	13.26	30.69
PBF (%)	15.45	3.606	7.73	30.98
FM (kg)	7.76	2.552	2.96	23.88
FFM (kg)	41.74	4.665	30.00	58.47
FMI (kg/m)	2.95	.986	1.19	9.51
FFMI (kg/m^2)	15.87	1.506	11.60	21.18
EI (Kcal/day)	1659.15	194.887	1086.28	2261.25
TEE (Kcal/day)	2467.41	138.123	2160.63	3012.10

SD = Standard Deviation; BMI = Body Mass Index; PBF = Percent Body Fat; FM = Fat Mass; FFM = Fat Free Mass; FMI = Fat Mass Index; FFMI = Fat Free Mass Index; EI = Energy Intake; TEE = Total Energy Expenditure

Age group-wise distribution of the studied population based on nutritional status (BMI) showed a high prevalence of undernutrition (48.5%) (Table 2). The prevalence of underweight participants increased with age, and the highest frequency was found in age groups III (56.9%) and IV (55.2%). A nominal presence of overweight participants (4.5%) was also seen.

Table 2. Age group-wise distribution of the studied population based on nutritional status (BMI)

Nutritional status (BMI)	Age groups (years)				Total N = 400
	Group I (18–28 years) N = 102	Group II (29–40 years) N = 109	Group III (41–50 years) N = 93	Group IV (51–60 years) N = 96	
Undernutrition	39 (38.2)	49 (44.9)	53 (56.9)	53 (55.2)	194 (48.5)
Normal	57 (55.8)	55 (50.4)	35 (37.6)	41 (42.7)	188 (47.0)
Overweight	6 (5.8)	5 (4.6)	5 (5.4)	2 (2.1)	18 (4.5)

Percentages are presented in parentheses

Table 3 represents the effect of age on the studied variables of the studied population. Generally, there was evidence of a gradual decrease in BMI, FFM, FFMI and EI and a steady increase in PBF, FM, and FMI with the increase in age. Weight was found consistent among age groups I and II and then reduced with age, whereas almost similar mean values of TEE were found in four age groups. Statistically significant mean difference was observed for all the studied variables across the age groups.

Table 3. Age group-wise distribution of the studied variables

Variables	Age Group (years)				*F*
	Group I (18–28 years) N = 102	Group II (29–40 years) N = 109	Group III (41–50years) N = 93	Group IV (51–60 years) N = 96	
Height (cm)	161.67±5.18	163.04±5.17	162.49±5.48	161.02±5.03	2.947*
Weight (kg)	50.30±6.47	50.77±6.28	49.20±5.98	47.49±6.08	5.491*
BMI (kg/m²)	19.22±2.10	19.07±2.03	18.67±2.43	18.31±2.13	3.558*
PBF (%)	12.11±2.65	14.72±2.46	16.56±3.0	18.77±2.56	110.878*
FM (kg)	6.23±2.18	7.60±2.18	8.29±2.67	9.04±2.33	25.750*
FFM (kg)	44.06±4.51	43.17±4.33	40.91±3.68	38.45±3.93	36.411*
FMI (kg/m²)	2.38±0.80	2.85±0.79	3.16±1.10	3.49±0.89	27.090*
FFMI (kg/m²)	16.84±1.32	16.22±1.27	15.50±1.36	14.82±1.27	44.263*
EI (Kcal/day)	1705.08± 187.85	1688.68± 200.63	1633.33± 182.07	1601.80± 192.07	6.277*
TEE (Kcal/day)	2473.90± 168.89	2495.37± 132.38	2464.83± 117.46	2431.26± 119.34	3.847*

BMI = Body Mass Index; PBF = Percent Body Fat; FM = Fat Mass; FFM = Fat Free Mass; FMI = Fat Mass Index; FFMI = Fat Free Mass Index; EI = Energy Intake; TEE = Total Energy Expenditure; *significant at 0.05 level

Table 4 depicts the relationship of EI and TEE with the nutritional categories. EI was found to be lower compared to TEE in each nutritional category. The mean values of both EI and TEE were gradually increasing from the undernutrition to overweight category. The result of the one-way ANOVA test expressed statistically significant mean differences for both EI ($F_{(2,397)} = 189.654$; $p < 0.05$) and TEE ($F_{(2,397)} = 248.869$; $p < 0.05$) across all the nutritional categories.

Table 4. Differences in mean energy intake (Kcal/day) and total energy expenditure (Kcal/day) among different nutritional (BMI) categories

Variables	Nutritional status (BMI)			*F*
	Undernutrition	Normal	Overweight	
EI (Kcal/day)	1530.523 ±124.657	1756.931 ±150.322	2024.097 ±175.764	189.654*
TEE (Kcal/day)	2380.183 ±84.367	2524.343 ±96.708	2812.949 ±122.441	248.869*

EI = Energy Intake; TEE = Total Energy Expenditure; * Significant at 0.05 level

DISCUSSION

The study conducted among 400 adult Sabar males in the Purulia district of West Bengal found that the participants had a higher prevalence of undernutrition (48.5%). It was also observed that mean BMI values decreased with age, and the highest level of undernourishment was found among the elderly individuals in groups III (56.9%) and IV (55.2%) (Table 2). Recent studies have shown a global trend of increasing undernutrition among older people compared to younger ones [77–79]. When comparing the findings with some selected global studies conducted in recent years mainly in semi-urban areas, it was revealed that the prevalence of undernutrition among the Sabar elderly was much higher than in the elderly individuals of Sri Lanka (30.6%) [80], Lebanon (7.6%) [81], China (8.0%) [82], Iran (11.5%) [83], Africa (19.2%) [78], Taiwan (20.2%), [79], Nepal (24.0%) [84], Bangladesh (26.0%) [85], and southern India (17.9%) [86]. It is evident from different studies that, with ageing, changes occur in body shape, size, and composition, probably due to alterations in energy balance (positive energy balance leading to weight gain and negative balance resulting in weight loss) [87–89]. There is also a hormonal element. Aging is associated with less insulin action leading to less anabolism of fat and muscle protein, and declining testosterone leading to reduced muscle mass. This is the reason why, even in rich countries, BMI often declines after about 65 years of age [90, 91]. A recent study on a cohort of 8499 men and women (40–80 years) from a Central European population revealed age-dependent alterations, including changes in body type and anthropometric indices, indicating similar results [88]. In India, most tribal communities reside in rural and forest areas where the frequency of undernutrition is significantly higher across all age groups and genders compared to their urban counterparts [92–94]. A study by Arlappa et al. in nine states of India reported a very high prevalence of undernutrition (61.8%) among tribal elderly males [95]. Likewise, according to a study conducted by NNMB, 40% of tribal males were undernourished [75]. Another study among nine tribes from three states – Gujarat, Odisha and West Bengal – reported that prevalence of undernutrition among tribal males was 32.1% [93]. The present study also revealed that the Sabars exhibited a higher prevalence of undernutrition when compared to the Savars (38.0%) of Keonjhar, Orissa [96], Shabars (40.3%) of Cuttack and Khurda, Orissa [97], and Sabars of Bankura in West Bengal (46.8%) [65]. When comparing the results of the current study with previous research conducted on other tribal communities of West Bengal, a high prevalence of undernutrition was also found among adult male Bhumij (52.3%), Munda (50%), Koras (51.9%), Santals (55.0%), and lower among Oraon (46.2%), Lodhas (45.2%), and Birhor (19.4%) [92, 93, 98–102]. This may result from changes in food habits and physical activities, which were identified as the common reasons for the increase in undernutrition in some of the studied tribal populations [92, 93, 100]. Several studies have shown that, in recent years, urban market centres were developed close to the habitat of indigenous people in most of the low and middle-income countries, and these people became exposed to the urban lifestyle and have explicitly exhibited a broad shift in the structure of their diet and physical activities [93, 103, 104]. Alongside the significantly higher prevalence of undernutrition among Sabar males, there was also a small proportion of individuals who were overweight (4.5%). This may be due to the rapid economic progress in India, which has resulted in transitions in various aspects, such as economic conditions, lifestyle, dietary habits, reduced physical activities, etc. [105–107].

It has already been mentioned that age has a significant impact on body composition; throughout the ageing process, several changes occur in the body, including shifts in muscle mass, fat distribution, and bone density [89, 108–110]. Even alterations in body composition due to ageing are frequently observed where people's body weight does not increase with age, but body fat increases [111, 112]. The current study observed a pattern regarding the rise in mean values of PBF, FM and FMI with age (Table 3). This finding is consistent with earlier studies indicating that PBF and FM tend to rise as individuals age, primarily due to the decline in FFM [89, 113]. Again, this study found a negative association between FFM and FFMI with age, aligning with previous global studies that have reported a decline in FFM and FFMI as age increases [114–117]. One of the possible reasons behind such conditions is sarcopenia, a progressive condition characterised by muscle loss, disordered energy metabolism, reduced strength, and decreased functionality, which ultimately leads to malnutrition [90, 118, 119]. Multiple risk factors have been associated with sarcopenia, and some studies have identified excessive alcohol consumption as one potential factor [120–124]. In the specific context of this study, excessive consumption of alcohol from an early age among the studied population has already been reported by Das et al. [9], which may be a possible reason behind such a condition. Contrarily, numerous studies have also expressed the view that the consumption of alcohol does not impact the progression of sarcopenia [125–127]. Further in-depth research on various indigenous communities living in diverse environments is required to substantiate this observation.

When considering EI, it is seen that the Sabar males in the present study consume very few calories (1659.15±194.887 Kcal/day) compared to recommended dietary allowances (RDA) of ICMR for moderately active men (2710 Kcal/day) [26]. Low calorie intake was also seen among other tribes like the Soligas (1630 Kcal/day) of Karnataka; Dubla (1540 Kcal/ day) and Worli (1350 Kcal/day) of Central and Eastern India; Irula (1860 Kcal/ day), Paniyan (1975 Kcal/day), and Malapandaram (1836 Kcal/ day) of South India; Nokte (1930 Kcal/day) of North East India; and Pahariya (2210 Kcal/ day) and Koya (2380 Kcal/day) of Eastern India (128). Even higher calory consumption than recommended was seen among a few North Indian tribes, like Riang (3059 Kcal/day) [128], Sherpa (3017 Kcal/ day) and Lepcha of Kalimpong (3571 Kcal/day) [129]. In this context, it is to be mentioned that the balance between EI and TEE is essential for maintaining body temperature, respiration, muscle functioning, metabolism, and physical activity [28, 130]. Energy balance may be used as a fundamental thermodynamics principle to demonstrate how body weight will change over time in response to changes in EI and TEE [28, 130]. The present study observed that all the age groups had expressed a negative energy balance where daily TEE persistently exceeds EI (Table 3). The mean of EI showed a steady decline. In contrast, TEE was consistent with increasing age, which indicated the decrease in muscle mass relative to the total body could be wholly responsible for the age-related declines in BMR [60, 131]. Several studies in the last few decades showed that TEE depends on FFM and is influenced by FM, especially by fat distribution [132, 133]. However, a few studies have shown contradictory results, revealing that the decline in EE with advancing age cannot be totally due to changes in body composition [134, 135]. In a recent study on tribal communities living in south Rajasthan, India, Saxena et al. [136] revealed the presence of satiety and negative energy flow as an outcome measure to combat household food insecurity. The idea of satiety, precisely the inhibitory effect of dietary consumption on appetite, was conceptualized and proposed by Blundell et al. [137]. This conceptual framework is dependent on the metabolic effects of nutrients in the gut and intestine, which combines the physiological events controlling appetite with the simultaneous behaviours and physiological experiences that are integral to the eating process as well as lower calorie intake as a key outcome [138–141]. Previous studies have shown a close association between the higher consumption of macronutrients and satiety, where specific high protein and carbohydrate meals induce satiety, and therefore, reduced body weight, resulting in a negative energy balance [142, 143]. Recently, Das et al. [63] reported satisfactory consumption of protein (57.02 ± 21.21 g/day) and fat (32.68 ± 11.26 g/day) and much higher consumption of carbohydrate (288.80 ± 42.39 g/day) compared to RDA of ICMR among the Sabar males in West Bengal. Thus, the low energy consumption among the studied population raised the possibility that unintentional negative energy balance may be induced by increased TEE and decreased EI and weight loss. Further, the difference between EI and TEE was found higher among the undernourished than the overweight or normal individuals (Table 4). So, observing the differences in EI and TEE among different age groups as well as among different nutritional categories, it can be concluded that there may be a direct relationship between EI and TEE as the participants have low normal BMI, and some other factors may cause such kind of results which needs further exploration.

CONCLUSION

This study revealed that almost half of the studied participants were undernourished, while a trend of increase in undernutrition cases with age was identified. Further, a decline in FFM and FFMI and an increase of PBF, FM and FMI with age was seen. When considering EI and TEE, a negative energy flow was found among the population where TEE exceeds EI in each age group as well as in nutritional categories. As this is an exploratory study, further studies are required with a larger sample size among other indigenous communities living in similar or different ecological conditions for better understanding and formulation of micro-level nutritional policies with special emphasis on elderly people.

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