Original Article

Journal of Occupational Health and Epidemiology
Journal homepage: http://johe.rums.ac.ir

Dietary Habits and a Need Assessment Survey of Obese Working Adults in Delhi, India

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Citation: Singh C, Jain N, Saini V, Jain M, Tyagi G. Dietary Habits and a Need Assessment Survey of Obese Working Adults in Delhi, India. J Occup Health Epidemiol. 2022;11(3):238-45.

Article Info

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Article history
Received: Apr 2022
Accepted: Sep 2022

10.61186/johe.11.3.238

Print ISSN: 2251-8096
Online ISSN: 2252-0902

Peer review under responsibility of Journal of Occupational Health and Epidemiology

Abstract

Background: Lifestyle changes in working adults have caused a high prevalence of obesity and various interrelated comorbidities, including hypertension, type 2 diabetes, and cardiovascular diseases. Healthy dietary modifications can help tackle these problems, but easy accessibility to healthier options is an issue. This study aims to investigate the dietary habits of obese adults and identify their unmet food-related needs.

Materials and Methods: In this cross-sectional study, subjects were of 30-59 (n = 400) years. The subjects worked in offices in Delhi and were diagnosed with obesity based on their body mass index (BMI) being ≥ 25 kg/m^2. A self-administered questionnaire was used to record dietary information and perform a need assessment survey. Additionally, mean, standard deviation, Z-test, and odds ratio were used for statistical analysis.

Results: The mean BMI of males and females was 28.02 ± 2.25 kg/m^2 and 28.04 ± 2.00 kg/m^2. Waist circumference was higher than 90 cm in 98.0% of males and 80 cm in 97.7% of females. Besides, over half of the subjects (56.75%) reported comorbidities, most commonly diabetes, hypertension, and dyslipidemia. Unhealthy foods including fast foods, sweets, ice cream, burgers, fries, chips, and other high-fat snacks like samosas were frequently consumed by over two-thirds of subjects. The highest unmet need among the subjects was nutraceutical-rich healthy food.

Conclusions: High waist circumference was prevalent among the subjects causing a high risk of NCDs. The urgent need among subjects was for non-ultra-processed nutraceuticals rich and high-fiber foods.

Keywords: Need Assessment, Nutraceuticals, Obesity.

Introduction

The global prevalence of obesity has reached over one billion people. The present number of obese adults has been reported to be 650 million [1]. The prevalence of obesity is anticipated to increase to 57.8% of the total world population in 2030 [2, 3]. Both developing and developed countries have shown a greater prevalence of overweight and obesity in women than in men [4, 5]. The prevalence of obesity is rising at a faster pace in the South Asia, including India [6]. According to the National Family Health Survey (NFHS-5) (2019-21) [7], the prevalence of obesity has risen to 22.9 and 24.0% in men and women, respectively. In fact, the prevalence of obesity has been found to be higher in the urban population than in the rural population, though the prevalence is increasing in rural areas as well. Besides, the prevalence of obesity in men has increased to 29.8% in urban and 19.3% in

rural areas; on the other hand, it has increased to 33.2 and 19.7% in urban and rural areas, respectively, among women.

Obesity increases the risk of several non-communicable diseases (NCDs), including type 2 diabetes, stroke, cardiovascular disease, osteoarthritis, and many types of cancer, such as breast, ovarian, liver, prostate, kidney, colon, gall bladder, and endometrial cancer [8]. Factors contributing to obesity and its associated risks in developing countries mainly include the intake of energy-dense foods (falling into unhealthy food habits), sedentary lifestyle, shortage of healthcare services, and monetary support [9]. Diet plays an important role in developing and preventing obesity [10]. Developing prudent or healthy dietary habits along with minimal intake of unhealthy diets can prevent obesity [11].

Changes in dietary patterns have been mainly caused by urbanization, women's employment, and longer work hours [12]. In fact, frequent consumption of fast foods and junk foods has been observed to result in adverse consequences, such as obesity [13]. Additionally, availability of healthy snacks can be a constraint in healthy eating behaviors among working adults, which has not been well studied through need assessment. Need assessment is the systematic process of determining a particular population's met and unmet needs [14]. Identifying obese working adults' unmet needs and providing healthier options can help reduce obesity and associated comorbidities. Against this backdrop, the present study aims to study obese adults' dietary habits and identify their unmet food-related needs.

Materials and Methods

This cross-sectional study was conducted in New Delhi within the time period from May, 2017 to July, 2017. The study sample included 30-59 year-old obese working adults in some determined offices of Delhi. The sample size was calculated at 384.16, which was rounded off to 400 and calculated using formula $n= s^2t^2/ (ME)^2$ [15], where $s^2= 0.50$, $t^2= 1.96$, and $ME= 0.05$ were the values put in the formula. Multistage sampling was performed for sample selection. Besides, random sampling was used to select the areas of Delhi. Furthermore, convenience sampling was used to select offices for the purpose of sample selection, followed by purposive sampling for the selection of obese subjects of the study. The criterion for the selection of obese subjects was the BMI being ≥ 25 kg/m^2 [16]. Besides, BMI was calculated through the formula of body weight (kilograms) divided by height (square meters) [17]. A total number of 312 males and 88 females participated in this study. Informed consent forms were obtained from all the study participants by following ethical guidelines as per the World Medical Association Declaration of Helsinki (2013) [18]. The inclusion criteria of this study were the subjects belonging to the age range of 30-59, males and females working in the offices identified in Delhi as the classes of III, II, and I employees, those diagnosed with obesity based on their BMI estimation, those providing secondary data on biochemical parameters concerning their health status based on their medical checkups performed within the past six months, and those willing to participate in the need assessment survey. The exclusion criteria were the subjects working in the offices outside Delhi, those recognized with any other problems causing inconvenience for the researcher, and those following the diet prescribed by qualified dieticians.

Data collection was performed using the pre-tested self-administered questionnaire for carrying out need assessment. The total time taken for collecting data from an individual was about 15-20 minutes. Anthropometric measurements, including height, weight, BMI, and waist circumference were recorded. The variables of height, weight, and waist circumference were measured following standard procedures using the anthropometry procedure manual [19]. The obese subjects were categorized as per the Asian BMI classification presented by the WHO [20]. In addition, the subjects were assessed based on their waist circumference as per the cutoffs provided for the Asian Indians [6]. Next, secondary data on biochemical parameters, including systolic and diastolic blood pressure (BP) levels, fasting and postprandial blood glucose levels, as well as the lipid profile, including total cholesterol, triglyceride, high density lipoprotein cholesterol (HDL-c), and low density lipoprotein cholesterol (LDL-c) levels were collected based on the subjects' latest medical checkups performed within the past six months. These parameters were categorized based on diagnostic criteria presented by standard sources, including the seventh report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure (JNC-VII report) [21] for hypertension, American Diabetes Association (2016) [22] for type 2 diabetes, National Cholesterol Education Program (NCEP) (2001) [23], and Indian Heart Association (2019) [24] for dyslipidemia. Metabolic syndrome is the presence of at least three or more abnormalities from among insulin resistance, hypertension, dyslipidemia (low HDL-c and hypertriglyceridemia), and central obesity [25].

Subjects with metabolic syndrome were identified as per the criteria accepted for the Indians [26].

To study the subjects' dietary habits as well as unmet food and nutritional needs, a self-administered questionnaire was designed. Next, the questionnaire was pre-tested for its appropriateness. Accordingly, a clearer and more precise questionnaire was redesigned based on suggestions and the experts' advice. Information on the subjects' demographic characteristics, recognition of obesity-associated comorbidities, dietary habits, and need assessment were collected through the questionnaire.

Besides, information on the subjects' dietary habits was collected by recording their food habits, fruit and vegetable consumption, frequency of snack consumption, and frequency of healthy and unhealthy snack use through the questionnaire. Additionally, need assessment was performed to identify the unmet food-related needs of the obese working adults. The primary goal of the need assessment was to assess the met and unmet needs of the adults for various health-promoting foods. Next, an inventory of healthy food categories was prepared by reviewing relevant literature and expert opinion. Using this inventory, the subjects were asked to select one of the options of "no need (already satisfied)", "low need", "moderate need", and "high need" for every food category. Additionally, food categories for which a maximum number of subjects selected "high need" were considered their unmet needs.

SPSS V20.0 was utilized for statistical data analysis (IBM SPSS statistics for Windows V20.0, IBM Corp., Armonk, NY, USA). The mean, standard deviation, Z-test, and odds ratio (OR) were used for statistical analysis as well. Furthermore, p-values < 0.05 were considered statistically significant. In addition, the Z-test was used to measure statistical differences in the mean values of the males and females. Additionally, the odds ratio was used to assess the risk of developing comorbidities associated with various dietary factors, such as snack consumption and frequent consumption of unhealthy or healthy foods.

Results

The mean age (years) of the males and females was 46.25 ± 8.82 and 41.07 ± 8.84, respectively. No significant differences were observed in the mean age of the males and females. Table 1 shows the details of the subjects' demographic information. Accordingly, about 45.8 and 51.1% of the males and females, respectively, were university graduates. Besides, most of the males (94.5%) and females (87.5%) were married. In addition, about 60% of the males had approximately a monthly household income of ≥ 36,997 rupees, whereas a greater number of women (46.5%) had it within the range of 18,498-36,997 rupees per month.

Table 1. The study participants' demographic information

Characteristics		n (%)
Highest level of education	Completed graduation	188 (47.0)
	Completed post-graduation	106 (26.5)
	Completed professional training/additional diplomas after graduation	70 (17.5)
	Completed professional training/additional diplomas after graduation	36 (9.0)
Marital status	Single	25 (6.2)
	Married	372 (93.0)
	Widower/Widow	3 (0.7)
Approximate household income per month (rupees)	≥ 36.997	225 (56.2)
	18,498 - 36,996	146 (36.5)
	13,874 - 18,497	22 (5.5)
	9,249 - 13,873	7 (1.7)

Table 2 shows the mean values of anthropometric measurements as well as biochemical parameters of both the males and females. Accordingly, the subjects' mean BMI was 28.03 ± 2.00 kg/m^2. In addition, the majority of both males (n = 260) and females (n = 74) belonged to the category of obese class I (25-29.9 kg/m^2), compared to the rest of the subjects belonging to class II (≥ 30 kg/m^2). Furthermore, no significant difference was observed in the mean BMI of the males and females. The subjects' mean waist circumference was 102.63 ± 6.42 cm. In fact, the majority of the subjects, except for about 2% of the males and females, had the waist circumference of greater than the cutoffs suggested for Asian Indians, having been > 90 cm for the males and > 80 cm for the females. However, there were no significant differences in the mean waist circumference of the males and females.

Table 2. The study subjects' mean values of anthropometric measurements and biochemical parameters

		Males	Females	P-value
		Mean ± SD		
Anthropometric measurements	BMI (kg/m^2)	28.02 ± 2.25	28.04 ± 2.00	0.500
	WC (cm)	103.38 ± 5.61	102.64 ± 6.42	0.321
Biochemical parameters	Systolic BP (mmHg)	121.65 ± 10.27	123.09 ± 10.12	0.051
	Diastolic BP (mmHg)	80.29 ± 8.66	79.76 ± 6.22	0.012*
	Fasting blood glucose (mg/dl)	107.13 ± 20.24	108.18 ± 21.29	0.002*
	Postprandial blood glucose (mg/dl)	160.58 ± 44.53	164.39 ± 45.75	0.000*
	Serum cholesterol (mg/dl)	186.45 ± 19.88	183.89 ± 19.69	0.732
	Serum triglycerides (mg/dl)	138.86 ± 13.35	137.12 ± 13.48	0.283
	HDL-c (mg/dl)	65.66 ± 10.06	63.67 ± 11.01	0.002*
	LDL-c (mg/dl)	95.46 ± 17.67	96.06 ± 17.24	0.975

*Statistically significant at $p < 0.05$

Based on the data collected on systolic and diastolic blood pressure levels, 44.5 and 39.7% of the males and females, respectively, reported higher levels than desired. The majority of them (77 males and 23 females) belonged to the prehypertension stage. Over two thirds of the subjects out of the total hypertensive males (n = 62) belonged to stage I hypertension, whereas out of the total hypertensive females (n = 12), 11 had stage I hypertension. According to the data on fasting and postprandial blood glucose levels, over half of the males (n = 168) and one third of the females (n = 35) were pre-diabetic or diabetic. Besides, the majority of these males (58.9%) were diabetics, while 83% of the females were pre-diabetics. In fact, over 90% of the males and females had desired cholesterol levels (< 200 mg/dl). Most (74.0%) of the total number of the males with higher cholesterol levels (n=27) had borderline high cholesterol levels. On the other hand, an equal number of the females out of the total females with higher cholesterol levels (n = 8) had borderline high and high cholesterol levels. In addition, the higher triglyceride levels were recorded in 5.7 and 9.0% of the males and females, respectively. Accordingly, the majority of them were in the category of borderline high triglyceride levels. In this study, an HDL-c level of ≤ 40 mg/dl was considered a risk factor for various heart diseases. In this respect, about 5% of both males and females had it lower than 40 mg/dl. As per the safer levels (50-60 mg/dl) recommended for the South Asians, 7.6 and 13.6% of the males and females, respectively, had levels lower than this. About 11 and 14% of the males and females, respectively, had LDL-c levels of higher than optimal. In fact, the majority of these males (n = 20) and females (n = 7) belonged to the near or above optimal category, followed by high levels in males (n = 10) and borderline high levels in females (n = 5). In addition, about 7.3 and 15.9% of the males and females, respectively, had metabolic syndrome. A significant difference was observed in the mean diastolic blood pressure levels, fasting blood glucose levels, postprandial blood glucose levels, and HDL-c levels between the males and females.

Over 50% (n = 227) of the subjects had one or more obesity-associated comorbidities. Additionally, the majority of the comorbidities reported were hypertension (n = 126), type 2 diabetes (n = 107), dyslipidemia (n = 73), and cardiovascular diseases (CVDs) (n = 10). Accordingly, some of the other comorbidities reported were chronic lung, liver, renal, gastrointestinal, and musculoskeletal diseases, as well as hypothyroidism.

The majority of the males (n = 157) and females (n = 63) were vegetarians, followed by non-vegetarian males (n = 149) and females (n = 24). However, none of the subjects was vegan. Only about 1% of the males, but none of the females, consumed fruit and vegetables five or more times daily. In addition, over 60% of both males and females consumed fruit and vegetables only once or twice per day. Additionally, the majority of the males (n = 253) and females (n = 69) consumed snacks at least once or twice daily between meals. In fact, subjects not having snacks at all or having them only once or twice daily had a significantly higher odds ratio (OR = 2.97) so that they would not develop diabetes compared to those having snacks over three times a day between meals (p = 0.001).

Over 70% of both males and females consumed unhealthy foods, including fast foods, sweets, ice creams, cola, sweetened juices, beverages, burgers, fries, chips, and other unhealthy snacks, like samosas and chocolates at least once a week or less. Fried sandwiches and pizzas were consumed at least once a week or less by 69.8 and 68.1% of the males and females, respectively. Besides, sweets, ice creams, and other unhealthy snacks, like samosas and chocolates were the most commonly consumed unhealthy foods by the subjects. In addition, 56.0 and 81.8% of the males and females, respectively, would not drink alcohol. The subjects consuming alcohol twice a week or

more had a significantly higher odds ratio (OR = 2.80) of developing dyslipidemia (p = 0.038). In addition, the subjects drinking alcohol had a significantly higher odds ratio (OR = 1.76) of developing comorbidities, including hypertension, type 2 diabetes, dyslipidemia, and CVDs than the subjects not drinking alcohol (p = 0.018) at all. Furthermore, the subjects consuming unhealthy snacks, such as fried sandwiches and pizzas had a significantly higher odds ratio (OR = 1.85) of developing the above-mentioned comorbidities than those not consuming them at all (p = 0.028).

Over 90% of both males and females consumed healthy foods, including dry fruit, milk, and yogurt at least once a week or less. In contrast, these foods were consumed 2-7 times a week by the majority (> 45%) of the subjects. In fact, fresh fruit and vegetable juices or soups were consumed at least once a week or less by over 85% of both males and females. Consumption of smoothies was at a minimum of once a week or less by 73.3 and 67.0% of the males and females, respectively. In addition, the odds ratio of developing dyslipidemia was significantly higher (OR = 1.67) in the subjects not consuming yogurt or consuming it only once a week or less, than those consuming it twice a week or more (p = 0.047). The subjects not consuming smoothies or consuming them only once a week or less had a significantly higher odds ratio (OR = 6.62) of developing dyslipidemia than those consuming them twice a week or more (p = 0.034). Furthermore, the odds ratio of developing CVDs was significantly higher (OR = 10.60) in the subjects not consuming fresh fruit juices at all (p = 0.000). Additionally, the subjects not consuming milk or consuming it only once a week or less had a significantly higher odds ratio (OR = 4.52) of developing CVDs than those having it twice a week or more (p = 0.022).

Table 3 shows the assessment results for need levels of various health-promoting foods. Accordingly, the highest needs were those of nutraceutical-rich healthy foods marked by 81.4 and 80.6% in males and females, respectively, followed by fruit and vegetable snacks (66.0 and 64.7% in males and females, respectively), high-fiber snacks (61.2 and 63.6% in males and females, respectively) and multigrain snacks (60.5 and 54.5% in males and females, respectively).

Table 3. Assessment of need levels for various health-promoting foods

	Responses			
Health-promoting foods	**No need; already satisfied**	**Low need**	**Moderate need**	**High need**
	n (%)			
Fruit- and vegetable-based snacks	18 (4.50)	21 (5.25)	98 (24.50)	263 (65.75)
Tasty fast foods, low in fat	79 (19.75)	76 (19.00)	142 (35.50)	103 (25.75)
Low-calorie meal replacements	42 (10.50)	38 (9.50)	128 (32.00)	192 (48.00)
High-fibre snacks	21 (5.25)	8 (2.00)	124 (31.00)	247 (61.75)
Nutraceutical-rich health foods	14 (3.50)	8 (2.00)	53 (13.25)	325 (81.25)
Fermented low calorie foods	42 (10.50)	49 (12.25)	166 (41.50)	143 (35.75)
Multigrain snacks	19 (4.75)	23 (5.75)	121 (30.25)	237 (59.25)
Healthy extruded precooked foods	66 (16.50)	62 (15.50)	150 (37.50)	122 (30.50)
Low-calorie ready-to-eat (RTE) foods	63 (15.75)	67 (16.75)	166 (41.50)	104 (26.00)
Junk foods with similar tastes, less junks, and more nutrients	105 (26.25)	123 (30.75)	111 (27.75)	61 (15.25)

Discussion

The BMI is the worldwide criterion used for measuring obesity. Accordingly, it was used in the present study to select obese subjects with their BMI being ≥ 25 kg/m^2. Although classifications of the BMI for overweight and obese people are 25-29.99 kg/m^2 and ≥30 kg/m^2, respectively, as per the WHO, given the increasing risks of type 2 diabetes and cardiovascular diseases observed among obese Asian Indians at much lower levels of the BMI, obesity is identified as having BMI levels of ≥ 25 kg/m^2 for Indians [27]. Waist circumference is the measure of central obesity [28]. Asian Indians have higher chances of predisposing themselves to abdominal obesity and visceral fat accumulation, also known as the "Asian Indian Phenotype" [29]. The present study showed that the majority of the subjects had high waist circumference values. Waist circumference helps assess abdominal subcutaneous and intra-abdominal fat. A number of proteins and hormones, such as cortisol, adipokines, and angiotensinogen are produced through the intra-abdominal fat, resulting in a number of cardiometabolic diseases, including hypertension, coronary heart diseases, and dyslipidemia [30]. High waist circumference values show a strong association with all-cause mortality as well as cardiovascular mortality [31]. Over half of the subjects in the present study had some obesity-

associated comorbidities, with all of them having had high waist circumference values.

There is a rise observed in the prevalence of metabolic syndrome among the Indian population, which ranged from 11 to 41% among different parts of India [32]. The prevalence of metabolic syndrome in Delhi was reported at 43% [33]. Another study reported the prevalence of metabolic syndrome at 62% among employed adults of urban Delhi [34]. The overall metabolic syndrome recorded in the present study was lower than that in other studies. Variations in the prevalence of metabolic syndrome could be because of differences in the criteria used, differences in the age groups studied, and differences in the prevalence rates observed for individual components of metabolic syndrome [35].

As a conclusion of the present study, higher consumption of unhealthy foods was observed than healthy foods. Some of the possible reasons could be the convenience, price, number of choices in the menu, enhanced flavor, and taste that such foods provide [36]. Accordingly, some studies suggest that the consumption of junk foods can lead to obesity, specifically central obesity, being the major concern for CVDs and other NCDs [37, 38]. The present study showed a significant association between frequent snacking, drinking alcohol, and consuming fried foods with most of common comorbidities. Thus, increased consumption of energy-dense foods along with associated eating behaviors, such as binge eating, snacking, and eating out promote unhealthy weight gain [36, 39]. Moreover, being physically inactive, adopting an unhealthy lifestyle, and developing dietary habits can increase the risk of NCDs [40]. In a study, a significant association was found between obesity and the risk of breast cancer [41].

Appropriate changes in the lifestyle with the inclusion of modifications to diets [42, 43] rich in fruit and vegetables [44] can lessen the risk of CVDs. Formulating appropriate health policies and interventions can improve dietary consumption among people. However, a greater number of individual approaches are required to help address the persistent nutritional gaps and further prevent forthcoming morbidities among the groups of higher risks [45]. Need assessment helps analyze affected people's needs and determine the gaps [46]. In addition, identifying the gaps between expected and actual situations can help determine people's actual needs. Moreover, it can help formulate better prevention and management strategies for obesity and associated comorbidities.

There were some limitations in this study. Accordingly, this study was confined to Delhi, and only some approachable offices were chosen. Thus, proper randomization was not possible. In addition, biochemical parameters used were based on secondary data.

Conclusion

High waist circumference values, as risks of CVDs, were observed in the majority of the subjects. Over half of the subjects had one or more associated comorbidities, with the most common ones having been hypertension, diabetes mellitus, and dyslipidemia. Consumption of unhealthy snacks was by far higher among the majority of the subjects, whereas consumption of fruit and vegetables was by far less. Despite awareness of healthy food choices, lower accessibility, higher costs, and longer time required for preparing them make their use difficult. The subjects' unmet needs for nutraceutical-rich healthy foods and other healthy snacks suggest that they must be formulated so as to replace unhealthy marketable foods. As a conclusion, healthy foods are not easily accessible, are expensive, and longer time is needed to purchase them. Thus, it is required that proper strategies, policies, and intervention programs be formulated to promote healthy food choices among people at household and national levels.

Acknowledgement

The authors would like to extend their sincere gratitude to the administrative authorities of all the governmental and non-governmental organizations for granting permission for the present study. Furthermore, the authors would like to thank all the participants who cordially participated in this study.

Conflict of interest: None declared.

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