Differences in consumption of food items between obese and normal-weight people in India

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ABSTRACT

Background. There is a rising prevalence of obesity in India, and diet may be a major determinant of this. We aimed to assess differences in types and quantities of food items consumed by obese and normal-weight people in India.

Methods. Cross-sectional data of 7067 factory workers and their families were used from the Indian Migration Study, conducted in four cities across northern, central and southern India. Food frequency questionnaire data were used to compare the quantities of consumption of 184 food items between 287 obese (body mass index >30 kg/m²) and 1871 normal-weight (body mass index 18.50–22.99 kg/m²) individuals, using *t* tests and ANCOVAs. Individuals with diabetes, hypertension and cardio-vascular disease were excluded. SPSS 16.0 was used for analysis.

Results. After adjusting for age, sex, location and socio-economic status, obese individuals were found to eat significantly larger quantities of 11 food items compared with normal-weight individuals. These included *phulkas, chapatis/parathas/naan*, plain *dosa*, mutton/chicken *pulao/biryani*, chicken fried/grilled, *rasam*, mixed vegetable *sagu*, vegetable *raitha*, honey, beetroot and bottlegourd ($p<0.01$). Consumption of plain milk was higher among normal-weight than among obese individuals ($p<0.05$). Consumption of some of these food items was also found to increase by socioeconomic status, decrease by age, and be higher among men relative to women.

Conclusion. Obese individuals were found to consume larger quantities of certain food items compared with normal-weight individuals. Interventions should aim at limiting overall food consumption among obese individuals.

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INTRODUCTION

Obesity is a major risk factor for cardiovascular disease and diabetes,[1,2] and is becoming a problem in India.[3] According to the National Family Health Survey-3 (NFHS-3), a nationally representative survey of health and reproductive indicators in India, the prevalence of overweight and obesity in India is 9.8% and 2.8% among women, and 8.4% and 1.3% among men, respectively.[4] Data from regional studies in India support this growing trend. For instance, the prevalence of obesity among schoolchildren in Amritsar ranges from 4.9% to 6.3%,[5] and the overall prevalence of obesity was estimated to be 15% in Kashmir among those over 40 years of age,[6] and 27.8% among adults in Delhi.[6]

Obesity is a result of energy imbalance. Two factors that are thought to contribute to this imbalance are decreased physical activity and increased consumption of energy-dense foods.[7] The National Nutrition Monitoring Board for India indicated that between 1975 and 1995, while consumption of cereal grains had fallen in the Indian population, consumption of milk and milk products, animal products, fats and oils had increased.[6] The NFHS data also showed that between 1998 and 2006, the frequency of intake of all food groups available increased with wealth.[8] The relationship between consumption of food types and obesity is not well known in India. Thus, we aimed to assess differences in the types and quantities of food consumed by obese and normal-weight people in India.

METHODS

Data were used from the Indian Migration Study (IMS), a cross-sectional study aimed at elucidating the effects of within-country migration on obesity. The study was done after obtaining ethical approval from the ethics committee of the All India Institute of Medical Sciences, the Indian Council of Medical Research and the Health Ministries Screening Committee. The IMS collected detailed data on health, nutritional status and food consumption among urban, rural as well as migrant factory workers and their spouses and siblings in Lucknow, Nagpur, Hyderabad and Bangalore. The factory workers were rural-to-urban migrants as well as urban residents. One sibling of each factory worker, close in age and sex (if possible), was included in the study. For migrant factory workers, non-migrant rural siblings were chosen, and for urban factory workers, urban resident siblings were chosen.

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Further details about the IMS design can be found at Lyngdoh *et al*.[9] and Ebrahim *et al*.[10]

The quantities consumed of 184 food items (along with their region-specific recipes) were assessed using a validated semi-quantitative Food Frequency Questionnaire (FFQ) (Annexure I, available at *www.nmji.in*). In the FFQ, for each food item, the average portion size and frequency of consumption (per day/ week/month/year) were reported by subjects. From these data, average daily consumption in terms of number of portions consumed per day was calculated. A standard portion size was assigned to each food item and the relevant quantity in gram/ millilitre was calculated (e.g. tablespoon, ladle, bowl). The list of 184 food items was generated by conducting a single 24-hour recall of individuals (from rural/urban areas, different socio-economic and age groups). Supplementary questions were asked about foods consumed on special occasions (festivals, family gatherings), as well as the availability of wild foods consumed in times of food scarcity or for other reasons. Information on seasonal foods that may have been missed by 24-hour recall was collected from the local markets. We included all foods consumed by the individuals, irrespective of whether they were eaten at home or outside. Recipes (cooked or uncooked) were presumed to be proxies for the standardized recipes of that particular region.

The initial sample consisted of 7067 factory workers and their families. Individuals were selected based on their body mass index (BMI). Obesity was defined as having a BMI $\geq$30 kg/m^2 (*n*=612) and normal weight was defined as having a BMI of 18.50–22.99 kg/m^2 (*n*=2338)[11] because we wanted to compare people at the extreme of the obesity spectrum with normal-weight people to discern whether there were any differences in diet between them. Although there have been suggestions that Indians should have lower BMI cut-offs for defining obesity, these lower cut-offs are yet to be recommended by WHO.[11] Analysis was confined to only 'healthy' individuals, as it is possible that people may change their diets after the diagnosis of a chronic condition. Healthy individuals were those with systolic blood pressure <140 mmHg and/or a diastolic blood pressure <90 mmHg, as well as those with fasting plasma glucose <126 mg/dl. Individuals with self-reported hypertension, diabetes, heart disease and stroke were excluded from the analysis, as were those on medication/ special diet for hypertension, diabetes and cardiovascular disease.

Our sample size was reduced to 2158, with 287 obese and 1871 normal-weight individuals. Blood pressure was measured after a 5-minute period of rest using an Omron M5-I automatic machine in the sitting position using the right upper arm and an appropriate-sized cuff. Glucose was measured on the day of sample collection in the local laboratories at each site by the GOD-PAP method using RANDOX kits.[12] Socioeconomic status (SES) was defined by a composite variable of 14 items (household characteristics and possessions), derived from the Standard of Living Index (SLI) of the NFHS.[13]

Student *t* test was applied to all the 184 food items to identify differences in consumption between the two groups. Food items for which differences were significant at $p \leq 0.01$ were included for further analysis in which age, sex, factory location and SES (referred to as SLI) were adjusted for, using ANCOVAs. After controlling for these potential confounders, food items for which significant differences were observed at $p<0.05$ are reported. Statistical package for the social sciences (SPSS) for Windows version 16.0 was used for the analysis.[14]

RESULTS

Characteristics of the study population

The age range of the participants was 18–68 years, with a median of 36 years, and 59% were men. In the obese group, there was a higher proportion of women, a higher mean age, and a higher mean SLI score compared to the normal-weight group (Table I).

Differences in food consumption between 'healthy' obese and normal-weight individuals

Of the 184 food items, significant differences were found in the consumption of 45 food items between the 1871 normal-weight and the 287 obese individuals ($p \leq 0.01$; Table II). After adjusting for age, sex, factory location and SES, the number of food items for which significant differences were observed decreased to 12 ($p<0.05$; Table III). After adjustment, all items, except milk, were found to be consumed in larger quantities by obese compared with normal-weight individuals. Regarding milk, normal-weight individuals consumed 1.7-times more whole milk than did obese individuals, while the latter consumed 1.5-times more skimmed milk and 2.6-times more toned milk. The mean (SD) daily calorie intake of normal-weight individuals (2980 [1030]) was higher than that of obese individuals (2840 [920]). The difference was not significant when controlled for age.

The consumption of 11 of the 12 food items increased with SES, that of 2 food items decreased with age (mutton/chicken *pulao/biryani* and chicken fried/grilled) and for 5 food items (*phulkas, chapatis*, mutton/chicken *pulao/biryani*, chicken fried/ grilled and milk), consumption was higher among men than women ($p<0.05$).

DISCUSSION

The obese population in our study consumed a diet that was largely similar to that of those with normal weight. For instance, for several commonly eaten food items such as *roti*, rice, *tur dal*, potato, curd, tea and coffee, no significant differences were observed. However, obese individuals had a tendency to eat larger quantities of some of these foods. The types of food items eaten in larger quantities by obese people included carbohydrates (*phulkas, chapatis, dosas, biryani*), sugars (honey), fats (chicken fry), vegetables (beetroot, bottlegourd) and pulse/curd/vegetable-based dishes (mixed vegetable *sagu*, *rasam*, vegetable *raitha*). Most food items can be unhealthy if eaten in large quantities. Both the type of food and the quantity contribute to a food item being good for health or not. This implies that regulating the quantity of food items consumed is important, irrespective of whether people are perceived as obese or of normal weight.

Previous research in the Indian context has shown mixed

TABLE I. Sample characteristics

Characteristics	Normal-weight individuals (*n*=1871)	Obese individuals (*n*=287)	Total (*n*=2158)
Mean (SD) age (in years)	36.35 (10.08)	42.75 (7.33)*	37.20 (9.99)
Median age (in years)	35	43*	36
Male *n* (%)	1178 (63.0)	99 (34.5)*	1277 (59.2)
Mean (SD) Standard of Living Index	19.65 (6.69)	24.51 (5.25)*	20.30 (6.72)
Literacy *n* (%)	1688 (90.2)	268 (93.4)†	1956 (90.6)
Mean (SD) BMI (kg/m^2)	20.77 (1.32)	32.60 (2.64)*	22.34 (4.31)

BMI body mass index * $p \leq 0.001$, independent sample *t* tests for continuous variables, and chi-square tests for categorical variables †not significant

TABLE II. Comparison of food portions consumed between obese and normal-weight individuals

Food item	Portion size		Mean (SD)*	Mean difference†	95% CI	p value
Tandoor roti/phulka/wheat *phulka*	37.6 g	Normal	4.05 (3.77)	–1.37	–1.83, –0.91	<0.001
		Obese	2.68 (3.51)			
Chapatis/parathas/naan	45.4 g	Normal	0.58 (1.17)	0.25	0.11, 0.40	0.001
		Obese	0.83 (1.11)			
Plain *dosa*	39 g	Normal	0.13 (0.24)	0.12	0.10, 0.16	<0.001
		Obese	0.25 (0.35)			
Mutton/chicken *pulao/biryani*	220 g	Normal	0.03 (0.12)	0.03	0.01, 0.06	0.002
		Obese	0.06 (0.36)			
Chicken fried/grilled	67.5 g	Normal	0.05 (0.16)	0.05	0.02, 0.07	<0.001
		Obese	0.10 (0.24)			
Rasam	56 ml	Normal	0.18 (0.44)	0.26	0.19, 0.32	<0.001
		Obese	0.44 (0.82)			
Mixed vegetable *sagu*	56 ml	Normal	0.04 (0.14)	0.08	0.06, 0.10	<0.001
		Obese	0.12 (0.28)			
Vegetable *raitha*	10 ml	Normal	0.37 (0.86)	0.39	0.25, 0.52	<0.001
		Obese	0.76 (2.00)			
Honey	5 ml	Normal	0.02 (0.12)	0.06	0.04, 0.08	<0.001
		Obese	0.08 (0.36)			
Beetroot	10 ml	Normal	0.46 (0.90)	0.25	0.14, 0.37	<0.001
		Obese	0.72 (1.22)			
Bottlegourd (*lauki*)/ashgourd/ridgegourd (*turai*)/snakegourd	10 ml	Normal	0.67 (1.00)	0.25	0.13, 0.38	<0.001
		Obese	0.93 (1.25)			
Plain milk	125 ml	Normal	0.55 (1.08)	–0.17	–0.30, –0.04	0.009
		Obese	0.38 (0.78)			

* Number of portions consumed per day (unadjusted) † With normal-weight individuals as reference

TABLE III. Comparison of food consumption between obese and normal-weight individuals, adjusted for age, sex, factory location and socioeconomic status

Food item	Mean difference*†	95% CI†	p value†	Mean difference*†	95% CI†	p value‡
Tandoor roti/phulka/wheat *phulka*	0.36	0.02, 0.65	0.016	0.40	0.12, 0.69	0.005
Chapatis/parathas/naan	0.23	0.08, 0.38	0.004	0.27	0.12, 0.42	<0.001
Plain *dosa*	0.04	0.01, 0,.07	0.009	0.06	0.03, 0.09	<0.001
Mutton/chicken *pulao/biryani*	0.03	0.01, 0.05	0.008	0.04	0.02, 0.06	0.001
Chicken fried/grilled	0.03	0.01, 0.06	0.004	0.04	0.02, 0.06	<0.001
Rasam	0.12	0.06, 0.18	<0.000	0.14	0.08, 0.20	<0.001
Mixed vegetable *sagu*	0.04	0.02, 0.06	<0.000	0.05	0.03, 0.07	<0.001
Vegetable *raitha*	0.21	0.08, 0.34	0.002	0.29	0.16, 0.42	<0.001
Honey	0.04	0.02, 0.06	0.001	0.05	0.02, 0.07	<0.001
Beetroot	0.14	0.02, 0.26	0.019	0.20	0.09, 0.32	<0.001
Bottlegourd (*lauki*)/ashgourd/ridgegourd (*turai*)/snakegourd	0.12	0.01, 0.23	0.041	0.17	0.06, 0.28	0.003
Plain milk	–0.16	–0.30, –0.03	0.017	–0.13	–0.26, –0.003	0.045

* With normal-weight individuals as reference † Controlling for age, sex and factory location ‡Controlling for age, sex, factory location and SES

results. Gera and Khetarpaul.[15] found that obese Indian men eat larger quantities of pulses, green leafy vegetables, roots and tubers, fruits, milk and milk products, sugar and fats than their non-obese counterparts, which is in line with the present findings. Contrary to our findings, Ghosh *et al*.[16] found only egg, fried snacks and Bengalee sweet consumption to be associated with central obesity among Bengalee Hindu men, with chicken and fish consumption showing an inverse relationship. Our study, because of its wide geographical scope and including both men and women in its analysis, adds to the above findings. However, more studies are needed before any conclusion can be generalized.

There is evidence that the increase in obesity in India is seen particularly in women with high school education, the elderly, in urban areas and in high socioeconomic groups.[6,8] Our results re-affirm some of these findings. Consumption of all foods (with the exception of *phulkas*) increased with increasing SES, irrespective of the BMI status of this study population. This may be fuelled by the increase in purchasing power.[17] The nutrition transition predicts that fats, simple sugars, processed foods and animal products will become the predominant sources of energy in developing countries as wealth increases.[18]

One of the strengths of the study is that analysis was confined to the healthy population of the sample, therefore minimizing errors associated with underlying disease conditions that may influence people to change their food habits. Additionally, the study sample was large, representing populations from the northern, central and southern regions of India, although larger populationwide studies will be needed before these results can be generalized to the whole country. A larger prospective study looking at both dietary intake and physical activity is warranted to be able to establish more conclusive links between obesity and food consumption patterns, although such a study may be difficult to undertake.

Limitations

Our study was cross-sectional and hence we cannot draw any causal conclusions between the increased quantities and types of foods consumed and obesity. In addition, the varied nature of diets makes it particularly difficult to accurately assess food intake of large study populations such as ours. Although we collected information on a variety of foods, misreporting bias associated with food intake may have taken place. The analysis was restricted to food consumption and did not account for levels of physical activity within the study population and hence attributing the occurrence of obesity to increased food intake should be interpreted with caution. For instance, the finding that obese and normal-weight individuals did not differ significantly in their calorific intake indicates possible differences in physical activity.

FFQs are useful for ascertaining the types of foods consumed, but are not as useful in assessing calorific intake. As such, the lack of difference could also be due to our methodology. Additionally, although data were collected from rural, urban as well as migrant groups, the analysis did not account for possible dietary differences between these groups. Lastly, conducting multiple tests, as was done in this study, risks the possibility of arriving at a few significant findings by chance, although an attempt was made to deal with this by restricting further analysis to differences significant at $p \leq 0.01$. Another potential limitation of this study was that it did not take into account the genetic determinants of obesity. The prime focus of this study was to assess the types and quantities of food consumed by obese and normal-weight individuals. Collection of data related to the genetic aspects of obesity would have been useful, especially in light of the associations found among populations in developed countries, which indicate that obesity has both genetic and environmental components.[19,20] Data on family history would have informed us about the role of heritability together with food consumption habits in the manifestation of obesity. However, efforts in India to establish genetic associations with obesity to date have omitted the exploration of environmental factors[21] and evidence suggests that these novel genetic variants only modestly explain the variation in human BMI and body weight, which again points towards the important role of the environmental component.[19]

Conclusion

We found strong evidence of differences between normal-weight and obese individuals in the quantities consumed of 12 food items, which persisted after adjustment for age, sex, location and SES. Public health interventions should not only target specific populations (e.g. the wealthy, young) but should also focus on limiting the overall quantity of food consumption among obese individuals, and consider behaviour and attitudes to food. In addition, adequate physical activity should be promoted along with healthy eating.

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