Original Article

Association of dietary factors and other coronary risk factors with social class in women in five Indian cities

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The association between social classes, food intake and coronary risk factors was determined. Cross-sectional surveys were conducted in 6–12 urban streets in each of five cities, each one from five different regions of India using similar methods of dietary intakes and criteria of diagnosis. We randomly selected 3257 women aged 25–64 years inclusive, from Moradabad (n = 902), Trivandrum (n = 760), Calcutta (n = 410), Nagpur (n = 405) and Bombay (n = 780). All subjects, after pooling of data, were divided into social class 1 (n = 985), class 2 (n = 790), class 3 (n = 774), class 4 (n = 602) and class 5 (n = 206) based on various attributes of socioeconomic status. Social class 1 was the highest and 5 was the lowest social class. Social classes 1–3 had greater intake of pro-atherogenic foods; total visible fat, milk and milk products, meat and eggs, as well as sugar and confectionery, compared to social classes 4 and 5. The consumption of wheat, rice, millets, fruits, vegetables and legume/total visible fat ratio were inversely associated with social class. Mean body mass index (BMI), obesity, overweight, central obesity and sedentary lifestyle were also significantly more common among subjects from higher social classes. Spearman's rank correlation showed that bodyweight, BMI, wheat, rice, millets, total visible fat, milk and milk products, meat, eggs, sugar and jaggery intakes were significantly correlated with social class. Social class 5 subjects had a lower intake of all foods and a lower BMI, suggestive of a higher rate of undernutrition among them. The findings indicate that the consumption of pro-atherogenic foods and other coronary risk factors are more common in higher social classes compared to lower social classes.

Key words: body mass index, Bombay, Calcutta, central obesity, fruit, India, legume, Morababad, Mumbai, Nagpur, obesity, Tirvadrum, total visible fat, vegetable.

Introduction

The countries of Asia are in a rapid socioeconomic transition from poverty to affluence.[1–8] There are marked changes in the diet and lifestyle characteristics resulting in a rapid emergence of cardiovascular disease and cancers. However, association of diet and lifestyle factors with cardiovascular risk factors and social class has not been studied adequately in Indians. Surveys conducted in ten states of India indicate that dietary fat intake in Indians is related to social class, traditional methods of cooking and eating patterns.[2,3] The Council on Arteriosclerosis of the World Heart Federation has reported a rapid emergence of cardiovascular diseases in Asia and has predicted an epidemic in the near future as socioeconomic changes proceed further.[8] The first step in the initiation of a prevention strategy is to examine the current status of dietary patterns in relation to social class and coronary risk factors among populations of Asia. We have reported the prevalence and risk factors of hypertension in five Indian cities without any emphasis on dietary patterns.[9,10] In the present report, we describe the diet and lifestyle characteristics in relation to social class in women subjects of the five city study, because there are wide differences in dietary intakes between rich and poor, as well as between rural and urban in association with differences in pattern of diseases.[11–14] There is a rapid transition of risk factors with economic development and affluence among people of Indian origin living in developed countries.[15–20]

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Subjects and methods

The subjects and methods of this multicentre collaborative study have been described.[9,10] We used standard study protocol for this cross-sectional survey in five different cities of India.[9,10] The study methods, sample selection and criteria of diagnosis were similar to the study conducted at Moradabad.[1] We reported our results only in women, because data in men are not yet analysed. The sampling frame consisted of the total final population of the concerned city according to the census of India 1991. Random samples were selected by each centre with an aim to select women aged 25–64 years. The study populations chosen were not necessarily representative of the whole region, but the random samples had to be representative of the population from which they were drawn. The women were selected from urban streets of each city after excluding suburban streets. We randomly selected 6–12 urban streets from each city and from these selected streets, subjects were selected at random, an example of cluster sampling. The response rate varied between 83 and 90% in different cities and the subjects who did not agree to complete examination were excluded. There were 410 women from Calcutta, 405 from Nagpur, 780 from Bombay, 760 from Trivandrum and 902 from Moradabad. The study was conducted between 1993 and 1996.

A physician and dietitian administered the questionnaire to obtain information on age, physical activity, tobacco intake, alcohol intake, socioeconomic status, menopause and salt consumption. Salt intake was assessed with the help of a salt measure, by measuring the salt used in the cooking of food and mixed during eating by each subject. Salt intake was calculated by finding out the total amount of salt mixed in the food during cooking in a week divided by the number of subjects consuming food in the family and adding it to the amount of salt consumed during eating by the individual subjects. Physical examination included measurements of height, weight, waist and hip circumference and blood pressure. Social classes were graded into socioeconomic status 1–5 according to the British Registrar General and other Indian studies based on scores of education, occupation, housing conditions, ownership of consumer durables and per capita occupational and other incomes of the family.[1] Educational status was assessed by finding out the number of years of education calculated from the highest class achieved in the school. Subjects were divided into social class 1 (n = 985), social class 2 (n = 790), social class 3 (n =774), social class 4 (n = 602) and social class 5 (n = 206) based on socioeconomic status. Social class 1 was the highest social class and 5 was the lowest social class. Bodyweights were measured by the dietitian independently, in light underclothes to the nearest of 0.5 kg. Height was measured in a standing position. Waist and hip girths were measured with the subject standing. Waist girth was measured as the smallest horizontal girth between the costal margin and the iliac crests. The hip girth was measured as the greatest circumference at the levels of the greater trochanters.

Dietary intakes were obtained by 7 day food intake record diaries on 7 consecutive days for each subject, throughout the year by means of a validated questionnaire. Food models, food measures, food portions and help from educated members of the family were taken to get information on dietary intakes in subjects of this study. A cross-check questionnaire was filled based on diaries to obtain more accurate food intake in an individual. Body mass index (BMI) was calculated and obesity defined as >27 kg/m^2 and overweight as >25 kg/m^2. General obesity was defined when the waist-hip ratio was >0.85. Smoking was defined when tobacco was consumed at least once in a week, in any form, for example, chewing or smoking. Subjects who admitted to drinking alcohol at least once per week were categorised as alcohol consuming. Alcohol intake is rare in Indian women. Sedentary lifestyle was assessed based on occupational or household activities and spare time activities according to the Indian classification of activities as described earlier for the Moradabad sample.[1] Energy cost of activities were calculated from the tables.[11] Cessation of menstruation at least for the last 1 year was considered menopause.

Statistical analysis

All P values were two-tailed and significance was taken as $P < 0.05$. Due to a lack of difference across the five centres and the differences in social class composition, data were pooled from all the five centres and mean values expressed 1SD. Prevalences are given as percentages. We used χ^2 test to determine the significance of trends in the prevalence of risk factors in various social classes. The Mantel–Haenzel statistic (which tests for linear association) was determined. We also calculated the Spearman's coefficient of correlation between levels of social class and the mean of the independent variables within each class. Food intakes were obtained at various levels of social class and the significance of trends was checked with Kendall's t. Z score test for proportions and Student's t-test were used for checking the significance in intercity comparisons.

Results

The social class categories among the total 3257 women showed that social class 5 subjects were significantly lower ($P < 0.05$) in Trivandrum (2.7%) compared to Moradabad (9.3%), Nagpur (9.1%), Calcutta (6.0%) and Bombay (5.0%). The overall percentage of social class 1–3 subjects was 75.2% (n = 2445). However, social class 1–3 subjects were more common ($P < 0.05$) in Trivandrum (79.9%) and Bombay (77.3%) compared to Moradabad (70.6%) (Table 1). The consumption of total food as well as wheat, rice and millets was significantly greater ($P < 0.05$) in Trivandrum and Bombay compared to other cities. Total visible fat intake, total fruit, vegetable and legume intake were slightly higher in Calcutta, Nagpur and Bombay, where staple oils are mustard and ground nut oils, respectively. In Trivandrum, the source of visible fat is coconut oil and fish intake is quite high.

Table 2 shows the mean quantity of various food intakes in different social classes among the total number of women. An increasing level of social classes from 5 to 1 were associated with a greater consumption of total visible fat, milk and milk products, sugar and confectionery, as well as meat and eggs and these trends were significant. However, the consumption of wheat, rice, millets and also the ratio of total fruit, vegetable and legumes/total visible fat showed inverse association with social class. Body mass index showed a decreasing trend with a decrease in social class from 1 to 5. Social class 5 subjects had a lower intake of all the foods and lower BMI, which is suggestive of a higher rate of undernutrition among them. Total fruit, vegetable and legume intake showed no association with social class.

An increasing level of social class was associated with a higher prevalence of obesity, overweight, central obesity and sedentary lifestyle. Salt intake and tobacco consumption were not associated with social class. Alcohol consumption was very rare in women (Table 3). Table 4 shows that there was significant positive rank correlation of the level of social class with mean bodyweight, BMI, total visible fat intakes, milk and milk products, meat, egg, sugar and confectionery intake. Wheat, rice and millet intakes were negatively corre-

Table 1. Food consumption pattern and body mass index of women in five cities

Foods (g/day)	Moradabad (*n* = 902)	Trivandrum (*n* = 760)	Calcutta (*n* = 410)	Nagpur (*n* = 405)	Bombay (*n* = 780)
Body mass index	22.5 ± 4	22.6 ± 4	22.3 ± 4	22.6 ± 4	23.1 ± 4
Wheat, rice, millets (kg/m^2)	245 ± 25	328 ± 22	268 ± 25	213 ± 41	354 ± 35
Roots and tubers	74 ± 10	108 ± 12	94 ± 10	112 ± 27	67 ± 12
Nuts and oil seeds	44 ± 1	116 ± 13	2.6 ± 0.5	5 ± 1	4 ± 1
Pulses (legumes)	38 ± 6	30 ± 5	28.01	56 ± 21	56 ± 17
Vegetables	70 ± 6	102 ± 10	148 ± 26	80 ± 23	128 ± 25
Fruits	76 ± 10	40 ± 7	109 ± 18	80 ± 5	103 ± 18
Milk and milk products	232 ± 16	120 ± 16	189 ± 32	151 ± 41	152 ± 50
Sugar and confectionery	34 ± 5	56 ± 6	24 ± 6	43 ± 21	30 ± 8
Total visible fat	22.8 ± 14	27.6 ± 14	35 ± 18	51 ± 16	36.0 ± 17
Indian ghee	7.8 ± 1	—	0.6 ± 0.2	3.1 ± 0.4	2.4 ± 0.6
Butter	2.6 ± 0.1	2.2 ± 0.4	0.6 ± 0.2	1.9 ± 0.3	1.9 ± 0.7
Vegetable ghee	9.4 ± 1.8	—	0.2 ± 0.01	2.0 ± 0.4	3.1 ± 0.4
Refined oils	2.0 ± 0.6	2.8 ± 0.6	—	44.0 ± 10	28.6 ± 8.6
Oils	1.8 ± 0.3	22.6 ± 13	30 ± 15	—	—
Meat and eggs	3.8 ± 1	7.2 ± 2	1.6 ± 0.5	1.5 ± 0.3	38 ± 11
Fish	—	202 ± 15	56 ± 12	—	29 ± 9
Total foods	800 ± 132	1191 ± 202	955 ± 156	792 ± 190	1194 ± 185
Total fruits, vegetable and pulses	184 ± 16	172 ± 18	285 ± 35	215 ± 25	287 ± 37
Social class					
1–3(%)	70.6	79.9	73.9	73.1	77.3
Staple oil	Mustard Oil + vegetable ghee	Coconut oil	Mustard oil	Ground nut oil	Ground nut oil veg.ghee

Vegetable ghee = trans fatty acid, Indian ghee = clarified butter (figures were rounded). – indicate no data.. All data entries are given as mean ± SD.

Table 2. Food intakes (g/day) in relation to social class

Pro-atherogenic foods	Milk and milk products	Sugar and confectionery	Indian ghee	Butter	Veg. ghee	Veg. oils	Total visible fat	FVL foods fat ratio	Meat and eggs
Social class 1	196 ± 71	52 ± 71	3.8	2.1	3.1	36 ± 6	45 ± 18	5.0 ± 2	16 ± 6
Social class 2	183 ± 62	42 ± 12	2.7	2.0	2.1	29 ± 4	34 ± 15	6.5 ± 2	14 ± 5
Social class 3	170 ± 52	32 ± 15	1.6	1.5	1.8	24 ±	27 ± 12	9.4 ± 3	10 ± 4
Social class 4	162 ± 55	25 ± 8	–	1.0	2.4	19 ±	22 ± 9	9.5 ± 4	8 ± 4
Social class 5	35 ± 12	13 ± 3	–	–	2.2	5.2	8 ± 4	17.5 ± 5	3 ± 1
Total	171 ± 62	38 ± 18	2.8	1.84	2.94	26.4	32 ± 21	7.9 ± 1.8	12 ± 4
Kendall's *t*	0.071**	0.041*	0.039*	0.028*	0.19	0.052**	0.068**	0.048*	0.038*
Social class	**Wheat, rice, millets (g/day)**	**Root and tubers**	**Pulses, legumes**	**Vegetables and fruits**	**Total FVL**	**Nuts and oil seeds**	**Fish**	**Total foods**	**BMI(kg/m^2)**
Social class 1 (*n* = 985)	267 ± 36	76 ± 20	36 ± 10	189 ± 40	225 ± 55	23 ± 4.1	45 ± 7	988 ± 182	24.1 ± 4.7
Social class 2 (*n* = 790)	298 ± 47	96 ± 22	40 ± 12	182 ± 35	222 ± 51	31 ± 5.5	52 ± 12	981 ± 175	23.8 ± 4.4
Social class 3 (*n* = 774)	325 ± 58	121 ± 25	51 ± 15	205 ± 42	256 ± 38	40 ± 6.8	64 ± 15	995 ± 183	22.0 ± 4.0
Social class 4 (*n* = 602)	356 ± 48	124 ± 26	48 ± 16	162 ± 36	210 ± 32	41 ± 7.1	61 ± 13	1052 ± 212	21.2 ± 3.8
Social class 5 (*n* = 206)	252 ± 41	80 ± 18	26 ± 8	114 ± 25	140 ± 26	32 ± 5.4	42 ± 10	922 ± 176	19.4 ± 3.5
Total (*n* = 3357)	302 ± 56	104 ± 21	41 ± 11	181 ± 28	222 ± 30	34 ± 6.3	57 ± 16	986 ± 205	22.7 ± 2.8
Kendall's *t*	0.041*	0.018	0.019	0.22	0.025	0.022	0.018	0.028	0.066**

*$P < 0.05$, **$P < 0.01$, FVL, fruit,vegetable, legume; BMI, body mass index (figures were rounded).

Table 3. Prevalence of risk factors *n* (%) of chronic diseases in relation to social class

Social classes	BMI (>27 kg/m)	BMI (>25 kg/m^2)	Central obesity (WHR >0.85)	Sedentary life style	Salt intake (> 6 g/day)	Tobacco users (>once/week)
Social class 1 (*n* = 985)	209(21.2)	612(62.1)	955(96.9)	908(92.2)	496(50.3)	81(8.1)
Social class 2 (*n* = 790)	130(16.4)	395^{500}	452(57.2)	564(71.4)	421(53.3)	47(5.9)
Social class 3 (*n* = 774)	60(8.9)	331(19.5)	265(39.3)	285(42.3)	451(66.9)	45(6.7)
Social class 4 (*n* = 602)	18(3.0)	39(6.4)	72(11.9)	90(14.9)	398(66.1)	48(7.9)
Social class 5 (*n* = 206)	8(3.8)	12(5.8)	18(8.7)	18(8.7)	123(59.7)	18(8.7)
Total (*n* = 3357)	425(13.0)	1189(36.5)	1762(54.0)	1865(57.2)	1889(58.0)	241(7.4)
Mantel–Haenzel $\chi 2$	7.55	12.17	11.66	12.65	3.14	3.16
P-Value	<0.01	<0.001	<0.001	<0.01	<0.09	<0.09

BMI, body mass index.

Table 4. Mean levels of food intake and body mass index and their correlation with social class (Spearman's rank correlation)

Food intakes and risk factor	Mean ± SD	*r*
Bodyweight (kg)	52.3 ± 15	0.09*
Body mass index (kg/m^2)	22.7 ± 2.8	0.07*
Wheat, rice, millets (g/day)	302 ± 56	0.08*
FVL (g/day)	222 ± 30	0.05
Total visible fat (g/day)	32 ± 21	0.13**
Milk and milk products (g/day)	171 ± 62	0.12**
Meat and eggs (g/day)	12 ± 4	0.07*
Sugar and confectionery (g/day)	38 ± 18	0.09*

*$P < 0.05$, **$P < 0.01$, FVL, fruit, vegetables and legumes.

lated with social class and fruits, vegetable and legume intake showed no correlation with social class (Table 4).

Discussion

This study shows that the consumption of pro-atherogenic foods; total visible fat, milk and milk products, meat, eggs and also sugar and confectionery were significantly increased in higher social classes. Mean BMI, obesity, overweight, central obesity and sedentary lifestyle were also significantly more common among subjects with higher social classes compared to the lower social classes. Higher social classes 1–3 subjects were significantly more common in Trivandrum and Bombay compared to Moradabad.

Diet, lifestyle factors and cardiovascular disease in relation to social class have not been studied adequately in Indians and in other developing countries. The few studies which have examined this question indicate that hypertension and coronary risk increases with higher social classes. These problems are more common among wealthier groups with sedentary occupations consuming high fat diets.[12,13] National surveys conducted by the National Nutrition Monitoring Bureau and Food and Nutrition Board indicate that the consumption of dietary fat, milk, flesh foods and eggs, combined with a sedentary lifestyle were associated with higher socioeconomic groups in Indians. Our study showed that the consumption of these foods was significantly decreased in lower social classes. It is possible that the higher cost of these foods was not within the limits of poor socioeconomic groups.

In one study from north India, the range of daily intake of visible fat was 41.8–51.4% energy of total fats in various socioeconomic groups.[14] However, total visible fat intake was significantly lower in low socioeconomic groups compared to middle and high socioeconomic groups, respectively (45.5 *vs* 62.4, 59.5 g/day). This study did not include subjects in social class 5 and the criteria for social classes were incomplete and poorly defined.[14] In Madras City, the visible fat intake, depending on social class, ranged from 10 g/day in slum dwellers to 40 g/day in high social classes.[2,3] In our study, the visible fat intake ranged from 45 g/day in high social class 1 to 8 g/day in lower social class 5. According to national surveys in ten states of India, total dietary fat intake per day per subject is significantly higher in the states of Gujrat followed by Punjab, Orissa, Maharastra, Kerala and West Bengal. It is important to note that Orissa and Kerala are considered poor states.[3] It is possible that traditional and cultural factors common in Orissa and the easy availability of coconut oil and coconut at an affordable cost in Kerala allow these populations to consume more fat than other rich states of India. In our study, the total visible fat intake was 51 g/day in Nagpur, Maharastra which was greater than Moradabad in north India (22.8 g/day), Trivandrum, Kerala (27.6 g/day), Calcutta in West Bengal (35 g/day) and Bombay (36 g/day) metro city. Our data for Trivandrum (Kerala) are not consistent with the data from the national survey, because we compared only visible fat intake. Invisible fat intake in the form of coconut was highest in Trivandrum, Kerala as reported in the national surveys.[3]

We also observed that subjects in social classes 4 and 5 were poor, unskilled workers whose earnings were irregular which did not allow them to consume adequate food. However, in social classes 1–3, the subjects were professionals, wives of businessmen, shopkeepers and skilled workers who are usually household workers. These classes of women were consuming a higher amount of pro-atherogenic food and had helpers for household work, resulting in a higher prevalence of sedentary lifestyle among them. Occupational and household physical activity is usually higher in social classes 4 and 5, because of their physically demanding occupations and lack of comfortable transport to workplace and domestic help for household work. High occupational physical activity and lower intake of visible fat, milk and flesh foods in lower social classes have also been described by other workers from India and other developing countries.[2,7,14] Dietary fat is very conducive to weight gain, therefore higher dietary fat intake and low physical activity may be the cause of higher BMI, obesity, overweight and central obesity in higher social classes 1–3. It is clear from this study, that the socioeconomic status of Indian urban women from various regions of India may be classified into social classes 1–5 based on attributes of occupation, educational status, housing condition, per capita monthly income and ownership of consumer durables. The estimates appear to be accurate and may be applicable to the whole of India, provided a long-term follow-up study confirms these results. Higher social classes also had a higher prevalence of hypertension and other coronary risk factors, as reported earlier, indicating epidemiological transition of patterns of cardiovascular diseases in Indians.[9,10,15] However, the pattern has not yet reversed even among Indian immigrants to Singapore, who have higher mortality and risk factors of heart diseases than Chinese and Malays.[16–20]

In brief, the results of our study indicate that higher social class women consume higher amounts of pro-atherogenic foods and had higher levels of other coronary risk factors; high BMI, obesity, central obesity and sedentary lifestyle than lower social classes.

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