Risk factor profile of non-communicable diseases among middle-income (18-65 years) free-living urban population of India

Meenakshi Bakshi Mehan, Somila Surabhi, Gautami T. Solanki
Department of Foods and Nutrition, MS University of Baroda, Baroda, Gujarat, India

AIM: Profile of non-communicable disease risk factors identified in free-living middle-income population (18-65 years) of an urban Indian city by WHO’s STEPS Questionnaire. SETTINGS AND DESIGN: Subjects (121) were selected after systematic random sampling of households from two geographical zones. METHODOLOGY: Behavioral risk factor profile and history of hypertension and diabetes (STEP I) were obtained by interview technique, followed by anthropometric measurements (STEP II) and biochemical assessment (STEP III) of ‘at risk’ subjects (≥3 risk factors). STATISTICAL ANALYSIS: Percentage calculation of subjects having noncommunicable diseases (NCDs) risk factors and odds ratios between risk factors and NCDs. RESULTS: Majority (76%) of the subjects had low daily intakes of vegetables and fruits, followed by physical inactivity and high waist-to-hip ratios (74.4 and 72% respectively). High BMI (≥23 kg/m²) was present in 54.5%, and 42.1% had high waist circumference. History of diabetes (32.2%), tobacco usage habit (in any form, 22.3%), history of hypertension (6.6%) and alcohol usage habit (5%) were also prevalent. About 48.8% of the subjects were identified at risk (≥3 risk factors), with 68.8% prevalence of low HDL-C levels. Equal percent (37.5) of subjects suffered from metabolic syndrome and high triglyceride levels, followed closely (34.4%) by adverse TC/HDL ratios. About one-fourth of ‘at risk’ subjects reported diabetes. CONCLUSIONS: A very high prevalence of NCD risk factors in middle-income free-living productive populations necessitates public health programs to be planned for this population to curtail the rising epidemic of NCDs.

KEY WORDS: Free-living population, non-communicable diseases, productive populations, risk factors, urban

Non-communicable diseases (NCDs), especially cardiovascular diseases, cancers and type 2 diabetes mellitus, account for 53 and 44% of all deaths and disability-adjusted life years (DALYs) respectively in India.[1] Cardiovascular disease (CVD) deaths are concentrated in people of working age between 35 and 64 years, in whom 35% of CVD deaths occur.[2] Prevalence of diabetes and its adverse health effects have risen more rapidly in south Asia, including India. By 2030, while most people with diabetes in developed countries will be aged 65 years or more, in the developing countries the majority will be in the 45-64 years age bracket and affected in their most productive years.[1,3] Cancer accounted for 14% mortality in the SEA region in 2002;[4,5] and in India alone in the year 2005, 7% deaths were attributed to cancers.[6]

Unhealthy diets and physical inactivity are the leading causes of major non-communicable diseases. The important risk factors identified are high blood pressure, high concentration of cholesterol in the blood, inadequate intake of fruits and vegetables, overweight and obesity, physical inactivity and tobacco use. Smoking also increases the risk for these diseases, although largely through independent mechanisms.[6–8] These factors are interrelated to each other, so much so that appearance/occurrence of one factor paves the way for the other, thereby leading to the development of NCDs.[6] Risk operates in continuum with adverse events in persons with modest elevation of many risk factors, having multiplicative effect.[8] Therefore, primordial prevention of occurrence of risk factors along with their early identification and management can help delay the progress to non-communicable diseases. Similarly, since the underlying (risk) factors for all the NCDs are common, identifying and modifying these risk factors have been recommended as a strategy for their prevention and control in various settings.[8,9]
WHO’s STEPS methodology provides framework for the surveillance of risk factors of NCDs.[10,11] Free-living middle-income productive populations need special attention owing to their changing lifestyles; therefore, this study was planned with an objective to identify the risk factors of NCDs in middle-income categories of an urban city of India. The results could help in sensitizing the government to the health risks of productive populations, in order to design strategies for their prevention and control.

**Methodology**

**Selection of sample**
Two zones of an urban city were selected for the study. All the adults between 18 and 65 years of age in each household were enrolled as study subjects. In the northern zone, colonies (middle income) were purposively selected with households having ≤2 bedrooms. In the north zone, from 12 households, 30 subjects consented to participate in the study. Selection of subjects from the western zone was different, as in this zone five colonies were randomly selected and 91 subjects from 30 households (having ≤2 bedrooms) were taken as study subjects. The semi-structured questionnaire of WHO STEPS method was used for studying the behavioral risk factor profile. Prior to the study, the questionnaire was pre-tested on 15 individuals in the age group of 20-65 years other than the individuals enrolled as ‘sample’ of the study.

**STEP I: Socio-economic and behavioral risk profile**
The information on the socio-economic status and behavioral risk factors of the subjects was collected with the help of STEPS questionnaire by using interview technique. This step focused on self-reported information on risk factors like tobacco usage (cigarette/rolled tobacco smoking, oral and snuff tobacco), alcohol consumption and average amount consumed in a day. A standard measure of 60 ml was used to obtain information on amount of alcohol consumed. Dietary and physical activity pattern and past history of hypertension and diabetes were also obtained. Information on total fruits and vegetables consumed daily, excluding tubers, was obtained by asking the serving size (100 gm of fruits and vegetable consumed was taken as one serving) of consumed vegetables and fruits in the last 24 h, with the help of standard cups (200 ml), which was also cross-checked by obtaining information about the amount of fresh fruits and vegetables purchased by the family every day and its portion that was consumed by the target subject. Type of physical activity undertaken by the subjects was assessed by guidelines provided by the center for disease control (CDC).[12] Based on the guidelines, activities undertaken as part of work, travel and leisure were measured and classified as mild, moderate and heavy intensity. The subjects undertaking at least 30 min of moderate-intensity activity daily in any sphere of their daily routine (activities during working hours, traveling and leisure) were considered as active. For assessing physical activity while traveling, information was obtained on of the mode of travel, viz., motorized vehicle, cycle or walking. The usage of motorized vehicle was considered as light activity. Usage of bicycle (<30 min) or walking (<20 min) was considered to be moderate activity; while if more time (>20–30 min) was spent on each activity, it was considered heavy.

**STEP II: Physical measurements**
Anthropometric measurements like weight, height, waist circumference and hip girth were taken. Sub optimal high blood pressure (≥120/80 mmHg) is the leading risk factor for noncommunicable diseases and is therefore included as a risk factor in WHO STEPS methodology. However, overall prevalence of diabetes was based on history only. The indices of body mass index (BMI) and waist circumference (WC), waist-hip ratio (WHR) were calculated from recorded measurements. Classification of overweight and obesity was done by global and Asia-Pacific classifications.[13] Central obesity was determined based on Lean et al. and Webb[14,15] and Indo-Asian classification.[16]

**STEP III: Biochemical estimations of the ‘at risk’ individuals**
The subjects having ≥3 behavioral and/or anthropometric risk factors from STEP I and II were identified as ‘at risk’ subjects. Those who consented to give blood sample were assessed biochemically for parameters like fasting blood glucose, fasting total cholesterol and triglycerides and HDL cholesterol levels by using standard methods.[17]

**Statistical analysis**
Data were analyzed using Epi-info version 6.04d computer package developed by Center for Disease Control and Prevention (CDC), U.S.A.; and WHO, Geneva. All values were expressed as percentages for qualitative variables, with mean ± SD calculated for quantitative variables. Odd’s ratios were calculated...
between risk factors and NCDs.

Results

Socioeconomic and behavioral risk factor profile of the selected study subjects (STEP I).

About 88.4% of the 121 subjects studied were in the age group of 18-59 years, which are considered the potentially productive years of life. Almost two-thirds of the subjects were in the age group of 18-44 years (64.5%), and 24% were from the age group of 45-59 years. Very small percentage of the subjects (11.6%) were in the age group of ≥60 years. Also, the study subjects comprised of a higher percentage of females (53.7%) compared to males (46.3%). Majority of the subjects (84.3%) were having a nuclear type of family and were educated up to either graduate level (62.8%) or up to high school level (14.9%). The monthly income of the subjects ranged from Rs. 1,000 per month to as high as Rs. 20,000 per month; however, majority of the subjects had their income ranging from Rs. 5,001 to 10,000 per month (67%) or Rs. 10,001 to 15,000 (13.2%), suggesting that majority of the subjects belonged to the middle class. Majority (94.2%) of the subjects were Hindus, while there were very few Muslims (2.5%). With regard to work status, 33.1% were homemakers, followed by 28.1% non-government employees, 13.2% self-employed, 10.7% government employees, 9.9% retired persons and 5% students.

Smoking and tobacco usage: Total tobacco usage habit, in any form, in both males and females in the free-living population of the urban city was 22.3%. Regarding type of tobacco usage habit, the data revealed that the habit of using oral tobacco and cigarettes/rolled tobacco was the highest (44.6%) in males, followed by smoking cigarettes alone in 28.6% of the males. Oral tobacco usage alone was only 16.1% in males. Fewer females, however, indulged in this unhealthy behavior; and even in those who had tobacco usage habit, use of both oral tobacco and cigarette was 3.1%.

Alcohol usage: About 5% of the study subjects had the habit of alcohol consumption. Alcohol consumption was more prevalent in males than in females (7.1% vs. 3.1%). Regarding the amount of alcohol consumed daily in the preceding 7 days, the majority (50%) of those who consumed alcohol were males who consumed beyond the prescribed limit for alcohol consumption (>2 standard drinks/day).

Fruit and vegetable intake: Overall, the mean (± SD) total daily vegetable and fruit intake was higher among males than females (320.53 ± 76.73 vs. 286.92 ± 83.04). Both the intake of fruits (136.6 ± 68.41 and 127.69 ± 51.56 males and females respectively) and vegetables (183.92 ± 37.05 and 159.23 ± 49.55 males and females respectively) was more among males than females, although in both sexes the intake was far below the recommended levels (400-500 gm/day). Thus, it can be concluded that the mean intake of the subjects reflected lower intake than the optimal level recommended by World Health Organization (5). About 76% of the subjects had less than the recommended (400-500 gm/day) intake of vegetable and fruits. Almost 21.5% of the subjects had the optimal intake of 400-499 gm/day, and about 2.5% consumed more than 500 gm per day. Females had lower intake of vegetables and fruits compared to males (76.9% vs. 75%).

Cooking medium used: The most common form of cooking oil used was cotton seed oil (52.9%), followed by groundnut oil (47.1%). Surprisingly, among the study subjects nobody used blended oils.

Physical activity: Physical activity of the study subjects was defined in three spheres of their daily routine, viz., physical activity at work, physical activity while traveling and physical activity during leisure time, depicting the level of physical activity of the subjects in three spheres. Only four subjects (3.3%) were involved in heavy activity at work like heavy housework, dealing with heavy machineries, etc.; while 9.9% were engaged in doing moderate activity like climbing stairs, walking as break from work, brisk walking at the workplace, playing table tennis in the gymnasium, etc. Majority of the subjects (86.8%) were sedentary at work, e.g., table work, sitting in front of the computer, paperwork, cooking and other such light activities. For assessing physical activity while traveling, information was obtained on usage of motorized vehicle/bicycle or walking. The usage of bicycle for <30 min or walking for <20 min was considered to be moderate activity, and >20-30 min spent for walking to workplace or using bicycle as mode of transportation was considered heavy. Almost 38%, of the subjects used motorized vehicle for travel, while 62% of the subjects had the habit of walking/cycling for short distances. During leisure time, more than half of the study subjects (81%) engaged in light activities like watching TV, reading books/newspaper, etc., while 14% was involved in moderate activities like walking for pleasure, playing badminton, gardening, etc.
Surprisingly, 5% of the study subjects were involved in heavy activities like swimming, horse riding, playing cricket, etc. Subjects involved in moderate activity for 30 min daily for at least 5 days in a week/2.5 h of moderate activity per week were considered as active. By these criteria, overall, physical inactivity was seen in 74.4% of the study population, of which 81.5% were females and 66.1% were males.

**History of hypertension and diabetes:** At the end of STEP I, about 32.2 and 6.6% of the study subjects were found to have history of diabetes and hypertension respectively. There were more males with history of diabetes (33.9% vs. 30.8%) and hypertension (8.9% vs. 4.6%) as compared to their female counterparts.

Risk factor profile after STEP I is summarized in Figure 1.

### Physical/anthropometric measurements of the study subjects (STEP II)

BMI of the study subjects was classified according to two different classifications - namely, WHO classification and the classification recommended for Asia-Pacific population. The prevalence of high BMI (overweight + obesity) in the study subjects was 54.5% ($\geq 23 \text{ kg/m}^2$) and 29.8% ($\geq 25 \text{ kg/m}^2$) respectively depending upon the criteria used to define high BMI. The prevalence of obesity in the study subjects was 29.8% by Asia-Pacific classification and 4.1% by WHO classification. The prevalence of high BMI (overweight + obesity) in males was higher as compared to females irrespective of the classification used. The prevalence of suboptimal BMI ($\geq 23 \text{ kg/m}^2$) was 57.1% in males as compared to 52.3% in females. Similar trends [Figure 2] were observed on taking the cutoff as $\geq 25 \text{ kg/m}^2$ (32.1% in males and 27.7% in females). Similarly, the prevalence of obesity in males was higher than in females by Asia-Pacific classification (32.1% vs. 27.7%). However, by WHO global criteria only females (7.7%) were found to be obese. Abdominal/central obesity was present in 42% and 72% by high WC and high WHR respectively. Contrary to the BMI trends, which showed higher prevalence of suboptimal BMI in males, central obesity when measured by WC or WHR was more prevalent in females, suggesting that women were at higher risk for developing CVD and its complications [Figure 3]. At the end of STEP I
and STEP II, none of the subjects were found to be free from any risk factors, while most of the subjects (39.7%) had two risk factors, followed by presence of one risk factor (11.6%). At the end of Step I and Step II, a total of 59 (48.8%) subjects were identified at risk (≥3 risk factors). Amongst ‘at risk’ subjects [Table 1] also, higher percentage of males were identified at risk as compared to females (51.8% vs. 46.2%). The risk factor profile after STEP I and II is shown in Figure 4.

**Biochemical assessment of ‘at risk’ study subjects (STEP III)**

STEP III was aimed at conducting biochemical assessment for fasting blood sugar, triglycerides, cholesterol levels and lipid profile in subjects having ≥3 risk factors, who were identified as ‘at risk’ subjects. Of the total identified ‘at risk’ subjects (48.8%), only 54.2% consented for biochemical assessment.

Among ‘at risk’ subjects, 68.8% had low HDL-C levels (<40 mg/dl in males and <50 mg/dl in females), followed by 37.5% subjects with high triglyceride levels (≥150 mg/dl) and equal percentage with metabolic syndrome (presence of any three out of the five risk factors: increased WC – ≥102 cm in men and ≥88 cm in women; TG ≥150 mg/dl; decreased HDL ≤40 mg/dl in males and <50 mg/dl in females; BP >130/>85; glucose above 125 mg/dl) was 37.5%. Adverse TC/HDL ratios (≥4.5) were seen in 34.4% of subjects, and the prevalence of diabetes (fasting blood sugar level ≥125 mg/dl) was 25%. About 15.6% of the subjects had blood cholesterol levels above 200 mg/dl [Figure 5].

**Relationship of various risk factors with NCDs**

No significant association was found between the risk factors and the prevalence of history of hypertension in males and females. This could be attributed to under-estimation of prevalence of hypertension in the study subjects as 50% of the study subjects had never got their blood pressure checked, thereby being unaware of their health status. Similarly, there was no significant association between risk factors and history of diabetes.

**Discussion**

The risk factors of today are the diseases of tomorrow. Identifying these risk factors in populations occupies a central place in the surveillance system because of the importance of the lag time between exposure and disease. Therefore, public health strategies have to be driven by the motive of identifying risk factors in populations, and countries need to know the profile of risk factors of populations in different settings.\[11\]

The results of the present study reveal that the mean fruits and vegetable intakes of study subjects were higher than that reported for SEAR region. The mean fruit and vegetable intake in the SEAR has been reported to be 236 gm/day, which itself is one-third of the optimal level.\[6\] Since the population studied in the present study was middle-income group, affordability of fruits and vegetables could be an issue, thereby suggesting

### Table 1: Number of noncommunicable disease (NCD) risk factors present in productive populations of urban India in 2006 at the end of STEP I and II

<table>
<thead>
<tr>
<th>Risk factor</th>
<th>Males N</th>
<th>Males %</th>
<th>Females N</th>
<th>Females %</th>
<th>Total (121) N</th>
<th>Total (121) %</th>
</tr>
</thead>
<tbody>
<tr>
<td>No risk factors</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>One risk factor</td>
<td>6</td>
<td>10.7</td>
<td>8</td>
<td>12.3</td>
<td>14</td>
<td>11.6</td>
</tr>
<tr>
<td>Two risk factors</td>
<td>21</td>
<td>37.5</td>
<td>27</td>
<td>41.5</td>
<td>48</td>
<td>39.7</td>
</tr>
<tr>
<td>Three risk factors</td>
<td>5</td>
<td>8.9</td>
<td>11</td>
<td>16.9</td>
<td>16</td>
<td>13.2</td>
</tr>
<tr>
<td>Four risk factors</td>
<td>9</td>
<td>16.0</td>
<td>12</td>
<td>18.5</td>
<td>21</td>
<td>17.4</td>
</tr>
<tr>
<td>Five risk factors</td>
<td>11</td>
<td>19.6</td>
<td>5</td>
<td>7.7</td>
<td>16</td>
<td>13.2</td>
</tr>
<tr>
<td>More than five risk factors</td>
<td>4</td>
<td>7.1</td>
<td>2</td>
<td>3.1</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>At risk subjects (≥ 3 risks)</td>
<td>29</td>
<td>51.8</td>
<td>30</td>
<td>46.2</td>
<td>59</td>
<td>48.8</td>
</tr>
</tbody>
</table>

Total at risk subjects (males + females) 59 (48.8)
It was disturbing to note that history of diabetes in the study population was very high (32.2%; males - 33.9%, females - 30.76%) and was 25% in the ‘at risk’ population, having more than or equal to three risk factors. The history of diabetes in the present study, though quite high in both the sexes, was higher in males, which is supported by another study in which urban males in Jaipur had higher prevalence of diabetes than females (17.7% vs. 14.2%). Although no recent data on prevalence of diabetes based on history was available, a study reporting prevalence of diabetes across different regions of urban India revealed highest prevalence of diabetes in the western region (5.9%), followed closely by southern region (5.7%) in all age groups. No data was available for prevalence of diabetes in productive populations of urban Gujaratis. However, there is a need to substantiate the study findings in the western region by conducting a large-scale survey of diabetes in the region. Focused strategies for its prevention and control are required as the dietary pattern of Gujaratis consists of two heavy meals with abundant use of sugar and oil, and their lifestyle is sedentary; these are the risk factors for development of diabetes.

History of hypertension in the present study was 6.6%. Since in the present study only history of hypertension was taken, the results could be a fraction of the real situation as it is uncommon in India to go for regular checkups. (In the present study, only 50% of the study subjects had got any type of checkups done). Studies conducted in the past have demonstrated that on screening for hypertension a three times increase in prevalence is seen as compared to the reported history, thus suggesting a high percentage of prevalence of hypertension in the population.

Obesity is an important factor in the pathogenesis of hypertension, dyslipidemias, diabetes mellitus, which, together with hyperinsulinemia, make up the ‘deadly quartet’ for the metabolic syndrome. The results of the present study corroborate with the prevalence of obesity in India as depicted by WHO/SEAR-NCD profile in the range of 20-40% in the urban areas by the criteria of BMI ≥25 kg/m². In the present study also, obesity was seen in 29.8% of the study subjects with the criteria of BMI ≥25 kg/m², which is also supported by a study from urban industrial population of northern India demonstrating a prevalence of 43% obesity (BMI ≥25 kg/m²).
clearly demonstrated that the prevalence of obesity was higher in males compared to females; similar trends have earlier been reported by studies in industrial populations.[13,24] Very recently, much lower levels of WC measures (≥290 cm in men and ≥80 cm in women) than the levels suggested by WHO for defining the risk of central obesity in Indians have been proposed, and medically supervised weight management has been recommended as a strategy worth pursuing.[16] In the present study also, an attempt was made to classify the subjects based on the presence of abdominal obesity. About 42.1% of the population was found to have high waist circumference - above the proposed recommended levels for Indians - and 72% had higher waist:hip ratios. It was alarming to note that females had higher abdominal obesity than males by both the criteria used for its measurement (WC 70.5% in females vs. 8.9% in males; WHR 98.5% in females vs. 41.1% in males). Similar trends were also seen in a study of the Jaipur population - that females had higher truncal obesity than males (WC 55.6% vs. 34.5%; WHR 80.2% vs. 77.4%).[21]

The study clearly demonstrated that a very high percentage (68.8%) of the study subjects had low HDL-C levels, also supporting the high prevalence of physical inactivity (74.4%) seen in the population. About 40% of the identified ‘at risk’ population had dyslipidemias, metabolic syndrome and hypertriglyceridemia. It was disturbing to note the risk factors of NCDs were quite high in free-living subjects, being affected in their peak productive years of life (18-59 years), in the middle-income populations. Thus the study clearly demonstrated that as a public health care approach, conducting ‘risk factor’ profile by STEPS approach can be recommended as a strategy for action in a population setting wherein biochemical assessment could be restricted for those having a cluster of risk factors.

The study demonstrated high prevalence of CVD and its risk factors against a background of poor awareness among productive populations of the urban city of India considered in the present study. The study thus supports the findings of high prevalence of risk factors, especially CVD risk factors, in productive populations in India and abroad. The recent estimate of loss of 9.2 million potentially productive years of life in India in the year 2000 due to CVD thus calls for an urgent need for action at all levels to control the emerging epidemic of NCDs.[1-3]

Therefore, it is important that government and health officials are sensitized about the emerging public health problem, and efforts and strategies are planned to combat this rising epidemic. Focused communication strategies, including media programs, need to be worked out for the populations for prevention of these disorders.

References


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