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Original Research Article

Risk factor profile for non-communicable diseases: findings of a STEPS survey from urban settlement of Bangalore

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ABSTRACT

Background: Increasing burden of non-communicable diseases (NCDs) across the globe is largely due to the rise in prevalence of various risk factors. These risk factors are measurable and largely modifiable. Quantifying the present levels of risk factors exposure in a community is helpful in predicting the future risk and driving the public health policy for prevention and control of NCDs. Keeping this in mind, present study was planned to estimate the prevalence of NCDs risk factors in an urban settlement of Bangalore.
Methods: A community based cross-sectional survey was done with 600 individuals aged 15-64 years in Hegganahalli locality of Bangalore city from April to October 2017. Systematic random sampling technique was applied to obtain the desired sample size. Information on NCD risk factors was collected by using STEPS questionnaire.
Results: Tobacco and alcohol consumption was observed in 27.2% and 11.8% of respondents respectively. Low level of physical activity was recorded among 14.8% and inadequate consumption of fruit and vegetable was observed among all the respondents. Prevalence of general and central obesity in the study population was found to be 30.7% and 12.8% respectively. Hypertension was prevalent among 35.5% respondents.
Conclusions: High prevalence of NCD risk factors was observed among the study population that needs to be addressed through a comprehensive approach with due emphasis on preventive care in order to make 'healthy living' a social norm.

Keywords: Non-communicable diseases, Risk factors, Prevalence, Bangalore

INTRODUCTION

Among the major health transitions of 21st century, the most globally pervasive change has been the rising burden of non-communicable diseases (NCDs). NCDs have replaced communicable diseases as the most common causes of morbidity and premature mortality worldwide. Overall, 38 million people died every year due to NCDs; out of which, 28 million deaths occur in low and middle income countries.[1]

In India, NCDs claiming 5.87 million deaths every year.[2] 53% of all deaths were due to NCDs in 2011, this proportion increased upto 60% in 2014 and projections indicate a further increase to 67% by 2030.[3] According to estimate, there are 2.8 million cases of cancer, 39 million of chronic respiratory diseases, 64 million of cardiovascular diseases[4] and 69 million people with diabetes.[5]

This increasing magnitude of NCDs has also a huge impact on the economy of the country. As per estimates, the cumulative cost associated with NCDs was US$ 6.15

trillion in 2010.[6] A study reported that 39 million peoples in India are pushed into poverty every year, due to diagnostic and treatment costs associated with these NCDs.[7] The multi-dimensional effect of NCDs at individual, household, health system, and macroeconomic level, labeled them as the global 'chronic emergency'.

This emergence of NCDs epidemic is largely due to rise in the prevalence of various risk factors. World health organization have identified that most NCDs are a result of four particular lifestyle related behavioural risk factors like tobacco use, physical inactivity, unhealthy diet, and the harmful use of alcohol that lead to four key metabolic/physiological changes e.g., raised blood pressure, overweight/obesity, raised blood glucose and raised cholesterol levels.[8]

Evidence suggests that 40-50% of non-communicable disease related, premature deaths can be prevented, if risk factors are controlled. It is rational and makes perfect sense that the action to prevent these major chronic diseases should focus on controlling these risk factors.[8] These are measurable and thus continuing surveillance of the levels of risk factors in a community is of fundamental importance in NCD control.

City specific data on NCD risk factors prevalence, so crucial for planning and implementing the effective interventions for disease prevention and control, was therefore, lacking. This lack of quality health information was realized and a community-based cross-sectional survey was planned to estimate the prevalence of key risk factors for NCDs in a pre-identified urban settlement of Bangalore.

METHODS

Study area and duration

A survey based on the "Stepwise approach to NCD surveillance (STEPS)" was conducted in urban settlement (Hegganahalli, BBMP ward no.71) of Bangalore city from April to October 2017. This area was purposively selected due to easy accessibility and is about 3kms away from the institute. This study was conducted upto the level of step-II (questionnaire based assessment and physical measures). Biochemical measurements of step-III were not performed due to some technical and logistic limitations. The risk factor assessment incorporated all core modules as recommended by the WHO. The physical measurements (height, weight, waist circumference, blood pressure) were recorded in hegganahalli primary health centre within 1 week of recruitment and questionnaire based assessment was carried out in the environs of participants' residence.

Study design

Cross-sectional study design

Study population

The study population included household members aged 15-64 years living for at least 1 month in the defined area and who consented to participate in the study. Participants were stratified by sex and 10 year age group, with 120 participants in each stratum. Information about the number of households in the selected area was taken from census report of 2011.

Sample size and sampling techniques

The computation of optimum sample size was based on the formula mentioned below:[9]

$$N = \frac{[Z^2P(1-P)]}{d^2} x \frac{d_{eff}}{R}$$

Sample size for this study comes out 576 (increased to 600).

Sampling procedure

All the households in this area constituted the sampling frame. Systematic random sampling technique was applied to obtain the desired sample size. The sampling interval (k) was calculated as (k=N/n). The sampling was started by selecting an element from the list at random and then every k^{th} element in sampling frame was selected till the required sample size was achieved.

Method of data collection

Data was collected from individual households in the selected locality through house to house survey. Survey was carried out in morning as well as in evening hours to get maximum number of study subjects at home. Participants were eligible, if they were aged 15-64 years and had resided in the household for at least 1 month at the time of survey. When more than one individual in the household fulfilled the criteria, one member aged 15-64 was selected using the KISH Method. Selected households were followed up atleast twice in case of unavailability of the respondent on the first visit. A respondent who could not be contacted even after the second attempt was counted as a non-response.

Survey instrument

An adapted questionnaire for this survey was developed using steps I and II of WHO STEPS questionnaire. All the core components of the questions were incorporated. The questionnaire was designed in English, translated into the local language- Kannada, and pre-tested for any translation errors. Data was collected through face to face interviews using this questionnaire. In the first section (Step-I), information about sociodemographic characteristics of participants (age, sex, religion, marital status, education, occupation, and income) and on behavioral risk factor for NCDs (tobacco use, alcohol consumption,

fruits and vegetable intake and physical activity) was obtained. In the second section (Step-II), physical measurements of participants such as height, weight, waist circumference (not measured for pregnant women) and blood pressure were recorded.

Ascertainment of variables and operational definitions

Tobacco use

Information on tobacco use was collected for both smoking and smokeless forms. Those who smoke or use smokeless tobacco either daily or occasionally are considered as "Users" and those who never smoked/use tobacco in the lifetime are categorized as "Non-users''.

Alcohol use

Those who consumed one or more than one drink of any alcohol in the year preceding the survey are considered as "current drinkers/users" and those who have never consumed any type of alcohol in lifetime are categorized as "non-drinkers/non-users".

Fruits and vegetables intake

Respondents were asked for the number of days they ate fruits and vegetables in a typical week, and how many servings they ate on one of those days. Servings were measured by showing pictorial show-cards (for uncooked items) or measuring cups (cooked items). One cup of raw leafy vegetables or half cup of other vegetables (cooked) was considered as one serving. One medium-sized piece of fruit or half cup of chopped fruit was measured as one serving. Unhealthy diet was defined as consumption of less than five servings of fruits and vegetables per day.[10]

Physical activity

Physical activities were measured by asking the respondents about their weekly and daily vigorous and moderate activities during work and leisure time, and during transport, and the time spent in these activities. The physical activity status was determined by quartiles of the number of MET hours per week: physically inactive/sedentary (<40); light activity (40-83), moderate activity (83-103) and vigorous activity (>103) MET-hours per week.[11,12]

Anthropometric measurements

Headgear, footwear, and heavy clothing (jackets, coat etc.) were removed before measuring height (to the nearest 0.1 cm) and weight (to the nearest 0.1 kg) and body mass index (BMI) was calculated. Individuals were grouped as underweight if they had a BMI of <18.5 kg/m^2, normal (18.5-24.99 kg/m^2), overweight (25-29.99 kg/m^2) and obese ($\geq$30 kg/m^2).[13]

Waist circumference was measured to the nearest 0.1 cm at the narrowest point between lower end of the rib cage and iliac crest. The waist circumference of the study subjects had been classified as normal; <94 cm for men and <80 cm for women. As with a waist circumference of $\geq$94 cm among males and $\geq$80 cm among females is associated with a substantially high risk of metabolic and cardiovascular complication.[14]

Blood pressure

Blood pressure was measured using digital sphygmomanometer (OMRON HEM 7120, Omron Corporation, Kyoto, Japan) in mmHg on the right arm while the participants were in a sitting position after having a rest for at least 5 minutes. A second reading was taken after 2 minutes and the mean of these measurements were used in the analysis. Hypertension was defined as a systolic blood pressure of $\geq$140 mm of Hg and/or a diastolic blood pressure of $\geq$90 mm of Hg or the use of blood pressure lowering medications for hypertension.[15]

Data processing and analysis

All narrative data was collected under three predetermined broad categories: demographic information, behavioral risk factors and biological risk factors for NCDs. In order to ensure the quality of the data, each completed questionnaire was manually checked for completeness and consistencies before it was tabulated in Microsoft excel 2007. SPSS version 20 and Epi info 7 were used to calculate the descriptive and analytical statistics, in accordance with the WHO STEPS guidelines. Prevalence of different risk factors was determined. Multiple logistic regression models were constructed relating the behavioral risk factors, and biological risk factors as dependent variables which were modeled individually to the demographic variables (predictor) i.e. age, sex, gender, religion, marital status, socioeconomic status (modeled simultaneously). Association between behavioral (predictor) and biological (outcome) risk factors was also determined.

Ethics and consent procedure

The study was started following approval of the study protocol by the Institutional Ethical Committee, NIUM, Bangalore vide IEC No: NIUM/IEC/2015-16/020/ TST/05. Formal permission was taken from the concerned authorities in the selected locality. Verbal and written consents were obtained from each participant after explaining the purpose and procedure of the study in a simple language. They were also given opportunity to ask any question concerning the study. Respondents were informed that they could choose to or not to participate in the study. Only after they agreed to participate in the study, they were asked to sign the consent form and in case of illiterate persons their thumb impression was taken. The respondents were informed that all responses

would be noted down but would be kept confidential at all times. Privacy was ensured during the interview. Strict confidentiality was maintained in data handling.

RESULTS

Table 1 provides information on socio-demographic profile of respondents. A total of 600 respondents stratified by 10 years age group (five strata, 120 in each stratum) and sex (50% male and 50% female) were included. Hinduism was the predominant religion among the respondents (51.5%). More than half of the respondents (64%) were from upper lower socio-economic class. Majority (85%) of them were married.

Table 1: Sociodemographic characteristics of respondents (n=600).

Variables	Frequency N (%)
Age group (years)	
15-24	120 (20)
25-34	120 (20)
35-44	120 (20)
45-54	120 (20)
55-64	120 (20)
Gender	
Male	300 (50)
Female	300 (50)
Religion	
Hindu	309 (51.5)
Muslim	287 (47.8)
Christian	4 (0.7)
Marital status	
Married	510 (85.0)
Unmarried	84 (14.0)
Widow/divorced/separated	6 (1.0)
Socioeconomic status	
Upper	2 (0.4)
Middle	209 (34.8)
Lower	389 (64.8)

Table 2 provides information on prevalence of behavioral and biological risk factor for NCDs in the study population. Prevalence of current tobacco (smoking as well as smokeless form) and alcohol use among respondents was found to be 27.2% and 11.8% respectively. Low level of physical activity was prevalent among 14.8% respondents and inadequate consumption of fruits and vegetables was found among all the respondents. 30.7% respondents were found to be obese; central obesity was present among 12.8%. Hypertension was prevalent among 35.5% respondents.

Table 3 provides information on distribution of NCD risk factors in the study population according to socio-demographic characteristics. It was found in the study that prevalence of risk factors was highest in the age group of 55-64 years as compared to other age-groups. Furthermore, the survey revealed the gender differences in the distribution of NCD risk factors. Risk factors such as tobacco use, alcohol consumption, physical inactivity and hypertension were more prevalent among males; while obesity and central obesity were more prevalent among female.

Table 2: Distribution of NCD risk factors in study population (n=600).

Variables	Frequency N (%)
Tobacco use	
Non-users	437 (72.8)
Users	163 (27.2)
Alcohol use	
Non-users	529 (88.2)
Users	71 (11.8)
Physical activity	
Physically inactive	89 (14.8)
Physically active	511 (85.2)
Fruits and vegetables intake	
Appropriate intake	0 (0.0)
Inappropriate intake	600 (100)
Body mass index (Kg/m^2)	
Normal	416 (69.3)
Overweight/Obese	184 (30.7)
Waist circumference (cm)	
Normal	480 (80)
Above normal	77 (12.8)
Pregnant*	43 (7.2)
Blood pressure (mmHg)	
Normal	387 (64.5)
Hypertensive	213 (35.5)

*Waist circumference of pregnant women was not measured

Table 4 shows association of demographic variables with behavioural risk factors for NCDs. On multiple logistic regression, gender ($p<0.001$) and marital status ($p=0.046$) were found as the significant predictors for tobacco use. Male gender and married persons were associated with higher odds of tobacco use. Males were found more likely (42.6 times) to use tobacco as compared to females. Unmarried (OR 0.316) were less likely to use tobacco as compared to married.

Age ($p<0.001$) and religion ($p=0.010$) were found as the significant predictors for physical inactivity. Age group from 15-54 years was found associated with lesser odds as compared to 55-64 years age group. Lesser the age, lesser the odds i.e. people of younger age, were more physically active as compared to elderly. Hindus (OR 2.157) were found more physically inactive, when compared to Muslims.

Table 5 shows association of demographic variables with biological risk factor for NCDs. Multiple logistic

regressions revealed obesity to be significantly associated with age (p<0.001). Gender (p<0.001) was found as the only predictor of central obesity. Hypertension was significantly associated with increasing age (p<0.001), gender (p<0.001) and marital status (p=0.004).

Table 3: Distribution of risk factors according to sociodemographic characteristics of respondents.

Demographic variables	Tobacco use (n=163)	Alcohol use (n=71)	Physical inactivity (n=89)	Inappropriate dietary intake (n=600)	Overweight /Obesity (n=184)	Central Obesity (n=77)	Hypertension (n=213)
Age group (years)	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**	**N (%)**
15-24	12 (7.4)	2 (2.8)	0 (0)	120 (20)	6 (3.3)	1 (1.3)	6 (2.8)
25-34	22 (13.5)	5 (7.0)	7 (7.9)	120 (20)	36 (19.6)	13 (16.9)	38 (17.8)
35-44	37 (22.7)	22 (31.0)	7 (7.9)	120 (20)	43 (23.4)	19 (24.7)	44 (20.7)
45-54	39 (23.9)	18 (25.4)	14 (15.7)	120 (20)	40 (21.7)	14 (18.2)	51 (23.9)
55-64	53 (32.5)	24 (33.8)	61 (68.5)	120 (20)	59 (32.1)	30 (39.0)	74 (34.7)
Gender							
Male	152(93.3)	70(98.6)	48 (53.9)	300 (50)	84 (45.7)	14 (18.2)	134 (62.9)
Female	11 (6.7)	1 (1.4)	41 (46.1)	300 (50)	100 (54.3)	63 (88.8)	79 (37.1)
Religion							
Hindu	89 (54.6)	66(93.0)	57 (64.5)	309 (51.5)	95 (51.6)	43 (55.8)	113 (53.1)
Muslim	70 (42.9)	5 (7.0)	32 (35.5)	287 (47.8)	88 (47.8)	34 (44.2)	100 (46.9)
Christian	4 (2.5)	0 (0)	0 (0)	4 (0.7)	1 (0.5)	0 (0)	0 (0)
Marital status							
Married	153(93.9)	70(98.6)	84 (94.4)	510 (85.0)	177 (96.2)	73 (94.8)	209 (98.1)
Unmarried	9 (5.5)	1 (1.4)	0 (0)	84 (14.0)	4 (2.2)	0 (0)	3 (1.4)
Widow/divorced/separated	1 (0.6)	0 (0)	5 (5.6)	6 (1.0)	3 (1.6)	4 (5.2)	1 (0.5)
Socioeconomic status							
Upper	2 (1.2)	0 (0)	0 (0)	2 (0.3)	0 (0)	0 (0)	2 (0.9)
Middle	68 (41.7)	34 (47.9)	20 (22.5)	209 (34.8)	81 (26.1)	12 (15.6)	76 (35.7)
Lower	93 (57.1)	37 (52.1)	69 (77.5)	389 (64.9)	136 (73.9)	65 (84.4)	135 (63.4)

Table 4: Association of demographic variables with behavioural risk factors for NCDs.

Demographic variables	Tobacco use		Physical inactivity	
	O.R. (95% CI)	**P value**	**O.R. (95% CI)**	**P value**
Age group (years)				
15-24	0.336 (0.110-1.027)	0.056	0.000	0.995
25-34	0.454 (0.205-1.008)	0.052	0.091 (0.034-0.242)	0.001*
35-44	0.787 (0.375-1.649)	0.526	0.067 (0.027-0.168)	0.001*
45-54	0.799 (0.383-1.668)	0.550	0.160 (0.078-0.328)	0.001*
55-64	REF	0.217	REF	<0.001*
Gender				
Male	42.666 (20.237-89.951)	0.001*	1.630 (0.894-2.969)	0.111
Female	REF	-	REF	-
Religion				
Hindu	1.366	0.226	2.157 (1.205-3.862)	0.010*
Muslim	REF	-	REF	-
Marital status				
Married	0.316(0.102-0.978)	0.046*	0.000	0.996
Unmarried	REF	-	REF	-
Socioeconomic status				
Upper	2.554 (0.815-8.007)	0.108	0.649 (0.130-3.231)	0.597
Middle	1.108 (0.540-2.273)	0.781	1.991 (0.767-5.171)	0.157
Lower	REF	0.218	REF	0.157

Table 5: Association of demographic variables with biological risk factors for NCDs.

Demographic variables	Obesity		Central obesity		Hypertension	
	O.R. (95% CI)	P value	O.R. (95% CI)	P value	O.R. (95% CI)	P value
Age group						
15-24	0.092 (0.033-0.260)	<0.001*	0.094(0.012-0.766)	0.027	0.087 (0.032-0.238)	<0.001*
25-34	0.551 (0.303-1.004)	0.051	0.595 (0.254-1.392)	0.231	0.384 (0.207-0.712)	0.002*
35-44	0.660 (0.380-1.145)	0.139	0.706 (0.335-1.488)	0.360	0.361 (0.202-0.644)	0.001*
45-54	0.560 (0.324-0.970)	0.038	0.543 (0.250-1.179)	0.122	0.478 (0.271-0.844)	0.011
55-64	REF	<0.0001*	REF	0.172	REF	<0.001*
Gender						
Male	0.970 (0.637-1.476)	0.886	0.172 (0.087-0.339)	<0.001*	2.721(1.760-4.207)	<0.001*
Female	REF	-	REF	-	REF	-
Religion						
Hindu	1.088 (0.738-1.604)	0.670	1.398 (0.790-2.475)	0.250	1.034 (0.694-1.541)	0.870
Muslim	REF	-	REF	-	REF	-
Marital status						
Unmarried	0.401 (0.123-1.301)	0.130	0.997	<0.001*	0.151 (0.041-0.550)	0.004*
Married	REF	-	REF	-	REF	-
Socioeconomic status						
Upper	0.600 (0.239-1.506)	0.277	0.423 (0.085-2.097)	0.292	1.365 (0.546-3.417)	0.506
Lower middle	0.611 (0.342-1.090)	0.095	0.738 (0.281-1.942)	0.539	1.372 (0.766-2.456)	0.287
Lower	REF	0.227	REF	0.552	REF	0.558

Table 6: Association between behavioural and biological risk factors for NCDs.

Behavioural risk factors	Obesity		Central obesity		Hypertension	
	O.R. (95% CI)	P value	O.R. (95% CI)	P value	O.R. (95% CI)	P value
Tobacco use						
Non-users	REF	-	REF	-	REF	-
Users	0.971 (0.628-1.504)	0.897	0.277 (0.136-0.563)	<0.001*	4.085 (2.729-6.116)	<0.001*
Physical activity						
Physically active	REF	-	REF	-	REF	-
Physically inactive	7.375 (4.439-12.254)	<0.001*	11.217 (6.188-20.335)	<0.001*	3.687 (2.230-6.097)	<0.001*

Age group 15-24 (OR 0.092) were less prone to become obese as compared to age group (55-64) i.e. Lesser the age, lesser the chance of becoming obese. Males (OR 0.172) had lesser waist circumference as compared to females. Age group 15-44 had lesser chance of developing hypertension as compared to 45-64. Males (OR 2.721) were more prone to develop hypertension as compared to females. Unmarried (OR 0.157) were on the safer side to develop hypertension as compared to married.

Table 6 shows association between behavioural and biological risk factor for NCDs. Multivariate logistic regression analysis revealed that tobacco use is significantly associated with hypertension (p<0.001). Tobacco users were found at more risk (4.085 times) of developing hypertension when compared to non-users. Physical activity was found as the significant predictor of obesity (p<0.001), central obesity (p<0.001) and hypertension (p<0.001). It was found that physically inactive persons were at 7.37 times more risk to develop obesity, 11.2 times to develop central obesity and 3.6 times to develop hypertension as compared to persons who do strenuous activity.

DISCUSSION

The prevalence of tobacco use estimated in the current study is 27.2%; which is higher than the national prevalence of tobacco use (14%).[16] Our findings are in line with a previous study conducted by Singh et al, (2014).[17] High prevalence of tobacco use highlights the need of awareness campaign in the study area along with

strong implementation and monitoring of the tobacco control law.

Alcohol use was prevalent in about 11.8% of the study population, it is also higher than those reported by other surveys.[18,19] Variations in findings may be due to different study settings and population. Similar to Thakur JS et al, our survey, had also found a higher prevalence of alcohol use among older age groups and claimed contrary to belief that alcohol use is a problem among reckless youth and prevalence declines as people mature and take responsibilities.[19] This highlights the need of a behaviour change campaign for stopping the alcohol consumption in the study area especially among the elderly population.

Low level of physical activity is considered as an important predictor of many chronic NCDs.[20] The global estimate for the prevalence of physical inactivity among adults is 17%, whereas our rate is 14.8%.[21] There are certain subgroups (elderly population, office going workers, and people with high educational status) among whom physical inactivity was higher; hence they need special attention. Promotion of physical activity at work place can play a critical role in this regard.

Consumption of inadequate amount of fruits and vegetables was found among all the study participants. The finding is consistent with the regional and global pattern.[22,23] Although vegetables are a frequently consumed item in Indian diet, but the quantity is inadequate. This problem is more prominent in the case of fruits. There is a need to promote fruit and vegetables intake and public awareness for a dietary paradigm shift.

A high prevalence of overweight and obesity (30.7%) has been recorded in this study; findings are in accordance with the report published in times of India newspaper.[24] It indicates the high burden of the problem, which has to be addressed by promotion of physical activity and appropriate dietary intake. In this study, a large proportion of obese were females. Hopkins et al, also reported a higher prevalence of obesity among women as compared to men.[25] Sex differences in obesity can be explained in part by the influence of gonadal steroids on body composition.[26]

The observed prevalence of central obesity in current study was 12.8% with highest proportion among females. These findings are in line with the findings of ICMR-INDIAB study.[27] Gravena et al, reported that several alterations in fat deposits among women occur with the advent of the menopause, leading to a change in the distribution of body fat.[28] Hypoestrogenism has a negative effect on fat metabolism, favouring the appearance of central obesity. This may be the most probable reason for finding the higher proportion of centrally obese among females; because in our study, 39% centrally obese were in the age group of 55-64 years.

High prevalence of hypertension (35.5%) in the study area is alarming and adds to estimates from other cross sectional surveys in the city.[29,30] Survey revealed a huge amount of undiagnosed hypertension. Keeping in account the newly diagnosed hypertensive population, majority of participants were not currently under any treatment for raised blood pressure, which indicates a high unmet need for prevention and management.

In our study, 62.9% hypertensives were males and 37.1% were females. No such difference was observed in a study conducted by Shraddha et al, whereas a study conducted by Everett et al, showed an increase in proportion of hypertension among males than females.[31,32] Sandberg et al, also reported that men have higher blood pressure than women through much of life regardless of race and ethnicity.[33] Although the mechanisms responsible for the gender differences in blood pressure control are not clear, there is significant evidence that androgens, such as testosterone, play an important role in gender associated differences in blood pressure regulation.[34]

In our study, hypertension was more prevalent in the 35-64 years age group as compared to 15-34 years age group. These findings are in accordance with the Framingham heart study, which reported that systolic blood pressure shows a continuous increase between the ages of 30 and 84 years or over.[35] The increase in blood pressure with age is mostly associated with structural changes in the arteries and especially with large artery stiffness. Large artery stiffness is mainly due to arteriosclerotic structural alterations and calcification.[36]

In current study, tobacco use was found as the significant predictor of hypertension; while physical inactivity for obesity, central obesity and hypertension. A study conducted by Gao et al, also reported that life course adjusted smoking consumption is significantly positively associated with risks of hypertension.[37] Findings of a study conducted by Pietiläinen et al, showed that the risk of general obesity (OR 3.9) and especially central obesity (OR 4.8) significantly increases in physically inactive adolescents.[38] Experimental evidence from interventional studies have also confirmed a relationship between physical activity and hypertension as the exercise reduces blood pressure have been well characterized in recent years.[39,40]

Study limitations

This study was limited to one geographical location; hence, the results cannot be extrapolated to entire Bangalore city. Second issue is of over reporting, which is a well-recognized issue for self-report surveys as participants tend to report in socially desirable ways. Third, it is a cross sectional study design which limits causality of relations.

Implications of findings

Finding of this study provides first, most comprehensive, evidence on the magnitude of NCDs risk factor in the study area. Present data will be an invaluable advocacy support to the concerned local authority in the formulation of policy and plan of action for the prevention and control of NCDs.

CONCLUSION

This STEPS survey suggests that NCD risk factors are quite prevalent among the study population. Among these, tobacco use, inadequate consumption of fruits and vegetables, overweight/obesity and hypertension are the areas of concern. These risk factors needs to be addressed through a comprehensive approach with due emphasis on preventive care in order to make 'healthy living' a social norm.

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