

Original Research Article

Non-communicable disease risk factors: a cross-sectional study among the adult population of rural Patna, India

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ABSTRACT

Background: Non-communicable diseases (NCDs) are a leading cause of morbidity and mortality worldwide, primarily driven by cardiovascular diseases, diabetes, cancers and chronic respiratory conditions. This study aimed to assess the prevalence of NCD risk factors among adults in a rural area of Patna, Bihar.

Methods: A community-based cross-sectional study was conducted over two months (April–May 2024) among adults aged 18 years and above using convenience sampling. Data were collected using a modified WHO STEPS tool through face-to-face interviews, along with physical and biochemical measurements. Descriptive and inferential statistics, including chi-square tests, were applied for analysis.

Results: Among 211 participants (mean age: 47.05 ± 16.63 years), tobacco use (31% smoking, 36.8% smokeless) and alcohol consumption (42.5%) were markedly higher among males, while inadequate fruit and vegetable intake was common in both sexes; physical activity was higher in males (64.4%) than females (53.2%). Hypertension was observed in 21.8% of males and 17.7% of females. Overweight was more prevalent in males (37.9%), whereas obesity was slightly higher in females (22.6%). Despite this, central obesity was notably high, affecting 85.1% of males and 76.6% of females, indicating increased metabolic risk even among individuals with normal or mildly elevated BMI. Overall, 74.88% of participants had three or more NCD risk factors, indicating a clustering of NCDs, with no significant association across socio-demographic variables.

Conclusions: A high burden of clustered NCD risk factors across all groups highlights the need for population-wide prevention and early screening strategies.

Keywords: Central obesity, Non-communicable diseases, Prevalence, Risk factor clustering, Rural population, WHO STEPS

INTRODUCTION

Non-communicable diseases (NCDs) represent an important cause of morbidity and mortality globally, with cardiovascular disorders, diabetes, cancers and chronic respiratory diseases contributing most. NCDs accounted for over 43 million deaths in 2021, representing nearly three-quarters of all global deaths, according to the World Health Organization (WHO). A considerable proportion of these deaths happened prematurely and are most common in low- and middle-income countries. Cardiovascular diseases account for the largest proportion

of NCD-related mortality, causing more than 19 million deaths each year.¹ The worldwide burden of NCDs is predominantly attributed to a cluster of modifiable risk factors. These include the use of tobacco, hypertension, the detrimental effect of alcohol consumption, raised blood glucose levels, unhealthy diet, physical inactivity, overweight and obesity.² Similar to many other low- and middle-income countries, India has also experienced a rise in the burden of NCDs over the past few decades due to rapid urbanization, lifestyle changes and demographic transition. This transition has led to non-communicable diseases surpassing communicable diseases and

accounting for 63% of all deaths, which is the major cause of mortality.³⁻⁶ Furthermore, per 100,000 populations in India, non-communicable diseases account for an estimated 16,939 disability-adjusted life years (DALYs).⁷

While NCDs were earlier concentrated in India's developed states, their burden is now increasing in less developed and rural regions.⁸⁻¹⁰ Bihar, an eastern state of India, despite its low Human Development Index and a larger population, has experienced a rising NCD burden.¹¹⁻¹³ Among individuals aged ≥ 15 years, the prevalence of hypertension and diabetes is 17.15% and 14.45%, respectively.¹⁴ Hypertension, diabetes, alcohol use, smoking, hyperlipidemia and elevated homocysteine levels are major contributors to cardiovascular disease, particularly stroke, in the state of Bihar.¹⁵

India launched the National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Diseases and Stroke (NPCDCS) in 2011 to address the increasing prevalence of NCDs. Despite this initiative, the utilisation of public health services for NCD prevention remains suboptimal, particularly at the community level, where the perceived susceptibility and severity of NCDs are often low, as in Tanzania.¹⁶ In alignment with Sustainable Development Goal (SDG) target 3.4, India aims to attain a 33% decrease in early mortality resulting from NCDs by 2030.² However, the prevalence of NCD risk factors continues to rise in Bihar.^{13,17} Although several studies in India have assessed NCD risk factors using the WHO STEPS approach and the Community-Based Assessment Checklist (CBAC), the application of anthropometric measures, including waist-to-hip and waist-to-height ratios, remains limited for the assessment of risk of cardiovascular disease. Reliable community-level estimates of NCD risk factors are essential for effective planning, implementation and monitoring of national programmes. While some urban studies have been conducted in Patna, there is a paucity of community-based up-to-date data from rural areas. Therefore, the present study sought to determine the prevalence of NCD risk factors among adults residing in the rural community of Patna.

METHODS

Study design

A descriptive cross-sectional research design was used for this study.

Operational definition

Prevalence

The proportion of individuals in the study population who have a specific condition or identified risk factor at a given point in time.

Hypertension

An individual was considered hypertensive if the measured systolic blood pressure was greater than or equal to 140 mmHg or the diastolic blood pressure was greater than or equal to 90 mmHg.

Overweight and obesity

When the body mass index (BMI) is between 23.0 and 24.9 kg/m², it is considered overweight and a BMI ≥ 25 kg/m² is considered obesity, according to consensus guidelines for Asian Indians.¹⁸

Central obesity

Central obesity assessed using waist-hip ratio and waist-to-height ratio.

Waist-hip ratio

Based on WHO cut-off values, a WHR of ≥ 0.85 for women and ≥ 0.90 for men was considered an increased health risk.

Waist-to-height ratio

A value greater than 0.5 was indicative of a health risk.

Random blood glucose

A random blood glucose value of >200 mg/dl was considered as diabetes mellitus, while values between 140 mg/dl and 200 mg/dl were classified as prediabetes.

Study setting

This research was conducted in Badipur, a rural village situated in Naubatpur Block of Patna district, Bihar. Naubatpur Block includes 97 villages with an overall population of 25,011. Badipur is among the larger villages in the block, comprising 388 households and a population of 2,439.

Study duration

The study period was of 2 months from April to May 2025.

Sample

Individuals aged 18 years or older living in the rural community of Badipur village of Patna district were considered the sample.

Inclusion criteria

The study enrolled individuals who were aged 18 years and above, were permanent residents of Badipur village

and were available during data collection. Participants who were willing to take part in the study and were coherent were included.

Exclusion criteria

Adults who had been previously diagnosed with NCDs or had attended any NCD prevention and control programme or were pregnant, were excluded from the study.

Sampling technique

A non-probability convenience sampling technique was adopted.

Sample size

Sample size calculation for the present study-

Stephanie Ross et al carried out a study in rural Bihar and reported a prevalence rate of hypertension among adults aged 35–70 years, with estimates of 27.3% in women and 27.6% in men. 13 So, from there, the prevalence rate was taken as $p=27.6\%$, $d=5\%$, $Z_{\alpha}=1.96$ at 95% CI. So, by putting the values in the formula-

$$n = \frac{\{(Z_{\alpha})^2 \times p \times q\}}{d^2}$$

$n=307$

So, the calculated sample size for the final study was 307.

Variables of the study

Socio-demographic variables

Age, sex, religion, education, occupation, monthly family income, marital status, type of family, hearing about any NCD and source of health information.

Data collection tool

The Modified WHO STEPS Tool was adopted to assess risk factors for NCDs.¹⁹ Three tools were used in the study: Tool I included socio-demographic variables; Tool II (Modified WHO STEPS 1) covered behavioural risk factors for NCDs; and Tool III (Modified WHO STEPS 2 and 3) included physical and biochemical measurements for metabolic risk factors. All tools were validated by experts from the community medicine department and pre-tested before data collection.

Technique

Data were collected through face-to-face interviews first to obtain socio-demographic variables and behavioural risk factors. Then, physical and biochemical measurements were done to assess metabolic risk factors.

Ethical approval

The ethical approval for this study was obtained from the Institutional Ethical and Research Committee, All India Institute of Medical Sciences, Patna (Ref. No.: AIIMS/Pat/2025/IEC/23, dated 26 March 2025). Informed written consent has been obtained from the participating individuals with proper explanation regarding the study's aims, objectives, benefits and potential risks. Confidentiality was maintained and data were anonymised throughout the study.

Data collection process

Eligible participants were identified through a household survey conducted in Badipur village. Information was gathered using a Hindi-translated, modified WHO STEPS instrument. Height was measured without footwear using a measuring tape and body weight was recorded in kilograms by a calibrated digital weighing scale, with participants wearing light clothing. Waist and hip circumferences were obtained in centimetres with a measuring tape while ensuring privacy. Blood pressure was measured from the left arm using a standardised manual sphygmomanometer, with the cuff positioned at heart level. Participants rested for 15 minutes before the first measurement. A second reading was obtained after a 3-minute gap and the average of the two readings was used for analysis. Random blood glucose was assessed in mg/dL using a glucometer following standard aseptic procedures. Measurements were taken at any time of the day to determine current blood glucose levels.

Statistical method

Completeness of the collected data was checked, coded and entered into Microsoft Excel and subsequently analysed using SPSS software. Categorical variables were presented as frequency and percentage, while continuous variables were reported as mean±standard deviation, depending on data normality. Each risk factor was scored as present (1) or absent (0). Tobacco consumption was considered at risk if the score was ≥ 2 out of 3 components; unhealthy diet if the score was ≥ 3 ; and alcohol use and insufficient physical activity if the score was 1. Metabolic risk factors were defined using standard cut-offs. A value greater than the normal cut-off is considered a risk. Clustering of NCD risk factors was present if any individual had three or more NCD risk factors, in line with previous studies. 20 Central obesity was assessed using WHtR due to its simplicity and consistent cut-off across sexes. For the association between NCD risk factors and socio-demographic variables, a chi-square test was performed. A p-value less than 0.05 was considered statistically significant with a confidence interval of 95%.

RESULTS

Table 1 summarises the socio-demographic profile of 211 participants, with a mean age of 47.05 ± 16.63 years. The

largest proportion of participants belonged to the 30–44 years' age group (31.8%) and Females (58.8%). All participants belonged to the Hindu religion and 29.4% of participants had no formal education. Over half (52.6%) were homemakers or unemployed and the income distribution demonstrated that 37.9% of families earned $\leq$ ₹10,000 per month, suggesting a lower socioeconomic bracket. Most participants were married (90.5%) and resided in joint families (71.6%). Overall, 82% were aware of NCDs, with healthcare providers (43.6%) being the most common source of information.

Frequency and percentage distributions of behavioural risk factors are depicted in Table 1. Tobacco use was mainly found among males, with 31% reporting smoking and 36.8% using smokeless tobacco, compared to negligible use among females. Alcohol consumption was reported by 42.5% of males, while it was almost absent among females (0.8%). Adequate physical activity was reported by 64.4% of males and 53.2% of females. However, both groups commonly had inadequate fruit and vegetable intake. Consumption of salty/processed foods and fatty foods was slightly higher among females, while daily sugary beverage intake was low in both genders. Family history of NCDs was reported by 46% of males and 41.9% of females. Self-reported hypertension (37.9% vs. 29%) and raised blood sugar (17.2% vs. 15.3%) were slightly higher among males. Cervical cancer screening uptake among females was negligible (0.8%), highlighting limited utilisation of preventive services.

Table 3 presents the gender-wise mean distribution of physical and biochemical measurements. It shows slightly higher mean systolic (126±12 mmHg compared to 124±16 mmHg) and diastolic blood pressure (81±9 mmHg compared to 77±9 mmHg) in males than in females. The mean body mass index (BMI) was 23.96±3.01 kg/m² for males and 23.12±3.66 kg/m² for females, indicating that, on average, both groups were within the overweight range according to Asian Indian guidelines. Indicators of central obesity showed elevated values, with a mean waist-to-height ratio of 0.57±0.07 in males and 0.56±0.08 in females. The mean waist-to-hip ratio was 0.92±0.1 in males and 0.89±0.14 in females, suggesting increased cardiovascular risk in both groups. The mean random blood glucose levels were comparable

between males (113±23 mg/dl) and females (112±38 mg/dl), indicating overall similar glycaemic profiles.

Table 4 depicts the prevalence of metabolic risk factors among males and females. Hypertension was observed in 21.8% of males and 17.7% of females. Overweight status was more common among males (37.9%) than females (29.8%), whereas obesity was slightly higher among females (22.6%) compared to males (20.7%). A strikingly high proportion of participants exhibited central obesity based on the waist-to-height ratio, affecting 85.1% of males and 76.6% of females.

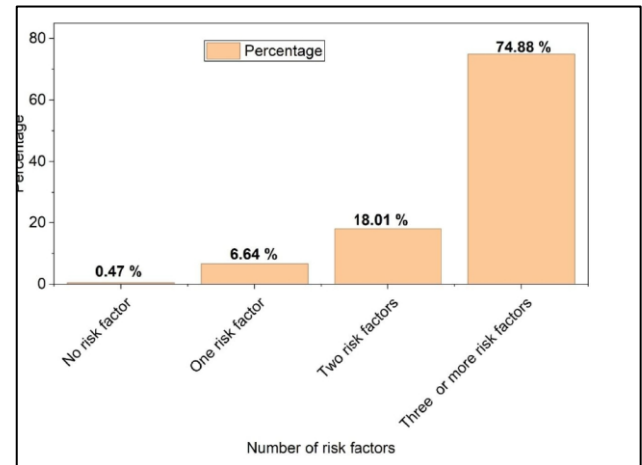


Figure 1: Distribution of clustering of NCD risk factors.

Figure 1 illustrates the distribution of participants according to the number of non-communicable disease (NCD) risk factors. It was observed that only 0.47% of participants had no risk factors, while 6.64% had one and 18.01% had two. The majority of participants (74.88%) had three or more risk factors, indicating clustering of NCD risk factors. Table 5 shows the association between sociodemographic variables and clustering of NCD risk factors. Clustering increased with age and was higher among males (87.4%) than among females (66.1%). However, Chi-square analysis revealed no statistically significant association for age, sex, education, occupation, income, marital status or family type ($p>0.05$), indicating that clustering was common across all socio-demographic groups.

Table 1: Frequency percentage distribution of socio-demographic variables (n=211).

S. no.	Variables	Categories	Frequency	%
1.	Age (in years)	Mean±SD	47.05±16.63	
		18-29	31	14.7
		30-44	67	31.8
		45-59	52	24.6
		$\geq$ 60	61	28.9
2.	Sex	Male	87	41.2
		Female	124	58.8
3.	Religion	Hindu	211	100

Continued.

S. no.	Variables	Categories	Frequency	%
4.	Education	No formal education (Illiterate)	62	29.4
		Primary school (grades 1–5)	26	12.3
		Middle school (grades 6–8),	43	20.4
		High school (grades 9–10)	24	11.4
		Intermediate (grades 11–12)	28	13.3
		Graduation & above	28	13.3
5.	Occupation	Govt. employee	11	5.2
		Private employee	19	9.0
		Business	12	5.7
		Farmer	34	16.1
		Labourer/Worker	24	11.4
		Home maker/Unemployed	111	52.6
6.	Monthly family income	≤ ₹10,000	80	37.9
		₹10,001–25,000	79	37.4
		₹25,001–50,000	40	19.0
		> ₹50,000	12	5.7
7.	Marital status	Married	191	90.5
		Unmarried	9	4.3
		Widow	11	5.2
8.	Type of family	Joint	151	71.6
		Nuclear	60	28.4
9.	Have you heard about any NCD	No	38	18
		Yes	173	82
10.	If yes, the source of health information	Family and friends	63	29.9
		Health care provider	92	43.6
		Mass media	18	8.5
		No information	38	18

Table 2: Gender-wise distribution of behavioural risk factors among study participants (n=211, males=87, females=124).

Domains	S. no.	Behavioural risk factor	Male		Female	
			Yes N (%)	No N (%)	Yes N (%)	No N (%)
Tobacco	1.	Have you ever smoked tobacco products, either currently or in the past?	27 (31)	60 (69)	1 (0.8)	123 (99.2)
	2.	Have you ever been exposed to passive or second-hand smoke?	51 (58.6)	36 (41.4)	47 (37.9)	77 (62.1)
	3.	Have you ever used smokeless tobacco products, such as snuff, chewing tobacco or betel nut, either currently or in the past?	32 (36.8)	55 (63.2)	2 (1.6)	122 (98.4)
Alcohol	4.	Have you ever consumed alcohol, such as beer, wine, etc., either currently or in the past?	37 (42.5)	50 (57.5)	1 (0.8)	123 (99.2)
Physical activity	5.	Do you undertake any physical activities for a minimum of 150 minutes in a week / 30 minutes per day?	56 (64.4)	31 (35.6)	66 (53.2)	58 (46.8)
Diet	6.	Do you take total five servings of fruits and vegetables in whole day?	39 (44.8)	48 (55.2)	54 (43.5)	70 (56.5)
	7.	Do you consume any salty or processed food like pickle, fast food, canned food, sauce regularly?	34 (39.1)	53 (60.9)	56 (45.2)	68 (54.8)
	8.	Do you take any sugary beverages like soda, energy drinks every day?	10 (11.5)	77 (88.5)	12 (9.7)	112 (90.3)
	9.	Do you consume any fatty foods like fried food, processed snacks regularly?	16 (18.4)	71 (81.6)	25 (20.2)	99 (79.8)

Continued.

Domains	S.	Behavioural risk factor	Male		Female	
History of NCDs	10.	Do you have a family history of any Non-Communicable Diseases like hypertension, diabetes, heart disease, cancers, etc.?	40 (46)	47 (54)	52 (41.9)	72 (58.1)
	11.	Have you ever been told by a health care worker that you have raised Blood pressure?	33 (37.9)	54(62.1)	36 (29)	88 (71)
	12.	Have you ever been told by a health care worker that you have raised Blood sugar?	15 (17.2)	72 (82.8)	19 (15.3)	105 (84.7)
	13.	Have you ever been told by a health care worker that you have raised cholesterol?	6 (6.9)	81(93.1)	7 (5.6)	117 (94.4)
	14.	Have you ever had a stroke or paralysis from heart disease (cerebrovascular accident or incident)?	1 (1.1)	86(98.9)	2 (1.6)	122 (98.4)
	15.	For women only: Have you ever had a screening test for cervical cancer?	NA*	NA*	1 (0.8)	123 (99.2)

NA*-Not Applicable for men.

Table 3: Gender-wise mean distribution of physical and biochemical measurements.

Domain	Sl. no	Measurements	Male (Mean±SD)	Female (Mean±SD)
Blood pressure (BP)	1	Systolic BP (mm of Hg)	126±12	124±16
	2	Diastolic BP (mm of Hg)	81±9	77±9
BMI	3	Weight in kg / (Height in m) ²	23.96±3.01	23.12±3.66
Central obesity	4	Waist-to-height ratio	0.57±0.07	0.56±0.08
	5	Waist-to-hip ratio	0.92±0.1	0.89±0.14
Blood sugar	6	Random blood glucose (mg/dl)	113±23	112±38

Table 4: Gender-wise prevalence of metabolic risk factors.

Metabolic risk factor	Male N (%)	Female N (%)
Hypertension (BP≥140/90 mmHg)	19 (21.8)	22 (17.7)
Overweight (BMI 23–24.9 kg/m ²)	33 (37.9)	37 (29.8)
Obesity (BMI ≥25 kg/m ²)	18 (20.7)	28 (22.6)
Waist to Height Ratio (>0.5)	74 (85.1)	95 (76.6)
Waist to hip ratio (male ≥0.90, Female ≥0.85)	52 (59.8)	91 (73.4)
Raised random blood glucose (≥140 mg/dl)	7 (8)	12 (9.7)

Table 5: Association between sociodemographic variables and clustering of NCD risk factors.

Sociodemographic variable	Category	Clustering present (≥3 risk factors) N (%)	Clustering absent (<3 risk factors) N (%)	Degree of freedom (DF)	Chisquare (χ ²)
1. Age (in years)	18-29	19 (61.3)	12 (38.7)	3	2.4
	30-44	45 (67.2)	22 (32.8)		
	45-59	42 (80.8)	10 (19.2)		
	≥60	52 (85.2)	9 (14.8)		
2. Sex	Male	76 (87.4)	11 (12.6)	1	3.08
	Female	82 (66.1)	42 (33.9)		
3. Education	No formal education (Illiterate)	44 (71)	18 (29)	5	1.67
	Primary school (grades 1–5)	23 (88.5)	3 (11.5)		
	Middle school (grades 6–8),	36 (83.7)	7 (16.3)		
	High school (grades 9–10)	16 (66.7)	8 (33.3)		
	Intermediate	20 (71.4)	8 (28.6)		

Continued.

Sociodemographic variable	Category	Clustering present (≥ 3 risk factors) N (%)	Clustering absent (< 3 risk factors) N (%)	Degree of freedom (DF)	Chisquare (χ^2)
	(grades 11–12)				
	Graduation & above	19 (67.9)	9 (32.1)		
4. Occupation	Govt. employee	9 (90)	1 (10)	5	10.3
	Private employee	16 (84.2)	3 (15.8)		
	Business	10 (83.3)	2 (16.7)		
	Farmer	31 (91.2)	3 (8.8)		
	Laborer/Worker	19 (79.2)	5 (20.8)		
	Home maker/ Unemployed	44 (59.5)	30 (40.5)		
5. Monthly family income	$\leq 10,000$	56 (70.9)	23 (29.1)	3	1.55
	₹10,001–25,000	65 (83.3)	13 (16.7)		
	₹25,001–50,000	25 (64.1)	14 (35.9)		
	$> ₹50,000$	11 (78.6)	3 (21.4)		
6. Marital status	Married	146 (76.4)	45 (23.6)	2	0.7
	Unmarried	5 (55.6)	4 (44.4)		
	Widow	7 (63.6)	4 (36.4)		
7. Type of family	Joint	112 (74.2)	39 (25.8)	1	0.04
	Nuclear	46 (76.7)	14 (23.3)		

$p < 0.05$.

DISCUSSION

The present study assessed the NCD risk factors among adults in a rural community of Patna, Bihar, using a modified WHO STEPS approach and found a high burden of behavioural and metabolic risks. Most participants were middle-aged, female, illiterate, in a joint family structure, unemployed/homemaker and belonged to a lower socioeconomic status. These findings were similar to recent studies conducted in India, where limited education, low income and joint family structure influence health behaviours and access to healthcare services.^{21,22} Although 82% were aware of NCDs and the source of information was mainly health care providers, this awareness did not translate into healthy practices, as consistent with other Indian studies.^{23,24}

In the present study, tobacco use (smoking and smokeless) and alcohol consumption were markedly higher among males compared to females. This is consistent with findings from national surveys and recent studies in India.^{25,26} This disparity may be due to social acceptability and fewer restrictions on substance use among men, while it remains low for women due to cultural stigma. This highlights the urgent need for gender-specific interventions to reduce substance use and associated health risks.

Dietary practices, particularly inadequate intake of fruits and vegetables and high consumption of salty and processed foods, were prevalent across both genders in the present study, which is consistent with the World Health Organization STEPwise approach survey in India

and the National NCD Monitoring Survey, where low intake of fruits and vegetables (< 5 servings/day) in a majority of the population were found, irrespective of gender.²⁰ Physical activity levels were relatively better among males than females. This gender difference may be attributed to sociocultural restrictions and occupational roles limiting women's mobility. Similar trends have been documented in recent Indian and global studies.^{27,28}

The study showed slightly higher mean systolic and diastolic blood pressure, as well as hypertension, among males than females, consistent with existing literature indicating a clear gender difference in blood pressure patterns.^{29–31} Also showed that both males and females had BMI in the overweight range with elevated central obesity, indicating increased cardiovascular risk. The ICMR supports this—INDIAB Study, which reported a high prevalence of general and abdominal obesity among Indian adults even at lower BMI levels.^{32,33} Similar findings from other studies also highlight that a significant number of normal-weight South Asians can be metabolically unhealthy.³⁴ Raised random blood glucose levels were slightly higher among females than males in this study. This aligns with findings from Pradeepa et al, but is contradictory to the study of Kerala, which shows higher levels among males, indicating variation across populations.^{35,36}

There was a very high burden of clustering of NCD risk factors, with nearly three-fourths (74.88%) of participants having three or more risk factors, while only a negligible proportion (0.47%) were free from any risk factor. These findings are consistent with several other studies in India reporting similar high clustering, such as in rural South

India, where 56.3% and in Puducherry, where 73% of adults had three or more risk factors.³⁷⁻⁴⁰ This finding suggests that most adults in the rural community are exposed to multiple risk factors simultaneously, which increases their risk of developing chronic diseases such as hypertension, diabetes and cardiovascular diseases. Therefore, the urgent need for integrated and comprehensive interventions rather than single risk factor approaches is crucial to manage the circumstances.

The study found no significant association between clustering of NCD risk factors and socio-demographic variables, consistent with some Indian studies.³⁸ However, others report an association with factors like age and education, suggesting that certain subgroups may still be at higher risk.⁴⁰

The study is constrained by its cross-sectional design, convenience sampling and an incomplete sample size due to time and resource limitations, which affect generalizability and causal inference. Additionally, reliance on self-reported data of behavioural risk factors and the use of only random blood glucose instead of fasting blood glucose or HbA1C estimation may introduce bias and limit accuracy.

CONCLUSION

This study demonstrates a substantial burden of clustered NCD risk factors within the population, with most individuals exhibiting multiple concurrent risks. The lack of significant variation across socio-demographic groups indicates that these risk factors are broadly prevalent rather than confined to specific subpopulations. These findings emphasise the importance of implementing comprehensive, population-wide strategies focused on prevention, early detection and promotion of healthy lifestyles to address the rising challenge of non-communicable diseases.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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