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Non-Communicable Disease Risk Factors Assessment among Socio-economically Weaker Rural Population of Jabalpur, Madhya Pradesh

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ABSTRACT

Background: The rapid epidemiological transition in India has resulted in a steep rise in non-communicable diseases (NCDs), commonly cardiovascular diseases (heart attacks and stroke), cancers, chronic respiratory diseases (such as chronic obstructive pulmonary disease, asthma), and diabetes. Vast rural populations are equally vulnerable to lifestyle-related non-communicable diseases due to a lack of awareness and adoption of harmful lifestyle practices under the increasing trend of urban influences. The National Programme for Prevention and Control of Non-communicable Diseases (NPNCD) aims at addressing these issues; tools like the Community-Based Assessment Checklist (CBAC) have been introduced to identify individuals at risk for NCDs.

Objectives: To estimate the NCD risk factors and to identify individuals at risk for NCDs, using the Community-Based Assessment Checklist (CBAC) among the rural adult population of Jabalpur district, Madhya Pradesh, India

Materials & Methods: A descriptive, community-based cross-sectional study conducted at the rural field practice area of Medical College, Jabalpur, Madhya Pradesh. 209 randomly selected adult participants aged 18 years or more were assessed for NCD risk factors using CBAC, and a risk score was assigned to individuals. A score above 4 indicates that a person is at high risk of developing NCDs.

Result: High prevalence of NCD risk factors like tobacco use in any form (61.7%), exposure to indoor smoke during cooking (52.2%), inadequate physical activity (51.7%), and positive family history for NCDs (18.2%) were noted among the study subjects. 56% of participants were classified as high-risk for NCDs with CBAC scores of more than four. NCD risk score above 4 was significantly high ($p = 0.00002$) in males, with increase in age ($p = 0.00001$), both in overweight and obese category ($p = 0.00001$), among the subjects with central obesity ($p = 0.035$ for women; $p = 0.0005$ for men respectively), with hypertension ($p = 0.00001$), and with no formal schooling ($p = 0.004$), and who were separated or widowed ($p = 0.001$).

Conclusion: The CBAC tool demonstrated strong effectiveness in identifying individuals at risk in resource-limited settings, providing an opportunity for increasing awareness, to be investigated further for NCDs, and for initiating early interventions and management for NCDs.

Keywords: NCD Risk factors, Rural areas, Community-Based Assessment Checklist

INTRODUCTION

Due to an epidemiological transition, India has already noticed a shift from infectious diseases to non-communicable diseases (NCDs) as the leading cause of death and high morbidity. As per the WHO-NCD India profile - 2022, NCDs are estimated to account for 66% of all deaths in the country [1].

The burden of NCDs and their associated risk is no longer confined only to urban populations; significant increases are now being observed in rural areas as well. The Indian Council of Medical Research-India Diabetes (ICMR-INDIAB) study, 2008-2020 - a population-based survey on diabetes and other metabolic NCDs covering all states of India, observed moderate to high prevalence (ranging from 20 to 25%) of NCDs in the rural population of Madhya Pradesh, e.g., hypertension, hypertriglyceridemia, high LDL cholesterol, and abdominal obesity [2].

More than two-third of the country's population live in rural areas [3]. The increase in prevalence of NCD risk factors among the rural population in recent years is now recognized to be a public health concern [4,5]. Yasmin Fatima et al reported a high prevalence (49.8%) of non-communicable diseases in rural areas of Bhopal, Madhya Pradesh [6]. Rural populations, particularly economically weaker sections, face the hardship of dealing with NCDs and finding it difficult to afford expensive lifelong treatment for such chronic conditions [7].

Based on the 2011 Census data, the socio-economically backward population in the Jabalpur district comprises a significant portion of Scheduled Castes (SC) and Scheduled Tribes (ST) [3]. A recent survey among livestock owners in the Jabalpur region noted that a substantial portion of respondents belonged to Other Backward Classes (OBC) at 47.08%, followed by Scheduled Tribes (17.92%) and Scheduled Castes (14.17%) [8].

Most NCDs are strongly associated with major behavioral and environmental risk factors such as tobacco use (smoking and smokeless), excessive alcohol consumption, unhealthy diets, insufficient physical activity, and indoor air pollution. These risk factors - if not managed or modified- may contribute to the development of metabolic risk factors such as overweight/obesity, raised blood pressure, raised blood sugar, and high cholesterol/lipids [9]. Monitoring and control of the rise in NCD risk factors at present is crucial to prevent the NCD surge in the future.

The Government of India launched the National Prevention and Control of Cancer, Diabetes, Cardiovascular Disease, and Stroke (NPCDCS) in 2010 [10]. The programme evolved over the years and is now being implemented under the new name of National Prevention and Control of Non-Communicable Diseases (NP-NCD) [9]. A Community-Based Assessment Checklist (CBAC) was introduced in 2016 for population-based screening for common NCDs and associated risk factors. NP-NCD has also endorsed its use as a screening tool to identify high-risk individuals in the population by health workers in primary health centers, and assigning a risk score to individuals.

However, there is a paucity of studies to assess NCD risk factors using CBAC as a screening tool in rural areas of India, in contrast to that of the urban population.

The current study was conducted to estimate the NCD risk factors and to identify individuals at risk for NCDs, using the Community-Based Assessment Checklist (CBAC) among the rural adult population of Jabalpur district, Madhya Pradesh, India

MATERIALS & METHODS

A descriptive, community based, cross-sectional study was conducted at three villages of the rural field practice area of the Department of Community Medicine, Sukh Sagar Medical College, Jabalpur, Madhya Pradesh, India with an aim to estimate the NCD risk factors and find associated variables, using CBAC (community-based assessment checklist) as the screening tool

among rural adult population (aged 18 years or more) of the Jabalpur district, Madhya Pradesh, India.

Selected villages were chosen for being predominantly populated by socio-economically backward OBC & SC communities, ease of access, logistics, and local cooperation provided by the village heads & health functionaries. The population of the three villages is approximately 1910.

For sample size estimation, the prevalence of obesity (12%), being the lowest among a few key NCD indicators in the rural population of Madhya Pradesh of NFHS-5 survey [11] was considered. The sample size is calculated using the formula: $n = Z^2 \times p \times q / d^2$ where, n = sample size p = prevalence of obesity = 12% = 0.12; q = (1-p) = 0.88; d = absolute precision, taken as 5% = 0.05; Z = 1.96 at 95 per cent Confidence Interval ($\alpha = 0.05$). Considering 10% non- response rate, the final sample size was derived as 181.

In each village, houses were selected by systematic random sampling, and eligible subjects were included in the study. During the study, data were collected randomly from 209 adult participants aged 18 years or older, which was adequate to study the prevalence of NCD risk factors.

Data was collected using CBAC [9]. CBAC is an NCD risk assessment tool, which was introduced in 2016 in India, later revised in 2018, and is now widely used by the frontline health workers in India to screen for NCDs and associated risk factors. CBAC is a detailed questionnaire intended to capture demographic, socio-economic, and personal details of the respondent as well as the information related to NCD risk factors such as exposure to tobacco, alcohol use, physical activity, and dietary intake of fruits and vegetables. In addition, anthropometric measurements (weight, height, waist circumference) and blood pressure were recorded for all participants as part of a routine general physical examination. Risk score to individuals is assigned based on their age-group, tobacco use and its frequency, alcohol consumption, physical inactivity, family history of NCDs, BMI, and waist circumference.

The presence of more than four risk factors in the same individual was considered as the presence of clustering of NCD risk factors. A score above 4 indicates that the person is at higher risk of NCDs and needs to be prioritized for further investigation and appropriate actions [9].

Participants were interviewed and examined by senior undergraduate medical students. The participants were briefed about the purpose of the study and informed consent was obtained prior to the data collection. Quality of data collection was ensured under supervision of faculty members of Department of Community Medicine, Sukh Sagar Medical College.

Institutional Ethics Committee approval was obtained prior to the study and the data was collected for a period of three months (from March to June 2025).

a. Socio-economic scale was adopted using the Updated Modified BG Prasad Socio-economic scale, October 2023 [12].
b. Intake of ≥ 5 servings of fruits and vegetables per day for 5 days a week was termed as adequate intake of fruits and vegetables [13].
c. Body mass index (BMI) was calculated to define Underweight as BMI < 18.5 kg/m^2, Overweight as BMI ≥ 25.0 kg/m^2, and obesity as BMI $\geq$ 30.0 kg/m^2 [14].
d. Central obesity was defined as having a waist circumference of ≥ 90 cm in males and ≥ 80 cm in females [14].
e. Hypertension was defined when the systolic blood pressure was ≥ 140 mm of Hg and/or diastolic blood pressure ≥ 90 mm of Hg, including those on medication [14].

Statistical Analysis

Results were tabulated on Microsoft Excel 2019 and transposed to Jamovi 2.6.44 for statistical analysis. Categorical variables were reported as frequencies and proportions. The Chi-square test was

applied to find an association between subjects with high-risk CBAC scores and various other variables.

RESULT

Data was collected from 209 subjects, of which 55% (n = 115) were males and 45% were females (n = 94). Respondents are Hindu in religion and self-identified as belonging to the socio-economically weaker class - 67.9%. belonging to Other Backward Class (OBC), 15.8% were Scheduled Caste (SC), and 16.3% were Scheduled Tribe (ST).

64.5% (n = 137) of the study subjects were below or equal to the middle socio-economic class. 57.4% (n = 120) had a primary level of education or even less than that, or had not had any formal education. 48.3% (n =101) of subjects were engaged in occupations of moderate to high intensity activities like farmers, construction or mining labourers, and others, while 51.7% (n =108) were mainly sedentary workers engaged in service, business, shopkeeping, or unemployed or managing just household chores. 77.5% (n = 162) were currently married; 8.6% (n = 18) were either divorced, separated, or widowed [**Table 1**].

60.3% (n = 126) of individuals were current tobacco users (smoke and/or smokeless). Tobacco users were predominantly male, nearly 82% (n =103). 77% (n = 97) of tobacco users were between the age group of 18-49 years [**Table 2**]. 11.5% (n = 24) of subjects, exclusively males, reported to consume alcohol daily [**Figure 1**].

Responses on other NCD risk factors [**Figure 1**] - 51.7% subjects were reported to have inadequate physical activity (<150 minutes of moderate activity per week).

Table 1- Distribution of Study Participants according to socio-demographic variables

Socio-demographic variables		No	%
Socio-economic group	*Lower*	18	8.6
	Lower Middle	77	36.8
	Middle	42	20.1
	Upper	16	7.7
	Upper Middle	56	26.8
	Total	**209**	**100.0**
Educational status	College/university completed	14	6.7
	High school completed	32	15.3
	Secondary school completed	43	20.6
	Primary school completed	49	23.4
	Less than primary school	28	13.4
	No formal schooling	43	20.6
	Total	**209**	**100.0**
Marital status	Currently married	162	77.5
	Never married	29	13.9
	Divorced	2	1.0
	Separated	5	2.4
	Widowed	11	5.3
	Total	**209**	**100.0**
Occupational status	Farmer	26	12.4
	Labourer	61	29.2
	Others	14	6.7
	Service	6	2.9
	Shopkeeper/business	17	8.1
	Housewife	69	33.0
	Student	11	5.3
	Unemployed/retired	5	2.4
	Total	**209**	**100.0**

Table 2. Age-group wise use of tobacco in any form

Age-group	Current smoker		Smokeless tobacco users		Total of each category
	No	Yes	No	Yes	
18-29 years	43 (72.9%)	16 (27.1%)	41 (69.5%)	18 (30.5%)	59 (100%)
30-39 years	45 (72.6%)	17 (27.4%)	42 (67.7%)	20 (32.3%)	62 (100%)
40-49 years	23 (63.9%)	13 (36.1%)	23 (63.9%)	13 (36.1%)	36 (100%)
50-59 years	16 (64.0%)	9 (36.0%)	15 (60.0%)	10 (40.0%)	25 (100%)
>= 60 years	22 (81.5%)	5 (18.5%)	22 (81.5%)	5 (18.5%)	27 (100%)
Total	**149 (71.3%)**	**60 (28.7%)**	**143 (68.4%)**	**66 (31.6%)**	**209 (100%)**

Only 23.4% (n = 49) of subjects responded LPG as fuel used for cooking, while 52.2% (n = 109) were using a set of smoke generating fuel such as firewood, cow dung cake, crop-residue, etc., and thereby exposed to indoor smoke while cooking. 61.7% responded to have inadequate fruit intake (i.e., less than 4 days in a week), while 12.4% persons had inadequate green leafy vegetables (i.e., less than 4 days in a week). 9.3% subjects were reported to have high salt intake in the diet. 18.2% had a positive family history of NCD.

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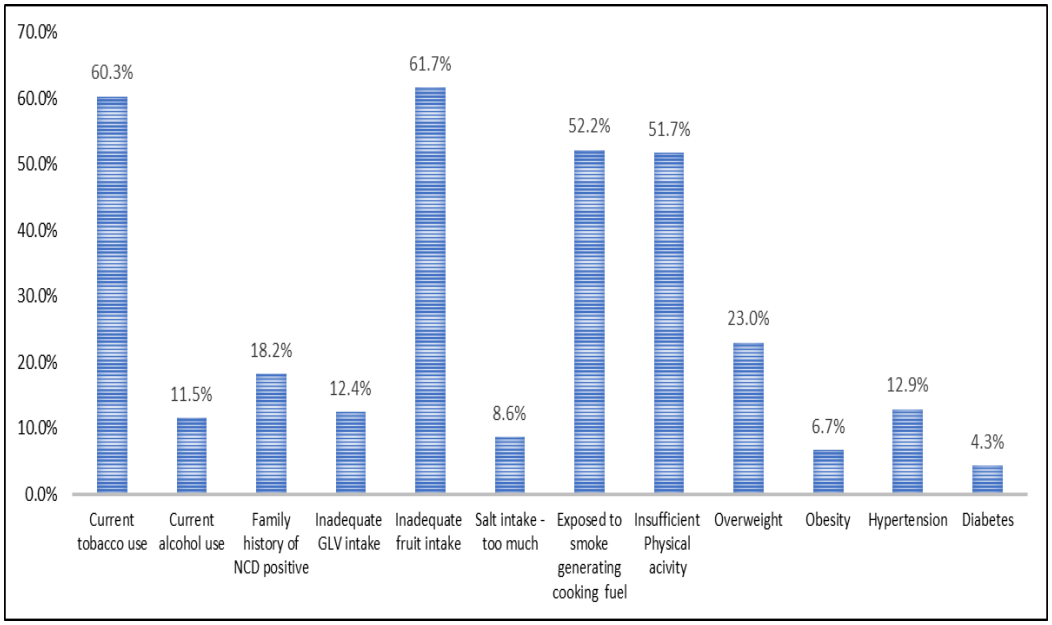

Figure 1. Prevalence of NCD risk factors among study participants

Anthropometric measurements:

Based on BMI classification - 10% of subjects (n =21) were in underweight category, 23% (n = 48) were found to be overweight and 6.7% (n = 14) were obese [**Figure 1**]. Central obesity was revealed in equal proportion (34%) of individuals in each sex according to waist-circumference measurements **[Table 3].**

Table 3. Waist circumference (men and women)

WC men (n = 115)	Frequency	%	WC women (n = 94)	Frequency	%
≤ 90 cm	76	66.1	≤ 80 cm	62	66.0
91 - 100 cm	36	31.3	81 - 90 cm	26	27.6
> 100 cm	3	2.6	> 90 cm	6	6.4
Total	**115**	**100**	Total	**94**	**100**

NCD Risk score - Among the 209 randomly selected study participants, 56.5% (n = 118) had a risk score of above four, 26.8% with a risk score of 5 - 7; 22% with a risk score of 8 - 10, and 7.7% with a risk score of > 10 [**Figure 2**].

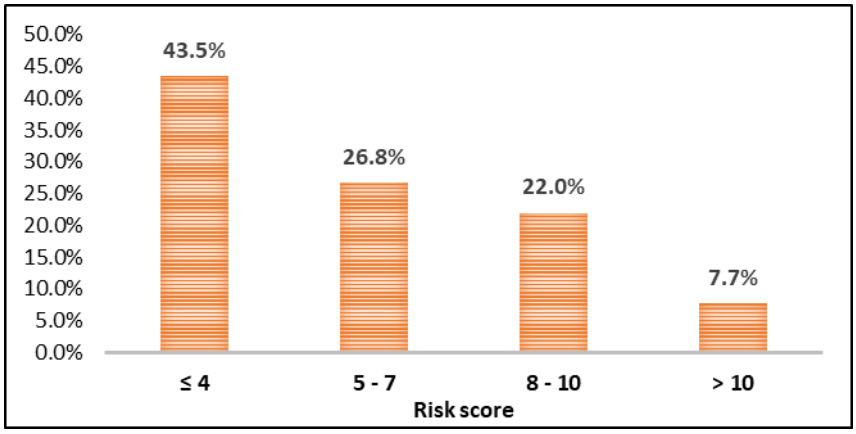

Figure 2: Prevalence of NCD risk score among study participants

NCD risk score above 4 was significantly high (*p = 0.00002*) in males (69.4%) compared to 40.4% in females, and risk was significantly higher with an increase in age (*p = 0.00001)*. NCD risk was more common among the subjects with no formal schooling (*p = 0.004*) and among the subjects who were separated, divorced, or widowed (*p = 0.001*). The association between high NCD risk score and occupation was just significant (*p = 0.004*), and there was no association across the socio-economic status of the individuals (*p = 0.529*) [**Table 4**].

NCD Risk score was very high both in the overweight and obese category (more than 85%), and lowest in the underweight (38%), and the association was statistically highly significant (*p = 0.00001*). Central obesity was associated with a high NCD risk score, and the association was statistically significant in both sexes (*p = 0.035* for women and *p = 0.0005* for men, respectively).

Table 4. Association of NCD risk score with variables

	NCD Risk Score	≤ 4		> 4		Total		χ^2 Value	P value
		No	%	No	%	No	%		
Gender	Male	35	30.4	80	69.6	115	100.0		
	Female	56	59.6	38	40.4	94	100.0	17.865	**0.00002***
Age-group	18-29 years	39	66.1	20	33.9	59	100.0		
	30-39 years	30	48.4	32	51.6	62	100.0		
	40-49 years	12	33.3	24	66.7	36	100.0	32.343	**0.00001***
	50-59 years	9	36.0	16	64.0	25	100.0		
	≥ 60 years	1	3.7	26	96.3	27	100.0		
Educational status	College/university	12	85.7	2	14.3	14	100.0		
	High school	15	46.9	17	53.1	32	100.0		
	Secondary school	19	44.2	24	55.8	43	100.0	15.063	**0.004***
	Primary school	23	47.0	26	53.0	49	100.0		
	No formal schooling#	22	31.0	49	69.0	71	100.0		

Marital status	Currently married	70	43.2	92	56.8	162	100.0		
	Never married	19	65.5	10	34.5	29	100.0	13.405	**0.001***
	Separated/ Widowed	2	11.1	16	88.9	18	100.0		
Occupational Status	Farmer	9	34.6	17	65.4	26	100.0		
	Labourer	24	39.3	37	60.7	61	100.0		
	Other occupation@	7	19.0	30	81.0	37	100.0	20.385	**0.004***
	Housewife	40	58.0	29	42.0	69	100.0		
	Unemployed/retired	11	68.8	5	31.2	16	100.0		
Socioeconomic Class	Upper	8	50.0	8	50.0	16	100.0		
	Upper Middle	24	42.9	32	57.1	56	100.0		
	Middle	16	38.1	26	61.9	42	100.0	3.172	**0.529**
	Lower Middle	32	41.6	45	58.4	77	100.0		
	Lower	11	61.1	7	38.9	18	100.0		
BMI	Underweight	13	62.0	8	38.0	21	100.0		
	Normal	69	54.8	57	45.2	126	100.0		
	Overweight	7	14.6	41	85.4	48	100.0	30.581	**0.00001***
	Obesity	2	14.3	12	85.7	14	100.0		
Blood Pressure	Normal	89	49.0	93	51.0	182	100.0	16.467	**0.00004***
	Hypertension	2	7.4	25	92.6	27	100.0		
	Total	**91**	43.6	**118**	56.4	**209**	**100.0**		
WC - women	≤ 80 cm	42	67.8	20	32.2	62	100.0		
	> 80 cm	15	46.9	17	53.1	32	100.0	6.6738	**0.035***
	Total	**57**	60.6	**37**	39.4	**94**	**100.0**		
WC - men	≤ 90 cm	31	41.3	44	58.7	75	100.0		
	> 91 cm	4	10.0	36	90.0	40	100.0	12.097	**0.0005***
	Total	**35**	30.4	**80**	69.6	**115**	**100.0**		

*The chi-square statistic is significant at $p < .05$.
@ Other occupations involving sedentary activity – businessman, shopkeeper, service, etc.
# No formal schooling includes education less than primary level, or no formal schooling

The prevalence of pre-diagnosed hypertension and diabetes in the study population was 12.9% (n = 27) and 4.3% (n = 9), respectively. 92.6% study participants with the "hypertension" category had a very high NCD risk score, compared to those of 51% in the "normal" category. The association between hypertension and NCD risk score was statistically highly significant (*p = 0.00001*) [Table 3]. A similar association between pre-diagnosed diabetes and NCD risk score was not calculated due to the very small sample size of individuals.

DISCUSSION

The present study was conducted in rural practice areas of Sukh Sagar Medical College in Jabalpur district of Madhya Pradesh. The study aimed to estimate non-communicable disease risk factors among the adult population (aged 18 years or more) using the CBAC (community-based assessment checklist).

Few attempts were made earlier to test the validity of CBAC as the screening tool of NCDs in the field settings by some authors. V K Kalidoss et al in their study in Kerala [15] reported sensitivity and specificity of the tool to be 85.7% and 53.7%, respectively. Sensitivity increased with risk score of four and above to 98%. Gupta et al [16], however, reported less predictive accuracy of CBAC for NCD in the rural population of Western India, with a sensitivity to be 65.4% and a specificity (52.4%).

The present study was conducted among 209 randomly selected adult participants aged 18 years or above, of which 55% (n = 115) were males and 45% were females (n = 94). Fair participation by sex and the broader age range of participants helped to generate a representative population for which the risk factors of interest are more prevalent.

In the present study, 34% of respondents were educated below the primary level or

did not have any formal education, which is consistent with findings of other studies [2,17].

60.3% individuals were current tobacco users (smoke and/or smokeless). Community-based (IDSP-NCD) Risk Factors Survey (2007-08) mentioned high prevalence of tobacco use in any form (47%) in Madhya Pradesh [18], while some studies also reported very low prevalence of tobacco use in rural populations of Punjab, Haryana [17,19]. The difference may be explained by variations of findings across rural settings, local demographics, the self-reporting nature of the screening tool, likely under-reporting of taboo behaviors [19], and the influence of some focused interventions on NCD amongst the study population [20, 21]. 83% cases started tobacco use (in any form) at the age of 18-20 years. This finding aligns with the mean age of initiation of smoking in the ICMR-IDSP NCD Risk Factor Survey Report [18].

52.2% were exposed to indoor smoke when using smoke-generating fuel (coal, firewood, crop residue, cow dung cake, etc.) for cooking. 11.5% (n = 24) of participants, exclusively males, reported to consume alcohol daily, similar to the findings of other studies [19, 22].

18.2% had positive family history for NCDs (hypertension, diabetes & heart disease).

Based on the responses on other NCD risk factors, 51.7% were mainly sedentary and reported to have inadequate physical activity (<150 minutes per week), consistent with other studies [19, 22-24]**.** Kaur P et al reported a very high prevalence of physical inactivity (71.4%) in rural Haryana [17]. 61.7% responded to have inadequate fruit intake (i.e., less than 4 servings of fruits in a week), which was comparable to other studies [2,13, 25]. Low consumption of fruits could probably be due to the lack of awareness of the population, and due to limiting purchasing power of the majority of families. A very high prevalence of inadequate intake of fruits and vegetables (98%) was reported in the rural population of India in the NNMS survey [14], and Gokul Sarveswaran et al also reported a prevalence of 82.3% in their studies in the rural population of South India [23].

Based on BMI classification, 10% of subjects (n =21) were in the underweight category, 23% (n = 48) were found to be overweight, and 6.7% (n = 14) were obese. The estimate of overweight in our present study is similar to that from the NCDRI survey in rural Bihar [26], the NFHS-5 survey for Madhya Pradesh [11], and the rates are increasing in rural areas [24]. Central obesity was defined as having a waist circumference of ≥ 90 cm in males and ≥ 80 cm in females, the prevalence of which is nearly equal (34%) in each sex. Findings ae comparable to other studies [2, 22, 23].

56% (n = 118) of the participants were classified as high-risk (CBAC risk score > 4) for NCDs, which is similar to other studies that reported high-risk prevalences of 57.7% and 47%, respectively, in the rural population of Haryana [17] and in underserved rural areas of Jaipur [20]. Jaacks LM et al reported low prevalence (14.4%) of high-risk population using (CBAC score more than 4) in their study, and the difference may be due to under-reporting of tobacco behavior and thereby reducing the summary risk score among the study participants [19]. It is important to mention here that the majority of the NCD risk factors, except for the measurement of weight, height, and waist circumference in the CBAC score, are subjective and self-reported. Therefore, the possibility of under-reporting of risk factors related to tobacco, alcohol, and family history of disease cannot be ruled out.

69.6% of men were categorized as high risk, compared to only 40.4% of women, and the difference between gender and NCD risk score above 4 was statistically significant (p = 0.00002). It suggests that men are at a higher risk of developing non-communicable diseases compared to women. Several factors, like lifestyle choice, sedentary occupation, urban and peer-group influences, may have

contributed to this gender disparity. NCD risk was significantly higher with an increase in age (p = 0.00001), among subjects who had no formal schooling (p = 0.004), and who were separated, divorced, or widowed (p = 0.001). Other studies [17,19, 21, 22] also demonstrated a statistically significant association across age groups, gender, and educational and marital status. The present study showed a significant association between NCD risk score and occupational status (p = 0.004). The observation was similar to the study conducted in rural Punjab by Jaacks L.M.et al [19]. Association was not statistically significant across the socio-economic class (p = 0.529), i.e., individuals belonging to both higher and lower socio-economic classes have the same risk for developing NCD. Similar findings have been reported by Kalaskar PS et al [21] in their study**.**

NCD Risk score was very high both in the overweight and obese category (more than 85%), and lowest in the underweight (38%), and the association was statistically highly significant (p = 0.00001). Association of high NCD risk score (> 4) with central obesity was also statistically significant in both sexes (p = *0.035* for women and p = *0.0005* for men, respectively). Other studies [17,22,27] also reported similar findings, demonstrating a statistically significant association between high BMI, increased abdominal obesity, and NCD risk scores

92.6% study participants with the "hypertension" category had a very high NCD risk score, compared to those of 51% in the "normal" category. The association between high blood pressure and an NCD risk score above 4 was statistically highly significant. Findings are similar to other studies [19-21].

CONCLUSION

Implementation of the CBAC-based community screening program in rural areas has been slow, particularly in remote rural populations. The present study demonstrated the potential of CBAC as a valuable tool for early NCD risk factor detection. Since most harmful lifestyle practices like smoking, alcohol use, and unhealthy dietary practices are initiated around 18-20 years, the population aged 18 years of more are particularly vulnerable to developing NCDs in later ages. Therefore, early detection and control of NCD risk factors in young adults and later in life have become a healthcare priority. 56% of the participants were classified as high-risk (CBAC risk score > 4) for NCDs. The CBAC tool demonstrated strong effectiveness in identifying individuals at risk in resource-limited settings, providing an opportunity for increasing awareness, initiating early interventions and management for both lifestyle-related NCD risk factors and NCD conditions to prevent long-term health complications.

Future studies should also address the limitations of small sample sizes in specific categories of other NCDs, including diabetes, cancer, mental health, and COPD, and investigate the association of NCD risk factors using CBAC to ensure more generalizability of findings.

Declaration by Authors

Ethical Approval: Approved

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Conflict of interest: None declared.

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