

Structural barriers and lifestyle risks: Intersectional analysis of prevalence of noncommunicable disease risk factors among the transgender population of Bengaluru

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Abstract

Background

Transgender populations in India experience structural exclusion across education, employment, healthcare, and public spaces, contributing to health inequities and limiting their representation in NCD surveillance. This study assessed the prevalence and clustering of NCD risk factors among transgender individuals in Bengaluru and interpreted these patterns in relation to social determinants of health, minority stress, and intersectionality.

Results

Among 171 transgender participants (median age 30 years), the burden of behavioural and metabolic risk factors was high. Inadequate fruit and vegetable intake (95.6%) and low physical activity (91.2%) were nearly universal. Overweight (81.8%), central obesity (waist–hip ratio 77.6%), tobacco use (38.0%), alcohol use (45.6%), elevated blood pressure (15.3%), and high blood glucose (20.4%) were also prevalent. Risk factor clustering, defined as the presence of three or more NCD risk factors, was observed in 65.3% of participants. Several risk factors were significantly associated with age, gender identity, work status, living arrangement, and disclosure of gender identity.

Conclusion

The high prevalence and clustering of NCD risk factors among transgender individuals in Bengaluru highlight the need to centre transgender populations in NCD research, policy, and practice. These findings should be understood through intersectionality and minority stress frameworks, recognising that lifestyle risks are embedded within broader structural conditions, including stigma, discrimination, socioeconomic precarity, and barriers to safe public spaces and affirming healthcare. NCD prevention strategies for transgender communities should move beyond individual behaviour change to address these wider determinants through inclusive, community-informed, and rights-based public health approaches.

Introduction

The transgender population in India faces significant discrimination and marginalization. Historically, their representation in public domains, legislative frameworks, academic research, and similar spheres has been minimal. This systemic exclusion persists across education, formal employment, healthcare and policy making.[1] This is reflected in their invisibility even in official enumeration; for example, the Census of India recognized this demographic only in 2011, categorizing them under “others”. [2] The absence of legal and institutional recognition pushes them to insecure employments, which adds to their

financial disadvantage.[3] Consequently, the transgender population occupies a disadvantaged socioeconomic position, which has direct implications for their health outcomes.

The relationship between social determinants of health and health inequities is well established. Socioeconomic position and health follow a linear relationship at all levels of income.[4] This pattern can be seen in the distribution of noncommunicable diseases (NCDs) across and within countries. NCDs are chronic and result from a combination of genetic, physiological, environmental and behavioral risk factors. The risk factors are classified as modifiable (tobacco use, physical inactivity, unhealthy diet, harmful use of alcohol), metabolic (raised blood pressure, overweight/obesity, hyperglycemia, hyperlipidemia), and environmental (air pollution and other factors). [5] Collectively, these risk factors drive a substantial disease burden: NCDs are the largest contributor to mortality globally[6].

Living in low- and middle-income countries (LMICs) and having low socioeconomic status translate to a greater risk of NCDs. [7] LMICs are disproportionately affected by NCDs, as 73% of all NCD deaths occur in these countries. In India, NCDs are currently the largest contributor to mortality. [8] Within India, data from the Longitudinal Aging Study In India (LASI), the National Family Health Survey-5 (NFHS-5), the ICMR-INDIAB study, etc., consistently show that socioeconomically disadvantaged populations experience a greater burden of NCDs and their risk factors.[7, 9–12] Addressing this disparity is crucial in reducing the burden of NCDs. This is also relevant to Sustainable Development Goals (SDGs) target 3.4, which calls for a one-third reduction in premature NCD mortality by 2030. Therefore, reducing the NCD burden requires epidemiological data to include populations most at risk, i.e., socioeconomically marginalized groups that are historically overlooked by health systems such as the transgender community.

In studies of the transgender population in various parts of southern India, only 13–33% were salaried or had regular monthly wages, reflecting the economic disadvantage of the population. [13–15] Such research among transgender populations has only recently begun to include individuals with gender identities other than transwomen. Despite this, the available data reveal a high prevalence of behavioral risk factors for NCDs, including alcohol consumption (40–60%), tobacco use (35.2–43.5%), and inadequate intake of fruits and vegetables (90–90.5%).[13–17] However, evidence on metabolic risk factors and the geographic scope of existing research are limited.

This gap is particularly striking in the context of Bengaluru. NFHS-5 data for Bengaluru indicate that elevated blood sugar affects 19.4% of women and 21.3% of men, elevated blood pressure affects 30.7% of women and 33.5% of men, tobacco use affects 2.9% of women and 20.9% of men, and alcohol consumption affects 1.1% of women and 17.3% of men.[11] Community-based studies on NCD risk factors have shown that the prevalence of physical inactivity ranges from 14.8% to 46.8%, the prevalence of central obesity ranges from 12.8% to 46.4%, and the prevalence of inadequate intake of fruits and vegetables ranges from 82.3% to 100% [18, 19].

Despite the inclusion of transgender persons in the 2011 Census and the relatively greater visibility of transgender communities in Bengaluru, their health remains largely absent from mainstream

epidemiological data and public health discourse. [2] Existing population-level surveys and community-based studies on noncommunicable diseases (NCDs) in Bengaluru mentioned above do not include transgender individuals, reflecting a broader pattern of exclusion from health surveillance systems. This absence limits the understanding of health inequities faced by transgender populations and constrains the development of inclusive NCD prevention and control strategies. Given the intersecting influences of gender identity, socioeconomic marginalisation, employment precarity, housing instability, and barriers to healthcare access, it is essential to examine NCD risk within a framework that accounts for these structural and social determinants of health. Addressing this gap, the present study estimates the prevalence and clustering of NCD risk factors among transgender individuals in Bengaluru and situates these findings within an intersectional and minority stress-informed perspective, with the aim of contributing to more inclusive and equitable public health research and practice.

Methods

Study Design and Setting

This cross-sectional study aimed to determine the prevalence of risk factors for NCDs among the transgender population of Bengaluru. Participant recruitment and data collection took place from April 2023 to April 2024.

Participants

The study included individuals aged 18 years or older who identified themselves as transgender and resided in Bengaluru during the study period. Individuals who had moved into the study area within the previous 6 months were excluded.

After obtaining ethical clearance from the Institutional Review Board, participants were recruited through nongovernmental organizations (NGOs) working for the welfare of transgender individuals in Bengaluru. More participants were identified via snowball sampling. This nonprobability sampling approach was adopted because no sampling frame or line list of the transgender population exists in Karnataka, making probability-based sampling currently infeasible for this population.

Data Sources and Measurement

After providing informed consent, the data were collected via a pretested semistructured questionnaire. For the preparation of the study tool, experts in epidemiology, endocrinology and nutrition were consulted. The study tool was also reviewed by transgender NGO officials and other community members. The suggestions were used to modify the study tool before the commencement of data collection.

The questionnaire assessed various risk factors for noncommunicable diseases (NCDs), including current smoking, physical inactivity, inadequate intake of fruits and/or vegetables, high salt intake, current use of alcohol, increased blood pressure, overweight, high random blood sugar (RBS), and central

obesity. The WHO NCD risk factor STEPS 1 and 2 questionnaires were adopted for this purpose. Additionally, anthropometric measurements such as height, weight, and waist circumference were conducted via standardized procedures.

Socioeconomic position was assessed through three variables—educational attainment, work status, and living arrangements—considered jointly as proxies for socioeconomic disadvantage. An income-based composite classification was not applied, as such a calculation is not meaningful for individuals living in gharana communities or alone outside a conventional family unit. Such scales do not capture occupational precarity, housing insecurity, or dependence on informal economic activities, including begging and sex work, which are structurally characteristic of the socioeconomic disadvantage experienced by transgender individuals in India.

The participants identified with risk factors for NCDs were counseled on lifestyle modifications. Symptomatic medication for complaints and referrals to the nearest primary health center were provided accordingly for the participants.

Operational Definitions

The study assessed the following NCD risk factors as outcome variables: current smoking, physical inactivity, inadequate fruit and vegetable intake, high salt intake, current alcohol consumption, overweight (by BMI), central obesity (by waist circumference and waist–hip ratio), elevated blood pressure, and high random blood sugar. The variables and operational definitions are given below:

- Transgender is a person who identifies with a gender different from the sex they were assigned at birth.
- **A trans man** is a man who was assigned female at birth.
- **A trans woman** is a woman who was assigned male at birth.
- **Current smoking:** smoking tobacco products in the last 30 days.
- **Current alcohol consumption:** Current alcohol consumption was defined as the ingestion of no fewer than one standard alcoholic beverage within the preceding 30 days.
 - A standard alcoholic beverage is characterized as 285 ml of regular beer, a single serving of distilled spirit measuring 30 ml, one medium-sized glass of wine totaling 120 ml, and a single portion of an aqueous beverage amounting to 60 ml.
- **Inadequate intake of fruits and vegetables:** the intake of fewer than five servings of fruits and vegetables daily, excluding starchy vegetables.
 - A standard serving of vegetables is quantified as 80 grams, contingent upon the specific type of vegetable and standard cup measurement.
 - A single medium-sized fruit constitutes one serving.

- **Inadequate physical activity:** defined as engaging in fewer than 600 metabolic equivalents of moderate- and vigorous-intensity physical activities within an average weekly timeframe.
- **Overweight:** BMI of $\geq 23.0 \text{ kg/m}^2$
- **Elevated blood pressure:** Defined as an average SBP of $\geq 140 \text{ mm Hg}$ and/or a DBP of $\geq 90 \text{ mm Hg}$ or a known hypertensive.
- **High random blood sugar (RBS):** defined as a random blood sugar value of $\geq 140 \text{ mg/dL}$ or a known diabetic.
- **High waist–hip ratio:** defined as
 - ≥ 0.80 for participants who had not taken hormone therapy and were assigned a female at birth, and for participants who had taken estrogen therapy.
 - ≥ 0.90 for participants who have not taken hormone therapy and are male at birth, and for participants who have taken testosterone therapy.
- **High waist circumference:** defined as
 - $\geq 80 \text{ cm}$ for participants who had not taken hormone therapy and were assigned female at birth, and for participants who had taken estrogen therapy.
 - $\geq 90 \text{ cm}$ was used for participants who had not taken hormone therapy and were assigned male at birth, and for participants who had taken testosterone therapy.
- **High salt intake:** Participants were categorized as having high salt intake if they always or often add salt or salty food items such as pickles to their food before eating or as they are eating OR eat food processed high in salt.

Sample size

The sample size was calculated on the basis of a cross-sectional study conducted by Madhavan et al. among transgender individuals in Puducherry in 2020, where 90% of the participants reported unhealthy dietary practices, 84% were physically inactive, 41% had a high waist–hip ratio, and 36% were obese. [14]

In the present study, the prevalence of obesity was considered for sample size calculation, as it is the lowest prevalence, and similar results with a precision of 95% confidence level and 7.5% absolute precision were expected; this study required a minimum of 171 subjects.

Quantitative Variables

Age was bifurcated at the median (30 years) for the purpose of univariate analysis. Work status was analyzed both as a six-category variable (government employee, nongovernment employee, self-employed, sex work, begging, unemployed) and, for the purpose of examining associations with NCD risk factors, as a binary variable contrasting regular monthly wages (government and nongovernment employees combined, 25.8%) with occasional income or unemployment (self-employed, sex work,

begging and unemployed combined, 74.2%), reflecting the meaningful economic distinction in this population between formal employment and informal activity.

Standard binary cutoffs for waist circumference and the waist–hip ratio are derived from and validated in cisgender populations and apply a male/female binary that does not account for the body composition changes induced by gender-affirming hormone therapy, which shifts fat distribution in ways that do not align with either cisgender male or cisgender female reference values. To address this, cutoffs were adapted based on each participant's assigned sex at birth and current hormone therapy status, following criteria developed in consultation with endocrinologists with experience in transgender care. For participants assigned as females at birth who had not taken hormone therapy and for those receiving estrogen therapy, a waist–hip ratio of ≥ 0.80 and waist circumference of ≥ 80 cm were applied; for participants assigned male at birth who had not taken hormone therapy and for those receiving testosterone therapy, corresponding cutoffs of ≥ 0.90 and ≥ 90 cm were used. This represents a pragmatic adaptation in the absence of transgender-specific validated anthropometric reference standards, and the lack of such standards is acknowledged as a limitation of current evidence.

Statistical methods

Descriptive statistics of the waist–hip ratio, obesity, physical inactivity, unhealthy diet practices and other risk factors were analyzed and summarized in terms of percentages.

The chi-square test was used to compare the proportions of risk factors between sociodemographic profiles. The odds ratio was calculated to compare the risks between different strata.

Results

A total of 171 transgender individuals were enrolled across the study period (April 2023–April 2024). No participants were excluded after enrollment. Transwomen constituted 134 participants (78.4%), and transmen constituted 37 (21.6%). The sociodemographic profile is presented in Table 1.

Table 1
Sociodemographic profile of the participants (n = 171)

Characteristic	Category	Frequency	Percentage
Gender Identity	Transman	37	21.6
	Transwoman	134	78.4
Age group (years)	18–25	53	31.0
	26–35	72	42.1
	36–45	26	15.2
	46–55	17	9.9
	56–65	3	1.8
Education	Not literate	7	4.1
	Primary school	7	4.1
	Middle School	28	16.3
	High School	48	28.1
	Intermediate/diploma	39	22.9
	Graduate	36	21.1
	Postgraduate	6	3.5
Religion	Hindu	153	89.5
	Muslim	9	5.2
	Christian	6	3.5
	Others	3	1.8
Marital Status	Never married	133	77.7
	Currently married	16	9.4
	Divorced	15	8.8
	Cohabiting	7	4.1
Work status	Government employee	3	1.8
	Nongovernment employee	41	24.0

Characteristic	Category	Frequency	Percentage
	Self-employed	6	3.5
	Sex work	45	26.3
	Begging	48	28.0
	Unemployed	28	16.4
Living Arrangements	Community residence	63	36.9
	With biological family	47	27.5
	Staying alone/Hostel	61	35.7
Gender Identity revealed to family and/or friends	Yes	140	81.9
	No	31	18.1
Residence	Rural	45	26.3
	Urban	126	73.7

Table 1: Sociodemographic profile of the participants (n = 171)

The median age of the participants was 30 years (24–27), and the largest age group was 26–35 years (72 participants, 42.1%). Nearly half (83 participants, 48.5%) had completed education up to the 10th standard (high school) or below, and most of the participants were Hindu (89.5%). Begging and sex work were the reported work statuses of the majority of the participants (28.0% and 26.3%, respectively). The average monthly income was INR 17,500 (IQR 12,500–58,000). The majority of the participants lived away from their biological families (124 participants, 72.5%) and revealed their gender identity to family and/or friends (140 participants, 81.9%). Most participants were urban residents (126, 73.7%).

The prevalence of all NCD risk factors assessed is presented in Table 2. The burden of both behavioral and measurement-based risk factors was high.

Among the measurement-based risk factors, overweight BMI ($\text{BMI} \geq 23 \text{ kg/m}^2$) was the most prevalent, affecting 140 participants (81.8%; 95% CI: 76.0–87.6). High waist circumference and a high waist–hip ratio was similarly prevalent at 81.3% (95% CI: 75.9–87.5) and 77.6% (95% CI: 71.4–83.8), respectively. Elevated blood pressure was present in 24 participants (15.3%; 95% CI: 9.9–20.7), and high RBS was present in 35 participants (20.4%; 95% CI: 16.6–24.1).

Among the behavioral risk factors, inadequate fruit and vegetable intake was nearly universal, affecting 155 participants (95.6%; 95% CI: 92.5–98.7). Low physical activity was similarly prevalent, reported by 156 participants (91.2%; 95% CI: 87.0–95.4). Current alcohol consumption was reported by 78 participants (45.6%; 95% CI: 38.1–53.0), and current smoking was reported by 65 participants (38.0%; 95% CI: 30.7–45.2). High salt intake was observed in 24 participants (14.0%; 95% CI: 8.8–19.2).

Table 2
Prevalence of risk factors for noncommunicable diseases among the study participants

Risk Factor	Frequency n (%)	95% Confidence Interval of prevalence
Risk factor based on measurements		
Overweight	140 (81.8)	76.0–87.6
High Waist Circumference	139 (81.3)	75.9–87.5
High Waist-Hip Ratio	132 (77.6)	71.4–83.8
Elevated BP	24 (15.3)	9.9–20.7
High RBS	35 (20.4)	16.6–24.1
Behavioral risk factors		
< 5 servings of fruits and/or vegetables/day	155 (95.6)	92.5–98.7
High salt intake	24 (14.0)	8.8–19.2
Low physical activity	156 (91.2)	87.0–95.4
Current Smoking	65 (38.0)	30.7–45.2
Current Drinking	78 (45.6)	38.1–53.0

Risk factor clustering, defined as the co-occurrence of three or more NCD risk factors in a single individual, was identified in 111 participants (65.3%). The remaining 60 participants (34.7%) had fewer than three risk factors.

Research findings indicate that, compared with their younger counterparts, transgender individuals in Bengaluru over 30 years of age exhibit greater risk factors for noncommunicable diseases, such as increased BMI, waist circumference, blood pressure, and random blood sugar levels. Additionally, transwomen appear to have greater mean values of blood pressure and RBS than transmen do (Table 3).

Table 3
Mean values of different physical parameters

Physical parameters	Age (in years)		Gender	
	≤ 30	> 30	Transmen	Transwomen
	Mean ($\pm$ SD)	Mean ($\pm$ SD)	Mean ($\pm$ SD)	Mean ($\pm$ SD)
BMI(kg/m ²)	25.9 ($\pm$ 4.5)	28.6 ($\pm$ 5.6)	27.6 ($\pm$ 4.2)	27.1 ($\pm$ 5.8)
Waist circumference (cm)	88.8 ($\pm$ 10.5)	98.6 ($\pm$ 18.8)	88.8 ($\pm$ 8.5)	95.1 ($\pm$ 17.4)
Hip Circumference(cm)	99.9 ($\pm$ 9.2)	105.8 ($\pm$ 19.4)	105 ($\pm$ 6.2)	102.1 ($\pm$ 17.1)
Waist -Hip Ratio	0.9 ($\pm$ 0.1)	0.9 ($\pm$ 0.1)	0.8 ($\pm$ 0.1)	0.9 ($\pm$ 0.1)
Systolic Blood Pressure (mm Hg)	121.5 ($\pm$ 10.6)	126.8 ($\pm$ 20.8)	118.4 ($\pm$ 7.0)	125.8($\pm$ 18.2)
Diastolic blood pressure (mm Hg)	76.4 ($\pm$ 7.6)	82.4 ($\pm$ 10.7)	76.7 ($\pm$ 6.9)	80.1 ($\pm$ 10.3)
Random Blood Sugar(mg/dL)	108.9 ($\pm$ 19.8)	149.5 ($\pm$ 89.5)	104 ($\pm$ 21.3)	137 ($\pm$ 75.4)

Older individuals (> 30 years) tend to consume slightly more fruits and vegetables per day and smoke more cigarettes daily than younger individuals (≤ 30 years). Compared with transmen, transwomen smoke more cigarettes per day on average. Alcohol consumption in terms of standard drinks is slightly greater among older individuals and transmen than among younger individuals and transwomen, although the differences are minimal. (Table 4)

Table 4
Mean values of different behavioral parameters

Behavioral parameters	Age (in years)		Gender	
	≤ 30	> 30	Transmen	Transwomen
	Mean	Mean	Mean	Mean
	($\pm$ SD)	($\pm$ SD)	($\pm$ SD)	($\pm$ SD)
No.of servings of fruit and vegetables per day	2.7 ($\pm$ 0.2)	2.9 ($\pm$ 0.1)	2.8 ($\pm$ 0.3)	2.7 ($\pm$ 0.1)
No. of cigarettes smoked per day by daily smokers	4.3 ($\pm$ 0.9)	4.8 ($\pm$ 0.7)	4.5 ($\pm$ 0.4)	5.1 ($\pm$ 0.5)
No .of standard drinks of alcohol per day	0.5 ($\pm$ 0.0)	0.7 ($\pm$ 0.0)	0.7 ($\pm$ 0.0)	0.6 ($\pm$ 0.0)

For each risk factor, univariate analysis (Chi square) was performed to determine associations with the following variables: sex, age group (bifurcated at median age), sex identity, work, family history of NCD, and living arrangement. In addition, each risk factor's association with other risk factors was also tested. Associations with significant p values are listed in Table 5. The full analysis for each risk factor in separate tables is available in the supplementary material. (Additional File 1.docx)

Age was significantly associated with high sugar levels (OR 6.5 (2.5–16.7)). Compared with adequate intake, inadequate intake of fruits and vegetables was associated with 8.93 (1.86–42.89) times greater odds of hypertension. The univariate analysis for current alcohol consumption (in the last month) revealed several significant associations. Compared with transwomen, transmen were more likely to consume alcohol, with a significant p value of 0.002 and a crude odds ratio (OR) of 3.2 (95% CI: 1.5–6.9). Age under 30 years was associated with increased alcohol consumption, with a significant p value of 0.001 and an OR of 0.4 (95% CI: 0.2–0.7), suggesting that younger individuals are more likely to consume alcohol. Those who revealed their gender identity also showed a significant association with higher alcohol consumption, as indicated by a p value of 0.001 and an OR of 4.4 (95% CI: 1.7–11.4). Physical activity levels and living arrangements were also significantly associated, with inadequate physical activity (OR 0.2, 95% CI: 0.1–0.6) being linked to lower alcohol consumption and living without family (OR 1.3, 95% CI: 1.2–1.7) being linked to higher alcohol consumption. Transmen (OR 0.1, 95% CI: 0.04–0.4) were less likely to have inadequate physical activity levels, whereas participants with occasional earnings/unemployment were more likely to have inadequate physical activity levels. Participants with elevated blood pressure were more likely to have inadequate intake of fruits and vegetables. (OR 8.9, 95% CI: 1.9–42.9)

Table 5
Factors associated with risk factors for NCDs

Outcome	Dependent Variable	Classification	p value	Crude OR (95% CI)
High random blood sugar (≥ 140 mg/dL)	Age (years)	> 30 vs ≤ 30 (ref)	< 0.001	6.5 (2.5–16.7)
Elevated blood pressure ($\geq 140/90$ mm Hg)	Fruit & vegetable intake	Inadequate vs adequate(ref)	0.001	8.9 (1.9–42.9)
Current alcohol consumption (past 30 days)	Gender	Transmen vs transwomen	0.002	3.2 (1.5–6.9)
	Age (years)	> 30 vs ≤ 30 (ref)	0.001	0.4 (0.2–0.7)
	Gender identity revealed to family	Yes vs no(ref)	0.001	4.4 (1.7–11.4)
	Work status	Occasional earning/unemployed vs Regular wages (ref)	< 0.001	0.2 (0.1–0.3)
	Physical activity	Inadequate vs Adequate (ref)	0.003	0.2 (0.1–0.6)
	Living arrangement	Without family vs with family(ref)	0.004	1.3 (1.2–1.7)
Physical Inactivity	Gender	Transmen vs Transwomen(ref)	< 0.001	0.1(0.04–0.4)
	Work status	Occasional earning/unemployed vs Regular wages (ref)	< 0.001	29.2(6.3–135.3)
*Chi square test				

Discussion

To our knowledge, this is the first study in Bengaluru to estimate the prevalence of NCD risk factors in a sample of transgender individuals. The prevalence of NCD risk factors observed in this study is high and consistent with findings reported across transgender populations in South India[13, 14, 16, 20]. The elevated prevalence of overweight BMI (81.8%, 95% CI: 76.0–87.6) relative to that reported in the comparative studies in this study is attributable to the use of an Asian-specific cutoff for BMI, which identifies risk at lower thresholds for South Asian populations. This interpretation is further corroborated by the concurrently high prevalence of elevated waist circumference (81.3%, 95% CI 75.9–87.5) and waist–hip ratio (77.6%, 95% CI 71.4–83.8) observed among participants.

The findings of this study are explained in line with the minority stress theory below. [21]The near universal presence of inadequate physical activity of the participants (91.2%) can be explained by the structural barriers that transgender populations face in accessing safe public spaces associated with mobility, including recreational spaces within rapidly urbanizing metropolitan environments, where equitable public infrastructure for physical activity remains inadequate. Research has shown that stigma, oppression and body image-related issues are strongly linked to low physical activity in transgender individuals.[22, 23] Unwelcoming and/or gendered spaces in changing rooms, pools and gyms feel unsafe to many trans people.[24, 25] Legal/administrative barriers such as the inability to change names have also been linked to lower levels of physical activity.[26] These barriers tend to weigh more heavily on transwomen in many datasets, contributing to lower activity than trans men do, as seen in this study. (OR 0.1). This is also related to body image in that transmen use exercise to align their bodies with gender, “building muscle for a more masculine shape”. [27, 28]

The significantly higher odds of current alcohol consumption among transmen (OR 3.2) may reflect the influence of normative masculine expectations and social scripts associated with male gender identity. [29, 30]Younger age was associated with greater odds of current alcohol consumption, potentially representing a behavioral stress response to the psychosocial disruptions that commonly accompany gender identity disclosure, including changes in housing stability, employment, and family and peer acceptance.[31–33] This finding is consistent with the literature reporting that the median age of gender identity disclosure is less than 25 years across multiple studies.[34] [35]The greater odds of alcohol consumption among participants who disclosed their gender identity further support this interpretation. (OR 4.4)

The lower odds of current alcohol consumption among participants with occasional earnings or unemployment (OR 0.2) and those with inadequate physical activity (OR 0.2) warrant an intersectional analysis.[36][37] Regular salaried employment elevates the socioeconomic position of transgender individuals sufficiently to better afford access to spaces of physical activity, including parks, recreational facilities, and gymnasiums, as well as to social environments where alcohol consumption is more prevalent. This finding is consistent with established associations between higher socioeconomic class and a higher frequency of current alcohol consumption.[38, 39]Furthermore, living arrangements independent of family were associated with higher odds of current alcohol consumption (OR 1.3), a finding that aligns with the literature documenting the relationship between family rejection and substance use among transgender individuals, wherein higher levels of family rejection were significantly associated with greater odds of alcohol and drug misuse as a coping mechanism for transgender-related discrimination and stigma.[40, 41]

Limitations

The current study uses snowball sampling, a non-probabilistic sampling method. The inherent limitation on external validity that this entails is acknowledged. Recruitment through NGOs and snowball sampling may introduce selection bias, as individuals with stronger community networks or NGO affiliation may be

overrepresented, potentially excluding more isolated or hidden members of the transgender population. Social desirability bias may affect self-reported behavioral risk factors and was partially mitigated by using a pretested, interviewer-administered semistructured questionnaire in a setting designed to ensure participant comfort and confidentiality. Multivariate analysis was not performed, as the sample size and the exploratory, descriptive nature of this study were not designed to support adjusted modeling; associations reported are therefore unadjusted and should be interpreted as hypothesis-generating rather than confirmatory.

Conclusion

This study highlights a high prevalence and substantial clustering of noncommunicable disease risk factors among transgender individuals in Bengaluru, pointing to significant and under-recognised health inequities within this population. Interpreted through intersectionality and minority stress frameworks, these results demonstrate that NCD risk cannot be reduced to individual behaviours alone, but is shaped by overlapping systems of disadvantage, including stigma, discrimination, socioeconomic precarity, exclusion from safe and inclusive public spaces, and barriers to accessing affirming healthcare. Future research using longitudinal and analytical designs is needed to build on these findings, but the current evidence already provides a critical foundation for advancing more equitable and transgender-inclusive approaches to NCD prevention and control.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ethical Committee of Ramaiah Medical College in accordance with the Declaration of Helsinki. Written informed consent was obtained from all participants prior to their participation in the study. The participants were fully informed about the study purpose, the voluntary nature of participation, their right to withdraw at any time without consequence, and how their data would be used and protected. All participants' privacy and confidentiality were carefully maintained throughout the research process.

Consent for publication

Not applicable

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Author Contribution

Conceptualization, NAJ and LK. ; Methodology, NAJ, LK and SG. ; Software, SNS and NAJ;Analysis: NAJ, LK, SG and SNS;Writing—Original Draft Preparation, NAJ; Writing—Reviewand Editing LK; Supervision, LK and SG

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Data Availability

The data that support the findings of this study are not openly available for reasons of sensitivity and are available from the corresponding author upon reasonable request.

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