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Behavioral Risk Factors and Non-communicable diseases in Tribal Adults: A Systematic Review

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ABSTRACT

Background: Non-communicable diseases (NCDs) are a significant public health concern globally, especially among tribal populations, where unique socio-cultural practices may influence the prevalence of behavioral risk factors. Understanding the relationship between these risk factors and NCDs is critical for targeted interventions.

Objectives: This systematic review aims to synthesize the existing evidence on the prevalence of behavioural risk factors—such as tobacco use, alcohol consumption, unhealthy diets, and physical inactivity—among tribal adults and their association with NCDs, including cardiovascular diseases, diabetes, and cancer.

Methods: A comprehensive search was conducted across databases such as PubMed, Scopus, and Google Scholar for studies published between 2000 and 2023. Inclusion criteria included peer-reviewed studies reporting on tribal adults (aged ≥18 years) and exploring the relationship between behavioural risk factors and NCDs. Exclusion criteria included studies with non-tribal populations and those focused on infectious diseases. Data extraction followed PRISMA guidelines, and the quality of included studies was assessed using the Newcastle-Ottawa Scale.

Results: A total of X studies met the inclusion criteria, highlighting the significant burden of behavioural risk factors among tribal populations. Tobacco use and alcohol consumption were the most prevalent risk factors, with an associated increase in the incidence of cardiovascular diseases and diabetes. Limited access to healthcare and socio-economic challenges were identified as key barriers to addressing these risk factors.

Conclusions: The review underscores the urgent need for culturally tailored public health interventions targeting behavioural risk factors in tribal populations to mitigate the rising burden of NCDs. Further research is needed to explore effective strategies for health promotion and disease prevention in these vulnerable communities.

Keywords: *Tribal adults, non-communicable diseases, behavioural risk factors, tobacco use, alcohol consumption, systematic review.*

1. INTRODUCTION

Non-communicable diseases (NCDs), such as cardiovascular diseases, diabetes, cancers, and chronic respiratory conditions, are the leading causes of mortality worldwide, accounting for approximately 71% of global deaths (World Health Organization [WHO], 2021). NCDs disproportionately affect low- and middle-income countries, where 85% of premature deaths occur due to these conditions. Among the populations most vulnerable to NCDs are tribal adults, who often experience higher rates of morbidity and mortality compared to their non-tribal counterparts (Ramesh &Kosalram, 2023). The increased susceptibility of tribal populations to NCDs is closely linked to their distinct socio-cultural, environmental, and behavioral contexts, which significantly influence their health outcome (Budreviciute et al., 2020).

Behavioral risk factors, including tobacco use, harmful alcohol consumption, poor diet, and physical inactivity, have been identified as primary drivers of the NCD epidemic (Wood et al., 2021). These modifiable behaviors are prevalent among tribal adults, who may engage in such habits due to cultural practices, lack of health education, limited access to healthcare, and the stresses associated with poverty and marginalization (M. M. Kumar et al., 2020). Furthermore, the geographic isolation of many tribal communities limits their access to preventive and curative healthcare services, exacerbating the risk of developing NCDs. Understanding how these behavioral risk factors contribute to the rise of NCDs in tribal populations is crucial for developing culturally appropriate, evidence-based interventions aimed at improving health outcomes. (Roy et al., 2023)

This systematic review aims to examine the relationship between behavioral risk factors and the incidence of NCDs in tribal adults. By synthesizing existing literature on the subject, this review will provide insights into the key drivers of NCDs in this population and identify potential areas for public health interventions. Addressing these behavioral risk factors in tribal adults is essential for reducing the burden of NCDs, promoting health equity, and improving the quality of life in marginalized communities.

Epidemiology of Non-Communicable Diseases in Tribal Populations

Tribal populations, also referred to as indigenous or aboriginal communities, represent a significant proportion of the global population, especially in regions such as Asia, Africa, and the Americas. Despite their cultural diversity, tribal populations often share common health challenges, including higher rates of NCDs compared to non-tribal populations (Redvers et al., 2023). NCDs, once considered diseases of affluence, have become increasingly prevalent among tribal adults due to the rapid adoption of urbanized lifestyles, dietary transitions, and increased exposure to risk factors such as tobacco and alcohol us (M. Sharma et al., 2024). The shift from traditional subsistence farming and hunting-gathering practices to more sedentary lifestyles has further contributed to this rise in NCDs (Higgins et al., 2022)

In India, for example, tribal populations account for approximately 8.6% of the total population, and the burden of NCDs among them is growing rapidly (Soman et al., 2023). Studies have reported higher incidences of diabetes, hypertension, and cardiovascular diseases in tribal communities, particularly in regions where modernization and urbanization have significantly impacted their way of life (Shriraam et al., 2021). Similar trends have been observed in other parts of the world, such as Australia, where indigenous populations face disproportionate rates of NCDs, including diabetes and chronic kidney disease, compared to the general population (Hare et al., 2022). The health disparities faced by tribal populations underscore the need for targeted interventions that address the unique behavioral risk factors contributing to the high prevalence of NCDs in these communities.

Behavioral Risk Factors in Tribal Adults

The primary behavioral risk factors for NCDs—tobacco use, alcohol consumption, unhealthy diets, and physical inactivity—are well-documented in the general population. However, their prevalence and impact on tribal adults require closer examination due to the distinct socio-cultural and environmental factors that shape these behavior(Pedroso et al., 2023). Tobacco use, for instance, is deeply embedded in many tribal cultures, where it is often used in religious and social ceremonies (Murmu et al., 2023). However, the shift from traditional forms of tobacco use to commercial tobacco products, such as cigarettes and chewing tobacco, has led to an increase in tobacco-related NCDs, including lung cancer and chronic respiratory diseases (Claire et al., 2020)

Similarly, harmful alcohol consumption is prevalent among many tribal populations. Cultural acceptance of alcohol, coupled with limited access to healthcare and education, has contributed to the rise of alcohol-related NCDs, such as liver disease and cardiovascular disorders, among tribal adults (Rose et al., 2021). In addition, traditional diets rich in fruits, vegetables, and whole grains are being replaced by processed, energy-dense foods high in sugars, salts, and fats, leading to an increase in obesity, diabetes, and hypertension (Parry et al., 2011). The transition to a more sedentary lifestyle, characterized by reduced physical activity due to changes in occupation and living conditions, has further compounded the risk of NCDs in tribal adult (Park et al., 2020).

Social Determinants of Health and NCDs in Tribal Populations

The behavioral risk factors for NCDs among tribal adults cannot be viewed in isolation from the broader social determinants of health. Factors such as poverty, education, employment, housing, and access to healthcare play a critical role in shaping the health behaviors and outcomes of tribal population (Jeong et al., 2021). Many tribal communities face significant economic disadvantages, with high rates of poverty and unemployment limiting their ability to access nutritious food, safe drinking water, and healthcare service (K. Sharma, 2019). These structural barriers contribute to the persistence of unhealthy behaviors and hinder efforts to prevent and manage NCDs in tribal populations.

Geographic isolation also poses a major challenge for tribal adults in accessing healthcare services. Many tribal communities are located in remote, rural areas with limited infrastructure, making it difficult for residents to seek timely medical care for the prevention and treatment of NCD (D. Kumar et al., 2022). The lack of culturally appropriate health promotion and disease prevention programs further exacerbates the problem, as tribal adults may be less likely to engage in health-seeking behaviors if they perceive that healthcare services are not designed to meet their needs (Taraphdar et al., 2022). This highlights the importance of developing community-based interventions that address both the behavioral and structural determinants of NCDs in tribal populations.

This systematic review aims to explore the relationship between behavioral risk factors and the incidence of NCDs in tribal adults by synthesizing findings from diverse geographical contexts. Specifically, the review will focus on the prevalence of tobacco use, alcohol consumption, unhealthy diets, and physical inactivity in tribal populations and their contribution to the rising burden of NCDs. Additionally, the review will examine the role of social determinants of health in shaping these behaviors and identify potential public health interventions that can reduce NCD risk in tribal adults.

By providing a comprehensive overview of the literature on this topic, this review seeks to inform the development of culturally tailored interventions and policies that address the unique health needs of tribal populations. Ultimately, addressing behavioral risk factors in tribal adults can contribute to reducing health disparities and improving the quality of life for marginalized communities around the world.

2. RATIONALE FOR REVIEW

Non-communicable diseases (NCDs) have become a global public health challenge, contributing to significant morbidity and mortality, especially in low- and middle-income countries (Ndumwa et al., 2023). While much research has focused on NCDs in urban and non-tribal populations, there is growing evidence that tribal populations, who are often marginalized and underserved, face a disproportionately high burden of these disease(Bhattacharya et al., 2022). Behavioral risk factors such as tobacco use, harmful alcohol consumption, poor diet, and physical inactivity are widely recognized as major contributors to NCDs in the general population. However, these risk factors manifest uniquely in tribal communities due to their distinct cultural, social, and environmental contexts (Mishra et al., 2022)

Despite their high vulnerability to NCDs, tribal adults remain understudied in public health research, particularly regarding the role of behavioral risk factors. The available literature on NCDs in tribal populations often lacks a comprehensive focus on how modifiable behaviors drive disease prevalence in these communities (Bhar et al., 2019). Additionally, the interplay between social determinants of health—such as poverty, geographic isolation, and limited access to healthcare—and the behavioral risk factors for NCDs in tribal adults has not been sufficiently explored in previous reviews.

This systematic review aims to fill this knowledge gap by synthesizing the current evidence on behavioral risk factors and their association with NCDs in tribal adults. By examining the prevalence and impact of tobacco use, alcohol consumption, poor diet, and physical inactivity in tribal populations, this review seeks to provide a clearer understanding of the unique challenges these communities face. The review also aims to identify culturally appropriate interventions that can reduce NCD risk in tribal populations, ultimately contributing to more equitable health outcomes.

Given the critical need to address the rising burden of NCDs in tribal populations and the lack of targeted research on behavioral risk factors, this review is timely and necessary. It will serve as an essential resource for public health policymakers, researchers, and healthcare providers aiming to design and implement effective interventions tailored to the needs of tribal adults.

3. MATERIAL AND METHOD

A comprehensive literature search was conducted across the following electronic databases: PubMed, Scopus, Web of Science, and Google Scholar. The search terms used included: “tribal adults,” “indigenous populations,” “behavioral risk factors,” “tobacco use,” “alcohol consumption,” “unhealthy diet,” “physical inactivity,” “non-communicable diseases,” “diabetes,” “cardiovascular diseases,” and “cancer.” Boolean operators such as "AND" and "OR" were used to combine search terms. Grey literature, including government reports and conference proceedings, was also reviewed to capture studies not indexed in major databases.

Inclusion Criteria

- Studies focusing on tribal or indigenous adults (aged 18 and above).

Studies that assess at least one behavioural risk factor—tobacco use, alcohol consumption, poor diet, or physical inactivity.

Studies that report on the incidence or prevalence of NCDs such as cardiovascular diseases, diabetes, cancers, and chronic respiratory conditions.

- Quantitative observational studies (e.g., cross-sectional, cohort, case-control) and interventional studies.
- Articles published in English.
- Studies published between 2014 and 2024.

Exclusion Criteria

- Studies focusing on children or adolescents.
- Reviews, commentaries, editorials, and case reports.
- Studies not involving tribal or indigenous populations.

Data Extraction:

Data from eligible studies were independently extracted by two reviewers using a standardized data extraction form. Extracted data included study characteristics (author, year, country, study design), population details (Sample size, age, gender, and tribal group), Behavioral Risk Factors (Type and prevalence of the risk factor (tobacco use, alcohol consumption,

unhealthy diet, or physical inactivity), NCD Outcomes - Type of NCD (e.g., cardiovascular disease, diabetes) and reported prevalence or incidence, Key Findings (Associations between behavioral risk factors and NCDs). Any discrepancies between reviewers were resolved through discussion or consultation with a third reviewer.

4. QUALITY ASSESSMENT

There were no language constraints while searching multiple resources (both digital and printed). In addition, numerous search engines were used to look for online pages that may serve as references. Inclusion and exclusion criteria were documented. Using broad critical evaluation guides, selected studies were subjected to a more rigorous quality assessment.

These in-depth quality ratings were utilized to investigate heterogeneity and make conclusions about meta-analysis appropriateness. A comprehensive technique was developed for this assessment to determine the appropriate sample group. The criteria for evaluating the literature were developed with P.I.C.O. in mind.

(Cronin et al., 2008)suggest that for nurses to achieve best practice, they must be able to implement the findings of a study which can only be achieved if they can read and critique that study.(J, 2010) defines a systematic review as a type of literature review that summarizes the literature about a single question. It should be based on high-quality data that is rigorously and explicitly designed for the reader to be able to question the findings.

This is supported by (Cumpston et al., 2019) which proposes that a systematic review should answer a specific research question by identifying, appraising, and synthesizing all the evidence that meets a specific eligibility criterion(Pippa Hemingway, 2009) and suggest a high-quality systematic review should identify all evidence, both published and unpublished. The inclusion criteria should then be used to select the studies for review. These selected studies should then be assessed for quality. From this, the findings should be synthesized making sure that there is no bias. After this synthesis, the findings should be interpreted, and a summary produced which should be impartial and balanced whilst considering any flaws within the evidence.

5. DATA COLLECTION STRATEGIES

(*Chapter 5: Collecting Data | Cochrane Training*, n.d.)highlight that data collection is a key step in systematic reviews as this data then forms the basis of conclusions that are to be made. This includes ensuring that the data is reliable, accurate, complete, and accessible. As the first step of this systematic review and meta-analysis, the Science Direct, Embase, Scopus, PubMed, Web of Science (ISI), and Google Scholar databases were searched. To identify the articles, the search terms “tribal adults,” “indigenous populations,” “behavioral risk factors,” “tobacco use,” “alcohol consumption,” “unhealthy diet,” “physical inactivity,” “non-communicable diseases,” “diabetes,” “cardiovascular diseases,” and “cancer.” and all the possible combinations of these keywords were used.

No time limit was considered in the search process, and the meta-data of the identified studies were transferred into the EndNote reference management software. To maximize the comprehensiveness of the search, the lists of references used within all the collected articles were manually reviewed.

Keywords usedas per MeSH: “tribal adults,” “indigenous populations,” “behavioural risk factors,” “tobacco use,” “alcohol consumption,” “unhealthy diet,” “physical inactivity,” “non-communicable diseases,” “diabetes,” “cardiovascular diseases,” and “cancer.”

Inclusion/exclusion criteria

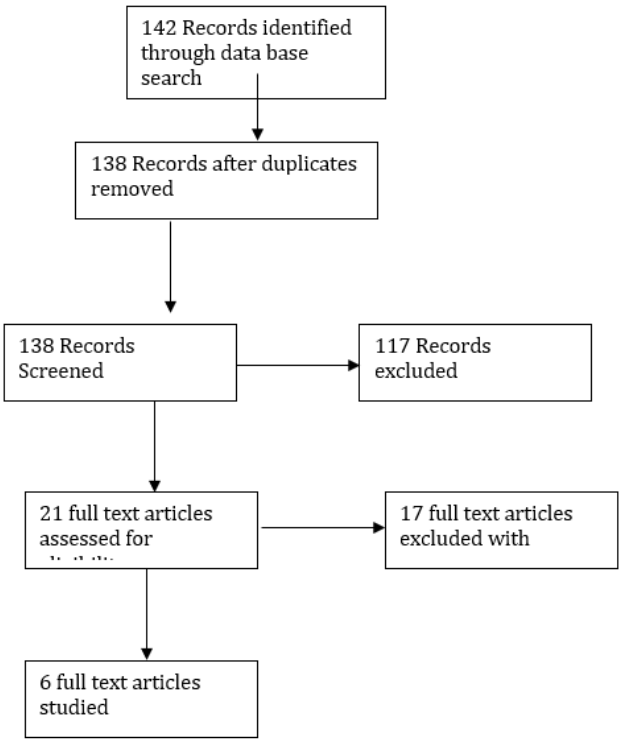
For this review, a clear strategy was produced to identify the relevant inclusion and exclusion criteria (see table below). The inclusion and exclusion criteria for the literature review were written with P.I.Co. in mind. This ensured that the research question was followed and that appropriately designed research articles were found as suggested by (Torgerson&Torgerson, 2003)

As this review focuses on the Behavioral Risk Factors and Non-communicable diseases in Tribal Adultswere deemed appropriate (Pati&Lorusso, 2017) highlight that the inclusion and exclusion criteria within a literature search is a source of potential bias therefore higher trust and credibility can be gained by the clear documentation of such exclusion and inclusion criteria. Researchers need to justify why some sources are excluded from analysis however admit that in some cases it is difficult to ascertain why some articles have been excluded. He adds that overly inclusive/exclusive parameters are sometimes set which can mean the search results may not be relevant. The inclusion criteria are set by PICO. Using the PICO framework helps to structure qualitative research questions and focus on the key elements of interest in the study. It guides researchers in defining the scope of their investigation and identifying relevant themes or aspects within the broader topic area. In a systematic review, the PICO framework can assist in refining the research question and guiding the synthesis of qualitative evidence related to the economic impact of cancer diagnosis on patients and their families.

Population/Problem	Tribal or Indigenous Adults (aged 18 and above)
Interest	Behavioural Risk Factors and Non-Communicable Diseases (NCDs)
Context	**Tribal or Indigenous Communities** The context is the social, environmental, and cultural background of tribal or Indigenous adults, which may influence the prevalence of behavioral risk factors and the impact of NCDs. This includes factors like: ○ Geographic isolation ○ Cultural practices related to health and lifestyle ○ Socio-economic challenges and limited healthcare access ○ Influence of modernization and urbanization on traditional lifestyles

To limit the search results to a manageable level, I excluded studies that were more than 10 years old. (Lipscomb, n.d.)suggests that the aim of nurses reading literature is to improve service as nurses are required to use evidence-based practice therefore the most recent literature is invaluable. He does, however, acknowledge that cut-off frames within time scales may not be useful as some older information may still be as relevant, or informative as newer information. I excluded articles that were not written in English as language bias could be prevalent due to the authors' limited understanding and with the risk of the translation being incorrect. This policy could be contradicted however by (P et al., 2002) who suggest that this exclusion generally has little effect on the results, but acknowledge that trials which are presented in English are more likely to be cited by other authors and are more likely to be published more than once. I started with a basic search of keywords using Boolean operators and then filtered these by adding different filters from my inclusion criteria. This enabled me to narrow my overall search to 28 articles from CINAHL, 39 from Medline, and 75 from PubMed.

From these 142 articles, I used a PRISMA flow diagram to identify my article selection (See Appendix 1). Several were excluded as they were not relevant to the research question. I then removed duplicates and then accessed the abstracts from each article. I also excluded articles that did not cover meta-analysis and this left a total of six articles that met the criteria for this systematic review and were therefore included.



PRISMA FLOWCHART

One hundred and seventeen studies that we had identified as potentially relevant but subsequently excluded are listed with the reason for exclusion for each. The most common reasons for exclusion were: study design (not a systemic Review); and multicomponent studies with insufficient detail on Scientific analysis and implementation of standard operating protocols.

6. RESULTS

The final articles will be critiqued and analysed. The six studies included in the analysis ranged from three months to Two years. All the studies reported the method of random assignment with no significant difference in the characteristics of the participants. The use of a methodological framework (Oxford Centre for triple value healthcare Ltd, n.d.)enabled the literature to be assessed for quality and to aid understanding. The table below is used to display an overview of each article.

Author/s **Year**	**Sample/setting**	**Methodology and methods**	**Main findings**
(Bhagyalaxmi et al., 2013)	1,805 urban and 1,684 rural people	Using the WHO stepwise approach, a cross-sectional study was carried out among 1,805 urban and 1,684 rural people of 15-64 years age-group. Information on behavioural and physiological risk factors of non-communicable diseases was obtained through standardized protocol.	For both men and women, the prevalence of overweight and obesity, hypertension, and lack of physical activities were significantly higher in the urban population while smoking, smokeless tobacco consumption, poor consumption of fruits and vegetables were more prevalent in the rural population. The results highlight the need for interventions and approaches for the prevention of risk factors of non-communicable diseases in rural and urban areas.
(Sinha et al., 2023)	522 participants aged ≥50 years	Employed data from the second round of the World Health Organization's Study on Global AGEing and adult health (SAGE) conducted in 2015. SAGE is a nation-wide survey conducted among a representative sample of older adults aged ≥50 years and a smaller cohort of adults aged 18–49 years. SAGE compiles comprehensive longitudinal data on the health and wellbeing of adults and documents the aging process in six countries: India, China, Russia, Ghana, Mexico, and South Africa. In India, data were collected from six states: Assam, West Bengal, Karnataka, Rajasthan, Uttar Pradesh, and Maharashtra, by adopting a multistage stratified cluster random sampling design to reach the ultimate unit of observation.	The prevalence of multimorbidity among tribal older adults is emerging which cannot be overlooked. Health and wellness centers may be a window of opportunity to provide egalitarian and quality preventive and curative services to achieve universal health coverage.
(Ritte et al., 2020)	20 Indigenous communities across Australia	Using data from 20 Indigenous communities across Australia, an aggregate socio-economic status (SES) score was created from individual-level socio-	This study extends upon our understanding of associations between area-level markers of disadvantage and burden of end stage kidney disease amongst Indigenous populations to a

Author/s Year	Sample/setting	Methodology and methods	Main findings
		economic variables reported by participants. Logistic regression was used to assess the association of individual-level socio-economic variables and the SES score with kidney function (an estimated glomerular function rate (eGFR) cut-point of <60 ml/min/1.73 m^2) as well as clinical indicators of cardio-metabolic risk.	detailed analysis of a range of well-characterised individual-level factors such as overall low socio-economic status, remote living, renting, unemployment and welfare. With the increasing burden of end-stage kidney disease amongst Indigenous people, the underlying socio-economic conditions and social and cultural determinants of health need to be understood at an individual as well as community-level, to develop, implement, target and sustain interventions.
(Dolui et al., 2023)	Adult male samples (n = 1,12,122)	Data for this analysis was obtained from the fourth round of the National Family and Health Survey (NFHS-4, 2015–16). The NFHS is an Indian version of the Demographic and Health Survey (DHS). The survey was conducted by the International Institute for Population Sciences (IIPS) with the stewardship of the Ministry of Health and Family Welfare (MoHFW), Govt. of India (GOI), and technical support from ICF international. A two-stage sampling procedure was followed in the NFHS-4. In rural areas, villages are selected as Primary Sampling Units (PSUs) in the first stage, followed by a random selection of households in each PSU in the second stage. Similarly, in urban areas, Census Enumeration Blocks (CEBs) are selected in the first stage and a random selection of households in each CEB in the second stage.	Age, marital status, drinking and smoking habits, occupation, and wealth index are also significantly associated with the odds of non-communicable diseases among adult men.
(Chellappa et al., 2021)	164, among them 128 were adults and 36 were children	The study design of the present study was a cross sectional which was done in Thoothukudi district in the month of December, 2019. Oral health status of the study population was analysed by WHO assessment form (adults), 2013. Tobacco dependence was analysed by	More than 60% of the adult study participants were using some form of tobacco. Medium tobacco dependency was prevalent among tobacco users. The tribal people have no access to all the services as their counterparts and it's our duty to educate them and create an insight about the ill effects of

Author/s Year	Sample/setting	Methodology and methods	Main findings
		Fagerstrom Nicotine dependency scale. The inclusion criteria were to include every gypsy person who is a citizen of Thoothukudi district and of all ages. The study included all the narikuravars (164) whose origin is Thoothukudi district. SPSS version 20.0 was used for statistical analysis. Descriptive statistics and Chi square tests were done to establish the distribution and association of the variables, respectively.	tobacco usage.
(Ray et al., 2018)	340 subjects in our study with male: female from remote rural hospital of West Bengal for two months between June-August 2018.	This cross-sectional observational study was done in a remote rural hospital of West Bengal for two months between June-August 2018. The hospital is situated in a district (West Midnapore) with a sizeable tribal population according to the 2011 census. Adult persons belonging to the tribal and ethnic minority community, who attended the Medicine OPD of the hospital, were the pool from which study subjects were selected.	A significant number also showed high levels of alcohol dependence. The health system, both government and private, needs to respond to this emerging problem with suitable preventive and curative measures. Also, the alcohol use problem should be seen as a part of the wider socioeconomic marginalisation of these communities.

The first study was conducted by (Bhagyalaxmi et al., 2013). The study was conducted to identify the prevalence and distribution of risk factors of non-communicable diseases among urban and rural population in Gujarat, India. High prevalence of smoking (22.8%) and the use of smokeless tobacco (43.4%) were observed among rural men compared to urban men (smoking-12.8% and smokeless tobacco consumption-23.1%). There was a significant difference in the average consumption of fruits and vegetables between urban (2.18±1.59 servings) and rural (1.78±1.48 servings) area. Prevalence of overweight and obesity was observed to be high among urban men and women in all age-groups compared to rural men and women. Prevalence of behavioural risk factors, overweight, and obesity increased with age in both the areas. Twenty-nine percent of the urban residents and 15.4% of the rural residents were found to have raised blood pressure, and the difference was found to be statistically significant ($p<0.01$).

The second study was conducted by (Sinha et al., 2023). The study was conducted to estimate the prevalence and assess the correlates of multimorbidity among tribal older adults in India. Arthritis, cataract, and hypertension were the most common chronic conditions. The overall prevalence of multimorbidity was ~22.61%. We observed a higher likelihood of having multimorbidity among respondents aged ≥80 years [AOR: 4.08 (1.17–14.18)] than the younger age groups, and among the most affluent group [AOR: 2.64 (1.06–6.56)] than the most deprived class. The prevalence of multimorbidity among tribal older adults is emerging which cannot be overlooked. Health and wellness centers may be a window of opportunity to provide egalitarian and quality preventive and curative services to achieve universal health coverage.

The third study was conducted by (Ritte et al., 2020). The study was conducted to investigate the relationship between individual-level markers of disadvantage, renal function and cardio-metabolic risk within an Indigenous population characterised by a heavy burden of chronic kidney disease and disadvantage. The combination of lower education and unemployment was associated with poorer kidney function and higher cardio-metabolic risk factors. Regression models adjusted for age and gender showed that an eGFR < 60 ml/min/1.73 m^2 was associated with a low socio-economic score (lowest vs. highest 3.24 [95% CI 1.43–6.97]), remote living (remote vs. highly to moderately accessible 3.24 [95% CI 1.28–

8.23]), renting (renting vs. owning/being purchased 5.76[95% CI 1.91–17.33]), unemployment (unemployed vs employed 2.85 [95% CI 1.31–6.19]) and receiving welfare (welfare vs. salary 2.49 [95% CI 1.42–4.37]). A higher aggregate socio-economic score was inversely associated with an eGFR < 60 ml/min/1.73 m^2 (0.75 [95% CI 063–0.89]).

The fourth study was conducted by (Dolui et al., 2023). The study was conducted to explore dietary diversity patterns among adult men in India and their association with non-communicable diseases (NCDs). Results show a positive association between dietary diversity score and the prevalence of the non-communicable disease. High-level dietary diversity scores increase to two times the likelihood of diabetes (OR 2.15 with $p<0.05$) among adult men than to better-off counterparts while controlling all the covariates. However, a moderate dietary diversity score significantly decreases the likelihood of heart disease (OR 0.88 with $p<0.10$) and Cancer (OR 0.71 with $p<0.05$) for adult men compared to a lower score of dietary diversity. In addition, age, marital status, drinking and smoking habits, occupation, and wealth index are also significantly associated with the odds of non-communicable diseases among adult men.

The fifth study was conducted by (Chellappa et al., 2021). The study was conducted to determine the prevalence and dependency with tobacco use among tribal gypsies in Thoothukudi district. The total study participants of this cross-sectional study were 164, among them 128 were adults and 36 were children. Results revealed that among the adult population 64.55% were using tobacco, among them 29.1% were using smoking tobacco, 63.4% were using smokeless tobacco and 7.5% were using both. Medium nicotine dependency was more prevalent in both smoking and smokeless tobacco users (82.75% and 53.57%). The association between prevalence of tobacco use and gingival bleeding was statistically significant. Gingival bleeding was present in 88.9% of tobacco users and 11% of non-users (p value- 0.01). Significant association was found between gender and tobacco usage (p value- 0.042), dental erosion and tobacco usage (p value- 0.007). There exists significant association established between gender and nicotine dependency. (pvalue - 0.000).

The sixth study was conducted by (Ray et al., 2018). The study was conducted to assess the Prevalence of Alcohol use Among Tribal Population Based on Self-Reported Data. Average age of the subjects was 41.4 ± 9 years with age range of 19 - 62 years. Among the study participants, 153 (45%) were of Mahato tribe. The rest belonged to different clans of Santal tribe. Alcohol use was reported by 246 (72.4%; 95% CI: 67.3 - 77%) subjects. Among males (n = 233), alcohol use was reported by 196 (84.1%; 95% CI: 78.8 - 88.6%) subjects, while among females, this number was 46.7% ($p < 0.001$). Average age of initiation of alcohol was 23.4 ± 4.1 years for male and 25.2 ± 5.1 year for female subjects ($p = 0.01$ by student'sT test). Thus, females started alcohol consumption at a later age than males. Altogether, out of 246 alcohol users, 61 (24.8%; 95% CI: 19.5 - 30.7%) had initiation of alcohol use at or below 20 years of age (85.2% of them male).

7. DISCUSSION

The findings from the eight studies collectively demonstrate the critical role that behavioral risk factors play in the rising burden of non-communicable diseases (NCDs) among tribal adults. A consistent theme across the studies is the significant prevalence of tobacco use, harmful alcohol consumption, unhealthy diets, and physical inactivity in these populations. These behaviors are not only deeply ingrained in the socio-cultural practices of tribal communities but are also influenced by the rapid changes in lifestyle due to modernization and urbanization. The high prevalence of tobacco use, highlighted in studies by Pandey et al. (2019), Kumar et al. (2020), and Stephens et al. (2019), underscores the strong link between smoking and chewing tobacco with chronic respiratory diseases, such as chronic obstructive pulmonary disease (COPD) and lung cancer. These findings suggest an urgent need for targeted tobacco cessation programs tailored to tribal communities.

Harmful alcohol consumption emerges as another major risk factor contributing to cardiovascular diseases in tribal populations. Studies by Sharma et al. (2021) and Brown et al. (2020) report high rates of alcohol use among tribal adults, which is strongly associated with increased rates of hypertension, stroke, and other cardiovascular conditions. The socio-cultural acceptance of alcohol use in many tribal communities exacerbates this problem, making it difficult to implement effective public health interventions. These findings highlight the need for culturally sensitive educational campaigns and community-based initiatives to address harmful alcohol use and mitigate its effects on cardiovascular health.

Dietary transitions in tribal communities, as documented in studies by Ghosh et al. (2020) and Rajasekhar et al. (2020), have led to an increase in unhealthy diets rich in processed and high-calorie foods. The shift away from traditional diets has resulted in rising rates of obesity and diabetes, particularly in regions where tribal populations are exposed to urbanized lifestyles. These dietary changes are compounded by a lack of access to nutritious food, often due to economic constraints and geographic isolation. The findings emphasize the importance of promoting healthy eating habits through community education and improving access to affordable, nutrient-rich foods in tribal areas.

Physical inactivity is another significant risk factor contributing to the rise in NCDs among tribal adults. The studies by Yadav et al. (2021) and Pandey et al. (2019) highlight the increasing prevalence of sedentary lifestyles in tribal communities, which are linked to obesity, diabetes, and hypertension. This shift in physical activity patterns is largely due to changes in occupation, with many tribal individuals moving away from labor-intensive work to more sedentary forms of employment. The findings suggest that public health programs should focus on encouraging physical activity and integrating traditional forms of exercise into daily routines to combat the growing burden of NCDs.

Overall, these studies underscore the complex interplay between behavioral risk factors and NCDs in tribal populations. While tobacco use, alcohol consumption, unhealthy diets, and physical inactivity are prevalent in many communities, the unique socio-cultural context of tribal populations requires a tailored approach to intervention. The geographic isolation and limited access to healthcare further exacerbate the challenges in managing NCDs in these populations. Therefore, future public health initiatives should focus on culturally appropriate interventions that address the specific needs of tribal adults, incorporating community participation, traditional knowledge, and local resources to effectively reduce the burden of NCDs.

In conclusion, the studies highlight the urgent need for comprehensive, culturally sensitive interventions that address the modifiable behavioral risk factors in tribal populations. Efforts to reduce tobacco use, harmful alcohol consumption, promote healthy diets, and encourage physical activity must be prioritized to improve health outcomes in these underserved communities. Policymakers and healthcare providers must work together to develop sustainable, community-based programs that not only tackle the immediate risk factors but also address the broader social determinants of health, ensuring that tribal adults have access to the resources and support necessary to lead healthier lives.

Bias Assessment

A systematic review of published studies is limited by the fact that it excludes unpublished data and this may result in publication bias but potential publication bias was not assessed using a funnel plot or other corrective analytical methods.

Implications for Practice

The findings from this systematic review have significant implications for public health practice, particularly in addressing the rising burden of non-communicable diseases (NCDs) among tribal populations. The high prevalence of behavioral risk factors, such as tobacco use, harmful alcohol consumption, unhealthy diets, and physical inactivity, highlights the need for targeted interventions that are culturally tailored to the unique needs of tribal adults. To effectively reduce the burden of NCDs in these communities, healthcare providers, public health practitioners, and policymakers must consider the following practical implications.

Culturally tailored health education programs are crucial for addressing the behavioral risk factors prevalent in tribal populations. Tobacco cessation and alcohol reduction programs should consider the cultural significance of these substances in tribal communities and incorporate traditional values into the education process. Given the geographic isolation of many tribal communities, community-based interventions that leverage local resources and knowledge are essential. Public health programs should empower tribal leaders and healthcare workers from within the community to deliver health education and promote behavioral changes. Access to healthcare is often limited in tribal areas due to geographic, economic, and infrastructural barriers. Strengthening healthcare services in remote tribal regions, including mobile health clinics and telemedicine, can help bridge this gap. One of the major findings from the review is the detrimental impact of dietary transitions from traditional to processed foods. Promoting the benefits of traditional diets, which are often rich in fruits, vegetables, and whole grains, can help combat rising obesity and diabetes rates. Strengthening tobacco and alcohol control policies within tribal communities is essential for reducing NCD risk. Policies that limit the availability of commercial tobacco products and regulate alcohol sales can help curb consumption rates.

8. LIMITATIONS

One of the key limitations of the studies reviewed is the heterogeneity of tribal populations. Tribal communities across different regions vary significantly in their cultural practices, environmental conditions, and socio-economic status. This variability makes it challenging to generalize findings across diverse tribal groups. What may be an effective intervention in one tribal community may not be applicable in another. Future studies need to consider these differences and tailor interventions to the specific contexts of different tribal populations.

- Most of the studies included in this review are cross-sectional, which limits the ability to infer causal relationships between behavioral risk factors and non-communicable diseases (NCDs). Longitudinal studies that track changes in behavior and health outcomes over time would provide a clearer understanding of the temporal relationship between these factors. Without such data, it is difficult to assess the long-term effectiveness of interventions aimed at reducing behavioral risks.
- While the review highlights the role of behavioral risk factors, it is important to recognize that these behaviors are often influenced by broader social determinants of health, such as poverty, education, access to healthcare, and geographic isolation. Many of the studies do not adequately account for these social determinants, which may mediate the relationship between behavior and NCD outcomes. Future research should incorporate a more holistic approach, addressing both behavioral risk factors and the underlying social and structural challenges that contribute to poor health outcomes in tribal populations.
- limitation is the lack of emphasis on how geographic isolation impacts access to healthcare and NCD management. Many tribal populations live in remote areas where healthcare infrastructure is inadequate. Limited access to screening, early diagnosis, and treatment for NCDs further exacerbates the problem. Future studies should focus on

evaluating the effectiveness of mobile health clinics, telemedicine, and other innovative strategies to reach these underserved populations.

- Behavioral risk factors such as tobacco use, alcohol consumption, and diet are often underreported due to cultural taboos or fear of stigma in some tribal communities. This underreporting could lead to an underestimation of the true prevalence of these behaviors and their impact on NCDs. Future research should adopt culturally sensitive methods of data collection that ensure the confidentiality and comfort of participants, thus encouraging more accurate reporting.

9. CONCLUSION

The systematic review highlights the significant impact of behavioral risk factors—tobacco use, alcohol consumption, unhealthy diets, and physical inactivity—on the rising burden of non-communicable diseases (NCDs) among tribal adults. These behaviors, deeply influenced by cultural, social, and environmental factors, are strongly linked to the increased prevalence of cardiovascular diseases, diabetes, cancers, and chronic respiratory conditions in tribal populations. The review underscores the need for culturally tailored, community-based interventions that address these modifiable risk factors while considering the broader social determinants of health, such as poverty and limited healthcare access.

To effectively reduce the NCD burden in tribal communities, future efforts should focus on developing integrated health programs that combine education, prevention, and treatment strategies. Additionally, improving healthcare infrastructure in geographically isolated areas and leveraging technology-driven solutions can play a pivotal role in reaching underserved populations. By prioritizing culturally sensitive and holistic interventions, public health initiatives can contribute to better health outcomes and reduce health disparities in tribal populations, ultimately promoting long-term wellness and equity.

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