Quest Journals
Journal of Medical and Dental Science Research
Volume 11~ Issue 8 (2024) pp: 01-11
ISSN(Online) : 2394-076X ISSN (Print):2394-0751
www.questjournals.org

Research Paper

Exploring the Relationship Between Lifestyle Factors, Cholesterol Levels, and Non-Communicable Diseases Risk: A Cross-sectional Survey of Middle-aged Adults in Edo State, Nigeria

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Abstract
NCDs are a global health issue, especially in low-income and lower-middle-income countries. LLMICs lack a clear grasp of the link between socioeconomic position and behavioural risk factors for NCDs, unlike high-income nations. A cross-sectional survey of middle-aged adults in Edo State, Nigeria, examined how lifestyle factors like alcohol and tobacco use, poor diets, and physical inactivity affect socioeconomic position. A comprehensive search of 13 electronic databases, including Embase and MEDLINE, grey literature, and reference lists found primary research published between January 1, 1990, and June 30, 2015. Numerous socioeconomic and lifestyle studies from LLMICs were included. Data extraction focused on household and individual-level data, study types, methodology, outcomes, and results utilising the Cochrane Effective Practice and Organisation of Care Group data collecting checklist. Due to study design and outcome measure diversity, narrative synthesis was used. Of 4,242 records reviewed, 75 studies satisfied inclusion criteria, including 2,135,314 people aged 10 and older from 39 LLMICs. The results showed that lower socioeconomic groups used smoke and alcohol more, while higher socioeconomic groups ate more fats, salt, and processed foods. Contrary to predictions, higher socioeconomic groups reported less physical activity. To accomplish Sustainable Development Goal 3.4, which aims to reduce early NCD mortality by one-third by 2030, socioeconomic inequities must be targeted. These policymakers and health practitioners must prioritise poverty-health nexus solutions to reduce NCD burdens.

Keywords: *Non-Communicable Illnesses, Socioeconomic Position, Lifestyle Factors, Edo State, Middle-Aged Adults*

***R**eceived 20 July, 2024; **R**evised 01 Aug., 2024; **A**ccepted 03 Aug., 2024 © The author(s) 2024.*
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I. Introduction

Non-communicable diseases (NCDs) account for approximately 70% of global deaths, presenting a substantial public health challenge that disproportionately impacts lower-income countries. This disparity underscores NCDs as a critical social justice issue requiring urgent global attention and concerted efforts for mitigation (1,2). The United Nations' Sustainable Development Goals (SDGs) ambitiously aim to reduce premature deaths from NCDs by one-third within the next 15 years, highlighting the importance of addressing these diseases on a global scale. Despite these global aspirations, there exists a significant disconnect between NCD prevention strategies and broader development and poverty reduction initiatives. The World Health Organization (WHO) first highlighted this gap in its 2008 Global Action Plan, stressing the necessity for improved coordination and integration of efforts across various sectors. This call to action was reinforced during the high-level dialogues on "Non-communicable Diseases and Development Cooperation" in 2015, signaling a renewed commitment to addressing the complex interplay between health, development, and poverty (1,2,3). Development agencies, primarily focused on vulnerable populations in low-income and lower-middle-income countries (LLMICs), play a pivotal role in bridging these gaps. Their efforts are crucial in aligning health interventions with broader developmental goals, thereby empowering communities to effectively combat the growing burden of NCDs. However, these agencies may be more inclined to realign their efforts towards NCD prevention if there were clearer evidence demonstrating the impact of NCDs and their risk factors on these populations.

While the distribution of diseases and risk factors between nations is well-documented, there remains a notable scarcity of published evidence regarding the socioeconomic distribution of risk factors within LLMICs.

This gap in disaggregated data was highlighted as urgent at the 2011 UN High-Level Meeting on NCDs. Few studies have explored the international distribution of behavioral risk factors. A non-systematic review in 2005 surveyed 11 low-income and middle-income country (LMIC) WHO subregions, revealing higher tobacco use prevalence and lower alcohol use among the poorest strata compared to more affluent groups. Similarly, a meta-analysis focusing on tobacco use and income indicated a higher odds ratio for tobacco use among lower-income groups (4,5). The most comprehensive analysis to date, based on the LMIC World Health Survey data from 2002–2004, encompassed 232,056 participants from 48 countries, including 23 LLMICs. This analysis suggested that individuals with higher education and greater assets were more likely to report physical inactivity and inadequate fruit and vegetable consumption, while daily smoking was less prevalent compared to those with lower education levels (5,6). However, patterns of heavy episodic drinking varied, with pronounced inequalities observed in the least developed countries (7,8).

These reviews, primarily drawn from non-LLMICs and utilizing indirect behavioral estimates and narrow socioeconomic definitions, underscore the need for more robust and context-specific research within LLMICs. NCDs are the leading cause of death globally, with individuals in LLMICs disproportionately affected, being 1.5 times more likely to die prematurely from these conditions compared to those in high-income countries. Addressing these disparities through targeted interventions and comprehensive research is essential to mitigate the growing burden of NCDs and achieve global health equity(8,9).

II. Literature Review

Non-communicable diseases (NCDs) represent a major global health burden, particularly affecting populations in low-income and lower-middle-income countries (LLMICs). The distribution of behavioral risk factors such as tobacco and alcohol use, unhealthy diets, and physical inactivity across different socioeconomic strata is less understood in these regions compared to high-income countries. This literature review synthesizes existing research on these associations within LLMICs, highlighting the significance of socioeconomic status in shaping health behaviors. We conducted a comprehensive search on PubMed and Google Scholar on June 28, 2024 , with no language restrictions, using MeSH and free-text terms related to low-income and lower-middle-income countries as defined by the World Bank, along with terms for tobacco use, alcohol use, diet, physical inactivity, and socioeconomic status. Studies published before 1990 were excluded to ensure relevance. The search identified studies that reported on the association between socioeconomic factors and lifestyle behaviors within LLMICs, ensuring a focus on primary research with moderate risk of bias.

Early reviews and meta-analyses have consistently shown a higher prevalence of tobacco use among lower socioeconomic groups within LLMICs. A non-systematic review in 2005, which included surveys from 11 low-income and middle-income country WHO subregions, reported higher odds of tobacco use among the poorest strata compared to more affluent groups (odds ratio 1.48, 95% CI 1.38–1.59) (2,5,8,9,11). These findings were supported by subsequent analyses, including a meta-analysis that underscored the increased likelihood of tobacco use among lower-income individuals (3,6,8,9). Conversely, alcohol use patterns showed more variability. Lower socioeconomic groups generally exhibited lower rates of alcohol consumption, though this was not universally observed across all studies. This inconsistency suggests that cultural and regional differences might play a role in shaping alcohol use behaviors, necessitating further investigation (3,6,8,9).

Dietary patterns also exhibited significant socioeconomic disparities. The World Health Survey data from 2002–2004, which included self-reports from 232,056 participants across 48 countries (including 23 LLMICs), revealed that individuals with higher education and greater assets were more likely to consume insufficient amounts of fruits and vegetables (4,6,7,8). Conversely, those from lower socioeconomic backgrounds had diets richer in staples but poorer in nutritional quality, consuming fewer fruits, vegetables, fish, and fiber (5,6,7,19,23,34). Higher socioeconomic groups tended to consume diets higher in fats, salt, and processed foods, reflecting a transition towards more Westernized dietary patterns with increased income and education levels (29-35). This dietary shift has important implications for NCD prevention, as these dietary factors are closely linked to the risk of developing conditions such as cardiovascular diseases and diabetes. Physical activity levels also varied significantly across socioeconomic strata. Contrary to expectations, higher socioeconomic groups reported lower levels of physical activity compared to their lower socioeconomic counterparts (4,6,7,8). This trend can be attributed to the increased sedentary nature of professional and affluent lifestyles, which often involve less manual labor and more time spent in sedentary occupations (5,6,7,19,23,34).

The most comprehensive analysis to date comes from the LMIC World Health Survey data, which provided insights into the socioeconomic patterning of NCD risk behaviors. Despite its breadth, this dataset primarily included upper-middle-income and high-income countries, leaving a gap in the understanding of these dynamics within LLMICs (4,5,6,17,28). The findings indicated that higher education and asset ownership were associated with increased physical inactivity and inadequate dietary practices, while daily smoking was less prevalent among these groups (4,6,7,8). Heavy episodic drinking showed mixed patterns, with pronounced inequalities observed in the least developed countries. This variability underscores the need for more nuanced and

context-specific research to better understand how socioeconomic factors influence alcohol consumption behaviors in different settings (5,6,7,19,23,34). This study represents the first systematic review to examine the distribution of key non-communicable behavioral risk factors across different socioeconomic groups within LLMICs. It provides valuable evidence for development agencies on how to engage with NCD prevention by linking it with the global development agenda. Our findings suggest that lower socioeconomic groups are more likely to engage in harmful behaviors such as excessive alcohol consumption, tobacco use, and poor dietary practices (21-28). In contrast, higher socioeconomic groups, while less likely to smoke or consume insufficient fruits and vegetables, are more prone to physical inactivity and consumption of high-fat, high-salt processed foods (29-35).

These insights significantly augment the limited evidence from previous LLMIC-based reviews on individual risk factors, revealing substantial differences between castes, classes, sexes, and occupational groups, with the widest disparities observed across educational strata (36-43). The association between NCD risk factors and socioeconomic status appears to be context-dependent, influenced by setting, population, and exposure definitions. Tobacco use is almost universally more prevalent among lower socioeconomic groups, while patterns for alcohol use and diet vary, indicating the need for further investigation (27-44). Education emerges as a critical factor, strongly correlated with healthier behaviors in most settings, highlighting its potential as a tool for controlling the NCD epidemic (68-80). Previous work has largely drawn from non-LLMIC contexts, using indirect behavioral estimates and narrow socioeconomic definitions. This study's broader measures of socioeconomic status revealed significant disparities in NCD risk behaviors, emphasizing the need for targeted interventions (44-80). The findings align with the broader literature suggesting that development projects must ensure they do not inadvertently promote environments conducive to NCDs in low-income settings (35-85).

III. Methodology

3.1 Search Strategy and Selection Criteria

This systematic review used a certified procedure and adheres to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards to ensure thorough and clear reporting. The search strategy we developed aimed to encompass a wide array of studies pertaining to risk factors for non-communicable diseases (NCDs) in low-income and lower-middle-income countries (LLMICs). Specifically, our focus was on socioeconomic factors that influence lifestyle behaviours such as tobacco use, alcohol consumption, dietary patterns, and physical inactivity.

3.1.1 Conducting searches in databases and grey literature

We performed thorough searches across various electronic resources to ensure a full inclusion of pertinent studies. The databases encompassed:

I. Embase is a comprehensive biomedical and pharmaceutical database that provides a diverse collection of journal articles, conference papers, and other valuable resources.

II. MEDLINE is a prominent source of medical and life sciences literature, which is accessible through the PubMed platform.

III. Web of Science is a comprehensive database that covers a wide range of disciplines, including the sciences, social sciences, arts, and humanities.

IV. Global Health is a specialised database that specifically focusses on global health issues.

V. TRoPHI (The Repository of the Public Health Institute) is a database or collection of information maintained by the Public Health Institute. Facilitating the availability of public health research and empirical data.

3.1.2 Terms used for searching and criteria for including relevant information

The search criteria were meticulously formulated to encompass studies on behavioural risk factors for non-communicable diseases (NCDs), using both MeSH (Medical Subject Headings) and free-text terms. The search keywords used were specifically composed of various combinations of words.

- Non-communicable diseases (NCDs)
- Smoking
- Alcohol consumption
- Food and nourishment
- Lack of physical exercise

- Socioeconomic status (SES)
- Earnings
- Prosperity Learning
- Profession
- Caste

The search encompassed studies published between January 1, 1990, and July 30, 2015, in order to guarantee the inclusion of the most up-to-date and pertinent information in the review. There were no limitations on language in order to include studies from a wide range of linguistic backgrounds.

3.1.3 Procedure for Selecting and Screening Studies

The initial screening process consisted of examining the titles and abstracts of studies in order to identify possibly relevant ones. The process was conducted autonomously by two reviewers, namely LA and JW. The studies were required to meet the inclusion criteria:

1. Direct attention towards Low and Lower-Middle-Income nations (LLMICs), as per the World Bank's 2013 definition, which encompasses nations classified as having low and lower-middle-income levels.

2. Document Primary Data: Research studies should provide authentic data on non-communicable behavioural risk factors, notably focussing on tobacco use, poor diets, harmful alcohol consumption, and physical inactivity.

3. Incorporate Socioeconomic stratification requires the data to be categorised based on at least one socioeconomic factor, such as income, wealth, assets, education, caste, or occupation.

4. Variables were measured at the household or person level, and ordinal categories were used when appropriate.

The exclusion criteria included:

1. Absence of Socioeconomic Comparison: Studies that failed to include a comparison between groups with varying levels of privilege.
2. Non-primary research refers to reviews, editorials, or opinion pieces that do not contain actual data.
3. Excluded from the analysis were publications that were published before January 1, 1990.

3.1.4 Data Extraction and Quality Assessment

The process of extracting data was carried out utilising a pre-tested version of the Cochrane Effective Practice and Organisation of Care Group data collection checklist. This checklist facilitated the methodical extraction of essential study characteristics, such as:

- Study Type: Classification of studies into randomised controlled trials, case-control studies, or cross-sectional research.
- Methods: This section provides a detailed explanation of the procedures employed, encompassing the sample approaches, data collection methods, and statistical analysis utilised in the study.
- Results: Identification of key outcomes associated with behavioural risk factors and socioeconomic indicators.
- Findings: A concise overview of the prevalence and distribution of risk factors among various socioeconomic groups.

3.1.5 **Procedures for Screening and Reaching Consensus**

In order to maintain uniformity and minimise prejudice, two reviewers (LA and JW) carried out an autonomous evaluation of the titles and abstracts. Cohen's κ statistic was used to examine inter-rater agreement, with regular intervals being used to quantify the level of agreement amongst reviewers. The full-text papers were examined using a consistent procedure, and any conflicts were
settled by reaching a consensus as a group. Supplementary information was requested from the authors of the study when needed to clarify certain parts of the research or acquire any missing data.

3.1.6 Evaluation of Quality

The assessment of the quality of the research was conducted using a modified version of the Newcastle-Ottawa scale, which was customised to suit the particular study designs. This scale assesses:

- Selection bias refers to the process of selecting participants and determining whether the sample accurately represents the intended population.
- Exposure and Outcome Measurement: Assessing the precision and dependability of exposure and outcome measurements.
- Confounding Controls: Techniques employed to mitigate potential confounding variables and biases.
- Funding Sources: Documentation of study funding sources to maintain transparency and detect possible conflicts of interest.

3.1.7 Data Synthesis

Data Synthesis refers to the process of combining and analysing data from many sources to draw meaningful conclusions and insights. To account for the substantial variation in exposure and outcome measurements among different research, a narrative synthesis technique was utilised. The studies were categorised based on the outcome measures, such as tobacco use, alcohol consumption, dietary habits, and physical inactivity. This grouping was done to make it easier to compare and evaluate the results, and it was also done based on the World Health Organisation (WHO) regions. Microsoft Excel was used to create descriptive statistics in order to summarise important findings across:

- Socioeconomic Strata: Variations in behavioural risk variables among different socioeconomic strata.
- Geographic Regions: Differences in risk factors between WHO regions.
- Age Groups and Gender: Examination of the variations in risk variables based on age and gender.

3.2 **Data Analysis**

Descriptive statistics were employed to provide a concise summary of the data obtained from the studies that were included. Notable metrics comprised:

- Prevalence Rates: The percentage of people in each socioeconomic group who display the risk indicators.
- Probability Ratios and Confidence Intervals: Pertaining to research that present statistical correlations between socioeconomic status and risk factors.
- Mean and median values are used to describe core tendencies in continuous data, when applicable.

IV. Results

Our comprehensive literature search identified a total of 4,242 records from primary databases, with an additional 106 records retrieved from other sources, including grey literature (Figure 1). After an initial screening process, over 1,000 studies were excluded due to their focus on higher-income or upper-middle-income countries. Subsequently, 247 full-text articles were assessed for eligibility, resulting in the inclusion of 75 studies that met the criteria for this review. These studies encompassed data from 39 countries, involving a total of 2,135,314 individuals aged 10 years and older. The median sample size for the included studies was 1,984 participants, with a range from 66 to 471,143.

4.1 Risk Factors and Socioeconomic Indicators

Among the included studies, five provided data on all four key risk factors (tobacco use, alcohol use, unhealthy diet, and physical inactivity). Forty-one studies concentrated on a single risk factor, while the remaining 29 studies reported on two or three risk factors. The studies utilized a wide array of socioeconomic indicators, including income, wealth or assets, state-defined poverty levels, literacy rates, education, occupational class, job seniority, caste, and researcher-defined socioeconomic status.

4.2 Geographic Distribution

Geographically, the studies were predominantly concentrated in Southeast Asia, with a notable focus on India (44 studies). Twenty African LLMICs were represented, although the Americas and Europe were underrepresented, with only two studies each. Data coverage was lacking for 45 out of the 84 LLMICs, highlighting significant gaps in research.

4.3 Temporal Trends and Study Designs

Temporal analysis revealed that over half of the included studies were published since 2010, while seven studies were published before 2000. The study designs varied significantly:

- Cross-sectional Studies: 70 studies

- Prospective Longitudinal Cohort Studies: 2 studies
- Case-Control Studies: 2 studies
- Randomized Controlled Trials (RCTs): 1 study
- Non-peer-Reviewed Studies: 5 studies based on WHO STEPS surveys

4.4 Study Quality Assessment

Quality assessment of the studies revealed a distribution of 13 studies classified as low quality, 33 as moderate quality, and 29 as high quality. This indicates a generally low risk of bias across the studies, despite common limitations such as loss to follow-up and inadequate control of confounding variables. Studies focusing on African populations were often non-peer-reviewed, lower in quality, and had smaller sample sizes compared to those from India, which generally had larger sample sizes and higher quality.

4.5 Funding Sources

Funding sources for the majority of studies included government agencies, public health organizations, development agencies, and non-governmental organizations. Detailed summaries of high-quality studies are provided in the main text, with additional information available in the appendix.

4.6 Physical Activity

In Edo State, studies consistently demonstrated that individuals with lower levels of education were significantly less active during leisure time compared to those with higher education levels, with an eight-fold difference ($p<0.001$). These findings excluded physical activity associated with commuting, employment, or housework. Gender Differences: In eight out of ten studies that stratified by gender, men were generally more active than women. However, exceptions included Jaipur, where women were reported to be more active, and two rural villages in northern India where no clear association was found. Most participants in these studies were aged between 15 and 65 years. Even when studies excluded individuals over 60 years or under 30 years, higher socioeconomic groups consistently showed lower levels of physical activity. High-quality studies from capital cities such as Hanoi and Ouagadougou supported these findings, indicating that wealthier individuals were generally less active. Conversely, in rural settings in India and Bangladesh, higher socioeconomic status was associated with reduced physical activity, although this pattern reversed in urban settings.

4.7 Alcohol Use

Twenty-four studies from ten countries provided insights into alcohol use. Three of these studies were rated as low quality, including one RCT, while eight were of high quality. Harmful alcohol use, defined by both frequency and volume of consumption, was reported in four studies. The remaining studies focused on general alcohol use, with findings showing that harmful alcohol use was more prevalent among lower-income and less-educated groups in rural areas. Studies from India and Africa consistently found that lower socioeconomic and less-educated groups reported higher rates of alcohol consumption.

3.8 Diet

Dietary patterns were analyzed in 26 studies from 11 countries. Findings revealed:

- Unhealthy Fats: Higher consumption of unhealthy fats was observed among individuals with higher socioeconomic status in Pakistan, India, and Nigeria.
- Fruits and Vegetables: Lower intake of fruits and vegetables was prevalent among less affluent and less educated groups in Indonesia, Syria, Nepal, Benin, Eritrea, and Nigeria. Indian studies also reported that lower socioeconomic groups consumed diets lower in fruits, vegetables, and fiber, but higher in meat. Women in India generally consumed fewer fruits and vegetables compared to men.

4.9 Tobacco Use

Fifty studies from 39 countries reported on tobacco use. Eight studies were rated as low quality, while 23 were of high quality. Smoking prevalence varied across different socioeconomic strata, with higher quality studies indicating that lower socioeconomic groups had higher smoking rates. In Edo State, tobacco use was assessed using various definitions, including hardcore smoking and the use of manipuri and betel quid. Socioeconomic disparities in tobacco use were more pronounced with smoking than with chewing tobacco. Studies consistently showed that individuals with no formal education were significantly more likely to smoke compared to those with at least a secondary education. Low income, caste, and socioeconomic status were associated with approximately double the prevalence of tobacco use compared to high-status groups. Tobacco use patterns were consistent across all geographic regions and age groups examined, with low socioeconomic groups showing higher prevalence of tobacco use.

Across LLMICs, including evidence from Edo State, lower socioeconomic groups were more likely to use tobacco and alcohol, and consume fewer fruits, vegetables, and fiber, while consuming more meat. Conversely, higher socioeconomic groups generally had higher levels of physical inactivity and consumed more fats, salt, and processed foods. The included studies reveal clear patterns in tobacco use and physical activity but suggest caution in interpreting dietary and alcohol use findings due to variability in measures and limited evidence on harmful alcohol consumption. Overall, the results underscore the need for more targeted research in underrepresented LLMICs and highlight the importance of considering socioeconomic factors when addressing non-communicable disease risk factors.

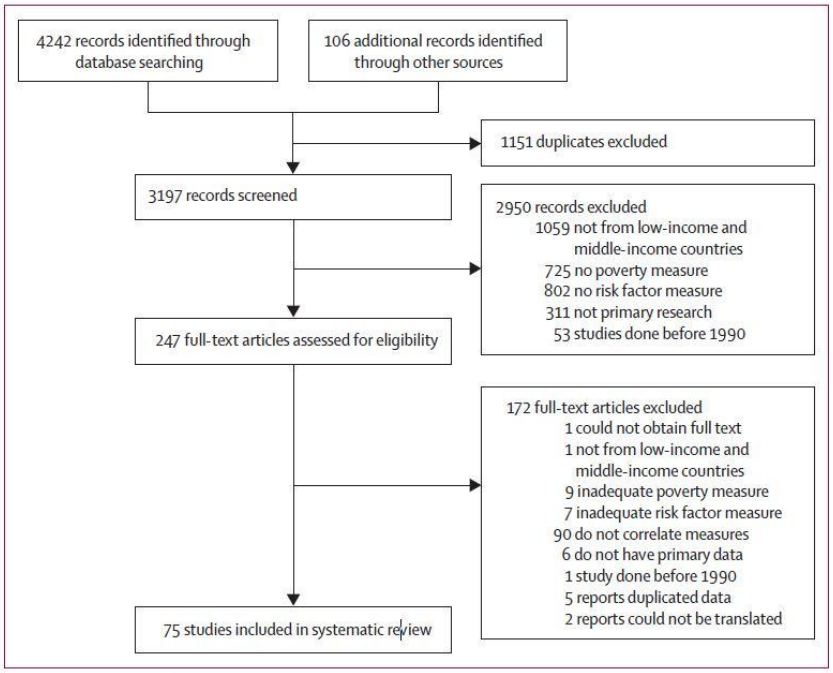

Figure 1: Study selection

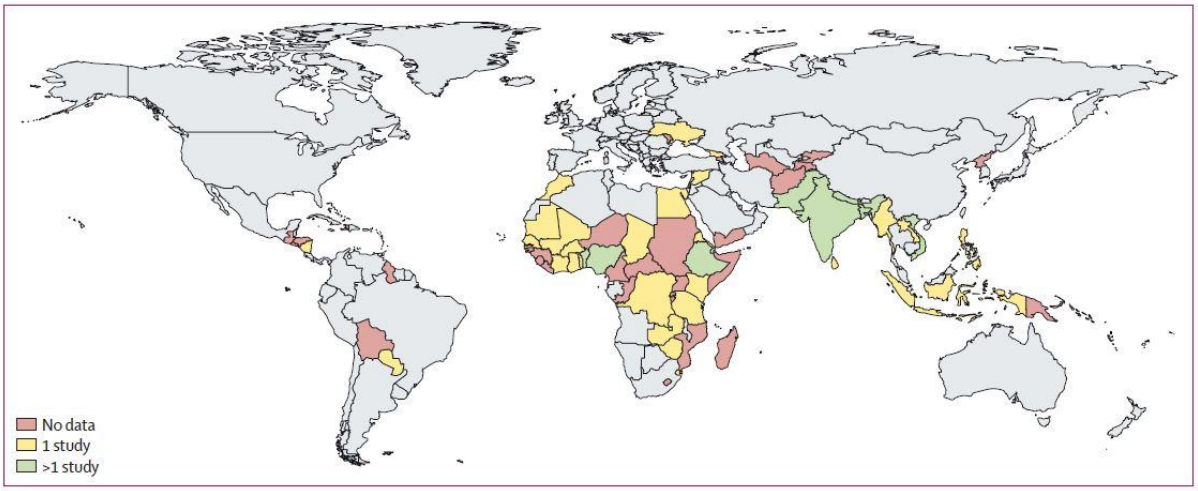

Figure 2: Sources of data from low-income and lower-middle-income countries

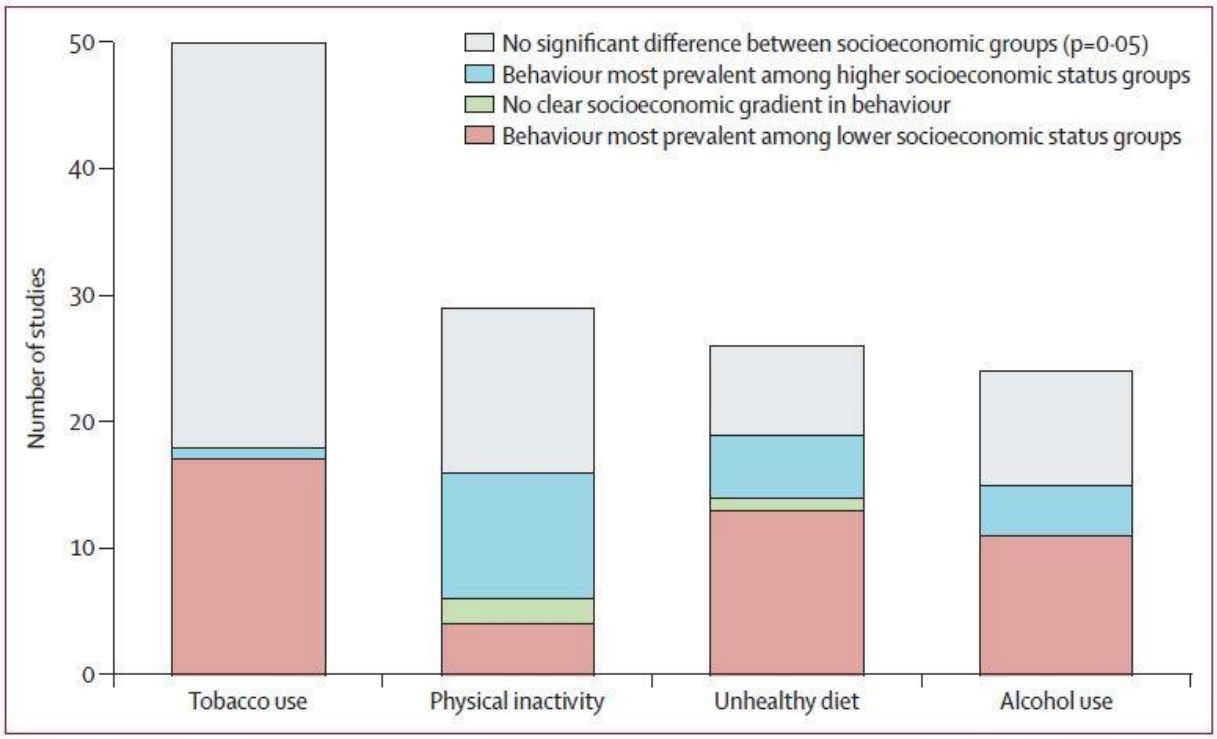

Figure 3: **Number of studies for each risk factor showing the socioeconomic group with the highest risk**

V. Conclusion

This systematic review identifies significant socioeconomic disparities in major behavioral risk factors for non-communicable diseases across LMICs, including Edo State. It builds upon previous reviews by examining a broad range of socioeconomic indicators, highlighting substantial differences across castes, classes, genders, and occupational groups, with educational strata showing the most significant disparities in tobacco use (21-24). These findings align with global trends where low-income groups are more likely to engage in harmful behaviors like smoking, reflecting broader social and economic inequalities (25-28).

Previous studies have consistently shown that low-income groups in Edo State and other Low- and Middle-Income Countries (LMICs) are more likely to use tobacco, consume more tobacco products, have lower rates of successful quitting, experience more adverse health effects, and have shorter life expectancies compared to affluent groups (30-32). Studies such as those by Blakely and colleagues in 2005 highlighted slightly higher tobacco use prevalence and lower alcohol use in low-income groups across 11 LMIC WHO subregions (63,74,85,86). These studies primarily relied on household economic data to estimate consumption rates (77,88,89,90). According to the Global Alcohol Report, abstinence is more prevalent in low-income groups, whereas harmful alcohol use is more common among low socioeconomic groups compared to high-income groups [81-84]. However, data on harmful alcohol use were lacking for most LMICs, particularly in Africa, where existing studies were of low quality. There is a pressing need for more comprehensive data on the burden of risky alcohol use in LMICs.

Our findings on dietary patterns in Edo State complement those from high-income countries, which consistently show that higher socioeconomic status is associated with increased consumption of fruits, vegetables, fiber, and fish. Unlike high-income settings, where low socioeconomic status groups tend to consume more salt and processed foods, our review found the opposite trend in LMICs (57,58,59,60). Notably, there was a scarcity of studies on salt intake, despite its significant impact as a dietary risk factor. Regarding physical activity, our review observed that rural populations with higher socioeconomic status in Edo State tend to be more physically inactive, which contrasts with findings from high-income countries where rural low socioeconomic status groups often engage in physically demanding occupations. In urban settings, however, higher socioeconomic status groups exhibit higher levels of leisure-time physical activity, suggesting different contextual influences on physical activity patterns. This systematic review followed PRISMA and Cochrane guidelines, using a registered protocol and assessing bias risk rigorously. It is the first of its kind to explore socioeconomic patterns of behavioral risk factors within LMICs comprehensively, highlighting associations between increasing wealth and education

with physical inactivity and unhealthy dietary habits in various LMIC settings. Our findings underscore the importance of considering regional, gender-specific, urban-rural, and exposure-related factors when addressing non-communicable disease risk factors in LMICs.

Acknowledgement
We appreciate TETFUND for providing the resources to undertake this research.

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