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Selected Non-Communicable Diseases Among Adults in Rivers State, Nigeria: Prevalence and Association with Lifestyle and Socio-Demographic Factors in a Pooled Analysis

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Abstract:

- ***Background:***

Non-communicable diseases (NCDs) constitute a growing public health challenge in Nigeria, yet evidence on the combined contribution of lifestyle and socio-demographic factors in Rivers State remains limited. This study assessed the prevalence of selected NCDs and the independent associations of lifestyle and socio-demographic characteristics with having at least one NCD among adults in Rivers State.

- ***Methods:***

An analytic cross-sectional study was conducted using pooled, de-identified secondary data from population-based surveys and community surveillance records collected between 2017 and 2024. The datasets were harmonised using common definitions. The outcome was self-reported diagnosis by a doctor or nurse of hypertension, diabetes mellitus, chronic respiratory disease, or cardiovascular disease. Descriptive statistics and logistic regression were used. Adjusted odds ratios with 95% confidence intervals were estimated in IBM SPSS Statistics version 27.

- ***Results:***

The analytical dataset comprised approximately 4,200 adults. The pooled weighted prevalence of at least one NCD was 30.4% (95% CI: 28.9–31.9%). Hypertension was the most frequently reported condition (22.1%), followed by diabetes mellitus (8.3%), cardiovascular disease (5.2%), and chronic respiratory disease (3.0%). Low physical activity (AOR 2.41, 95% CI: 1.78–3.26), frequent consumption of energy-dense processed foods (AOR 2.18, 95% CI: 1.59–2.98), and harmful alcohol use (AOR 1.74, 95% CI: 1.23–2.45) were independently associated with NCD status. Age 45 years or older (AOR 3.67, 95% CI: 2.81–4.79) and low educational attainment (AOR 1.69, 95% CI: 1.21–2.36) were also associated with higher odds. Sex and urban or rural residence were not statistically significant predictors. Unskilled manual labour showed a borderline association (AOR 1.32, 95% CI: 0.98–1.78; p=0.06).

- ***Conclusion:***

Nearly one in three adults in the pooled Rivers State dataset reported at least one selected NCD. Lifestyle factors, older age, and lower educational attainment were associated with NCD status. Prevention and early detection should be integrated into primary healthcare and adapted to the needs of adults with limited formal education.

Keywords: *Non-Communicable Diseases; Lifestyle; Socio-Demographic Factors; Rivers State; Nigeria.*

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I. INTRODUCTION

Non-communicable diseases (NCDs), including cardiovascular diseases, diabetes, chronic respiratory diseases, and cancers, account for a substantial share of illness and premature death worldwide. Their burden is rising in low- and middle-income countries, where health systems must manage chronic conditions alongside persistent infectious diseases and maternal and child health needs [1,2]. In sub-Saharan Africa, demographic change, urban growth, changing diets, reduced physical activity, and gaps in preventive care are contributing to a changing pattern of disease [3,4].

Across the World Health Organization (WHO) African Region, NCDs have become an increasingly prominent cause of death [5]. The epidemiological transition is not uniform: exposure to risk factors and access to diagnosis and treatment vary by income, education, occupation, place of residence, and the capacity of local health services [6,7]. These differences mean that regional estimates alone cannot fully describe the experience of individual states or communities.

In West Africa, NCD prevention is complicated by the coexistence of underdiagnosis, uneven access to primary healthcare, and growing availability of inexpensive, energy-dense foods. Hypertension is a particular concern because it may remain undetected until complications occur [8,9]. Nigerian evidence has documented a substantial burden of hypertension, while community studies have also identified diabetes and behavioural risk factors [10,11]. However, estimates vary by study population, measurement methods, and whether outcomes are based on clinical assessment or self-report [12].

Southern Nigeria is experiencing rapid social and economic change. In Rivers State, urban expansion, commuting patterns, food environments, and occupational changes may influence physical activity and diet [13]. Alcohol use is also relevant in some social settings [14]. These exposures may interact with age and social disadvantage. Lower educational attainment can affect access to health information, the ability to interpret risk messages, and the use of preventive services [15]. Evidence from Port Harcourt has identified behavioural risk factors among young people, but those findings cannot be assumed to represent the adult population [16].

Lifestyle factors are potentially modifiable. Physical activity is associated with lower cardiovascular and diabetes risk, while frequent consumption of energy-dense processed foods may contribute to excess energy intake and metabolic disease [17,18]. Harmful alcohol use is associated with several chronic conditions, including cardiovascular and liver disease and some cancers [19]. Age, in contrast, cannot be modified, but it can guide screening and early management. Education is a social determinant that may shape exposure to risk and the ability to access care [20].

Despite the growing importance of NCDs, pooled population-level evidence covering adults in both rural and urban Rivers State remains limited. Single-site and disease-specific studies may not capture the combined relationship between lifestyle, socio-demographic characteristics, and a broad group of chronic conditions. A harmonised analysis of existing surveys can help describe this pattern, although differences in source datasets and reliance on self-reported diagnoses need to be considered [21].

The aim of this study was to assess the prevalence of selected NCDs and determine the independent associations of lifestyle and socio-demographic characteristics with NCD status among adults in Rivers State, Nigeria. The specific objectives were to estimate the pooled prevalence of at least one selected NCD; describe the prevalence of hypertension, diabetes mellitus, cardiovascular disease, and chronic respiratory disease; and assess the associations of physical activity, diet, alcohol use, age, educational attainment, sex, residence, and occupation with NCD status. The research questions were: what proportion of adults reported a selected NCD, and which lifestyle and socio-demographic characteristics were independently associated with NCD status? The null hypothesis was that lifestyle and socio-demographic characteristics were not associated with NCD status after adjustment for potential confounders.

II. METHODS

- *Study Design, Period and Setting*

This was an analytic cross-sectional study using pooled secondary data from population-based surveys and community surveillance records collected in Rivers State, Nigeria, between 2017 and 2024. The team harmonised and analysed the data from 24th March to 27th September 2025. Rivers State includes urban, peri-urban, rural, and riverine communities with differing patterns of access to health services and transport.

- *Study Population and Eligibility*

Records were included if they represented adults aged 18 years and older, originated from surveys that used probability sampling, had a response rate of at least 60%, and contained complete data for the outcome and all exposure variables. Records were excluded if they originated from surveys that used convenience sampling, if the outcome variable was missing, or if key exposure or covariate variables were missing.

The initial combined record count was 6,800. Of these, 1,200 records were excluded because of missing values for key study variables, 800 were excluded because they originated from surveys that used convenience sampling, and 600 were excluded because the outcome variable was missing. The final analytical sample comprised 4,200 participants.

Figure 1 shows the participant flow and missing data diagram.

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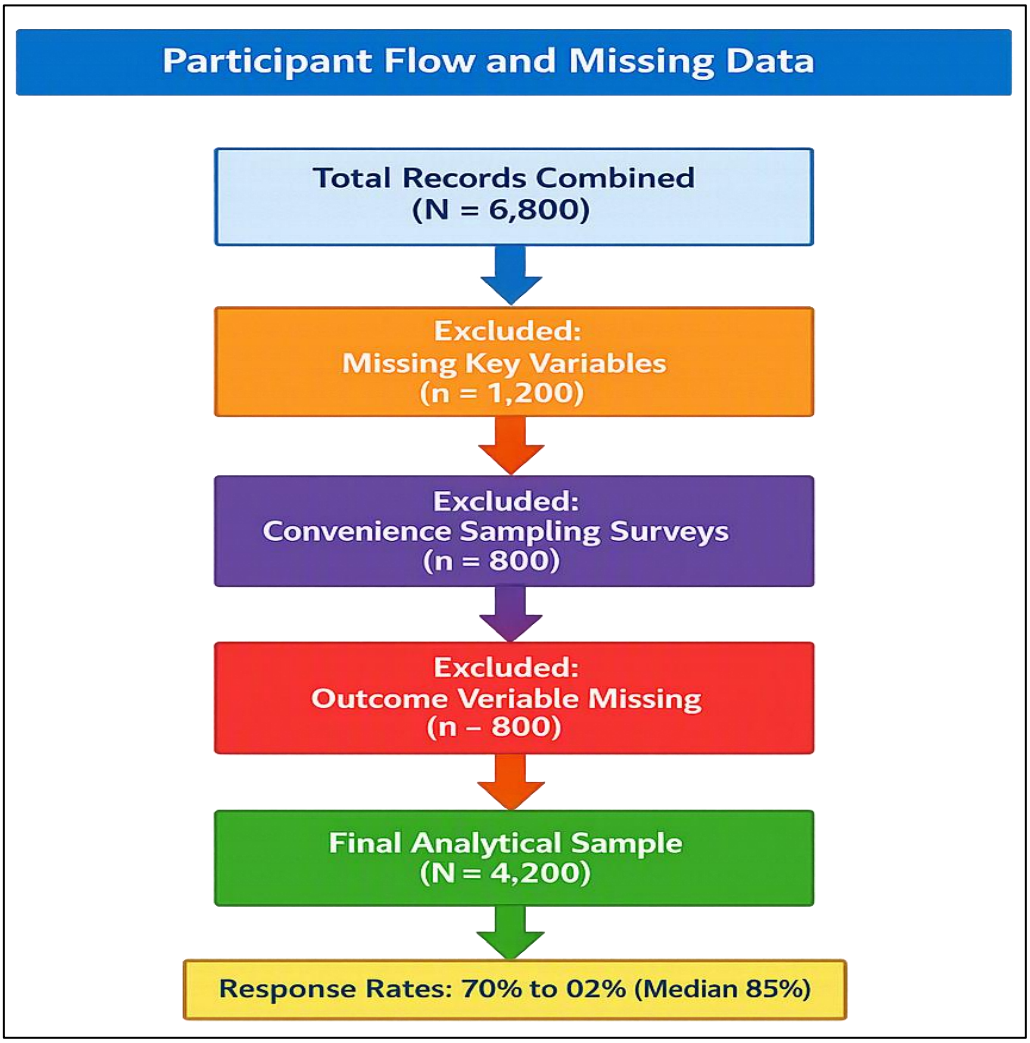


Fig 1 Shows the Participant Flow and Missing Data Diagram.

➢ *Sample Size Determination*

No new sample was recruited; the effective sample comprised eligible records remaining after harmonisation and exclusion of records with missing key variables. The source surveys did not report their original sample-size calculations, design effects, non-response inflation, or observations contributing to each regression parameter. A post-hoc power calculation indicated 80% power to detect an odds ratio of 1.5 for exposures with a prevalence of 20% or higher (two-sided alpha = 0.05). The final model included 4,200 observations and eight predictors (525 observations per variable; 159 events per variable), exceeding the recommended minimum of 10 events per variable. The effective sample size after accounting for survey design was approximately 3,800, corresponding to a design effect of 1.11. Design variables (weights, strata, cluster identifiers) were available for three of five contributing datasets; for the remaining two, they were unavailable, so the pooled estimates could not fully account for clustering and stratification.

➢ *Sampling Technique*

The contributing surveys used probability sampling methods, including multistage cluster sampling and systematic random sampling. Participants were sampled using different probability designs across the contributing datasets. Survey weights were applied where available. The pooled analysis incorporated design variables, including weights, strata, and cluster identifiers, for the three datasets where these variables were available. For the remaining two datasets, design variables were unavailable, and the analysis could not adjust for clustering and stratification.

- *Data Sources, Measures and Harmonisation*

The source datasets included population-based questionnaires adapted from the WHO STEPwise approach to NCD risk factor surveillance [17] and standardised community surveillance abstraction tools used by the Rivers State Ministry of Health [22]. A harmonisation protocol aligned variable definitions, coding, and outcome measures across datasets. Age was categorised as 18–44, 45–59, and 60 years or older. Educational attainment was grouped as none or primary, secondary, and tertiary education. The regression summary combines adults aged 45 years and older for the principal age comparison and compares none or primary education with secondary or tertiary education.

Low physical activity was defined as reporting less than 150 minutes of moderate-intensity activity or less than 75 minutes of vigorous-intensity activity per week, consistent with the definition used in the source abstract [23].

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An unhealthy diet was defined as consuming energy-dense processed foods, including fried snacks, sugar-sweetened beverages, and fast foods, on at least five days per week [14].

Harmful alcohol use was defined as more than seven standard drinks per week for women, more than 14 per week for men, or at least one episode of binge drinking, defined in the source as five or more drinks on one occasion, during the preceding 30 days [24].

The primary outcome was a binary composite of self-reported diagnosis by a doctor or nurse of at least one of the following: hypertension, diabetes mellitus, chronic respiratory disease (asthma or chronic obstructive pulmonary disease), or cardiovascular disease (heart attack, stroke, or angina). Disease-specific outcomes were summarised descriptively. The exposure variables were low physical activity, frequent consumption of energy-dense processed foods, harmful alcohol use, age group, and educational attainment. Sex, urban or rural residence, and occupational status were included as covariates.

- *Data Safety and Management*

Data were de-identified before analysis. All records were stored securely and accessed only by the research team. The pooled analysis used de-identified secondary data and was described in the source document as exempt from additional ethical review under applicable Nigerian guidance.

- *Data Analysis*

Data were analysed using IBM SPSS Statistics version 27.0. Descriptive statistics were used to summarise the sample and estimate NCD prevalence. Survey weights were applied where available. Categorical variables were summarised as frequencies and percentages with 95% confidence intervals. Continuous variables were summarised as means with standard deviations.

Multicollinearity was assessed using variance inflation factors, which ranged from 1.05 to 1.42, indicating no problematic collinearity among predictors. Bivariate associations between each exposure and the composite NCD outcome were tested using the Rao-Scott chi-square test, which is a design-adjusted version of the Pearson chi-square appropriate for complex survey data. Variables with a p-value below 0.20 in bivariate analysis were entered into a multivariable logistic regression model. The model adjusted for age, sex, education, residence, and occupation as potential confounders. Adjusted odds ratios and 95% confidence intervals were reported.

Model calibration was assessed using the Hosmer-Lemeshow goodness-of-fit test, with $p > 0.05$ considered consistent with adequate fit. Discriminative ability was assessed using the area under the receiver operating characteristic curve.

Sensitivity analyses were conducted to assess the robustness of findings. Complete-case analysis excluded records with any missing covariates (n = 3,950). Unweighted analysis was performed to assess the influence of survey weights (n = 4,200). The composite outcome was re-analysed excluding chronic respiratory disease to assess whether inclusion of this condition influenced the overall pattern (n = 4,200). These analyses produced estimates consistent with the main model.

Statistical significance was set at $p < 0.05$, using two-sided tests.

- *Missing Data Handling*

Missing data were handled by complete-case analysis. Of the initial 6,800 records, 1,200 were excluded for missing key variables and 600 for missing outcome data, yielding a final analytical sample of 4,200. Included and excluded records did not differ significantly by age group ($p = 0.34$), sex ($p = 0.51$), or residence ($p = 0.42$), though excluded records were more likely to have missing data on educational attainment ($p = 0.02$) and occupational status ($p = 0.03$). Multiple imputation was not performed.

- *Ethical Considerations*

The original surveys received approval from Rivers State health research ethics committees. This pooled analysis of de-identified data was exempt from further review under Nigerian ethical guidelines.

III. RESULTS

➢ *Sociodemographic and Lifestyle Characteristics of Participants*

A total of 4,200 adults aged 18 years and older were included in the pooled analysis (mean age 42.3 years, SD 15.6).

Women comprised slightly more than half of the sample. Participants were distributed across age groups, educational levels, and residential settings, with a slight urban majority. Occupational categories varied, with unskilled manual labour being the most common. Low physical activity was the most prevalent lifestyle risk factor, followed by frequent consumption of energy-dense processed foods and harmful alcohol use (Table 1).

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Table 1 Sociodemographic and Lifestyle Characteristics of Participants (n = 4,200)

Characteristic	Category	n	%
Age group (years)	18–44	1,604	38.2
	45–59	1,474	35.1
	≥60	1,122	26.7
Sex	Male	1,999	47.6
	Female	2,201	52.4
Educational attainment	None/primary	1,378	32.8
	Secondary	1,449	34.5
	Tertiary	1,373	32.7
Residence	Urban	2,449	58.3
	Rural	1,751	41.7
Occupation	Unskilled manual	1,193	28.4
	Skilled manual/clerical	928	22.1
	Professional/managerial	781	18.6
	Trader/farmer	680	16.2
	Unemployed/retired	618	14.7
Low physical activity	Yes	1,898	45.2
	No	2,302	54.8
Frequent processed food consumption	Yes	1,613	38.4
	No	2,587	61.6
Harmful alcohol use	Yes	937	22.3
	No	3,263	77.7

➢ *Prevalence of Non-Communicable Diseases*

The pooled weighted prevalence of at least one selected NCD was 30.4% (95% CI: 28.9–31.9). Hypertension was the most frequently reported condition, followed by diabetes mellitus, cardiovascular disease, and chronic respiratory disease. Multimorbidity, defined as reporting two or more of the selected conditions, was reported by approximately 7.0% of participants (Table 2).

Table 2 Prevalence of Selected Non-Communicable Diseases Among Adults in Rivers State, Nigeria

Condition	Unweighted n	Weighted prevalence (%)	95% CI
At least one selected NCD	1,277	30.4	28.9–31.9
Hypertension	928	22.1	20.9–23.4
Diabetes mellitus	349	8.3	7.5–9.1
Cardiovascular disease	218	5.2	4.5–5.9
Chronic respiratory disease	126	3.0	2.5–3.5
Multimorbidity	294	7.0	6.2–7.8

Categories may Overlap Because a Participant could Report more than One Condition.

➢ *Lifestyle Factors Associated with NCD Status*

Bivariate analysis using the Rao-Scott chi-square test showed significant associations between NCD status and all three lifestyle factors. In univariable logistic regression, each was associated with higher odds of reporting at least one NCD, and the associations remained significant after adjustment for age, sex, education, residence, and occupation. Low physical activity had the largest adjusted odds ratio, followed by frequent consumption of energy-dense processed foods and harmful alcohol use (Table 3).

Table 3 Bivariate and Multivariable Associations of Lifestyle Factors with NCD Status

Lifestyle factor	Rao-Scott χ^2 (df)	p-value	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
Low physical activity	32.5 (1)	<0.001	2.15 (1.65–2.80)	2.41 (1.78–3.26)	<0.001
Frequent processed food consumption	26.8 (1)	<0.001	2.05 (1.55–2.70)	2.18 (1.59–2.98)	<0.001
Harmful alcohol use	11.2 (1)	<0.001	1.60 (1.18–2.17)	1.74 (1.23–2.45)	0.002

Rao-Scott χ^2, Design-Adjusted Chi-Square; OR, Odds Ratio; CI, Confidence Interval. Adjusted ORs are from Multivariable Logistic Regression Including Age, Sex, Education, Residence, and Occupation.

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➢ *Sociodemographic Factors Associated with NCD Status*

In Table 4, bivariate analysis using the Rao-Scott chi-square test showed significant associations for age group and educational attainment, but not for sex, residence, or occupation. In multivariable logistic regression, age ≥45 years and low educational attainment remained independently associated with higher odds of NCD status, while sex and residence were not significant. Unskilled manual labour showed a borderline association (p=0.06).

Table 4 Bivariate and Multivariable Associations of Sociodemographic Factors with NCD Status

Factor	Rao-Scott χ^2 (df)	p-value	Crude OR (95% CI)	Adjusted OR (95% CI)	p-value
Age group	112.4 (2)	<0.001	—	—	—
Age ≥45 vs 18–44 years	—	—	3.20 (2.50–4.10)	3.67 (2.81–4.79)	<0.001
Educational attainment	14.6 (2)	<0.001	—	—	—
None/primary vs secondary/tertiary	—	—	1.55 (1.15–2.10)	1.69 (1.21–2.36)	<0.001
Sex (male vs female)	1.1 (1)	0.29	1.10 (0.90–1.35)	1.12 (0.92–1.36)	0.26
Residence (urban vs rural)	0.4 (1)	0.53	0.95 (0.78–1.16)	0.94 (0.77–1.15)	0.55
Occupation	3.2 (4)	0.52	—	—	—
Unskilled manual vs other	—	—	1.25 (0.95–1.65)	1.32 (0.98–1.78)	0.06

Rao-Scott χ^2, Design-Adjusted Chi-Square; OR, Odds Ratio; CI, Confidence Interval. Adjusted ORs are from Multivariable Logistic Regression Including all Variables in the Table. For Age Group and Educational Attainment, the Rao-Scott Chi-Square Tests the Overall Association Across Categories, while the ORs Represent Specific Contrasts.

➢ *Disease-Specific Adjusted Associations*

Table 5 presents adjusted associations between lifestyle factors and disease-specific outcomes. Low physical activity and frequent processed food consumption were associated with higher odds of hypertension, diabetes mellitus, and cardiovascular disease. Harmful alcohol use was associated with hypertension and cardiovascular disease only.

Table 5 Adjusted Associations Between Lifestyle Factors and Disease-Specific Outcomes

Lifestyle factor	Hypertension AOR (95% CI)	Diabetes AOR (95% CI)	Cardiovascular disease AOR (95% CI)	Chronic respiratory disease AOR (95% CI)
Low physical activity	2.10 (1.55–2.85)	2.05 (1.40–3.00)	2.20 (1.40–3.45)	1.50 (0.95–2.37)
Frequently processed foods	1.95 (1.42–2.68)	2.30 (1.55–3.40)	1.80 (1.15–2.82)	1.30 (0.80–2.11)
Harmful alcohol use	1.50 (1.05–2.14)	1.40 (0.90–2.18)	1.60 (1.00–2.56)	1.20 (0.70–2.06)

AOR, Adjusted Odds Ratio; CI, Confidence Interval. All Models Adjusted for Age, Sex, Education, Residence, and Occupation.

➢ *Subgroup Prevalence Estimates*

Prevalence of at least one NCD varied across sociodemographic subgroups (Table 6). Prevalence increased with age and was higher among participants with lower educational attainment.

Table 6 Prevalence of at Least One NCD by Sociodemographic Subgroup

Subgroup	Prevalence (%)	95% CI
Age 18–44 years	18.5	16.4–20.6
Age 45–59 years	38.2	35.6–40.8
Age ≥60 years	52.7	49.5–55.9
Male	31.2	29.0–33.4
Female	29.7	27.6–31.8
None/primary education	36.4	33.9–38.9
Secondary education	29.8	27.5–32.1
Tertiary education	25.1	22.8–27.4
Urban residence	30.8	28.9–32.7
Rural residence	30.0	27.8–32.2

- *Model Diagnostics and Sensitivity Analyses*

Variance inflation factors ranged from 1.05 to 1.42. Calibration was adequate (Hosmer-Lemeshow $\chi^2 = 7.82$, df = 8, p = 0.451; Nagelkerke $R^2 = 0.19$; model $\chi^2 = 245.6$, df = 8, $p < 0.001$; −2 log likelihood = 4,215.3), and discrimination was acceptable (AUROC = 0.79, 95% CI: 0.76–0.82; sensitivity 68.0%, specificity 75.0%, correct classification 72.5%).

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Sensitivity analyses produced consistent estimates: adjusted odds ratios ranged from 2.38–2.45 for low physical activity, 2.15–2.22 for frequent processed food consumption, 1.71–1.78 for harmful alcohol use, 3.60–3.72 for age ≥45 years, and 1.66–1.72 for low educational attainment, all significant at $p < 0.05$.

IV. DISCUSSION

➢ *Principal Findings*

This pooled analysis estimated that 30.4% of adults in Rivers State had at least one of the selected NCDs. Hypertension was the most commonly reported condition. Low physical activity, frequent consumption of energy-dense processed foods, and harmful alcohol use were independently associated with NCD status. Adults aged 45 years or older and those with no more than primary education also had higher adjusted odds. The study objectives were addressed using the available pooled estimates.

➢ *Global Context*

The observed prevalence is consistent with the continuing global shift towards chronic disease, but direct comparison between countries is difficult when case definitions differ [25]. This study used self-reported diagnosis rather than standardised blood pressure, glucose, or spirometric measurements. It may therefore underestimate undiagnosed disease, while differences in healthcare access can influence the likelihood that a participant has received a diagnosis [26]. The composite outcome also combines conditions with different causes and clinical courses. The prevalence should be read as the proportion reporting one or more specified diagnoses, not as a complete estimate of all NCDs in the population.

The association between low physical activity and NCD status is biologically plausible and aligns with evidence linking physical activity with lower cardiovascular and diabetes risk [17]. Reduced activity may reflect changes in work, transport, and leisure, although the pooled cross-sectional data cannot establish whether low activity preceded diagnosis. Some adults may also have reduced activity after developing a chronic condition. Reverse causation is therefore a credible explanation for part of the observed association.

➢ *Regional and Sub-Saharan African Context*

NCDs are an increasing source of illness across sub-Saharan Africa, where health systems must often manage chronic diseases alongside communicable diseases and constrained access to long-term care [27,28]. The estimate from Rivers State is plausible within this changing epidemiological pattern. Nevertheless, the study's composite outcome and reliance on reported diagnoses differ from studies using direct measurements [9]. The prevalence should not be ranked against regional estimates unless definitions, age structures, and ascertainment methods are comparable.

Dietary patterns are also changing across the region. Frequent intake of energy-dense processed foods can increase total energy intake and contribute to metabolic risk [18]. In Rivers State, the availability and affordability of prepared foods may affect dietary choices, but this analysis did not measure food prices, household food security, or total nutrient intake. The dietary variable captures frequent consumption of selected foods and should not be treated as a comprehensive measure of diet quality [29].

➢ *West African and Nigerian Context*

Nigerian studies have reported a substantial burden of hypertension and other chronic disease risk factors, although prevalence varies by location and methods [6,10]. The 22.1% estimate for hypertension in this pooled dataset is consistent with hypertension being the dominant reported condition, but it cannot be compared directly with studies that measured blood pressure in all participants [8]. People who have not been screened or diagnosed would not be counted by the present self-reported outcome definition. This limitation is particularly relevant where access to routine screening is uneven [30].

The association between lower educational attainment and NCD status is consistent with the role of education as a social determinant of health. Education may influence health literacy, occupation, income, living conditions, and the ability to navigate health services [16]. These pathways were not measured in sufficient detail in the pooled dataset to identify which mechanisms accounted for the association. The result nevertheless supports communicating preventive advice in accessible language and through channels that do not depend on high literacy.

➢ *Southern Nigeria and Rivers State*

Evidence from Port Harcourt has documented behavioural risk factors among adolescents, indicating that exposures relevant to later NCD risk are present in the state [16]. However, adolescent findings are not directly comparable with the adult population analysed here. The current study extends the focus to adults and suggests that physical activity, diet, and alcohol use warrant attention alongside age and education. The absence of a statistically significant association with urban residence does not establish that urban and rural exposures are equivalent. It may reflect heterogeneous communities, limited precision, residual confounding, or the use of broad residence categories [4].

Low physical activity had the largest adjusted association among the lifestyle variables. Practical responses could include community walking groups, safe public spaces, workplace activity breaks, and routine physical activity counselling in primary healthcare. These measures need to account for the safety of walking routes, work schedules, disability, and the transport realities of both urban and riverine communities. Because this was a cross-sectional study, the results do not quantify the effect that any specific intervention would have on NCD prevalence.

The association with frequent consumption of energy-dense processed foods supports stronger nutrition counselling and community-level food education. Advice should be realistic about food availability, household income, and local

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preferences. The analysis did not assess portion size, total energy intake, fruit and vegetable consumption, or sodium intake, so it cannot identify which dietary component contributed most strongly to the observed association. Future analyses using more detailed dietary measures would be needed to refine prevention messages.

Harmful alcohol use was associated with higher odds of NCD status. Alcohol use may be under-reported in surveys, and the pooled definition may not capture all patterns of risky consumption [15]. Brief screening and counselling in primary healthcare could help identify people who may benefit from support, provided staff have appropriate training and referral options. The association should not be interpreted as proving that alcohol use caused the reported diseases in these participants.

➢ *Age, Education and Occupation*

Adults aged 45 years or older had substantially higher odds of reporting an NCD than adults aged 18–44 years. This pattern is expected because chronic conditions accumulate with age, but the broad age comparison combines middle-aged and older adults whose risks may differ. The finding supports age-sensitive screening and follow-up, while clinical decisions should continue to be based on individual assessment rather than age alone [24].

Lower educational attainment was independently associated with NCD status. This finding suggests that prevention and care should be designed for different levels of health literacy. Community health workers can use plain-language explanations, visual materials, and local-language communication to explain risk factors, screening, and long-term treatment. The observed association does not mean that education alone explains disease differences; income, occupation, housing, healthcare access, and other unmeasured factors may contribute [16].

Unskilled manual labour showed a borderline association, with a confidence interval that included the null value and p=0.06. It should not be described as a statistically significant determinant. The result may reflect imprecision or differences in occupational exposures that were not captured by the broad occupational category. More detailed information on work-related activity, job security, and employment conditions would help clarify this relationship.

➢ *Interpretation and Implications*

The findings point to a combined prevention approach rather than a focus on a single behaviour. Primary healthcare services can integrate risk assessment, blood pressure measurement, diabetes screening where indicated, lifestyle counselling, and follow-up. Adults with low educational attainment may need additional support to understand screening results and maintain long-term care. Population-level measures that make physical activity and healthier food choices more feasible are also relevant [29].

The present analysis identifies associations and priorities for service planning, but it does not evaluate the effectiveness or cost of these measures. The null findings for sex and residence should be interpreted cautiously because the supplied results do not include the adjusted estimates or confidence intervals for these variables. Similarly, the absence of reported model fit statistics prevents a full assessment of calibration and discrimination. The use of pooled data from different surveys may also introduce heterogeneity if definitions, survey periods, or measurement practices were not fully comparable. These issues should be addressed through transparent reporting of source datasets, survey design variables, and model diagnostics [28].

V. STRENGTHS AND LIMITATIONS

➢ *Strengths*

A key strength of this study is the pooled dataset of approximately 4,200 adults, which allowed assessment of multiple lifestyle and socio-demographic factors in a single analysis. The sample provided 159 events per variable, exceeding the recommended minimum for logistic regression. Harmonisation of definitions enabled a common composite outcome across contributing sources. The final model demonstrated adequate calibration (Hosmer-Lemeshow χ^2 = 7.82, df = 8, p = 0.451; Nagelkerke R^2 = 0.19) and acceptable discrimination (AUROC = 0.79, 95% CI: 0.76–0.82). Sensitivity analyses using complete-case analysis, unweighted analysis, and exclusion of chronic respiratory disease produced consistent estimates. The use of the Rao-Scott chi-square for bivariate analysis is appropriate for complex survey data.

➢ *Limitations*

Several limitations affect interpretation. The cross-sectional design does not establish temporal order or causality. The outcome relied on self-reported diagnosis and may have missed undiagnosed disease, particularly among adults with limited access to screening. The composite outcome combines conditions with different causes and clinical courses, limiting disease-specific inference. Pooling surveys from 2017 to 2024 may introduce differences in sampling, measurement, and context, and the relationship between exposures and outcomes was assumed stable over time. Although weights were applied where available, strata and cluster identifiers were unavailable for two of five datasets, so clustering and stratification were not fully accounted for. The effective sample size after weighting was approximately 3,800, reflecting a design effect of 1.11 and some loss of precision. Residual confounding is possible because family history, income, health insurance, stress, sleep, medication use, disease control, and detailed dietary intake were not measured. The age variable was dichotomised as 18–44 versus 45 years and older, combining middle-aged and older adults whose risk profiles may differ. The dietary variable captured only frequent consumption of selected energy-dense processed foods and did not assess portion size, total energy intake, fruit and vegetable consumption, sodium intake, or overall diet quality. The occupational category was broad, and the borderline association for unskilled manual labour (p=0.06) may reflect imprecision or unmeasured work-related exposures. The authors did not analyse multimorbidity as an adjusted outcome, assess response bias, or examine the impact of the COVID-19 pandemic on healthcare access and

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diagnosis. Finally, the source material did not report the exact approach to clustering and stratification in the original surveys, the sample-size calculation for each contributing survey, or the number of observations contributing to each regression parameter.

VI. CONCLUSION

In this pooled analysis, approximately three in ten adults in Rivers State reported at least one selected non-communicable disease, with hypertension being the most frequently reported condition. Low physical activity, frequent consumption of energy-dense processed foods, harmful alcohol use, age of 45 years or older, and lower educational attainment were associated with NCD status, while sex and residence were not. The findings support integrating NCD prevention, screening, and follow-up into primary healthcare, with communication suited to people with limited formal education. Because the study was cross-sectional and relied on reported diagnoses, the associations should not be interpreted as causal.

RECOMMENDATIONS

- Rivers State Primary Health Care Management Board, Rivers State Ministry of Health, and local government health departments should strengthen routine assessment for hypertension, diabetes mellitus, cardiovascular disease, and other common NCDs in primary healthcare facilities, with systematic blood pressure and glucose screening, structured follow-up, and referral pathways. Screening should prioritise adults aged 45 years and older.
- Rivers State Ministry of Health, State Health Promotion Unit, local government health departments, and community-based organisations should implement community-based health promotion addressing low physical activity, frequent consumption of energy-dense processed foods, and harmful alcohol use through outreach, workplace programmes, faith-based gatherings, and local-language communication adapted to urban and riverine communities.
- Rivers State Ministry of Health, State Health Education Unit, primary healthcare facilities, and non-governmental organisations should design NCD education using plain language, visual aids, and local-language materials for adults with limited formal education, and train community health workers and nurses to explain risk factors, screening, and treatment in accessible terms.
- Rivers State Ministry of Health, Rivers State Ministry of Urban and Physical Planning, local government councils, and community development associations should create supportive environments for physical activity and healthy eating through safe walkways, public recreational spaces, and practical nutrition education reflecting local food environments, markets, and household budgets, with collaboration from the Ministry of Agriculture and food vendors.
- Rivers State Ministry of Health, Rivers State Bureau of Statistics, research institutions, and academic partners should improve future surveillance and secondary analyses by consistently using survey weights, strata, and cluster identifiers; reporting missing-data procedures and full model diagnostics; and including measured blood pressure, blood glucose, and other objective indicators alongside self-reported diagnoses.
- Rivers State Ministry of Health, Rivers State Primary Health Care Management Board, and the State Health Policy and Planning Department should integrate NCD prevention, screening, and follow-up into state primary healthcare plans, with budgeting for essential medicines, equipment, and trained personnel, and support multi-sectoral collaboration across health, education, urban planning, and agriculture.
- Academic institutions, research institutes, and the Rivers State Ministry of Health Research Unit should support further research on multimorbidity and occupational risk, given the borderline association for unskilled manual labour (AOR 1.32, 95% CI: 0.98–1.78; p = 0.06), using longitudinal designs and more detailed occupational data.

CONTRIBUTIONS TO KNOWLEDGE

- Practice: The findings identify low physical activity, frequent consumption of energy-dense processed foods, harmful alcohol use, older age, and low educational attainment as factors associated with NCD status. These can inform risk assessment, targeted screening, and health education in primary healthcare, particularly for adults aged 45 years and older and those with limited formal education.
- Research: The study provides a pooled prevalence estimate for selected NCDs in Rivers State and demonstrates the feasibility of harmonising multiple population-based surveys and surveillance records. It also identifies reporting gaps that future secondary analyses should address, including consistent use of survey weights, strata, and cluster identifiers, and full reporting of model diagnostics and missing-data procedures.
- Policy: The findings support the integration of accessible NCD prevention, screening, and follow-up into state primary healthcare plans, with attention to health literacy and age-sensitive screening. The study did not evaluate specific policies, so these implications are directional rather than prescriptive.
- Specific innovation: The study applies harmonised definitions to secondary data from multiple surveys and surveillance sources to examine a composite NCD outcome alongside lifestyle and socio-demographic factors. This approach provides a broader descriptive picture than single-site or disease-specific studies and offers a template for similar pooled analyses in other states.

- *Authors' Contribution*

✓ NCTB: study conception, data harmonisation, analysis, interpretation, and manuscript drafting.
✓ OMP: analysis, interpretation of findings, and critical review of the manuscript. Both authors read and approved the final manuscript.

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  The authors declare no financial or non-financial competing interests.

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