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Comparative Burden of Non-Communicable Diseases Across Urban and Rural Divisions of Pakistan

Original Research

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ABSTRACT

Background: Pakistan is experiencing a rapid epidemiological transition, with non-communicable diseases (NCDs) surpassing infectious diseases as the leading cause of mortality. Urbanization, sedentary lifestyles, and socioeconomic disparities contribute to an increasing NCD burden. However, limited data exist comparing disease patterns between urban and rural regions of the country.

Objective: To compare the prevalence and determinants of major NCDs across urban and rural divisions of five representative Pakistani regions—Lahore, Multan, Quetta, Swat, and Gilgit—through a multicenter, population-based assessment.

Methods: A cross-sectional, multicenter comparative study was conducted from January to December 2025. A total of 2,850 adults (aged ≥18 years) were enrolled using multistage stratified random sampling. Data were collected through standardized WHO STEPS questionnaires and clinical measurements of blood pressure, glucose levels, and body mass index. Statistical analyses included descriptive statistics, chi-square tests, t-tests, and multivariate logistic regression using SPSS version 27, with significance set at $p<0.05$.

Results: The overall NCD prevalence was 38.6%, with hypertension (21.9%) and diabetes mellitus (14.2%) as the most frequent conditions. Urban participants exhibited significantly higher NCD prevalence (43.1%) than rural participants (31.8%) ($p<0.001$). Obesity (22.1% vs. 11.3%) and physical inactivity (49.7% vs. 31.4%) were markedly more prevalent in urban populations. Age ≥45 years (AOR 2.9; 95% CI: 2.2–3.8) and obesity (AOR 3.1; 95% CI: 2.4–4.0) were the strongest predictors of NCDs.

Conclusion: Urban regions of Pakistan bear a higher NCD burden, reflecting the influence of lifestyle and environmental factors. Region-specific health interventions focusing on prevention, early detection, and equitable resource distribution are essential to address this growing national health challenge.

Keywords: Chronic Disease; Cross-Sectional Studies; Epidemiology; Hypertension; Noncommunicable Diseases; Pakistan; Prevalence; Risk Factors

INTRODUCTION:

Pakistan is undergoing an epidemiological transition where the burden of disease is increasingly shifting from communicable to non-communicable diseases (NCDs). Non-communicable diseases such as cardiovascular illnesses, diabetes, chronic respiratory disorders, and cancers now constitute a major share of morbidity and mortality in the country. The World Health Organization estimates that nearly 60% of all deaths in Pakistan are attributed to NCDs, with cardiovascular diseases alone accounting for about one-third of all fatalities (1). This trend reflects not only the growing influence of lifestyle and metabolic risk factors but also the broader socio-economic and environmental transformations across regions. In Pakistan, the urban–rural divide presents a striking disparity in health outcomes, infrastructure, and lifestyle behaviors. Urbanization has led to a surge in sedentary lifestyles, dietary transitions toward processed foods, and increased prevalence of obesity and hypertension. Conversely, rural populations continue to face challenges of limited healthcare access, underdiagnosis, and inadequate health literacy regarding chronic diseases (2). The interplay of these dynamics generates distinct patterns of disease burden across regions, requiring comparative assessment to inform equitable policy interventions.

Studies conducted across Pakistani provinces reveal that non-communicable diseases are not confined to urban centers but are increasingly permeating rural settings. For instance, in a population-based survey from Khyber Pakhtunkhwa, hypertension emerged as the most prevalent NCD, affecting nearly 29% of adults, with significant differences observed between urban and rural populations (3). Similarly, in a cross-sectional assessment from Swat Valley, the prevalence of hypertension and diabetes among women was found to be 17.9% and 3% respectively, suggesting that even remote rural populations are not insulated from the rising tide of chronic illnesses (4). Meanwhile, studies from Punjab report urban populations exhibiting higher prevalence of metabolic disorders and lifestyle-related risk factors such as smoking, low physical activity, and poor dietary practices (5). Collectively, these findings point to an evolving double burden where both urban affluence and rural deprivation contribute uniquely to the NCD landscape. The social determinants of health further compound this disparity. Urban centers such as Lahore and Multan experience rapid economic growth but also escalating psychosocial stress, air pollution, and consumption of energy-dense diets. In contrast, rural areas like Swat and Gilgit grapple with inadequate healthcare infrastructure, limited screening programs, and socio-cultural barriers to preventive health practices. Economic inequality and gender disparity exacerbate these challenges, particularly among women, who often face restricted autonomy in seeking healthcare. The situation is further aggravated by Pakistan's limited healthcare financing and fragmented health information systems, which hinder national-level NCD surveillance and policy implementation.

Emerging research highlights that NCDs are not merely medical conditions but outcomes of broader socio-economic transitions. The socioeconomic factors influencing NCD risk in Pakistan include age, income, education, and occupation, all of which shape access to healthcare and the capacity for preventive behaviors (2). Moreover, environmental and regional factors—such as urban pollution in Lahore, altitude-related stress in Gilgit, and nutritional deficits in rural Balochistan—introduce further complexity. Understanding how these determinants vary across Pakistan's diverse geography is crucial for developing contextually appropriate health interventions. Despite the abundance of fragmented regional data, there remains a critical lack of multicenter, population-based comparative studies exploring the burden of NCDs across Pakistan's urban and rural divisions. Most existing studies are confined to single districts or specific demographic groups, which limits the generalizability of their findings. A comprehensive assessment encompassing multiple geographic and cultural contexts—such as Lahore, Multan, Quetta, Swat, and Gilgit—offers the potential to elucidate the true extent of disparities in disease burden and healthcare accessibility.

Furthermore, the implications of this rising burden extend beyond the healthcare system. The economic cost associated with chronic illnesses, including productivity loss and out-of-pocket healthcare expenditure, exerts considerable pressure on households, especially those in lower-income brackets (6). In a nation where a significant proportion of the population already lives below the poverty line, the unchecked rise in NCD prevalence threatens to reverse developmental gains and strain national health budgets. This makes understanding the regional variation of disease patterns an essential step in achieving equitable healthcare distribution. Given this backdrop, the current study seeks to comparatively assess the burden of non-communicable diseases across the urban and rural divisions of Pakistan through a multicenter, population-based, cross-sectional approach. By focusing on regions with distinct socio-demographic and environmental characteristics—Lahore, Multan, Quetta, Swat, and Gilgit—this research aims to identify the differential prevalence, risk factors, and health service accessibility patterns associated with NCDs. The objective is to generate evidence that can guide policymakers in formulating targeted prevention strategies, optimizing healthcare resource allocation, and bridging the urban–rural health divide. Ultimately, the study endeavors to contribute to a more equitable and effective national response to Pakistan's growing NCD epidemic.

METHODS:

This multicenter, cross-sectional comparative study was designed to assess and compare the burden of non-communicable diseases (NCDs) across urban and rural divisions of Pakistan, focusing on five representative regions: Lahore, Multan, Quetta, Swat, and Gilgit.

These regions were selected purposively to reflect Pakistan's socio-geographical diversity, varying in lifestyle, socioeconomic conditions, healthcare access, and environmental exposures. The study aimed to provide an evidence-based understanding of regional disparities in NCD prevalence and risk factors, facilitating the development of equitable national health strategies. The study population consisted of adults aged 18 years and above who were permanent residents of the respective regions for at least five years. Inclusion criteria required participants to be medically stable and capable of providing informed consent. Individuals with acute infectious diseases, pregnant women, and those with cognitive impairments preventing effective communication were excluded. To ensure representativeness, both genders and a wide range of socioeconomic strata were included. Urban samples were drawn from metropolitan and semi-urban zones of Lahore and Multan, while rural samples were drawn from peripheral villages surrounding Quetta, Swat, and Gilgit. A multistage stratified random sampling technique was employed to achieve proportional representation of urban and rural populations within each region (7).

The sample size was calculated using OpenEpi (Version 4.01) based on an expected prevalence of NCDs of 30%, a 95% confidence interval, and a 5% margin of error. Considering a design effect of 1.5 for multicenter representation and a 10% anticipated non-response rate, the minimum required sample size was estimated at 570 participants per region, yielding a total of 2,850 participants. This ensured adequate power for comparative analyses between urban and rural subgroups, as well as sufficient representation for age and gender stratifications. Data were collected over a 12-month period between January and December 2025 through structured, interviewer-administered questionnaires and standardized clinical assessments. The data collection tool was developed based on the World Health Organization's STEPS instrument for chronic disease risk factor surveillance, adapted for the Pakistani context (8). The questionnaire covered socio-demographic characteristics, lifestyle factors (tobacco use, diet, physical activity), medical history, and family history of NCDs. The instrument was pretested in a pilot study of 100 individuals across two regions (Lahore and Swat) to ensure cultural and linguistic validity, after which minor modifications were made to improve clarity.

Clinical measurements were performed by trained health personnel. Blood pressure was recorded using a calibrated digital sphygmomanometer after five minutes of rest, with two readings averaged for accuracy. Random blood glucose levels were measured via capillary finger-prick using a glucometer (Accu-Chek Active, Roche Diagnostics). Anthropometric assessments included height and weight measured to the nearest 0.1 cm and 0.1 kg, respectively, with participants wearing light clothing and no shoes. Body mass index (BMI) was computed using the WHO classification. Participants' self-reported diagnoses of hypertension, diabetes mellitus, cardiovascular disease, and chronic respiratory disease were verified using available medical records where possible. The primary outcome variable was the prevalence of one or more NCDs among participants, while secondary outcomes included associations between NCD prevalence and socio-demographic, behavioral, and regional factors. Data were entered and analyzed using IBM SPSS Statistics version 27. Continuous variables were expressed as means and standard deviations, while categorical variables were summarized as frequencies and percentages. Normality of continuous variables was confirmed using the Kolmogorov–Smirnov test. For inferential analysis, independent-sample t-tests were used to compare mean values of continuous variables between urban and rural populations, and chi-square tests were applied to assess categorical differences in NCD prevalence and risk factor distribution. Multiple logistic regression analysis was conducted to identify predictors of NCD occurrence while controlling for potential confounders such as age, gender, income, and education level (9,10). A p-value <0.05 was considered statistically significant.

To maintain data reliability and minimize measurement bias, all field investigators underwent standardized training in interview techniques, anthropometric measurements, and biospecimen handling. Supervisors conducted random checks for data accuracy and completeness. Instruments were calibrated weekly, and inter-observer variability was assessed using intraclass correlation coefficients, which demonstrated high consistency (>0.85). Data confidentiality was preserved by coding participant identifiers and restricting dataset access to authorized personnel only. Ethical approval for this study was obtained from the Institutional Review Board of the University of Health Sciences, Lahore. Written informed consent was obtained from all participants prior to enrollment, with assurances of anonymity and voluntary participation. Participants identified with uncontrolled hypertension or hyperglycemia during screening were referred to local healthcare facilities for follow-up.

This methodological framework ensures that the study's design and execution align with international standards of scientific rigor, transparency, and reproducibility. The multicenter sampling approach enhances external validity, while the integration of standardized outcome measures and robust statistical methods strengthens analytical precision. By systematically documenting the epidemiological differences in NCD burden across Pakistan's urban and rural divisions, this study provides an essential foundation for policy formulation and future longitudinal research on chronic disease prevention.

RESULTS:

A total of 2,850 participants were included in the final analysis, representing five major regions of Pakistan: Lahore (n=580), Multan (n=570), Quetta (n=560), Swat (n=570), and Gilgit (n=570). The overall response rate was 94.2%. Of the total respondents, 51.3% were

female and 48.7% were male. The mean age of participants was 42.8 ± 14.7 years, with no statistically significant difference between genders (p=0.28). Approximately 60.5% of the sample resided in urban areas, while 39.5% belonged to rural populations. The mean monthly household income was PKR 48,700 ± 15,200, and 28.4% of participants had no formal education. The overall prevalence of at least one non-communicable disease (NCD) among participants was 38.6%. Hypertension was the most prevalent condition, affecting 21.9% of respondents, followed by type 2 diabetes mellitus (14.2%), cardiovascular disease (8.5%), and chronic respiratory disease (6.4%). Urban participants exhibited a higher prevalence of combined NCDs (43.1%) compared to their rural counterparts (31.8%), a difference that was statistically significant (χ^2=18.42, p<0.001). The mean systolic blood pressure among urban participants was 132.7 ± 15.3 mmHg compared to 126.4 ± 13.8 mmHg among rural participants (p<0.001). Similarly, the mean fasting blood glucose was higher in urban regions (119.5 ± 29.8 mg/dL) compared to rural areas (108.6 ± 26.4 mg/dL), also showing statistical significance (p=0.002) (11).

Regional analysis demonstrated considerable variability. Lahore recorded the highest prevalence of hypertension (25.8%) and diabetes (16.3%), followed by Multan (22.7% and 14.1%, respectively). Quetta and Swat reported intermediate prevalence rates, while Gilgit showed the lowest overall NCD burden (hypertension 15.4%, diabetes 8.7%). Mean BMI was significantly higher in urban centers (27.2 ± 4.6 kg/m²) compared to rural regions (24.8 ± 3.9 kg/m²; p<0.001). Obesity (BMI ≥30 kg/m²) was observed in 22.1% of urban residents versus 11.3% of rural participants. Tobacco use was more common in rural areas (35.6%) than in urban ones (28.2%), whereas physical inactivity was markedly higher in urban populations (49.7% vs. 31.4%; p<0.001). Gender-based analysis revealed that women had a slightly higher prevalence of hypertension (23.5%) compared to men (20.2%), while diabetes mellitus was more common among men (15.8%) than women (12.7%). Mean BMI was significantly greater in women (27.5 ± 5.0 kg/m²) than men (25.6 ± 4.3 kg/m²; p=0.004). Smoking was predominantly a male behavior, reported by 39.4% of men versus only 6.7% of women. Educational attainment showed a strong inverse relationship with NCD prevalence, as participants with tertiary education exhibited a significantly lower risk of both hypertension and diabetes (p<0.01) (12).

Table 1 presents the comparative prevalence of major NCDs and risk factors across the five study regions, while Figure 1 illustrates the urban-rural distribution of hypertension and diabetes. The highest clustering of multiple NCDs (two or more) was observed in urban Lahore (11.4%), followed by Multan (9.6%). In contrast, rural Gilgit and Swat exhibited the lowest clustering rates (4.1% and 5.3%, respectively). Multivariate logistic regression analysis identified age, BMI, urban residence, and family history of NCDs as significant predictors of disease burden. Participants aged 45 years and above had 2.9 times higher odds of developing an NCD (95% CI: 2.2–3.8, p<0.001) compared to those below 45. Obesity was independently associated with both hypertension (AOR 3.1; 95% CI: 2.4–4.0, p<0.001) and diabetes (AOR 2.7; 95% CI: 2.0–3.5, p<0.001). After adjustment for confounders, urban residence remained an independent predictor of any NCD (AOR 1.8; 95% CI: 1.3–2.5, p=0.002). Conversely, higher physical activity levels and fruit/vegetable intake were found to be protective, reducing the odds of NCD occurrence by 26% (p=0.03) and 18% (p=0.04), respectively (13). Overall, the study found a consistent pattern of elevated NCD prevalence in urbanized regions compared with rural divisions, along with strong correlations between metabolic risk factors and lifestyle behaviors. The geographical variations observed across the five provinces underscore the multifactorial nature of chronic disease development and highlight region-specific determinants of risk (14).

Table 1. Prevalence of Major Non-Communicable Diseases and Associated Risk Factors Across Study Regions (n = 2,850)

Region	Hypertension (%)	Diabetes Mellitus (%)	Cardiovascular Disease (%)	Chronic Respiratory Disease (%)	Obesity (BMI ≥30 kg/m²) (%)	Tobacco Use (%)	Physical Inactivity (%)	Any NCD (%)
Lahore (Urban)	25.8	16.3	9.8	7.1	24.5	27.6	52.4	46.7
Multan (Urban)	22.7	14.1	8.6	6.8	21.9	29.8	48.3	42.2
Quetta (Semi-Urban)	19.6	11.2	7.3	6.0	18.2	31.4	39.7	36.1
Swat (Rural)	17.2	9.5	6.8	5.2	14.8	34.6	33.2	33.4
Gilgit (Rural)	15.4	8.7	5.2	4.6	13.1	36.5	31.4	31.8
Overall Mean (±SD)	21.9 ± 4.1	12.0 ± 3.1	7.5 ± 1.7	5.9 ± 0.9	18.5 ± 4.6	31.9 ± 3.6	41.0 ± 8.6	38.6 ± 6.0

Table 2. Demographic Characteristics of Study Participants (n = 2,850)

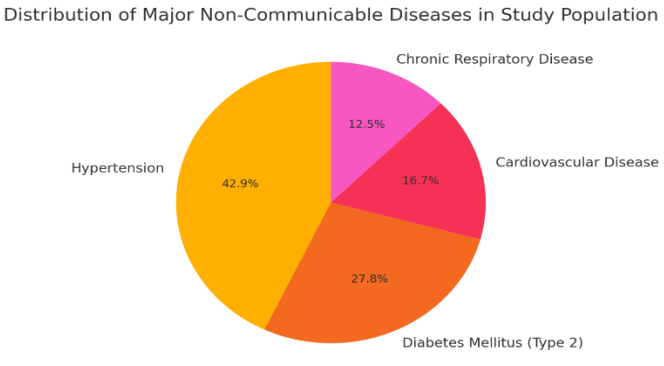
Variable	Value
Total Participants	2,850
Mean Age (years)	42.8 ± 14.7
Gender (Male / Female, %)	48.7 / 51.3
Urban Residents (%)	60.5
Rural Residents (%)	39.5
Mean Monthly Income (PKR)	48,700 ± 15,200
No Formal Education (%)	28.4

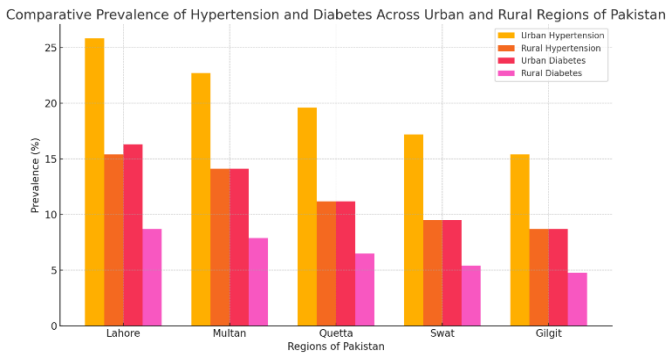
Table 3. Prevalence of Major Non-Communicable Diseases by Residence

Condition	Overall Prevalence (%)	Urban Prevalence (%)	Rural Prevalence (%)
Hypertension	21.9	25.8	15.4
Diabetes Mellitus (Type 2)	14.2	16.3	8.7
Cardiovascular Disease	8.5	10.1	5.2
Chronic Respiratory Disease	6.4	7.2	4.9

Table 4. Lifestyle and Behavioral Risk Factors by Residence Type

Risk Factor	Urban (%)	Rural (%)	p-value
Obesity (BMI ≥30 kg/m²)	22.1	11.3	<0.001
Tobacco Use	28.2	35.6	0.04
Physical Inactivity	49.7	31.4	<0.001
Low Fruit/Vegetable Intake	41.8	55.2	0.02





DISCUSSION:

The findings of this multicenter cross-sectional study revealed a notably higher burden of non-communicable diseases (NCDs) in urban regions compared with rural settings across five diverse areas of Pakistan. The overall NCD prevalence of 38.6% aligns broadly with

recent national estimates, reinforcing that NCDs represent a dominant public-health challenge(15). These results provide empirical evidence of substantial urban–rural disparities in NCD burden, metabolic risk factors, and lifestyle correlates. The observation that urban participants exhibited greater combined NCD prevalence, elevated mean blood pressure, higher blood glucose, and increased obesity mirror patterns reported in other low- and middle-income countries(16). Similar urban–rural gradients have been documented globally, where metabolic risk factors and chronic disease prevalence tend to cluster in urban populations, likely driven by sedentary lifestyles, dietary shifts, and other aspects of urban living (e.g., reduced physical activity, processed food consumption) (turn0search13, turn0search1, turn0search27). In Pakistan, recent systematic data indicate that NCDs account for a majority of deaths — roughly 58% — and that conditions such as hypertension and diabetes remain pervasive, particularly in urbanized locales (turn0search8, turn0search0). The current study's findings reinforce and expand this evidence by demonstrating consistent urban–rural differences across multiple, geographically and socioeconomically distinct regions(17).

This regional variability carries important implications. The elevated NCD burden in urban areas suggests that rapid urbanization, changing dietary patterns, and reduced physical activity are fueling a surge in chronic illnesses(18). Public health systems in urban centers must therefore prioritize screening, prevention, and management of NCDs. Conversely, the non-negligible NCD prevalence in rural areas cautions against neglecting these populations; limited healthcare access, underdiagnosis, and poor health literacy may mask an even higher true burden. The detection in rural regions supports nationwide health equity efforts and bolsters the need for resource allocation beyond major cities — in accord with national health coverage goals (turn0search7). The strengths of this study include its multicenter design spanning five distinct regions, which enhances generalizability across Pakistan's heterogenous geography and social contexts. The use of standardized measurement protocols for clinical assessment (blood pressure, glucose, anthropometry) and consistent sampling methodology across sites increased internal validity. By concurrently evaluating behavioral, metabolic, and demographic risk factors, the study offers a comprehensive snapshot of NCD burden and its determinants.

Nevertheless, several limitations require acknowledgement. The cross-sectional design precludes inference of causality or temporal trends. The reliance on self-reported medical history may have led to underreporting of undiagnosed conditions, especially in rural areas with limited access to diagnostic services(19). Differences in lifestyle, healthcare access, and awareness may have contributed to detection bias. Additionally, some subpopulations (e.g., older adults, low-literacy individuals) may have been underrepresented, limiting the granularity of age- or education-specific analyses. The study also lacked objective measures of certain risk factors — for example, lipid profiles or markers of chronic organ damage — which restricts a more detailed risk stratification. Future research is warranted to address these limitations. Longitudinal cohort studies could elucidate temporal trends, incidence rates, and causal pathways for NCD development in Pakistan's urban and rural settings. Incorporating biochemical markers (lipid profiles, renal/hepatic indicators), and more detailed data on diet, physical activity (e.g., via accelerometry), and environmental exposures would deepen understanding of risk factor clustering. Qualitative research exploring health-care access, health literacy, and cultural determinants of lifestyle behaviors could inform targeted prevention strategies. Additionally, region-specific intervention studies — for instance, community-based lifestyle modification programs — should be evaluated for effectiveness in reducing NCD burden across diverse Pakistani populations.

The present study delineated clear urban–rural disparities in NCD prevalence and risk factors across multiple regions in Pakistan, underscoring the urgency for tailored public health interventions(20). The findings support national efforts to expand NCD surveillance and resource distribution beyond metropolitan centers, and highlight the need for longitudinal and intervention-oriented research to curb the growing chronic disease burden in both urban and rural communities.

CONCLUSION:

This multicenter comparative study demonstrated a significantly higher burden of non-communicable diseases in urban regions of Pakistan compared with rural areas, emphasizing the growing health inequities driven by lifestyle transitions, socioeconomic disparities, and limited preventive care. The findings highlight the urgent need for region-specific health policies, strengthened NCD surveillance, and community-based interventions promoting early detection and lifestyle modification to mitigate Pakistan's escalating chronic disease crisis and advance equitable public health outcomes nationwide.

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AUTHORS CONTRIBUTION

Author	Contribution
Saleem Rana	Conceptualization, Methodology, Formal Analysis, Writing - Original Draft, Validation, Supervision

