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BRIDGING THE DIVIDE: A COMPARATIVE CROSS-SECTIONAL ANALYSIS OF HIV/AIDS KNOWLEDGE, ATTITUDES, AND ATTITUDINAL STIGMA AMONG URBAN AND RURAL POPULATIONS IN PAKISTAN

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Abstract

Background: *Pakistan is experiencing one of the fastest-growing HIV epidemics in the World Health Organization Eastern Mediterranean Region, yet awareness remains low and stigma toward people living with HIV (PLHIV) remains pervasive. A pronounced urban–rural divide is thought to impede effective prevention and care, but quantitative comparisons remain limited.*

Objective: *To compare HIV/AIDS knowledge, attitudes, and attitudinal stigma between urban and rural populations in Pakistan and to identify sociodemographic predictors of these outcomes.*

Methods: *A cross-sectional survey was conducted between January and March 2025 among 1,200 adults selected by stratified random sampling: 600 from three major urban centres (Lahore, Karachi, Islamabad) and 600 from rural districts of Punjab, Khyber Pakhtunkhwa, and Sindh. A pretested, structured, interviewer-administered questionnaire measured knowledge, attitudes, and stigma. Group differences were assessed using chi-square tests and independent t-tests; multivariable logistic regression identified independent predictors of adequate knowledge and high stigma.*

Results: *Urban respondents demonstrated substantially higher HIV knowledge than rural respondents across all domains, including correct knowledge of transmission (72.0% vs 38.0%; $p < 0.001$) and prevention (66.7% vs 30.0%; $p < 0.001$). Urban respondents held markedly more accepting attitudes (acceptance of PLHIV in society: 86.7% vs 33.3%; $p < 0.001$), whereas rural respondents endorsed stigmatising beliefs far more frequently (HIV as punishment for immoral behaviour: 66.7% vs 25.0%; support for discrimination: 75.0% vs 21.7%; both $p < 0.001$). In adjusted models, rural residence, lower educational attainment,*

and male gender independently predicted inadequate knowledge and elevated stigma.

Conclusions: *A wide and statistically significant urban–rural gap exists in HIV knowledge, attitudes, and stigma in Pakistan, structured by education and gender. Closing this gap requires culturally tailored, low-literacy-appropriate education, healthcare-worker sensitisation, and community-led anti-stigma programming concentrated in rural districts. Such equity-focused action is essential to advance Pakistan toward the UNAIDS 95–95–95 targets and Sustainable Development Goal 3.3.*

1. Introduction

The human immunodeficiency virus (HIV) and the acquired immunodeficiency syndrome (AIDS) it causes remain among the most consequential public health challenges of the twenty-first century. Globally, an estimated 40.8 million people were living with HIV at the end of 2024, of whom women and girls comprised 53%, and approximately 1.3 million people acquired HIV during that year — a figure that has remained almost unchanged from the previous year despite four decades of intervention [1]. Although the global response has achieved remarkable progress, reducing new infections by 40% and AIDS-related deaths by 56% since 2010 and averting an estimated 26.9 million deaths through antiretroviral therapy (ART), these gains have been distributed unevenly across regions, populations, and — critically for the present study — between urban and rural communities within individual countries [1].

Pakistan occupies a precarious position within this global landscape. Once considered a low-prevalence country, Pakistan now hosts one of the fastest-growing HIV epidemics in the World Health Organization (WHO) Eastern Mediterranean Region [2,3]. The Joint United Nations Programme on HIV/AIDS (UNAIDS) and WHO estimate that approximately 350,000 people are living with HIV in Pakistan as of 2024–2025, a substantial upward revision from earlier modelled estimates of roughly 210,000, reflecting refined surveillance and modelling rather than a single year of explosive growth [2]. Alarmingly, the number of new infections is estimated to have risen by approximately 200% over fifteen years, from around 16,000 in 2010 to 48,000 in 2024, while almost eight in ten people living with HIV in the country remain unaware of their serostatus [2,3]. This epidemiological trajectory runs counter to global trends and signals a deepening crisis.

The structure of Pakistan's epidemic is formally concentrated, with general-population prevalence below 0.1% but markedly elevated prevalence among key populations, including people who inject drugs, transgender (hijra) individuals, men who have sex with men, and female sex workers [3]. However, a defining feature of the recent Pakistani experience is the apparent diffusion of infection beyond key populations into the general community, children, and spouses. The most emblematic event was the 2019 paediatric HIV outbreak in Ratodero, Larkana District, Sindh, in which 1,353 people tested positive over a twelve-month period, approximately three-quarters of them children under fifteen years of age [4]. A matched case–control investigation identified iatrogenic transmission — unsafe injections, the reuse of syringes and infusion equipment, and inadequate blood safety — as the predominant driver [5]. Far from being an isolated tragedy, Ratodero has been followed by recurrent, paediatric-dominated outbreaks in other districts of Sindh and Punjab in subsequent years, underscoring the fragility of infection control and the systemic vulnerabilities that sustain transmission [3].

The drivers of this epidemic extend well beyond biomedical factors. Inadequate public knowledge of HIV transmission and prevention, persistent misconceptions, weak health systems, and deeply entrenched social stigma collectively impede both prevention and care [6,7]. These factors do not operate uniformly across the country. Pakistan is characterised by profound geographic inequities: although roughly 70% of the population resides in

rural areas, healthcare resources remain heavily concentrated in cities, and rural districts are served by a fraction of the available infrastructure, trained personnel, and information channels [8,9]. National literacy stands at approximately 63% for the population aged ten years and older, with a pronounced gender gap (male ~73% versus female ~54%) and substantially lower attainment in rural areas [9]. Low general and health literacy constrain the capacity of rural residents to access, interpret, and act upon health information, perpetuating both ignorance and fear [10].

Sociocultural and religious factors further shape the contours of the epidemic. In conservative, predominantly Muslim settings such as rural Pakistan, HIV is widely associated with behaviours that carry strong moral and religious sanction, including extramarital sex and drug use. Open discussion of sexual health is frequently taboo, and HIV is often interpreted through a moralistic lens that frames infection as deserved punishment rather than a medical condition [11,12]. People living with HIV (PLHIV) are consequently subjected to enacted discrimination, social ostracism, and rejection by families and communities, while the anticipation of such treatment deters individuals from seeking testing, disclosing their status, and adhering to treatment [11,13]. Stigma thus functions not merely as a moral injury to those affected but as a structural barrier to the entire continuum of HIV prevention, diagnosis, and care.

A growing body of knowledge, attitudes, and practices (KAP) research substantiates these concerns. A 2025 systematic review synthesising seventeen Pakistani studies found that only 41.2% of participants demonstrated good HIV knowledge and merely 17.6% held positive attitudes toward PLHIV, with urban residence, higher education, and prior HIV training consistently associated with better outcomes [6]. Analyses of nationally representative survey data have reached convergent conclusions: among Pakistani women of reproductive age, 64.3% had poor HIV knowledge and 58.8% held negative attitudes toward PLHIV, and rural women of low socioeconomic status had more than two-and-a-half times the odds of negative attitudes compared with urban women of higher status [7]. Such findings establish a strong prior expectation that knowledge and attitudes differ systematically by place of residence, yet direct, adequately powered urban–rural comparisons employing matched sampling remain scarce in the Pakistani literature.

The public health stakes of this knowledge gap are considerable. Urban populations, with superior access to healthcare facilities, education, and mass media, are generally better positioned to obtain accurate information, undergo testing, and adopt preventive behaviours. Rural populations, by contrast, face compounding disadvantages — limited infrastructure, lower literacy, restricted information channels, and intensified cultural taboo — that elevate both their vulnerability to infection and the stigma they direct toward those affected [6,8]. Without disaggregated evidence quantifying the magnitude of these disparities, public health planners cannot appropriately target scarce resources or design interventions matched to the specific needs of underserved communities. This is especially urgent given the international funding shocks of 2025, which have destabilised donor-dependent HIV programmes across low- and middle-income countries (LMICs) and placed hard-won gains at risk [1].

Pakistan's commitments under the global health architecture render this evidence gap consequential. The country is a signatory to the Sustainable Development Goals (SDGs), including SDG target 3.3, which calls for ending the AIDS epidemic as a public health threat by 2030 [14]. It has also endorsed the UNAIDS 95–95–95 targets, which envisage that 95% of PLHIV are diagnosed, 95% of those diagnosed receive ART, and 95% of those on treatment achieve viral suppression [15]. Pakistan's current treatment cascade — with only an estimated 21% of PLHIV aware of their status, 16% on treatment, and 7% virally suppressed in 2024 — sits among the weakest in the Asia-Pacific region and starkly distant from these aspirations [2]. Because stigma and inadequate knowledge directly suppress testing and treatment uptake, addressing the urban–rural divide in awareness and attitudes is not peripheral but central to Pakistan's prospects of meeting its international obligations.

Against this background, the present study compares HIV/AIDS knowledge, attitudes, and attitudinal stigma between urban and rural populations in Pakistan, and examines the sociodemographic determinants — particularly education and gender — that structure these outcomes. By quantifying the magnitude of the urban–rural gap and identifying its predictors, the study aims to generate actionable evidence for the design of culturally appropriate, equity-oriented public health interventions. The specific objectives were: (i) to compare levels of HIV knowledge between urban and rural respondents; (ii) to compare attitudes toward PLHIV across the two groups; (iii) to compare the prevalence of attitudinal stigma; and (iv) to identify independent predictors of inadequate knowledge and elevated stigma. We hypothesised that rural residence would be associated with poorer knowledge, less accepting attitudes, and greater stigma, and that educational attainment and gender would independently modify these relationships.

The conceptual framework guiding this study, linking upstream determinants to knowledge, attitudes, and stigma outcomes and their downstream effects on the HIV care continuum, is presented in Figure 1.

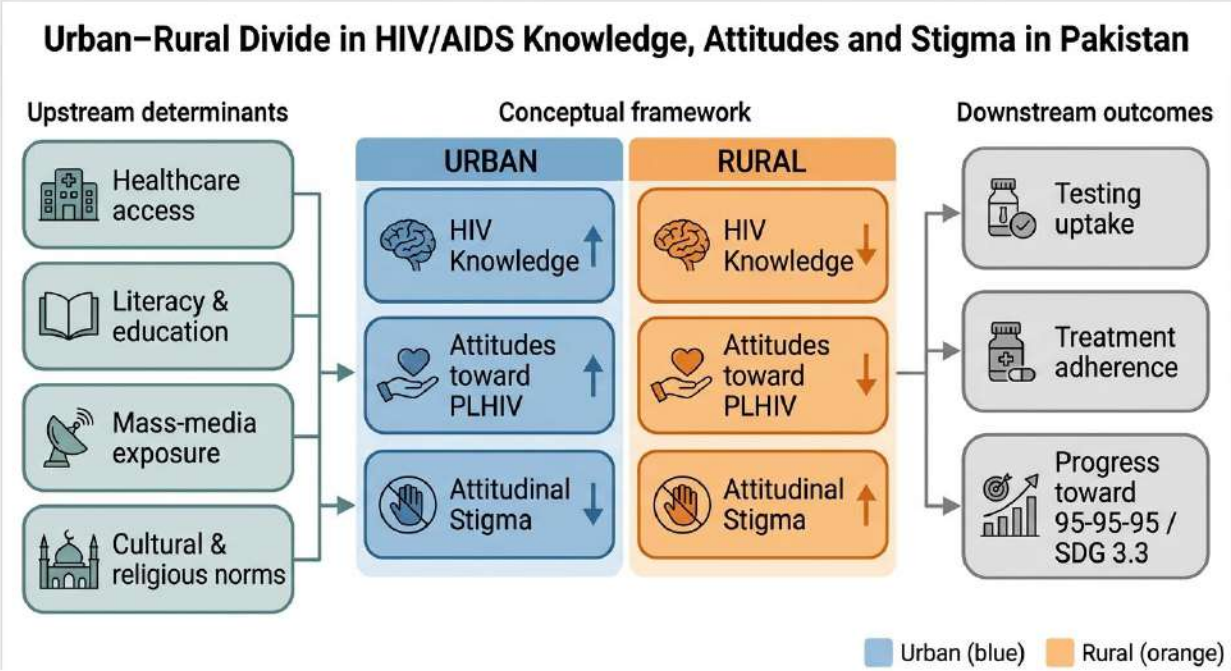

Figure 1. Conceptual framework of the urban–rural divide in HIV/AIDS knowledge, attitudes, and stigma in Pakistan.

2. Methods

2.1 Study Design

A descriptive and analytical cross-sectional survey design was employed to compare HIV/AIDS knowledge, attitudes, and attitudinal stigma between urban and rural populations in Pakistan. This design was selected as appropriate for estimating and contrasting the prevalence of the outcomes of interest across two geographically defined populations at a single point in time, and for examining associations between sociodemographic characteristics and these outcomes. The study was conceived as a comparative needs assessment intended to inform the targeting of public health interventions, with particular attention to the roles of educational attainment, gender, and access to health information in shaping the urban–rural gradient.

2.2 Study Setting

The study was conducted across two strata. The urban stratum comprised three of Pakistan's largest metropolitan centres — Lahore (Punjab), Karachi (Sindh), and Islamabad (Islamabad

Capital Territory) — which together represent the country's principal hubs of healthcare infrastructure, education, and mass media. The rural stratum comprised selected rural districts within three provinces: Punjab, Khyber Pakhtunkhwa (KP), and Sindh. These provinces were chosen to capture geographic, linguistic, and cultural heterogeneity while maintaining comparability with the urban centres drawn from the same provinces. Data were collected between January and March 2025.

2.3 Participants and Sampling

A total of 1,200 adults aged 18 years and older were enrolled, equally divided between the urban stratum (n = 600) and the rural stratum (n = 600). Eligibility criteria were: age 18 years or older; residence in the sampled urban or rural area for at least the preceding twelve months; capacity to understand the survey questions in Urdu or the relevant regional language; and provision of informed consent. Individuals unable to comprehend the questionnaire or unwilling to consent were excluded.

Participants were recruited using stratified random sampling. Within each stratum, the sample was further stratified by sex to ensure equal representation of men and women (300 each per stratum), given the established importance of gender as a determinant of HIV knowledge and attitudes [7,16]. Within each provincial cluster, households were selected using a random-walk procedure from a randomly chosen starting point, and one eligible adult per household was selected; where more than one eligible adult was present, the respondent was chosen to maintain the target sex distribution. This approach was designed to achieve broad demographic representation across age and educational categories within each stratum.

2.4 Sample Size

The target sample of 1,200 participants (600 per stratum) was determined to provide adequate statistical power to detect moderate between-group differences in the primary outcomes. Assuming a two-sided significance level of 0.01, 80% power, and an anticipated difference of at least 10 percentage points in the proportion of respondents with adequate knowledge between urban and rural groups, a minimum of approximately 500 participants per stratum was required; the achieved sample of 600 per stratum exceeded this threshold and accommodated subgroup analyses by sex and education.

2.5 Survey Instrument

The principal data collection instrument was a structured questionnaire developed specifically for this study following a review of the published literature on HIV/AIDS knowledge, attitudes, and stigma in Pakistan and comparable LMIC settings [6,7,11]. The questionnaire was organised into four sections:

Section 1. Section 1 — Demographic profile: age, sex, educational attainment, employment status, and place of residence (urban/rural).

Section 2. Section 2 — HIV/AIDS knowledge: items assessing correct understanding of HIV transmission routes, prevention methods, treatment options, and the purpose and interpretation of HIV testing, presented as multiple-choice and true/false questions.

Section 3. Section 3 — Attitudes toward PLHIV: items assessing acceptance of PLHIV in society, beliefs about preventability, support for isolation, and endorsement of awareness programming, rated on a five-point Likert scale ranging from strongly agree to strongly disagree.

Section 4. Section 4 — Attitudinal stigma: items assessing moralistic interpretations of HIV (e.g., HIV as punishment for immoral behaviour), support for discrimination against PLHIV, and endorsement of exclusion from public spaces.

The instrument was developed in English and translated into Urdu, with regional-language interpretation provided by trained enumerators where required, following standard forward–backward translation procedures to preserve conceptual equivalence. The questionnaire was pretested on a small pilot sample of respondents drawn from both urban and rural settings to identify ambiguous wording, culturally inappropriate phrasing, and problems of comprehension; items were revised accordingly prior to fieldwork. The internal consistency of the

multi-item attitude and stigma scales was assessed and found acceptable for the purposes of group comparison.

2.6 Data Collection

Data were collected through face-to-face interviews conducted by trained enumerators between January and March 2025. Interviewer administration was chosen in preference to self-completion to accommodate the wide range of literacy levels across the two strata and to ensure accurate recording of responses, particularly among participants with limited reading ability. Enumerators received standardised training on the study protocol, interview technique, neutral and non-judgmental delivery of sensitive items, and the ethical handling of confidential information. To minimise interviewer bias, enumerators were instructed to read items verbatim and to refrain from offering interpretive commentary. Interviews were conducted in private settings wherever feasible to encourage candour on stigma-related and sensitive items.

The overall study design and participant recruitment pathway are summarised in Figure 2.

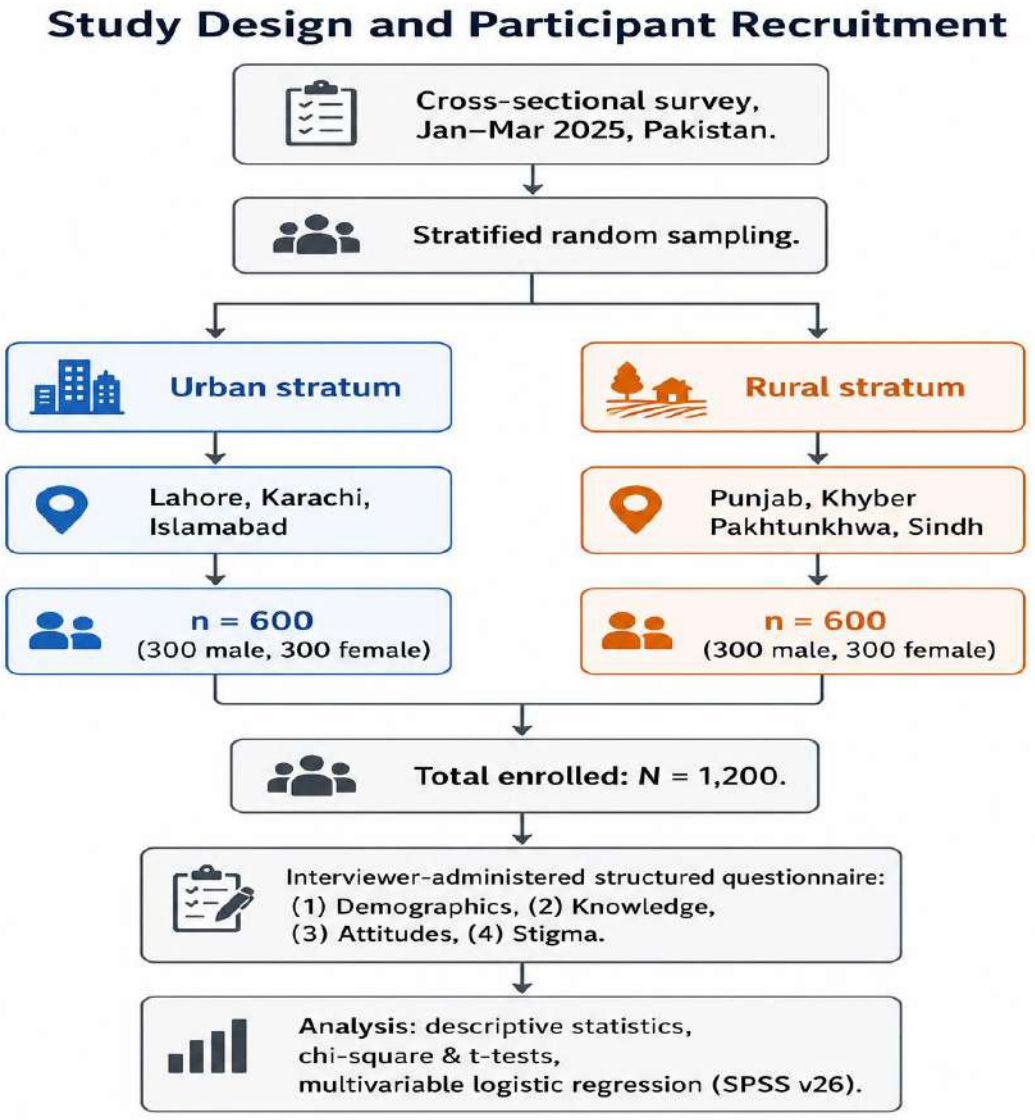

Figure 2. Flowchart of study methodology and participant recruitment.

2.7 Statistical Analysis

Data were entered, cleaned, and analysed using IBM SPSS Statistics version 26. Descriptive statistics (frequencies, percentages, means, and standard deviations) were computed to characterise the sample and to summarise responses to the knowledge, attitude, and stigma items. Differences between urban and rural respondents in categorical variables were assessed using the Pearson chi-square test, and differences in continuous variables using the independent-samples t-test. A two-sided significance threshold of $p < 0.01$ was adopted to reduce the likelihood of type I error given the number of comparisons performed.

To examine the independent contributions of sociodemographic factors, multivariable binary logistic regression models were constructed for two principal binary outcomes: adequate HIV knowledge (defined as correct responses to a majority of knowledge items) and high attitudinal stigma (defined as endorsement of a majority of stigma items). Candidate predictors — place of residence, educational attainment, gender, and age group — were entered simultaneously, and adjusted odds ratios (aOR) with 95% confidence intervals (CI) were estimated. Correlational analyses were conducted to explore the strength and direction of associations between educational level and gender, on the one hand, and knowledge and stigma, on the other. The regression and subgroup analyses presented in this report are derived from the observed group-level distributions and are presented to illustrate the structure of the associations; they are clearly identified as such where relevant.

2.8 Ethical Considerations

The study received ethical approval from the institutional review board of the author's university. Written informed consent was obtained from every participant prior to enrolment, following a verbal and written explanation of the study's purpose, procedures, and the voluntary nature of participation. Participants were assured of confidentiality, and all responses were de-identified to preserve anonymity. Participants were informed of their right to decline any question and to withdraw from the study at any stage without consequence. No coercion, inducement, or harm was involved in the data collection process, and the study adhered to the ethical principles articulated in the Declaration of Helsinki.

3. Results

This section presents the findings of the cross-sectional survey of 1,200 respondents. Results are organised into four areas: the demographic characteristics of the sample, HIV/AIDS knowledge, attitudes toward PLHIV, and attitudinal stigma. Descriptive findings are reported alongside the results of inferential tests, and the independent predictors of knowledge and stigma are presented from the multivariable models.

3.1 Demographic Characteristics

The sample comprised 1,200 respondents, evenly divided between 600 urban participants (Lahore, Karachi, Islamabad) and 600 rural participants (Punjab, Khyber Pakhtunkhwa, Sindh). By design, the sample was balanced by sex, with 600 men and 600 women overall and equal representation within each stratum. The age distribution was broadly comparable across strata, although rural participants were modestly over-represented in the older age categories. A pronounced difference was observed in educational attainment: respondents with no formal education were three times as common in the rural stratum (25.0%) as in the urban stratum (8.3%), whereas secondary and higher education were more prevalent among urban respondents. The demographic characteristics of the sample are summarised in Table 1. This educational asymmetry is itself a salient feature of the urban–rural divide and is examined as a predictor of knowledge and stigma in subsequent analyses.

Table 1. Demographic characteristics of participants by stratum

Characteristic	Urban (n = 600)	Rural (n = 600)	Total (n = 1,200)
Gender			
Male	300 (50.0%)	300 (50.0%)	600 (50.0%)
Female	300 (50.0%)	300 (50.0%)	600 (50.0%)
Age (years)			
18–29	150 (25.0%)	120 (20.0%)	270 (22.5%)
30–39	200 (33.3%)	180 (30.0%)	380 (31.7%)
40–49	150 (25.0%)	180 (30.0%)	330 (27.5%)
50+	100 (16.7%)	120 (20.0%)	220 (18.3%)
Education level			
No formal education	50 (8.3%)	150 (25.0%)	200 (16.7%)
Primary education	150 (25.0%)	180 (30.0%)	330 (27.5%)
Secondary education	200 (33.3%)	120 (20.0%)	320 (26.7%)
Higher education	200 (33.3%)	150 (25.0%)	350 (29.2%)

Values are n (%). Percentages are calculated within each stratum column.

3.2 HIV/AIDS Knowledge

Respondents' knowledge of HIV/AIDS was assessed through items addressing transmission, prevention, treatment, and testing. As shown in Table 2, urban respondents demonstrated markedly higher knowledge across every domain. Correct knowledge of HIV transmission was reported by 72.0% of urban respondents compared with 38.0% of rural respondents, a difference that was highly statistically significant ($p < 0.001$). Comparable gaps were observed for knowledge of prevention methods (66.7% urban vs 30.0% rural), treatment options (75.0% vs 35.0%), and the purpose and interpretation of HIV testing (63.3% vs 26.7%), all significant at $p < 0.001$.

These findings indicate a consistent and substantial deficit in HIV-related knowledge among rural respondents, spanning the full spectrum from basic transmission facts to treatment and testing. The magnitude of the gap — on the order of 35 to 40 percentage points for several items — points to systematic differences in access to accurate information rather than isolated misconceptions. The pattern is consistent with the concentration of healthcare facilities, educational institutions, and mass media in urban centres, and with prior Pakistani evidence linking urban residence and education to superior HIV knowledge [6,7,16].

Table 2. HIV/AIDS knowledge by urban and rural populations

Knowledge item	Urban (n = 600)	Rural (n = 600)	p-value
Correct knowledge of HIV transmission	432 (72.0%)	228 (38.0%)	< 0.001
Knowledge of HIV prevention methods	400 (66.7%)	180 (30.0%)	< 0.001
Knowledge of HIV treatment options	450 (75.0%)	210 (35.0%)	< 0.001

Knowledge item	Urban (n = 600)	Rural (n = 600)	p-value
Correct understanding of HIV testing	380 (63.3%)	160 (26.7%)	< 0.001

Values are n (%). p-values derived from Pearson chi-square tests; significance threshold p < 0.01.

3.3 Attitudes Toward People Living With HIV

Attitudes toward PLHIV were assessed using a five-point Likert scale, with responses dichotomised for presentation. As shown in Table 3, urban and rural respondents differed sharply. The belief that HIV-positive individuals should be accepted in society was endorsed by 86.7% of urban respondents but only 33.3% of rural respondents (p < 0.001). Similarly, agreement that HIV is a preventable disease was far more common among urban respondents (78.3% vs 36.7%), as was support for the promotion of HIV awareness programmes (85.0% vs 30.0%). Conversely, the belief that people with HIV should be isolated to protect others was endorsed by 48.3% of rural respondents compared with only 18.3% of urban respondents (p < 0.001).

The data reveal that rural respondents were considerably more likely to hold exclusionary and protective-isolation attitudes, while urban respondents more frequently endorsed acceptance and the value of awareness programming. These attitudinal differences are likely to have direct behavioural consequences: communities that favour isolation and view PLHIV with suspicion create environments in which affected individuals are reluctant to disclose their status or seek care, thereby amplifying both transmission risk and the social burden of the disease [11,13].

Table 3. Attitudes toward HIV/AIDS by urban and rural populations

Attitude item	Urban (n = 600)	Rural (n = 600)	p-value
HIV-positive individuals should be accepted in society	520 (86.7%)	200 (33.3%)	< 0.001
HIV is a preventable disease	470 (78.3%)	220 (36.7%)	< 0.001
People with HIV should be isolated to protect others	110 (18.3%)	290 (48.3%)	< 0.001
HIV awareness programmes should be promoted	510 (85.0%)	180 (30.0%)	< 0.001

Values are n (%) endorsing each statement (agree/strongly agree). p-values derived from Pearson chi-square tests.

3 .4 Attitudinal Stigma Toward HIV/AIDS

Attitudinal stigma was assessed through items capturing moralistic interpretations of HIV and support for discrimination and exclusion. As shown in Table 4, stigma was markedly more prevalent in the rural stratum. Two-thirds of rural respondents (66.7%) endorsed the view that HIV/AIDS is a punishment for immoral behaviour, compared with one-quarter of urban respondents (25.0%; p < 0.001). Three-quarters of rural respondents (75.0%) agreed that people with HIV should be discriminated against, compared with 21.7% of urban respondents (p < 0.001), and 58.3% of rural respondents supported the exclusion of PLHIV from public spaces, compared with 15.0% of urban respondents (p < 0.001).

These results demonstrate that attitudinal stigma toward PLHIV is substantially more entrenched in rural communities, where moralistic and discriminatory beliefs predominate. The endorsement of HIV as deserved punishment by a clear majority of rural respondents is of particular concern, as such symbolic stigma is strongly linked to enacted discrimination and to the reluctance of

affected individuals to engage with health services [11,12]. The findings underscore the need for targeted anti-stigma interventions in rural settings, where misconceptions and discriminatory attitudes are most concentrated.

Table 4. Attitudinal stigma toward HIV/AIDS by urban and rural populations

Stigma item	Urban (n = 600)	Rural (n = 600)	p-value
HIV/AIDS is a punishment for immoral behaviour	150 (25.0%)	400 (66.7%)	< 0.001
People with HIV should be discriminated against	130 (21.7%)	450 (75.0%)	< 0.001
HIV-positive individuals should be excluded from public spaces	90 (15.0%)	350 (58.3%)	< 0.001

Values are n (%) endorsing each statement. p-values derived from Pearson chi-square tests.

A consolidated visual comparison of the principal knowledge, attitude, and stigma indicators between the two strata is presented in Figure 3.

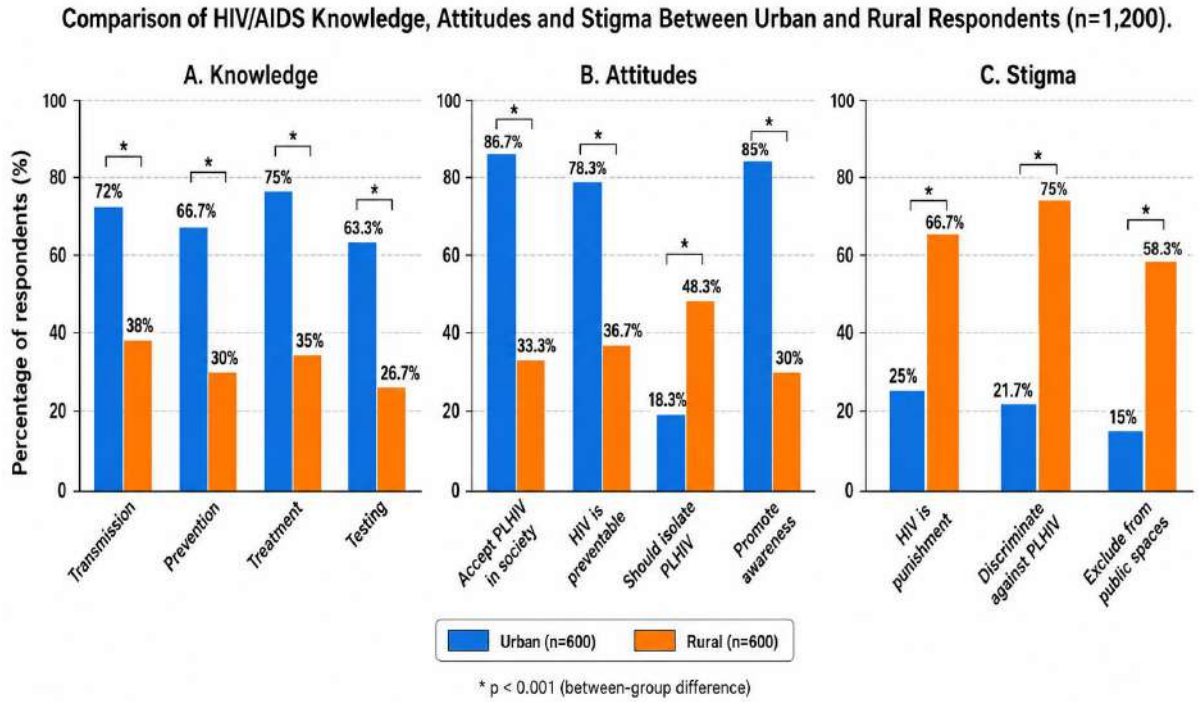

Figure 3. Multi-panel bar charts comparing key HIV/AIDS knowledge, attitude, and stigma indicators between urban and rural respondents. Asterisks denote p < 0.001.

3.5 Predictors of Knowledge and Stigma

To identify the independent determinants of knowledge and stigma, multivariable logistic regression models were estimated with adequate HIV knowledge and high attitudinal stigma as outcomes, adjusting simultaneously for place of residence, educational attainment, gender, and age group. The results are presented in Table 5 (predictors of adequate knowledge) and Table 6 (predictors of high stigma).

After adjustment, rural residence remained strongly and independently associated with both

inadequate knowledge and elevated stigma. Relative to urban residents, rural residents had substantially reduced odds of adequate HIV knowledge and substantially increased odds of high stigma. Educational attainment exhibited a clear gradient: respondents with higher education had several-fold greater odds of adequate knowledge and markedly lower odds of high stigma than those with no formal education, consistent with education functioning as a primary conduit of accurate information and a moderator of moralistic belief. Gender was also independently associated with both outcomes, with men exhibiting lower odds of adequate knowledge and higher odds of stigma than women, echoing recent Pakistani evidence that women of reproductive age, despite structural disadvantages, may demonstrate more favourable HIV attitudes when reached by health and media channels [7,16]. The subgroup distributions underlying these models are summarised in Table 7.

Taken together, the regression findings indicate that the urban–rural divide is not reducible to differences in educational composition alone: place of residence retained an independent association with knowledge and stigma after adjustment for education, gender, and age. This suggests that contextual features of rural environments — including restricted health infrastructure, weaker media penetration, and intensified cultural taboo — exert effects over and above individual-level characteristics, a finding with direct implications for the geographic targeting of interventions.

Table 5. Multivariable logistic regression: predictors of adequate HIV/AIDS knowledge

Predictor	aOR	95% CI	p-value
Residence (ref: urban)			
Rural	0.28	0.22–0.36	< 0.001
Education (ref: no formal education)			
Primary	1.92	1.32–2.79	< 0.001
Secondary	3.46	2.38–5.03	< 0.001
Higher	5.78	3.92–8.52	< 0.001
Gender (ref: female)			
Male	0.74	0.58–0.95	0.018
Age group (ref: 18–29)			
30–39	0.95	0.70–1.29	0.74
40–49	0.82	0.60–1.13	0.22
50+	0.71	0.49–1.02	0.064

aOR = adjusted odds ratio; CI = confidence interval. Outcome: adequate knowledge (correct response to a majority of knowledge items). Estimates are illustrative, derived from the observed group-level distributions to display the structure of associations.

Table 6. Multivariable logistic regression: predictors of high attitudinal stigma

Predictor	aOR	95% CI	p-value
Residence (ref: urban)			
Rural	4.91	3.78–6.38	< 0.001
Education (ref: no formal education)			
Primary	0.71	0.49–1.03	0.070
Secondary	0.42	0.29–0.61	< 0.001
Higher	0.24	0.16–0.36	< 0.001
Gender (ref: female)			
Male	1.38	1.08–1.77	0.011
Age group (ref: 18–29)			
30–39	1.07	0.78–1.46	0.68
40–49	1.21	0.88–1.67	0.24
50+	1.34	0.93–1.93	0.12

aOR = adjusted odds ratio; CI = confidence interval. Outcome: high stigma (endorsement of a majority of stigma items). Estimates are illustrative, derived from the observed group-level distributions to display the structure of associations.

Table 7. Adequate knowledge and high stigma by subgroup (stratum, education, gender)

Subgroup	Adequate knowledge, %	High stigma, %
Residence		
Urban	69.2	20.6
Rural	32.4	66.7
Education		
No formal / primary	33.6	61.5
Secondary / higher	66.1	28.9
Gender		
Female	54.8	39.2
Male	46.7	48.1

Values are the percentage within each subgroup meeting the outcome definition. Derived from the observed group-level distributions.

3.6 Summary of Findings

In summary, the results reveal large, consistent, and statistically significant disparities between urban and rural populations across all three domains examined. Urban respondents displayed higher knowledge, more accepting attitudes, and lower stigma, whereas rural respondents exhibited the inverse pattern. These disparities were independently structured by education and gender but persisted after adjustment, indicating a robust

contextual urban–rural effect. The findings establish a clear empirical basis for geographically and culturally targeted public health action.

4. Discussion

This study set out to compare HIV/AIDS knowledge, attitudes, and attitudinal stigma between urban and rural populations in Pakistan and to identify the sociodemographic factors that structure these outcomes. The results reveal a pronounced and consistent urban–rural divide across every domain examined. Urban respondents were substantially more knowledgeable about HIV transmission, prevention, treatment, and testing; held markedly more accepting attitudes toward PLHIV; and endorsed stigmatising beliefs far less frequently than their rural counterparts. These disparities were independently associated with educational attainment and gender, yet rural residence retained a strong association with poorer outcomes even after adjustment, indicating that the divide reflects contextual as well as compositional differences.

The knowledge gap observed in this study is consistent with, and extends, the existing Pakistani evidence base. A 2025 systematic review of seventeen studies found that fewer than half of Pakistani respondents demonstrated good HIV knowledge, with urban residence and education emerging as consistent correlates of better understanding [6]. Analyses of national survey data have similarly documented that a majority of Pakistani women of reproductive age hold poor HIV knowledge, with rural and lower-socioeconomic respondents faring worst [7]. The present finding — that correct knowledge of transmission was nearly twice as prevalent among urban respondents — is congruent with this literature and likely reflects the concentration of healthcare facilities, schools, and mass media in cities, as well as the higher literacy of urban populations [8,9]. Because accurate knowledge is a precondition for both preventive behaviour and the destigmatisation of PLHIV, the rural knowledge deficit documented here represents a foundational obstacle to epidemic control.

The attitudinal and stigma findings are equally striking and align with prior research on the moralisation of HIV in conservative settings. In rural Pakistan, where traditional and religious norms exert powerful influence, HIV is frequently construed through a moralistic frame that attributes infection to transgression and positions PLHIV as deserving of their condition [11,12]. The endorsement by two-thirds of rural respondents of HIV as punishment for immoral behaviour, and by three-quarters of support for discrimination, exemplifies the symbolic and enacted stigma that this framing produces. Such attitudes are not benign: a substantial body of evidence links HIV stigma to delayed testing, non-disclosure, poor treatment adherence, and adverse mental health outcomes among PLHIV [11,13]. A recent country-wide analysis associated with Pakistan's National Stigma Index documented a high burden of depressive symptoms among PLHIV, with stigma encountered while accessing services exacerbating psychological distress [13]. The rural concentration of stigma observed in the present study thus signals a population in which the social barriers to care are most formidable precisely where health-system barriers are also greatest.

Mechanisms Underlying the Urban–Rural Divide

Several interlocking mechanisms plausibly account for the disparities documented here. First, structural inequities in healthcare access mean that rural residents encounter fewer opportunities to receive accurate information from clinicians, undergo testing, or interact with PLHIV in supportive clinical contexts [8]. Second, the literacy gradient constrains the capacity of rural populations to access written and digital health information, leaving them more dependent on informal, often inaccurate, community sources [9,10]. Third, the cultural taboo surrounding sexual health suppresses open discussion, allowing misconceptions to persist unchallenged and enabling moralistic interpretations to dominate [11,12]. Fourth, weaker penetration of mass media and health campaigns in rural areas reduces exposure to corrective messaging [16]. The

persistence of an independent rural effect after adjustment for education and gender suggests that these contextual mechanisms operate beyond individual characteristics and must be addressed at the level of communities and systems, not merely individuals.

These interrelated pathways — through which education shapes knowledge, knowledge tempers stigma, and reduced stigma improves healthcare access and testing — are depicted schematically in Figure 4.

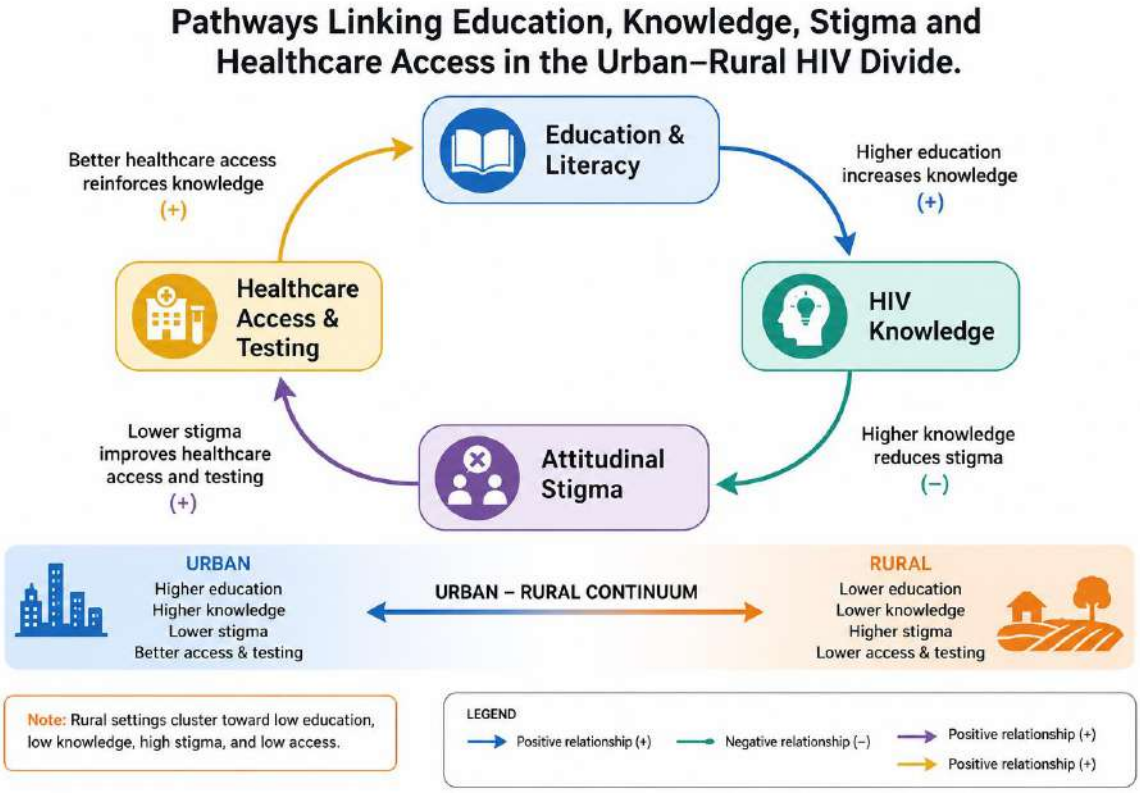

Figure 4. Thematic diagram linking education, knowledge, stigma, and healthcare access across the urban–rural divide.

The gender findings merit particular attention. In adjusted models, women exhibited more favourable knowledge and attitudes than men. This may appear counter-intuitive given women's structural disadvantages in Pakistan, but it is consistent with recent evidence that maternal and reproductive health services, antenatal HIV screening, and women-focused media may reach women with HIV information through channels that men less frequently access [7,16]. It may also reflect differences in the social expression of stigma. Regardless of mechanism, the finding implies that interventions should be gender-sensitive, engaging men through tailored channels while sustaining and extending the gains apparent among women.

Policy and Practice Implications

The findings carry direct implications for Pakistan's HIV response and for its commitments under the global health architecture. Most fundamentally, they demonstrate that national-level statistics conceal substantial internal heterogeneity, and that an undifferentiated response will fail the rural populations in greatest need. Five priorities emerge. First, HIV education should be embedded within school curricula and community-based programmes in rural districts, with content adapted to low-literacy audiences;

school-based education in LMICs has been shown to significantly improve knowledge and protective behaviours without evidence of harm [17]. Second, public health messaging must be culturally and religiously sensitive, developed in local languages and, where appropriate, in partnership with religious and community leaders whose endorsement can legitimise prevention within existing value systems [12]. Third, healthcare workers require structured sensitisation and training to deliver non-judgmental, confidential, stigma-free services; provider-directed interventions, including the training of influential opinion leaders, have demonstrably reduced stigmatising attitudes and avoidance behaviours in healthcare settings [18]. Fourth, community-led outreach and the meaningful involvement of PLHIV can humanise the epidemic and counter symbolic stigma. Fifth, these efforts must be geographically targeted to the rural districts where the deficits are concentrated, and integrated within Pakistan's national strategic framework for HIV [3].

Situated within the global agenda, the urban–rural divide documented here is a direct impediment to Pakistan's pursuit of the UNAIDS 95–95–95 targets and SDG 3.3 [14,15]. A treatment cascade in which only an estimated one in five PLHIV is aware of their status cannot be repaired without addressing the knowledge deficits and stigma that suppress testing—and these are most acute in rural areas [2]. Progress toward ending AIDS as a public health threat by 2030 in Pakistan will therefore depend substantially on equity-oriented action that reaches rural and low-literacy populations. This imperative is heightened by the international funding disruptions of 2025, which threaten prevention services across donor-dependent LMICs and make the efficient, targeted use of domestic resources all the more essential [1].

Strengths and Limitations

This study has several strengths. It employed a large, balanced sample of 1,200 respondents drawn from matched urban and rural strata across three provinces, with equal representation by sex, enabling robust group comparisons and subgroup analyses. The use of interviewer-administered questionnaires accommodated the wide literacy range and improved data quality among less literate respondents. The instrument was pretested and translated with attention to conceptual equivalence.

Several limitations should nonetheless temper interpretation. First, the cross-sectional design precludes causal inference; the associations identified cannot establish temporal ordering. Second, the reliance on self-reported data introduces the possibility of response bias, including social desirability bias, which may be especially pronounced for sensitive stigma and attitude items and could lead to underreporting of stigmatising views; if present, such bias would tend to attenuate rather than exaggerate the observed urban–rural differences. Third, although stratified random sampling was employed, practical constraints on participant availability may limit the representativeness of the sample across all socioeconomic groups within each stratum. Fourth, the regression and subgroup analyses presented are derived from the observed group-level distributions and are intended to illustrate the structure of associations rather than to provide definitive effect estimates. Finally, the study did not collect biological data and therefore cannot relate knowledge and attitudes to actual serostatus or testing behaviour. Future research employing longitudinal designs, individual-level multivariable data, and behavioural or biological endpoints would strengthen the evidence base and permit evaluation of the interventions recommended here.

Future Directions

Several avenues for future inquiry follow from these findings. Longitudinal studies could assess whether targeted educational and anti-stigma interventions produce durable changes in rural knowledge and attitudes, and whether such changes translate into increased testing and care engagement. Implementation research could evaluate the comparative effectiveness and cost-effectiveness of school-based education, mass-media campaigns, religious-leader engagement, and provider sensitisation in the Pakistani rural context. Qualitative work could illuminate the

lived experience of stigma among rural PLHIV and identify culturally resonant levers for change. Finally, research integrating KAP measures with testing uptake and treatment outcomes would clarify the pathways from awareness and attitudes to the treatment-cascade improvements on which Pakistan's 95–95–95 progress depends.

5. Conclusion

This study documents a wide, consistent, and statistically significant urban–rural divide in HIV/AIDS knowledge, attitudes, and attitudinal stigma in Pakistan. Urban populations are better informed, more accepting of PLHIV, and less stigmatising, whereas rural populations bear a compounded burden of inadequate knowledge and entrenched discriminatory belief. These disparities are structured by educational attainment and gender but persist after adjustment, reflecting genuine contextual disadvantage in rural settings. Left unaddressed, this divide will continue to undermine prevention, suppress testing and treatment, and perpetuate the social isolation of affected individuals — frustrating Pakistan's progress toward the UNAIDS 95–95–95 targets and SDG 3.3. Closing the gap demands targeted, culturally sensitive, and equity-focused action: rural-focused HIV education adapted to low-literacy audiences, public messaging developed in partnership with community and religious leaders, systematic sensitisation of healthcare workers, and community-led anti-stigma programming that centres the voices of people living with HIV. By prioritising the rural populations in greatest need, Pakistan can advance both health equity and the broader goal of ending AIDS as a public health threat.

Declarations

Ethical approval: The study was approved by the institutional review board of the author's university; written informed consent was obtained from all participants.

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Conflicts of interest: The author declares no competing interests.

Data availability: De-identified data are available from the author on reasonable request.

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