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Confirmed Type 2 Diabetes Prevalence, Missed Diagnoses, and Adiposity-Linked Risk Among Adults in an Urban Settlement of Lower Dir, Pakistan.

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Abstract

Background: Pakistan carries a high diabetes burden, but national estimates cannot be assumed to represent individual settlements. Community-based surveys can capture both previously known and newly confirmed disease while also identifying gaps in diagnosis, referral, and care. In Lower Dir, published settlement-specific data remain scarce. ***Objective*:** To propose a probability-sampled survey estimating confirmed type 2 diabetes prevalence among adults aged 25–65 years in a defined urban settlement of Lower Dir and to assess demographic, anthropometric, and socioeconomic correlates. ***Methods:*** The intended design is a community-based cross-sectional survey using household sampling, standardised interviews, anthropometry, fasting venous plasma glucose, and confirmatory testing when required. The planning assumptions were: assumed prevalence 15%, Z = 1.96, absolute precision 0.05, calculated n = 196, design effect 2.0, and 10% non-response allowance, giving an invitation target of 436. Fasting venous plasma glucose ≥126 mg/dL (7.0 mmol/L) was the diagnostic threshold, with a second abnormal result required for asymptomatic participants unless hyperglycaemia was unequivocal. Survey weighting, cluster-adjusted precision, and prevalence-ratio models were prespecified. The supplied figures are not field-verified. ***Results:*** The illustrative tabulation contained 436 invitations, 402 interviews (92.2%), 391 biochemical assessments (97.3%), and 384 records assigned a diabetes-status label (88.1%). Of these, 63/384 were labelled confirmed type 2 diabetes (16.4% unweighted), including 41/63 previously known (65.1%) and 22/63 newly identified (34.9%). In addition, 298/384 had no diabetes detected (77.6%), 14/384 were unresolved screen-positive cases (3.6%), and 9/384 had other or uncertain-type outcomes (2.3%). The source-reported weighted prevalence was 16.4% (95% CI 12.7–20.1%; margin ±4.7 percentage points), with 28 residential clusters, a design effect of 1.87, and an effective sample size of approximately 205. Referral figures were 19/22 newly identified cases referred, 16/22 reaching referral services, and 54/63 labelled cases with documented referral completion. Source-supplied adjusted prevalence ratios were: age per decade 1.47 (1.22–1.77); women versus men 1.18 (0.76–1.83); family history 1.94 (1.31–2.87); lowest versus highest assets 1.63 (1.04–2.55); middle versus highest assets 1.21 (0.74–1.98); low physical activity 1.52 (0.98–2.36); BMI ≥30 versus <25 2.41 (1.52–3.82); BMI 25–29.9 versus <25 1.38 (0.86–2.21); and elevated versus lower waist circumference 1.87 (1.18–2.96). ***Conclusion:*** The protocol is potentially feasible, but no actual Lower Dir prevalence or independent associations can be asserted from the supplied example. Ethical clearance, completed recruitment, adjudicated diabetes type, verified sampling weights, and reproducible participant-level analysis are prerequisites before publication as observed results.

Keywords: type 2 diabetes; Lower Dir; community survey; prevalence; probability sampling; study protocol analysis.

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INTRODUCTION

Diabetes is a major noncommunicable disease in Pakistan, contributing substantially to morbidity, premature mortality, and health-system costs. The 2025 IDF Diabetes Atlas reports national estimates for adults aged 20–79 years; these modelled national values must not be substituted for settlement-specific prevalence and should be interpreted cautiously because they are generated from pooled data rather than local measurement.[1] The second National Diabetes Survey of Pakistan provides a relevant national comparator, although its sampling and diagnostic methods differ from those of a single-settlement study.[2] The HbA1c-based DPS-PAK survey offers another national comparator, but differences in thresholds, sampling frames, and urban–rural composition limit direct comparison.[3] The proposed study targets adults aged

25–65 years residing in one selected urban settlement of Lower Dir, where published community-level data remain scarce. Facility-based records miss residents who have never been tested, while self-reported diagnosis alone misses undetected disease. Consequently, reliance on either source alone would underestimate true prevalence and bias associations. The 2026 American Diabetes Association standards accept validated glucose or HbA1c criteria and generally require confirmation in the absence of unequivocal hyperglycaemia.[4] Laboratory quality is crucial for valid classification. [5] The distinction between diabetes diagnosis and diabetes-type classification is also crucial, because misclassification can distort prevalence and aetiological inference. [6]

The primary objective is to estimate the prevalence of confirmed type 2 diabetes within a prespecified sampling frame and denominator. Secondary objectives are to describe variation by age, sex, family history, BMI, waist circumference, household assets, and physical activity, followed by adjusted association analyses only if real records permit. Age and sex will be treated as a priori covariates, while anthropometric and behavioural variables will be examined for descriptive patterns before any multivariable modelling. If sample size is insufficient for stable adjustment, analyses will remain descriptive and limitations will be stated explicitly. All instruments will be pretested and translated where needed to support valid measurement. Prevalence estimates should be accompanied by exact confidence intervals that reflect the sampling design. Subgroup analyses should be prespecified to reduce selective reporting. Transparent reporting of diagnostic accuracy is recommended, including indeterminate results.[7] Non-response and missingness should be reported so that selection bias can be assessed.[8] Where fasting glucose is used, participants without unequivocal hyperglycemia require a repeat confirmatory test.[9] Where HbA1c is used, assay standardization and local validation are essential before clinical or epidemiological interpretation.[10] The study will distinguish previously diagnosed diabetes from newly detected diabetes and will report the proportion of participants with incomplete or indeterminate data. Ethical approval and informed consent are required, and confidentiality must be maintained throughout data collection and analysis. Findings will be interpreted within the limits of the sampling frame and will not be generalized to all of Lower Dir or Pakistan. This design balances feasibility with diagnostic rigour and provides locally relevant evidence for planning, while acknowledging that modelled national estimates cannot replace settlement-specific measurement.

MATERIALS AND METHODS

This study is a community-based cross-sectional survey in a mapped urban settlement of Lower Dir, Khyber Pakhtunkhwa, Pakistan. Eligible residents would be aged 25–65 years and meet a documented residency criterion. Settlement boundaries, survey dates, exclusion criteria, response definitions, and household lists must be fixed before sampling. No study period or institutional approval number was supplied. The proposed design selects residential clusters with probability proportional to household count, followed by randomly selected households and one randomly selected eligible adult per household. Cluster IDs, inclusion probabilities, and non-response adjustments would be retained. With an assumed prevalence of 15%, Z = 1.96, and absolute precision of 0.05, $n = Z^2p(1–p)/d^2 \approx 196$. After a design effect of 2.0 and a 10% non-response allowance, the invitation target is ceiling(196 × 2 / 0.90) = 436 [7]. These are planning assumptions, not observed precision. The questionnaire would cover socio-demographic factors, assets, physical activity, tobacco use, first-degree family history, prior diagnosis, medicines, and access to care, informed by WHO STEPS [8]. Staff would use calibrated instruments for BMI (kg/m²), waist circumference, and blood pressure. BMI categories are specified as <25, 25.0–29.9, and ≥30.0 kg/m² for consistency with the supplied examples; these are not interchangeable with the lower Asian public-health action points [9].

A fasting venous plasma glucose level of ≥126 mg/dL (7.0 mmol/L) meets the fasting diagnostic threshold. Asymptomatic persons ordinarily require a second abnormal result; the protocol must prespecify the confirmatory assay, timing, test handling, and adjudication rules [4,5]. Previously known diabetes requires documentation of diagnosis or use of glucose-lowering treatment; a new diagnosis requires confirmed laboratory criteria. A diagnosis of diabetes does not, by itself, establish type 2 diabetes. Uncertain type and unresolved screen-positive outcomes remain separate until clinically evaluated [6]. The study will report recruitment, missing tests, unresolved classifications, and the correct population denominator. The primary estimate would use survey weights and design-based 95% confidence intervals, accounting for stratification and clustering [10]. Survey-weighted modified Poisson models with robust variance can estimate adjusted prevalence ratios for prespecified confounders if event counts and the sample design support stable estimation [11,12]. Model collinearity must be assessed, particularly for simultaneous BMI and waist circumference. Prespecified missingness analyses, sensitivity analyses, and a documented statistical script are required. Results reporting should follow STROBE [13]. Fieldwork would begin only after institutional ethics approval, written informed consent, secure data procedures, and a clinical referral pathway. The revised Declaration of Helsinki and CIOMS guidance provide ethical safeguards [14,15]. No approval, consent records, or actual laboratory files were provided with the manuscript.

RESULTS

The following tables retain the main quantities and coefficients present in the uploaded Word file so that the proposed reporting format can be inspected. No survey-weighted confidence interval, association, or recruitment number below has been authenticated against participant-level records. They MUST NOT be published as observed Lower Dir results.

Table 1. participant flow and diabetes-status tabulation

Stage / status	Count	Denominator	Percentage / interpretation
Invited	436	—	Planning/example count
Interviewed	402	436	92.2%
Biochemical assessments	391	402	97.3%
Records assigned one of four labels	384	436	88.1%
Confirmed type 2 diabetes label	63	384	16.4% (unweighted)
Previously known label	41	63	65.1% of 63
Newly identified label	22	63	34.9% of 63
Other/uncertain type	9	384	2.3%; requires case-level review
Unresolved screen-positive	14	384	3.6%; NOT confirmed negative
No diabetes detected	298	384	77.6%

Table 2. , demographic and exposure strata

Characteristic	Group	Cases / N	Source-reported weighted %*
Age	25–34 years	8/96	7.9
	35–44 years	15/104	13.6
	45–54 years	21/98	19.8
	55–65 years	19/86	28.4
Sex	Men	27/182	14.8
	Women	36/202	17.8
Family history	Yes	27/112	24.1
	No	36/272	12.3
Household assets	Lowest tertile	29/128	22.6
	Middle tertile	21/127	15.7
	Highest tertile	13/129	11.2
Physical activity	Low	34/174	20.3
	Moderate/high	29/210	12.1
BMI	<25	14/148	9.6
	25–29.9	25/156	15.9
	≥30	24/80	27.8
Waist circumference	Below threshold	21/196	10.8
	Above threshold	42/188	23.4

Table 3. Source-supplied, adjusted prevalence ratios

Predictor	Adjusted PR	95% CI
Age per decade	1.47	1.22–1.77
Women versus men	1.18	0.76–1.83
Family history yes	1.94	1.31–2.87
Lowest versus highest assets	1.63	1.04–2.55
Middle versus highest assets	1.21	0.74–1.98
Low physical activity	1.52	0.98–2.36
BMI ≥30 versus <25	2.41	1.52–3.82
BMI 25–29.9 versus <25	1.38	0.86–2.21
Elevated versus lower waist	1.87	1.18–2.96

Table 4. Referral process and survey metrics

Measure	Source figure
Newly identified cases referred	19/22
Newly identified cases who reached referral services	16/22
All labelled cases with documented referral completion	54/63

Residential clusters	28
Design effect	1.87
Effective sample size	≈205
Reported 95% CI for 16.4%	12.7–20.1%
Originally reported margin	±4.7 percentage points

DISCUSSION

The present findings align with the IDF 2025 estimate that diabetes affects 30.8% of Pakistani adults, yet this modelled national figure cannot replace settlement-specific measurement.[11] The second National Diabetes Survey reported a weighted national prevalence of 26.3%, with 19.2% known and 7.1% newly diagnosed, underscoring the substantial burden of undetected disease.[12] The HbA1c-based DPS-PAK survey reported a lower type 2 diabetes prevalence of 16.98%, a difference attributable to diagnostic method, sampling frame, and urban–rural composition.[13] These methodological differences mean that direct comparison with our single-settlement estimate should be made cautiously. The 2026 ADA standards require confirmatory testing in the absence of unequivocal hyperglycaemia, a requirement that strengthens diagnostic validity but may reduce observed prevalence if confirmation is incomplete. [14] HbA1c assay standardisation through NGSP and IFCC is essential for valid classification, as non-standardised assays can shift results across diagnostic thresholds. [15]

Our observed associations are consistent with prior Pakistani evidence. Waist circumference has been shown to outperform BMI and waist-to-hip ratio in predicting type 2 diabetes among Pakistani adults, suggesting that central adiposity is a particularly relevant marker in this population.[16] A positive family history was reported by 80.4% of diabetic participants in a recent Pakistani study, supporting the strong hereditary component observed in our descriptive analysis.[17] Low physical activity was associated with a 30–40% higher diabetes risk in a prior Pakistani study, reinforcing the importance of behavioural factors.[18]

Non-response and selection bias require careful consideration. High non-response rates can introduce selection bias and reduce statistical power, and residual biases may persist even after weighting adjustments.[19] Facility-based sampling would systematically miss residents who have never been tested, while self-reported diagnosis alone misses undetected disease.[20] Previous community studies in Pakistan have acknowledged that selection bias may lead to overestimation of prevalence, particularly when higher-risk individuals are more likely to participate.[21] Age and sex differences in prevalence are well documented, with higher prevalence typically observed in older age groups.[22] The findings should therefore be interpreted within the limits of the sampling frame and should not be generalised to all of Lower Dir or Pakistan. Future studies should incorporate random sampling, complete confirmatory testing, and standardised laboratory methods to generate robust local estimates. [23]

CONCLUSION

This revised manuscript provides a usable protocol and an internally annotated example of its future results section. It does not establish diabetes prevalence or associated factors in Lower Dir. Before conversion into an original-results article, the investigator must supply documented recruitment, laboratory confirmation, completed classifications, sampling weights, ethics approval and auditable participant-level analyses.

Authors' Contributions

O.U. – Conceptualization, Methodology, Writing – original draft.
T.H. – Supervision, Project administration, Writing – review & editing.
H.R. – Investigation, Resources.
I. A – Data curation, Validation.
J.A. – Formal analysis, Visualization.
F.N. – Methodology, Writing – review & editing.
All authors read and approved the final manuscript.

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