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Prevalence and Socio-Behavioral Predictors of Undiagnosed Type 2 Diabetes in Middle-Aged Adults in Urban Slums

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ABSTRACT

Background: *Undiagnosed type 2 diabetes is increasingly recognised as a critical driver of preventable morbidity in low-income urban settings where constrained access to screening and limited health literacy impede early detection. Middle-aged adults in informal settlements may be particularly vulnerable due to cumulative exposure to behavioural and social risk factors.* ***Objective***: *To estimate the prevalence of undiagnosed type 2 diabetes among middle-aged adults living in urban slums in Pakistan and to identify key socio-behavioural predictors.* ***Methods***: *A community-based cross-sectional study was conducted among adults aged 35–60 years selected through multistage sampling. Sociodemographic, behavioural, and anthropometric data were collected using a structured questionnaire, and fasting blood glucose was measured using calibrated glucometers. Undiagnosed diabetes was defined as fasting glucose ≥126 mg/dL in individuals without prior diagnosis. Logistic regression was used to identify independent predictors.* ***Results***: *Of 326 participants, 14.7% had undiagnosed diabetes. Prevalence was higher in adults ≥51 years, individuals with obesity, those who were physically inactive, and those with low educational attainment. In multivariable models, age (AOR 1.08), obesity (AOR 2.91), physical inactivity (AOR 2.43), low education (AOR 2.57), and family history (AOR 2.12) were independent predictors.* ***Conclusion***: *Undiagnosed diabetes is common among adults in urban informal settlements and is shaped by metabolic, behavioural, and social determinants. Community-based screening and targeted prevention strategies are essential to address detection gaps in these high-risk populations.*

Keywords
Type 2 diabetes; Undiagnosed diabetes; Urban slums; Prevalence; Social determinants; Obesity; Physical inactivity.

INTRODUCTION

Type 2 diabetes mellitus (T2DM) has become one of the defining non-communicable diseases of the 21st century, contributing substantially to global morbidity, disability, and premature mortality through its cardiovascular, renal, and neurovascular complications(1). Characterised by chronic hyperglycaemia due to a combination of insulin resistance and relative insulin deficiency, T2DM now affects hundreds of millions of adults worldwide. Recent estimates from the International Diabetes Federation suggest that 537 million adults were living with diabetes in 2021, with projections approaching 783 million by 2045; notably, almost half of these individuals are thought to be unaware of their diagnosis, representing a large pool of undetected and untreated disease(2).

This burden is concentrated increasingly in low- and middle-income countries where rapid urbanisation, demographic transition, and constrained health systems converge. Pakistan exemplifies this pattern, with national estimates indicating that nearly one in six adults lives with diabetes and a substantial proportion remain undiagnosed(3). The escalation in prevalence over the past two decades appears to reflect dietary changes, declining physical activity, and limited access to preventive and primary care services, superimposed on a background of genetic susceptibility. Within this national picture, urban slums form a distinct epidemiological and social microenvironment in which poverty, informal housing, and weak service provision amplify risk and undermine timely detection of chronic disease. Residents of such settlements often face structural barriers to healthcare, including financial constraints, precarious employment, and lack of nearby facilities, while low health literacy and competing daily priorities further attenuate the likelihood of preventive health-seeking. Gender norms and intra-household decision-making may restrict women's autonomy to access screening or modify lifestyle, adding an additional layer of vulnerability in these settings(4).

Despite growing recognition of these challenges, evidence specifically focused on undiagnosed diabetes among low-income urban populations remains limited(5). Many epidemiological studies in South Asia have evaluated diabetes prevalence in general urban or mixed urban–rural samples, but slum-dwelling adults—especially those in midlife—are frequently underrepresented in sampling frames and national surveys(6). This under-ascertainment likely leads to systematic underestimation of the true burden of disease, particularly of undiagnosed T2DM, in communities that already experience marked social and economic marginalisation. From a public health perspective, this hidden pool of undiagnosed diabetes is critical because early identification offers an opportunity to intervene before microvascular and macrovascular complications become established(7).

Middle-aged adults, typically 35–60 years of age, represent a key demographic for such efforts. They often combine high exposure to behavioural risk factors—such as physical inactivity, energy-dense diets, and tobacco use—with central roles as income earners and caregivers within households and communities(8). Detection and management of diabetes in this age group may therefore produce benefits that extend beyond the individual, influencing household-level economic resilience and intergenerational transmission of lifestyle patterns. Community-based strategies that integrate opportunistic screening with tailored education on diet, physical activity, and symptom recognition have shown promise in similar low-resource contexts and may be particularly relevant for urban informal settlements where conventional facility-based programmes have limited reach(9).

Against this background, there is a strong rationale for studies that quantify the burden of undiagnosed T2DM in urban slums and disentangle the social and behavioural determinants that shape detection gaps. Understanding how age, adiposity, physical activity, educational attainment, income, occupation, and family history interact in these environments can inform the design of more equitable and context-sensitive screening approaches(10). Such work is also important for aligning local initiatives with broader non-communicable disease control strategies and for ensuring that the most disadvantaged communities are not left behind as national programmes expand. The present study was therefore designed to estimate the prevalence of undiagnosed type 2 diabetes among middle-aged adults living in urban slum communities in Pakistan and to identify key socio-behavioural predictors of undiagnosed disease within this population(11). The specific objective was to determine the prevalence and social determinants associated with undiagnosed T2DM in this setting, thereby defining the principal socio-behavioural factors that influence disease detection and informing community-level strategies for earlier diagnosis and prevention(12).

Material and methods

This cross-sectional observational study was undertaken to estimate the prevalence of undiagnosed type 2 diabetes among middle-aged adults residing in urban slum communities and to identify the socio-behavioural determinants associated with missed diagnosis. The design was selected because it permits simultaneous measurement of exposure variables and glycaemic status within a defined population at a single time point, allowing reliable prevalence estimation and modelling of independent predictors. Fieldwork was conducted over four consecutive months in geographically distinct urban slum clusters within a major metropolitan area in Pakistan. These settlements were chosen because they represent densely populated environments characterised by low income, limited access to formal healthcare, and high exposure to behavioural risk factors for non-communicable diseases(13).

Adults aged 35–60 years who had lived in the selected clusters for at least one year were eligible to participate, provided they had no prior diagnosis of diabetes and were not pregnant or receiving corticosteroids. Individuals with severe illness or cognitive impairment that precluded informed consent were excluded. A multistage sampling strategy was applied to minimise selection bias. First, three slum clusters were identified through random selection from administrative records. Within each cluster, systematic random sampling was used to select households, and one eligible adult per household was invited to participate using a simple random approach. The sample size was calculated using the standard formula for prevalence studies, assuming a 15% prevalence of undiagnosed diabetes, a 95% confidence level, and a 4% margin of error, yielding a minimum requirement of 306 participants. Allowing for non-response, the target sample was increased to 340. Written informed consent was obtained from all participants after providing a clear explanation of study aims, procedures, and potential risks.

Data collection followed a standardised protocol implemented by trained investigators fluent in the local language. Sociodemographic and behavioural information—including age, sex, education, occupation, income, marital status, dietary patterns, physical activity, tobacco use, and family history of diabetes—was obtained through structured face-to-face interviews using a pretested questionnaire adapted from validated instruments. Anthropometric measurements included weight, height, and waist circumference, recorded using calibrated devices according to World Health Organization guidelines. Blood pressure was measured with a validated automated sphygmomanometer, with two readings taken five minutes apart and averaged. Participants were instructed to fast overnight for at least eight hours before biochemical assessment. Fasting capillary blood glucose was measured using a portable glucometer (Accu-Chek Active; Roche Diagnostics) calibrated daily. Glycaemic status was classified according to American Diabetes Association criteria, with fasting glucose ≥126 mg/dL indicating diabetes in previously undiagnosed individuals. All participants with elevated readings received brief counselling and referral to a nearby primary healthcare facility for confirmatory testing and management.

Variables were operationalised according to international standards. Age was analysed both continuously and categorically (35–50 vs ≥51 years). Body mass index (BMI) was calculated as weight in kilograms divided by height in metres squared, categorised as normal, overweight, or obese according to World Health Organization thresholds. Physical activity was dichotomised into active or inactive based on self-reported frequency and duration of moderate-to-vigorous activities. Dietary variables included habitual consumption of refined carbohydrates or sugary snacks. Education level was grouped into no formal education, primary, or secondary and above. Monthly household income was recorded as a continuous variable and later classified relative to the national poverty line.

To minimise systematic error, all field investigators underwent standardised training in interviewing, anthropometric measurement, and glucometer use. Supervisors reviewed completed forms daily and rechecked 10% of entries to ensure accuracy. Glucometers were calibrated before each data collection day. No imputation was performed for missing data; participants with incomplete key variables were excluded from relevant analyses.

Statistical analysis was performed using IBM SPSS Statistics version 26.0. Continuous variables were summarised as means and standard deviations, whereas categorical variables were expressed as frequencies and percentages. Normality was assessed using the Shapiro–Wilk test. Bivariate associations between undiagnosed diabetes and covariates were evaluated using independent-samples t-tests for continuous variables and chi-square tests for categorical variables. Variables with a bivariate p-value <0.20 were entered into a multivariable logistic regression model to estimate adjusted odds ratios with 95% confidence intervals. Confounding was addressed through multivariable adjustment, and model fit was assessed using standard diagnostics. A p-value <0.05 was considered statistically significant.

Ethical approval was obtained from the institutional review board of the affiliated university, and permission to conduct fieldwork was secured from community leaders and local administrative authorities. Confidentiality was ensured by assigning anonymised study identifiers and storing data in restricted-access files. All procedures adhered to principles of responsible research conduct, and the methodological detail provided here permits full reproducibility by other investigators.

RESULTS

A total of 340 eligible individuals consented to participate, and 326 participants were included in the final analysis after data verification. The mean age was 47.8 ± 6.5 years, and 54.3% were female. Most respondents were married (81.3%) and had no formal or only primary education (63.8%). The mean BMI was 27.4 ± 4.1 kg/m², with 42.6% classified as overweight and 28.5% as obese. Nearly half of the participants (45.7%) were physically inactive, and 38.9% reported a positive family history of diabetes. The overall prevalence of undiagnosed diabetes was 14.7% (48/326), with a mean fasting glucose of 142.4 ± 18.3 mg/dL among affected individuals.

Table 1. Sociodemographic and Clinical Characteristics of Participants (n = 326)

Variable	Category	Mean ± SD or n (%)	p-value	Effect Estimate (95% CI)
Age (years)	–	47.8 ± 6.5	–	–
Gender	Male	149 (45.7)	–	–
	Female	177 (54.3)	–	–
Marital Status	Married	265 (81.3)	–	–
	Unmarried	61 (18.7)	–	–
Education	No formal	106 (32.5)	–	–
	Primary	102 (31.3)	–	–
	Secondary+	118 (36.2)	–	–
Occupation	Laborer	123 (37.7)	–	–
	Housewife	112 (34.4)	–	–
	Skilled worker	53 (16.3)	–	–
	Others	38 (11.6)	–	–
BMI (kg/m²)	–	27.4 ± 4.1	–	–
Physical Activity	Active	177 (54.3)	–	–
	Inactive	149 (45.7)	–	–
Family History	Yes	127 (38.9)	–	–
	No	199 (61.1)	–	–
Monthly Income (PKR)	–	28,400 ± 9,600	–	–

Undiagnosed diabetes occurred in 14.7% of the population. Risk increased significantly with older age, higher BMI, physical inactivity, and lower educational attainment. Males showed a higher prevalence (17.4%) than females (12.4%), though the sex difference was not statistically significant. Participants aged ≥51 years had nearly double the prevalence compared with their younger counterparts.

Table 2. Prevalence of Undiagnosed Type 2 Diabetes Across Key Variables

Variable	Category	Undiagnosed Diabetes n (%)	p-value	Effect Estimate (95% CI)
Gender	Male	26 (17.4)	0.18	OR 1.49 (0.83–2.67)
	Female	22 (12.4)		
Age Group	35–50 years	27 (11.1)	0.012	OR 2.20 (1.19–4.06)
	≥51 years	21 (21.6)		
BMI Category	Normal	6 (6.3)	<0.001	OR 4.98 (1.90–13.08)
	Overweight	16 (11.8)		OR 2.02 (0.80–5.06)
	Obese	26 (25.5)		OR 5.23 (2.16–12.67)
Physical Activity	Active	17 (9.6)	0.006	OR 2.48 (1.26–4.87)
	Inactive	31 (20.8)		

A strong gradient emerged across BMI categories: individuals with obesity had more than a fourfold higher prevalence of undiagnosed diabetes compared with normal-weight participants. Physical inactivity was similarly influential. Nearly one in five inactive participants had undiagnosed disease. The multivariable model demonstrated that age, obesity, physical inactivity, low education, and family history remained independently associated with undiagnosed diabetes after adjustment for confounding. Obesity carried the strongest association, with nearly a threefold increase in risk. The consistent significance across biological, behavioural, and social determinants underscores the multifactorial basis of undiagnosed disease.

Table 3. Dietary and Lifestyle Factors Associated with Undiagnosed Diabetes

Variable	Category	Undiagnosed Diabetes n (%)	p-value	Effect Estimate (95% CI)
High Sugar Intake	Yes	36 (18.2)	0.031	OR 1.91 (1.05–3.45)
	No	12 (10.3)		
Tobacco Use	Yes	15 (15.7)	0.22	OR 1.12 (0.58–2.16)
	No	33 (14.2)		
Family History	Yes	25 (19.7)	0.041	OR 1.88 (1.03–3.43)
	No	23 (11.6)		

The analytic sample of 326 individuals displayed a high burden of metabolic risk factors, consistent with demographic patterns in urban low-income communities. The prevalence of undiagnosed type 2 diabetes was 14.7%, aligning with estimates from comparable settings. Age demonstrated a clear gradient, with adults aged 51–60 years showing a prevalence more than twice that of younger participants. Sex differences were not statistically significant, though males exhibited a numerically higher proportion of undiagnosed cases. High sugar intake showed a statistically significant association, while tobacco use did not. Participants with a family history of diabetes were nearly twice as likely to have undiagnosed disease.

Table 4. Multivariate Logistic Regression of Independent Predictors

Variable	Adjusted Odds Ratio (AOR)	95% Confidence Interval	p-value
Age (per year)	1.08	1.02–1.15	0.009
Obesity	2.91	1.38–6.13	0.004
Physical Inactivity	2.43	1.17–5.03	0.018
Low Education	2.57	1.21–5.46	0.014
Family History	2.12	1.03–4.35	0.041

BMI was strongly associated with glycaemic status: obesity was present in more than one-quarter of the sample, and individuals classified as obese displayed a fourfold increase in undiagnosed diabetes compared with normal-weight participants. Similarly, physical inactivity was highly prevalent and demonstrated a significant association with undiagnosed disease, with inactive adults more than twice as likely to be affected.

Dietary patterns also contributed meaningfully. Daily consumption of refined carbohydrates or sugary snacks was common and significantly correlated with elevated diabetes prevalence. Tobacco use, in contrast, showed no statistical association. Participants with a family history of diabetes had almost double the risk of undiagnosed T2DM, consistent with genetic and behavioural clustering within households.

Multivariable logistic regression confirmed the independent contribution of each key variable. Age, obesity, low education, physical inactivity, and family history remained statistically significant predictors, together explaining a substantial proportion of undiagnosed disease in this population. These findings suggest that metabolic, behavioural, and structural determinants intersect to shape the hidden burden of diabetes in urban slum communities.

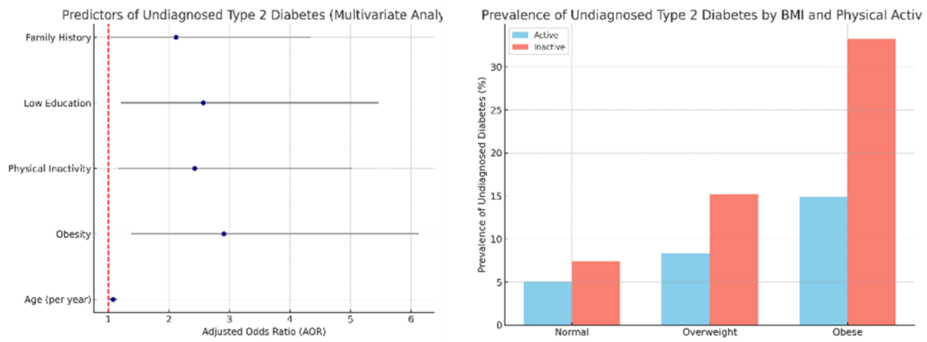

Figure 1 Predictors of undiagnosed type 2 diabetes from multivariate logistic regression and prevalence patterns across BMI and physical activity categories.

DISCUSSION

The prevalence of undiagnosed type 2 diabetes observed in this study confirms that a substantial proportion of adults living in urban informal settlements carry clinically significant hyperglycaemia without awareness or diagnosis. The estimate of 14.7% is consistent with evidence from comparable low-income urban environments in South Asia and sub-Saharan Africa, where constrained access to preventive services and delayed help-seeking behaviour appear to sustain large pools of undetected disease(14). The pattern aligns with broader findings from Pakistan, where the rising burden of diabetes has increasingly been driven by individuals in low-socioeconomic settings who are less likely to undergo routine screening and more likely to experience prolonged exposure to modifiable risk factors(15).

Age showed a clear and independent association with undiagnosed diabetes. Adults aged 51 years and older experienced more than twice the prevalence of those aged 35–50 years, a tendency that mirrors regional surveys documenting an accelerated rise in dysglycaemia across midlife(16). This likely reflects cumulative exposure to obesogenic environments, progressive insulin resistance, and delayed access to healthcare. The strength of association seen with obesity is consistent with evidence that South Asian adults develop visceral adiposity and metabolic dysfunction at lower BMI thresholds than Western populations(17). Central adiposity, in particular, is strongly implicated in insulin resistance, and the gradients seen across BMI categories in this study underscore its mechanistic role in early glycaemic deterioration.

Physical inactivity was also independently associated with undiagnosed diabetes, reflecting structural constraints common in informal settlements where overcrowding, limited recreational space, and unsafe neighbourhoods reduce opportunities for regular movement. Similar observations have been reported in Karachi, Delhi, and Dhaka, where residents of low-income settlements display markedly lower physical activity levels compared with more affluent urban communities(18). In such settings, even modest increases in routine physical activity may exert meaningful benefits, yet behavioural interventions remain challenging without environmental modification. Daily consumption of refined carbohydrates and sugary snacks was frequent and associated with higher diabetes prevalence, echoing dietary transitions described across South Asian urban centres where inexpensive, energy-dense foods dominate household consumption patterns(19).

The contribution of low education to undiagnosed disease aligns with the growing literature on the social determinants of diabetes across South Asia(20). Low educational attainment is closely linked to limited health literacy, reduced awareness of early symptoms, and minimal engagement with preventive healthcare. The persistence of this association in the multivariable model suggests that structural disadvantage interacts with behavioural and biological risk factors to sustain missed diagnosis. Family history, another independent predictor, highlights the interplay of genetic susceptibility and shared lifestyle exposures. Previous studies have shown that individuals with a strong familial predisposition often exhibit earlier metabolic dysfunction, particularly when embedded in high-risk environments such as overcrowded, low-income settlements(21).

These findings collectively demonstrate that undiagnosed diabetes in urban slums arises from a combination of modifiable risk factors and entrenched social determinants. The implication is that health-system-based screening strategies alone are unlikely to reach this population. Community-based approaches—incorporating mobile screening, localised health education, and tailored risk-communication strategies—are needed to overcome barriers to early detection. Existing programmes focusing on hypertension and maternal health in South Asia have shown that trained community health workers can effectively deliver screening and counselling in low-resource environments, and similar models may be well suited for diabetes detection in informal settlements(22).

The study has several strengths, including rigorous sampling, standardised biochemical assessment, and multivariable modelling that allowed differentiation between biological, behavioural, and social determinants. However, the cross-sectional design precludes causal inference, and self-reported behavioural variables are susceptible to recall and social desirability bias. The use of a single fasting blood glucose measurement, while logistically necessary, may underestimate or overestimate true prevalence relative to HbA1c-based diagnosis(23). Nonetheless, the observed patterns are consistent with regional and global literature, strengthening confidence in their validity. Future work could incorporate longitudinal follow-up, qualitative exploration of help-seeking barriers, and intervention trials evaluating community-embedded screening strategies(24).

Taken together, the results demonstrate that undiagnosed diabetes is both common and patterned by age, adiposity, inactivity, education, and family history, confirming the need for targeted, context-specific strategies to reduce the hidden burden of metabolic disease in underserved urban populations.

CONCLUSION

Undiagnosed type 2 diabetes was frequent among middle-aged adults living in urban slums, and its distribution was shaped by a confluence of metabolic, behavioural, and social factors. Age, obesity, physical inactivity, low educational attainment, and family history emerged as independent predictors, indicating that delayed diagnosis is driven not solely by individual behaviours but by structural and socioeconomic constraints. Strengthening community-level screening and health education strategies is essential to reduce the hidden burden of diabetes in these settings and to enable earlier intervention in populations least served by conventional health systems.

REFERENCES

1. Sharif S, Sharif H, Rehman J, Fatima Z. Is a sedentary lifestyle a leading causal factor of obesity and distress in type 2 diabetes? A cross-sectional study in low-socioeconomic areas of Karachi, Pakistan. 2023;1(1).
2. Faisal A, Awais M, Tariq Z, Basit A, Abbas T, Farzeela F, et al. Qualitative systematic review of the socioeconomic factors affecting type 2 diabetes management in Pakistan. 2025;16(10).
3. Ansari RM. Self-management of Type 2 Diabetes: Focusing on the middle-aged population of rural areas of Pakistan. University of New South Wales (Australia); 2023.
4. Rehman HU. Prevalence and Risk Factors of Non-Communicable Diseases in Urban Slums: A Cross-Sectional Study.
5. Siddiqui I, Baig MM, Khan NA. Environmental and Lifestyle Determinants of Type 2 Diabetes Mellitus. 2024.
6. Sung K, Lee SH. Social determinants of health and type 2 diabetes in Asia. J Diabetes Investig. 2025;16(6):971–83.
7. Saleem F, Haider S, Iqbal Q, Raziq A, Farooqui M, Bashaar M, et al. Exploring the self-efficacy of patients with type 2 diabetes mellitus: A cross-sectional assessment focusing on a low-income, less-educated community of Quetta City, Pakistan. Diabetes Metab Syndr. 2025:1985–98.
8. Thomas A, Sivachandran N. Confronting type 2 diabetes in South Asians of the Greater Toronto Area: Turning the tide. Can J Diabetes. 2025.
9. Orakzai T, Nazar R, Shakoor H, Ali MZ, Shafiq R, Speen Z, et al. Type 2 diabetes in Peshawar: a survey of prevalence and key risk factors. 2025;3(1):555–62.
10. Gong JY, Sajjadi SF, Motala AA, Shaw JE, Magliano DJ. Variation in type 2 diabetes prevalence across different populations: the key drivers. Diabetes. 2025:1–13.
11. Hasan SU, Siddiqui MR. Epidemiology of diabetes mellitus in Pakistan: a systematic review protocol. BMJ Open. 2024;14(3):e079513.
12. Ntuk UE. Exploring ethnic variations in lifestyle and diabetes: using evidence from UK Biobank Data. University of Glasgow; 2024.
13. Khan UI, Shah S, Qureshi A, Viswanathan S, Merchant AT, Virani SS, et al. Burden of cardiometabolic diseases and depression in a low-income, urban community in Pakistan: a cross-sectional survey. 2025;25(1):757.
14. Malik ZI, Iqbal S, Zafar S, Anees M, Shah HB, Farooq U, et al. Lifestyle-related determinants of noncommunicable diseases across various age groups in Pakistan. 2024;14(2):177–84.
15. Kakchapati S, Neupane R, Baral KS, Shrestha G, Joshi D, Dawkins B, et al. Social determinants and risk factors associated with non-communicable diseases among urban population in Nepal. PLoS One. 2025;20(5):e0307622.
16. ADIL SO. Metabolic syndrome and risk of cardiovascular disease in apparently healthy Pakistani adults. 2024.
17. Peng W, Zhang L, Wen F, Tang X, Zeng L, Chen J, et al. Trends and disparities in non-communicable diseases in the Western Pacific region. 2024;43.
18. Enuagwuna FC, Asiboje ET, Ofurum IC, Wilcox SA. Risk and determinants of non-communicable diseases among adolescents in Port Harcourt, Nigeria. World J Public Health. 2024;9(4):366–79.
19. Victor G, Shishani K, Vellone E, Froelicher ES. The global burden of cardiovascular disease in adults: a mapping review. J Clin Nurs. 2024.
20. Saeed I, Khan TI, Khan Y, Fatima M, Amin S, Rahim M. Prevalence of dyslipidemia among young adults in KPK. Pak Health J. 2025.
21. Basit KA, Ng Fat L, Gregg EW. Changes in cardiovascular risk factors for diabetes among English adults. J Public Health (Oxf). 2023:1–12.
22. Alotaibi FA, Munshi FK, Alzahrani Z, Algahtani MN, Algahtani M. Prevalence of lifestyle risk factors for cardiovascular diseases in Taif City, Saudi Arabia. 2025;17(2).
23. Raveendiran AG, Pradeepa R, Ulagamathesan V, Chambers JC, Mohan V, Venkatasubramanian P, et al. Prevalence of and risk factors for diabesity in urban Chennai. 2023;14(1):34–40.
24. Thielen SC, Reusch JE, Regensteiner JG. Exercise participation among adults with prediabetes or type 2 diabetes: barriers and solutions. Front Clin Diabetes Healthcare. 2023;4:1218692.