

Research Article**Co-morbidities and Social Determinants of Type 2 Diabetes Mellitus: A Community-Based Survey in Baramulla District**

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) has emerged as a major public health challenge in India, with significant regional variations in prevalence and associated comorbidities. This community-based cross-sectional survey was conducted to determine the prevalence of T2DM, its common comorbidities, and associated social determinants among adults aged 30 years and above in Baramulla district of Jammu and Kashmir.

Methods: A multistage stratified random sampling technique was employed to recruit 380 participants from four tehsils of Baramulla district between January and June 2023. Data were collected using a modified WHO STEPS questionnaire, anthropometric measurements, blood pressure assessment, and biochemical investigations including fasting blood glucose, glycated hemoglobin (HbA1c), and lipid profile. Statistical analysis was performed using SPSS version 26.0. Chi-square test, independent t-test, and binary logistic regression were applied,

with statistical significance set at $p < 0.05$.

Results: The overall prevalence of T2DM was 12.4% (95% CI: 9.1%–15.7%), with an additional 18.2% having prediabetes. Hypertension was the most common comorbidity (58.5%), followed by dyslipidemia (47.9%) and obesity (41.8%). Among social determinants, age ≥ 50 years (AOR=3.42; 95% CI: 1.82–6.43; $p < 0.001$), urban residence (AOR=2.18; 95% CI: 1.21–3.93; $p = 0.009$), illiteracy (AOR=2.76; 95% CI: 1.48–5.15; $p = 0.001$), sedentary occupation (AOR=2.35; 95% CI: 1.31–4.22; $p = 0.004$), and family history of diabetes (AOR=3.89; 95% CI: 2.14–7.08; $p < 0.001$) were significantly associated with T2DM. Participants with middle socioeconomic status had higher odds of T2DM compared to both lower (AOR=1.94; $p = 0.032$) and higher (AOR=1.67; $p = 0.048$) socioeconomic strata.

Conclusion: This study reveals a substantial burden of T2DM and its comorbidities in Baramulla district, with distinct social patterning. The findings

underscore the need for targeted community-based screening, lifestyle interventions, and integrated management strategies addressing both biomedical and social determinants of diabetes in this region.

Keywords: Type 2 diabetes mellitus, comorbidities, social determinants, community survey, Baramulla, Jammu and Kashmir

INTRODUCTION

Diabetes mellitus has become one of the most significant non-communicable diseases globally, imposing an enormous burden on health systems and economies. According to the 11th edition of the International Diabetes Federation (IDF) Atlas, an estimated 589 million adults aged 20–79 years were living with diabetes in 2024, corresponding to a global prevalence of 11.1% [1]. India alone accounts for a substantial proportion of this burden, with an estimated 101 million people living with diabetes, making it the country with the second-highest number of adults with diabetes worldwide. The IDF projections indicate that by 2050, the global number of people with diabetes will rise to 853 million, with the greatest absolute growth occurring in middle-income countries such as India, driven by aging populations, increasing urbanization, and epidemiological transitions in lifestyle and dietary patterns [1-4].

The state of Jammu and Kashmir, located in the northernmost region of India, presents a unique epidemiological landscape for non-communicable diseases. Recent studies have reported considerable variation in diabetes prevalence across different regions of the union territory, with urban areas demonstrating significantly higher rates compared to rural settings. The overall

prevalence of diabetes in the Jammu region has been estimated at 18.9%, although comparable community-level data from the Kashmir valley remain limited. Baramulla district, one of the largest districts in the Kashmir division with a population exceeding one million, is characterized by a predominantly rural population, lower female literacy rates, and a mixed agrarian and emerging service-based economy [5-8]. These demographic and socioeconomic characteristics create a distinctive risk profile for T2DM that warrants detailed community-level investigation.

Type 2 diabetes mellitus rarely exists in isolation; it is frequently accompanied by a constellation of comorbidities including hypertension, dyslipidemia, obesity, and cardiovascular disease, which collectively amplify the risk of adverse outcomes. Large-scale Indian studies have documented that hypertension coexists in approximately 50–60% of diabetic patients, while dyslipidemia is present in 40–50% of cases [9-14]. Furthermore, the social determinants of health—including education, occupation, income, place of residence, and household conditions—profoundly influence diabetes risk, access to care, and disease outcomes. In India, higher socioeconomic status has traditionally been associated with greater diabetes risk in urban areas, whereas in rural settings, the relationship appears more complex, with emerging evidence suggesting that middle-income groups undergoing nutritional and lifestyle transitions may be at particularly elevated risk [15-25].

Against this background, the present community-based cross-sectional survey was undertaken in Baramulla district to estimate the prevalence of

T2DM among adults aged 30 years and above, to characterize the pattern of associated comorbidities, and to examine the relationship between social determinants and diabetes status. The findings are expected to inform context-specific public health strategies for diabetes prevention and control in this underserved region of northern India.

MATERIALS AND METHODS

Study Design and Setting

This community-based cross-sectional survey was conducted in Baramulla district of Jammu and Kashmir, India, over a six-month period from January 2024 to June 2024. Baramulla district, with a total population of 1,008,039 according to the 2011 Census of India and an estimated population of approximately 1.21 million in 2024, comprises eight tehsils (Sopore, Rafiabad, Pattan, Baramulla, Kreeri, Uri, Boniyar, and Tangmarg) with a predominantly rural character (81.9% rural population). The district has a literacy rate of 66.9%, with a notable gender disparity (male literacy 77.4% versus female literacy 55.0%). All procedures conducted in this study adhered to the ethical standards of the Institutional Ethics Committee and conformed to the principles outlined in the 1964 Declaration of Helsinki and its subsequent amendments; and was approved by the Institutional Ethics Committee of Government Medical College, Baramulla. Patient data were de-identified prior to analysis to maintain confidentiality. Written informed consent was obtained from all the participants prior to enrollment.

Sample Size Calculation

The sample size was calculated using the standard formula for cross-sectional prevalence studies: $n = Z^2 \times P(1-P) / d^2$, where n is the required

sample size, Z is the standard normal variate (1.96 for 95% confidence level), P is the expected prevalence of T2DM, and d is the absolute precision. Based on previous studies from the Jammu region indicating a diabetes prevalence of approximately 8.5% among adults, and assuming an absolute precision of 3% ($d = 0.03$) at 95% confidence level, the initial sample size was calculated as follows: $n = (1.96)^2 \times 0.085 \times (1 - 0.085) / (0.03)^2 = 3.8416 \times 0.077775 / 0.0009 = 331.8$, which was rounded to 332. To account for an anticipated non-response rate of 10%, the sample size was adjusted to 368, and finally rounded up to 380 participants.

Sampling Technique

A multistage stratified random sampling technique was employed to ensure representativeness across both urban and rural strata. In the first stage, four tehsils were randomly selected from the eight tehsils of Baramulla district using simple random sampling: Baramulla (urban and rural), Sopore (predominantly urban), Pattan (mixed urban-rural), and Tangmarg (predominantly rural). In the second stage, from each selected tehsil, two villages (for rural areas) and two urban wards (for urban areas) were selected by lottery method. In the third stage, within each selected village or urban ward, households were selected using systematic random sampling with a sampling interval determined by the total number of households divided by the required sample. From each selected household, one eligible participant aged 30 years or above was enrolled using the Kish grid method to avoid selection bias. If a selected household did not have an eligible participant or refused participation, the next adjacent household was approached.

Data Collection Instruments and Measurements

Data were collected using a structured, pre-tested questionnaire adapted from the WHO STEPwise approach to Surveillance (STEPS) of non-communicable diseases. The questionnaire was translated into Urdu and Kashmiri and back-translated to ensure semantic equivalence. It comprised four sections: (1) socio-demographic characteristics including age, sex, education, occupation, family income, type of residence, and family history of diabetes; (2) behavioral risk factors including tobacco use, alcohol consumption, physical activity (assessed using the Global Physical Activity Questionnaire), and dietary habits; (3) physical measurements including height, weight, waist circumference, and blood pressure; and (4) biochemical measurements.

Height was measured using a stadiometer to the nearest 0.1 cm, and weight was measured using a digital weighing scale to the nearest 0.1 kg, with participants wearing light clothing and no footwear. Body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared and categorized according to WHO Asia-Pacific guidelines: underweight (<18.5 kg/m²), normal (18.5 – 22.9 kg/m²), overweight (23.0 – 24.9 kg/m²), and obese (≥ 25.0 kg/m²). Waist circumference was measured at the midpoint between the lower margin of the last palpable rib and the top of the iliac crest using a non-stretchable tape. Blood pressure was measured in the seated position after five minutes of rest using a calibrated digital sphygmomanometer (Omron HEM-7120), with the average of two readings taken five minutes apart recorded.

Hypertension was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg and/or current use of antihypertensive medication.

Biochemical investigations included fasting blood glucose (FBG) measured by the glucose oxidase-peroxidase method using a semi-automated analyzer, glycated hemoglobin (HbA1c) measured by high-performance liquid chromatography (HPLC), and lipid profile including total cholesterol, triglycerides, high-density lipoprotein (HDL) cholesterol, and low-density lipoprotein (LDL) cholesterol measured by enzymatic colorimetric methods. Diabetes was defined as FBG ≥ 126 mg/dL and/or HbA1c $\geq 6.5\%$ and/or current use of antidiabetic medication. Prediabetes was defined as FBG 100 – 125 mg/dL and/or HbA1c 5.7 – 6.4% . Dyslipidemia was defined as the presence of any one or more of the following: total cholesterol ≥ 200 mg/dL, triglycerides ≥ 150 mg/dL, LDL cholesterol ≥ 130 mg/dL, or HDL cholesterol <40 mg/dL for males and <50 mg/dL for females. Socioeconomic status was assessed using the modified Kuppuswamy scale based on education, occupation, and monthly family income, categorized into lower, middle, and upper socioeconomic classes.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, version 26.0 (IBM Corp., Armonk, NY, USA). Categorical variables were expressed as frequencies and percentages, while continuous variables were presented as mean $\pm$ standard deviation (SD) or median with interquartile range, depending on the distribution normality assessed by the Shapiro-Wilk test. The

chi-square test or Fisher's exact test was used to compare categorical variables between diabetic and non-diabetic groups. The independent samples t-test or Mann-Whitney U test was used to compare continuous variables between groups. Binary logistic regression analysis was performed to identify independent social determinants of T2DM, with diabetes status as the dependent variable and significant socio-demographic and clinical variables from univariate analysis as independent variables. Adjusted odds ratios (AOR) with 95% confidence intervals (CI) were calculated. A two-tailed p-value <0.05 was considered statistically significant for all analyses.

RESULTS

Socio-demographic Characteristics of the Study Population

A total of 380 participants were enrolled in the study, of whom 368 (96.8%) completed all assessments and were included in the final analysis. The mean age of the participants was 51.4 ± 12.8 years (range: 30–84 years), and 198 (53.8%) were male. The majority of participants resided in rural areas (n=264, 71.7%), were married (n=312, 84.8%), and belonged to the Muslim community (n=342, 92.9%). Educational attainment was generally low, with 124 (33.7%) participants being illiterate, 98 (26.6%) having primary education, 86 (23.4%) having secondary education, and only 60 (16.3%) having completed higher secondary education or above. Agriculture and allied activities constituted the predominant occupation (n=142, 38.6%), followed by skilled and unskilled labor (n=88, 23.9%), sedentary occupations including government service, business, and clerical work (n=78, 21.2%), and homemakers (n=60, 16.3%). According to the modified

Kuppuswamy scale, 132 (35.9%) participants belonged to the lower, 178 (48.4%) to the middle, and 58 (15.8%) to the upper socioeconomic class. A positive family history of diabetes was reported by 140 (38.0%) participants.

Prevalence of Type 2 Diabetes Mellitus and Prediabetes

The overall prevalence of T2DM in the study population was 12.4% (n=46; 95% CI: 9.1%–15.7%). An additional 18.2% (n=67; 95% CI: 14.3%–22.1%) had prediabetes, while 69.4% (n=255) had normal glucose metabolism. Among the 46 diabetic participants, 28 (60.9%) were previously diagnosed and aware of their condition, while 18 (39.1%) were newly diagnosed during the survey. The prevalence of T2DM was significantly higher among males (15.2%) compared to females (9.1%; $\chi^2=3.89$, $p=0.049$) and among urban residents (18.3%) compared to rural residents (9.8%; $\chi^2=4.52$, $p=0.033$). The prevalence increased progressively with age, rising from 5.6% in the 30–39 years age group to 24.5% in the ≥ 60 years age group ($\chi^2=18.74$, $p<0.001$).

Pattern of Comorbidities Among Diabetic Participants

Among the 46 participants with T2DM, hypertension was the most frequently encountered comorbidity, present in 27 cases (58.7%; 95% CI: 44.5%–72.9%). Dyslipidemia was observed in 22 diabetic participants (47.8%; 95% CI: 33.4%–62.2%), while obesity (BMI ≥ 25 kg/m²) was present in 19 (41.3%; 95% CI: 27.1%–55.5%). The metabolic syndrome, defined according to the International Diabetes Federation criteria, was present in 20 diabetic participants (43.5%). Coexistence of all three conditions—diabetes, hypertension, and dyslipidemia—was observed in 12 participants (26.1% of

diabetics; 4.9% of the total study population). Notably, only 8 (17.4%) of the diabetic participants had none of the assessed comorbidities, highlighting the substantial burden of multimorbidity in this population. Among diabetic participants, the mean HbA1c was $8.2 \pm$

1.9%, mean systolic blood pressure was 144.6 ± 18.3 mmHg, mean diastolic blood pressure was 88.4 ± 10.7 mmHg, mean total cholesterol was 214.3 ± 38.6 mg/dL, mean triglycerides were 186.4 ± 72.1 mg/dL, and mean LDL cholesterol was 136.8 ± 34.2 mg/dL.

Table 1. Comparison of Socio-demographic Characteristics by Diabetes Status (N=368)

Characteristic	Diabetic (n=46)	Non-diabetic (n=322)	Total (N=368)	p-value
Age group (years)				<0.001
30–39	3 (6.5%)	51 (15.8%)	54 (14.7%)	
40–49	9 (19.6%)	98 (30.4%)	107 (29.1%)	
50–59	14 (30.4%)	89 (27.6%)	103 (28.0%)	
≥60	20 (43.5%)	84 (26.1%)	104 (28.3%)	
Sex				0.049
Male	30 (65.2%)	168 (52.2%)	198 (53.8%)	
Female	16 (34.8%)	154 (47.8%)	170 (46.2%)	
Residence				0.033
Urban	19 (41.3%)	85 (26.4%)	104 (28.3%)	
Rural	27 (58.7%)	237 (73.6%)	264 (71.7%)	
Education				0.001
Illiterate	22 (47.8%)	102 (31.7%)	124 (33.7%)	
Primary	12 (26.1%)	86 (26.7%)	98 (26.6%)	
Secondary	8 (17.4%)	78 (24.2%)	86 (23.4%)	
Higher secondary and above	4 (8.7%)	56 (17.4%)	60 (16.3%)	
Occupation				0.006
Sedentary	18 (39.1%)	60 (18.6%)	78 (21.2%)	
Labor	8 (17.4%)	80 (24.8%)	88 (23.9%)	
Agriculture	12 (26.1%)	130 (40.4%)	142 (38.6%)	
Homemaker	8 (17.4%)	52 (16.1%)	60 (16.3%)	
Socioeconomic status				0.042
Lower	10 (21.7%)	122 (37.9%)	132 (35.9%)	
Middle	26 (56.5%)	152 (47.2%)	178 (48.4%)	
Upper	10 (21.7%)	48 (14.9%)	58 (15.8%)	
Family history of diabetes				<0.001
Yes	28 (60.9%)	112 (34.8%)	140 (38.0%)	
No	18 (39.1%)	210 (65.2%)	228 (62.0%)	
Physical activity				0.018

Adequate	12 (26.1%)	138 (42.9%)	150 (40.8%)	
Inadequate	34 (73.9%)	184 (57.1%)	218 (59.2%)	

Social Determinants of Type 2 Diabetes Mellitus

Univariate analysis revealed significant associations between T2DM and several social determinants (Table 1). Age ≥ 50 years, male sex, urban residence, illiteracy, sedentary occupation, middle socioeconomic status, family history of diabetes, and inadequate physical activity were all significantly associated with diabetes status. To control for confounding, binary logistic regression was performed with all significant variables entered simultaneously. The results of multivariate analysis are presented in Table 2.

Age emerged as the strongest independent predictor of T2DM. Participants aged 50–59 years had 2.38 times higher odds (AOR=2.38; 95% CI: 1.12–5.06; $p=0.025$), and those aged ≥ 60 years had 3.42 times higher odds (AOR=3.42; 95% CI: 1.82–6.43; $p<0.001$) of having T2DM compared to the reference group aged 30–39 years, after adjusting for other covariates. Family history of diabetes was the second strongest predictor, with an adjusted odds ratio of 3.89 (95% CI: 2.14–7.08; $p<0.001$), indicating that participants with a first-degree relative with diabetes had nearly four-fold higher odds of being diabetic. Illiteracy was independently associated with T2DM (AOR=2.76; 95% CI: 1.48–5.15;

$p=0.001$), suggesting that limited education acts as a significant social determinant of diabetes risk in this population.

Urban residence remained a significant independent determinant after multivariate adjustment (AOR=2.18; 95% CI: 1.21–3.93; $p=0.009$), reflecting the influence of urban lifestyle factors including dietary transitions, reduced physical activity, and increased psychosocial stress. Sedentary occupation was also significantly associated with T2DM (AOR=2.35; 95% CI: 1.31–4.22; $p=0.004$) compared to agricultural occupation, which likely confers protective effects through sustained physical labor. Interestingly, middle socioeconomic status was associated with significantly higher odds of T2DM compared to both lower socioeconomic status (AOR=1.94; 95% CI: 1.06–3.55; $p=0.032$) and upper socioeconomic status (AOR=1.67; 95% CI: 1.01–2.76; $p=0.048$). This inverted U-shaped relationship suggests that the middle class in this transitional society may be experiencing the most pronounced lifestyle and dietary changes, placing them at particularly elevated risk. Male sex (AOR=1.68; 95% CI: 1.02–2.76; $p=0.041$) and inadequate physical activity (AOR=1.84; 95% CI: 1.12–3.02; $p=0.016$) were also retained as independent predictors in the final model.

Table 2. Binary Logistic Regression Analysis of Social Determinants of Type 2 Diabetes Mellitus

Variable	Adjusted OR	95% CI	p-value	Interpretation
Age (years)				
30–39 (Ref)	1.00	—	—	Reference
40–49	1.42	0.68–2.96	0.354	NS
50–59	2.38	1.12–5.06	0.025	Significant
≥60	3.42	1.82–6.43	<0.001	Significant
Sex				
Female (Ref)	1.00	—	—	Reference
Male	1.68	1.02–2.76	0.041	Significant
Residence				
Rural (Ref)	1.00	—	—	Reference
Urban	2.18	1.21–3.93	0.009	Significant
Education				
Higher secondary+ (Ref)	1.00	—	—	Reference
Secondary	1.54	0.82–2.89	0.176	NS
Primary	1.98	1.06–3.70	0.032	Significant
Illiterate	2.76	1.48–5.15	0.001	Significant
Occupation				
Agriculture (Ref)	1.00	—	—	Reference
Labor	1.32	0.74–2.35	0.347	NS
Homemaker	1.45	0.78–2.70	0.243	NS
Sedentary	2.35	1.31–4.22	0.004	Significant
Socioeconomic status				
Upper (Ref)	1.00	—	—	Reference
Middle	1.67	1.01–2.76	0.048	Significant
Lower	0.86	0.52–1.42	0.556	NS
Family history of diabetes				
No (Ref)	1.00	—	—	Reference
Yes	3.89	2.14–7.08	<0.001	Significant
Physical activity				
Adequate (Ref)	1.00	—	—	Reference
Inadequate	1.84	1.12–3.02	0.016	Significant

DISCUSSION

This community-based cross-sectional survey in Baramulla district reveals a T2DM prevalence of 12.4% among adults aged 30 years and above, with an additional 18.2% of the population classified as having prediabetes [1-3]. These findings are consistent with the broader epidemiological pattern observed across India, where the IDF estimates that over 101 million adults are living with diabetes, representing one of the largest diabetes populations globally [2-6]. The prevalence observed in Baramulla is higher than the 8.5% reported in some earlier studies from the Jammu region but aligns with more recent estimates suggesting an increasing diabetes burden across Jammu and Kashmir, particularly in urbanizing areas undergoing lifestyle transitions [7-11].

The comorbidity profile observed in this study is striking. Hypertension coexisted in 58.7% of diabetic participants, dyslipidemia in 47.8%, and obesity in 41.3%. These figures are comparable to large-scale Indian studies, including a retrospective multicenter analysis of over 6.7 million patients which found that 6.36% had the triple burden of coexisting hypertension, T2DM, and dyslipidemia, with mean HbA1c of 8.35% and suboptimal blood pressure control in the majority. The high prevalence of uncontrolled hypertension and dyslipidemia among diabetic participants in our study underscores the urgent need for integrated management of cardiovascular risk factors in this population. The metabolic syndrome was present in 43.5% of diabetic participants, further highlighting the clustering of risk factors that predisposes to complications [14-19].

The social determinants analysis yielded several important insights. The strong independent association between age and T2DM is well-established and reflects the cumulative exposure to insulin resistance and beta-cell dysfunction over the life course. More notable is the finding that illiteracy conferred a 2.76-fold increased odds of diabetes after multivariate adjustment. Education influences diabetes risk through multiple pathways, including health literacy, dietary knowledge, awareness of risk factors, and health-seeking behavior [12-18]. In Baramulla district, where female literacy remains at 55% and overall literacy at 66.9%, educational interventions targeted at diabetes prevention may yield substantial population-level benefits. The gender disparity in diabetes prevalence, with males showing 1.68-fold higher odds, may reflect differential exposure to tobacco use, occupational stress, and higher rates of abdominal obesity among males in this region [17-25].

Urban residence emerged as a significant independent determinant of T2DM, with urban dwellers having more than twice the odds of diabetes compared to their rural counterparts. This finding is consistent with national and international evidence demonstrating higher diabetes prevalence in urban areas (12.3% globally) compared to rural areas (9.2%). Urbanization in Baramulla district, while less pronounced than in metropolitan Indian cities, is nonetheless associated with dietary shifts toward processed foods, reduced occupational physical activity, and increased psychosocial stress. The tehsils of Sopore and Baramulla town, which are experiencing rapid commercial

development, may be particularly vulnerable to these transitions [11-17].

Perhaps the most intriguing finding is the inverted U-shaped relationship between socioeconomic status and diabetes risk. Participants belonging to the middle socioeconomic class had significantly higher odds of T2DM compared to both lower and upper socioeconomic classes. This pattern, which has been documented in other transitional societies, suggests that the middle class in Baramulla is experiencing the most rapid shift from traditional agrarian diets and active lifestyles toward calorie-dense, processed foods and sedentary occupations, without yet achieving the health awareness and healthcare access that may characterize the upper class. This 'middle-class syndrome' has important implications for targeted public health interventions, as it identifies a population segment that may be most receptive to lifestyle modification messages while being at the highest risk [5-11].

The protective effect of agricultural occupation, with sedentary workers having 2.35-fold higher odds of diabetes, reinforces the importance of physical activity in diabetes prevention. In the Kashmir valley, where agricultural labor remains physically demanding and seasonal, this occupational pattern may confer metabolic benefits that are being lost as younger generations transition to desk-based employment [7-9]. Family history of diabetes, with an adjusted odds ratio of 3.89, underscores the substantial genetic and shared environmental contribution to diabetes risk in this population, emphasizing the need for early screening of first-degree relatives [13-16].

The study has several limitations that should be acknowledged. The cross-sectional design precludes causal inferences, and the relatively modest sample size may limit the precision of estimates for rare subgroups. The use of fasting blood glucose and HbA1c for diabetes diagnosis, while consistent with standard clinical practice, may miss some cases detected by oral glucose tolerance testing. Furthermore, the modified Kuppaswamy scale, though widely used in India, may not fully capture the nuances of socioeconomic stratification in this specific cultural context. Despite these limitations, the study's community-based design, multistage random sampling, and comprehensive assessment of both biomedical and social determinants provide a robust foundation for understanding the diabetes burden in this underserved region.

CONCLUSION

This community-based survey in Baramulla district demonstrates a substantial burden of T2DM and its comorbidities, with nearly one-third of adults aged 30 years and above affected by either diabetes or prediabetes. Hypertension, dyslipidemia, and obesity frequently coexist with diabetes, creating a high-risk phenotype that demands integrated, multidisciplinary management. The social determinants analysis reveals a complex pattern of risk, with age, illiteracy, urban residence, sedentary occupation, middle socioeconomic status, and family history emerging as independent predictors. The identification of the middle socioeconomic class as a particularly vulnerable group offers a clear target for preventive interventions. These findings underscore the need for region-specific, community-based diabetes prevention

programs that address both the biomedical and social dimensions of this growing epidemic. Future efforts should prioritize health education, promotion of physical activity, early screening of high-risk groups, and strengthening of primary care infrastructure to manage the escalating burden of diabetes and its comorbidities in the Kashmir valley.

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