

Original Article

Factors associated with diabetes mellitus among outpatients at the internal medicine clinic: A cross-sectional study

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Abstract

Background: Diabetes mellitus remains a major public health concern in Indonesia, including among patients receiving referral-level outpatient care. Understanding factors associated with diabetes status in hospital outpatient populations may inform targeted screening and health education.

Objective: To examine factors associated with diabetes mellitus among adult outpatients attending the Internal Medicine Clinic of Sungai Lilin General Hospital, Musi Banyuasin Regency, Indonesia, in 2026.

Methods: This analytical cross-sectional study included 99 purposively selected adult outpatients recruited between March 9 and April 9, 2026. The reported outpatient population in 2025 comprised 7,394 individuals. Diabetes status was obtained from medical records; sociodemographic, family-history, physical-activity, anthropometric, and dietary data were obtained from records and participant interviews. The Global Physical Activity Questionnaire and a food-frequency questionnaire were used. Data were analyzed using descriptive statistics, chi-square tests, and multivariable logistic regression.

Results: Of 99 respondents, 57 (57.6%) had diabetes mellitus. In bivariate analyses, age (crude odds ratio [OR] = 17.500; $p = 0.001$), lower educational attainment (OR = 4.600; $p = 0.001$), family history (OR = 29.179; $p < 0.001$), lower physical activity (OR = 2.750; $p = 0.027$), body mass index ≥ 23 kg/m² (OR = 3.403; $p = 0.022$), and dietary score category (OR = 0.198; $p < 0.001$) were associated with diabetes status; sex was not ($p = 0.239$). In the final multivariable model, family history (adjusted OR [aOR] = 37.221; 95% confidence interval [CI]: 9.064–152.844; $p < 0.001$) and lower educational attainment (aOR = 8.310; 95% CI: 2.043–33.810; $p = 0.003$) remained statistically significant. BMI was retained in the final model but did not reach statistical significance (aOR = 3.619; 95% CI: 0.865–15.138; $p = 0.078$).

Conclusion: Family history of diabetes and lower educational attainment were independently associated with diabetes status in the final model. These findings support risk-oriented outpatient education and screening.

Background

Diabetes mellitus is a major noncommunicable disease (NCD) and a global public health priority because of its contribution to morbidity and reduced quality of life. World Health Statistics 2025 notes that, despite improvements in some NCD mortality indicators, the absolute burden of premature NCD-related deaths remains substantial as populations grow and age. Diabetes also contributes to losses in healthy life expectancy (HALE) through long-term morbidity. Between 2000 and 2019, increasing diabetes-related morbidity among adults aged 30 years and older was estimated to have contributed to a loss of approximately 0.14 years of HALE globally, notwithstanding broader improvements in overall healthy life expectancy (WHO, 2025).

Indonesia has a substantial diabetes burden. According to the 11th edition of the International Diabetes Federation (IDF) Diabetes Atlas,

approximately 20.4 million people in Indonesia were estimated to be living with diabetes in 2024, placing the country fifth globally after China, India, the United States, and Pakistan (IDF, 2025). This burden calls for continued attention to diabetes prevention, early detection, and management.

Findings from the 2023 Indonesian Health Survey (Survei Kesehatan Indonesia [SKI]) reported higher proportions of type 2 than type 1 diabetes in both working-age and older populations (aged ≥ 60 years). The reported figures for type 2 diabetes were 52.1% among working-age respondents and 48.9% among older respondents, whereas the corresponding figures for type 1 diabetes were 15.5% and 17.8%. Approximately 30% of respondents in each age group reportedly did not know which type of diabetes they had. The survey also reported co-occurring physician-diagnosed hypertension and diabetes in 0.5% of the working-age population and 2.9% of older adults. These findings indicate the ongoing

importance of diabetes and its comorbidities, particularly in later life (Kemenkes, 2023).

Regional reports further indicate a considerable burden. According to South Sumatra in Figures 2025, diabetes was the third most frequently reported disease category in South Sumatra during 2022–2024, following hypertension and acute respiratory infections. Recorded diabetes cases increased from 435,512 in 2022 to 605,570 in 2023, before declining to 397,253 in 2024. These fluctuations underscore the continuing need for prevention and disease management at the health-service level (BPS, 2025; Dinkes Sumsel, 2024).

In Musi Banyuasin Regency, the reported number of people with diabetes was 38,976 in 2023, 38,921 in 2024, and 42,153 in 2025, according to local minimum service standard reports. The continued burden supports further investigation of factors associated with diabetes in local populations, including those attending Sungai Lilin General Hospital (Dinkes Muba, 2025).

Previous Indonesian studies have examined sociodemographic and behavioral correlates of diabetes. A cross-sectional investigation in Taman District, Madiun, considered education, knowledge, age, and family history in relation to type 2 diabetes prevention behavior. Using a self-administered online questionnaire, the study reported a significant association between family history and prevention behavior ($p = 0.048$) (Ramadhani et al., 2023). Another study at Tanah Sareal Community Health Center, Bogor, investigated family history, physical activity, and diet using questionnaire data and accidental sampling, reporting significant associations between family history and physical activity and diabetes mellitus (Irayani, 2024).

Medical-record reports from the Internal Medicine Clinic of Sungai Lilin General Hospital recorded 4,533 outpatient visits and 756 cases of type 2 diabetes in 2023, 6,073 visits and 960 cases in 2024, and 7,394 visits and 386 cases in 2025. Thus, clinic visits increased during this period, whereas recorded diabetes cases declined in 2025. The hospital report attributed part of this decline to changes in its information-system reporting, which emphasized primary diagnoses and did not consistently capture diabetes recorded as a comorbidity. Changes in case mix, referrals of stable patients to primary care, and improvements in service delivery were also noted as possible contributors. Despite changing reporting patterns, diabetes remained an important clinical concern (RSUD Sungai Lilin, 2026).

Earlier investigations have implicated obesity, hypertension, family history, and age in diabetes status. However, simultaneous evaluation of demographic characteristics, familial predisposition, anthropometric status, and health behaviors in a hospital outpatient population may provide a more comprehensive account of their associations. Previous studies have not fully resolved whether individual associations persist after adjustment for other covariates in the specific context of Sungai Lilin's internal medicine service.

The present study therefore considered seven candidate variables: age, sex, educational attainment, family history of diabetes, physical activity, body mass index (BMI), and dietary pattern. These variables span demographic, familial, anthropometric, and lifestyle domains. Multivariable analysis was used to examine associations with diabetes status while accounting for the other variables entered into the model and to compare the relative magnitude and precision of the resulting associations.

This study aimed to identify factors associated with diabetes mellitus among outpatients attending the Internal Medicine Clinic of Sungai Lilin General Hospital in Musi Banyuasin Regency. Its findings may help inform context-specific patient education, early detection, and risk-factor management strategies in outpatient services.

Methods

Study Design

This quantitative study used an analytical cross-sectional design to examine associations between potential risk factors (independent variables) and diabetes status (dependent variable) (Anggreni, 2022). Candidate factors comprised age, sex, education, family history of diabetes, physical activity, BMI ≥ 23 kg/m², and dietary pattern (Soelistijo et al., 2024). The design assesses associations at a single period and does not establish temporal or causal relationships.

Study population and sampling

The study population was defined as outpatients attending the Internal Medicine Clinic of Sungai Lilin General Hospital. The hospital reported 7,394 outpatients in 2025. Using Slovin's formula with a specified 10% margin of error, the authors calculated a sample size of 98.6, which was rounded to 99 participants. Participants were

recruited using purposive sampling from March 9 to April 9, 2026.

Eligibility criteria were attendance at the internal medicine outpatient clinic in 2026; age ≥ 18 years; availability of information on age, sex, education, family history, physical activity, BMI, and diet; and willingness to provide written informed consent. Patients were excluded if cognitive impairment or their clinical condition prevented participation in an interview, if relevant medical-record data were incomplete, or if they declined or withdrew consent.

Variables and measurement instruments

Primary information was obtained through respondent interviews using questionnaires, while secondary data were extracted from outpatient medical records. Diabetes status (diabetes versus no diabetes) was based on the diagnosis documented in the medical record. Age and sex were also obtained from medical records. The analysis grouped age as <35 versus ≥ 35 years, and sex as male or female. Educational attainment was determined by interview and classified as higher education (senior high school through university) or lower education (no formal schooling through junior high school). Family history was based on the respondent's report of diabetes among blood relatives and categorized as present or absent.

Physical activity was evaluated using the Global Physical Activity Questionnaire (GPAQ), including activity at work, during transport, and in recreation. The total metabolic equivalent of task (MET) score was calculated using the questionnaire's scoring approach. Participants were categorized as more active (score ≥ 640 , the sample median) or less active (score < 640). The threshold was sample-dependent rather than a clinical diagnostic cutoff (Adigüzel et al., 2021).

BMI was calculated as weight in kilograms divided by height in meters squared (kg/m^2) and categorized as <23 versus $\geq 23 \text{ kg}/\text{m}^2$. The authors selected the $23 \text{ kg}/\text{m}^2$ threshold with reference to expert consultation concerning metabolic risk in Asian populations, among whom metabolic risk may increase at BMI values lower than the conventional international overweight threshold of $25 \text{ kg}/\text{m}^2$. The selected cutoff was intended to identify a category with potentially increased

metabolic risk, not to establish a clinical diagnosis of obesity.

Dietary patterns were assessed by interview using a food-frequency questionnaire (FFQ) covering foods consumed and frequency of consumption. Based on the study's scoring system, respondents with a total FFQ score ≥ 302.48 (the sample mean) were classified as having a "healthy dietary pattern," whereas those with scores < 302.48 were classified as having an "unhealthy dietary pattern." The operational meaning of the summed FFQ score and these labels requires confirmation against the questionnaire scoring protocol.

Data collection

Respondents were interviewed regarding age, sex, educational attainment, diabetes in blood relatives, weight and height, physical activity, and dietary behavior, with medical records used to confirm documented variables. The GPAQ covered physical activity across the work, transport, and recreational domains and was administered by asking respondents to describe the activities they performed in daily life (Adigüzel et al., 2021). The FFQ was used to characterize the reported frequency and variety of food consumption.

Statistical analysis

The analysis comprised univariate descriptive statistics, bivariate chi-square tests, and multivariable binary logistic regression using SPSS for Windows. The dependent variable was diabetes status. The stated candidate-selection threshold for the multivariable analysis was $p < 0.25$ at the bivariate stage, supplemented by theoretical considerations. Model building involved a stepwise variable-removal process described in the Results section. The methods stated that multicollinearity was evaluated and, where relevant, linearity of continuous predictors with the logit was assessed. Crude odds ratios (ORs), adjusted odds ratios (aORs), 95% confidence intervals (CIs), and p-values were used to summarize associations and statistical uncertainty. As the study was cross-sectional, these estimates describe associations rather than causal effects.

Ethical considerations

The study was reported as being conducted in accordance with the ethical principles of autonomy, confidentiality, voluntary participation,

and protection from harm. Before data collection, eligible participants were informed about the purpose and procedures of the study, the information requested, and their right to refuse or withdraw without adverse consequences. Only individuals who provided written informed consent were included. Eligibility criteria were also intended to ensure that participants were able to complete the interviews safely. An ethics committee name, approval number, and approval date were not provided in the source manuscript.

Results

Table 1. Characteristics of study participants

Characteristic / category	n	%
Diabetes status		
No diabetes	42	42.4
Diabetes mellitus	57	57.6
Age		
<35 years	11	11.1
≥35 years	88	88.9
Sex		
Male	37	37.4
Female	62	62.6
Educational attainment		
Higher (senior high school–university)	33	33.3
Lower (no school–junior high school)	66	66.7
Family history of diabetes		
Absent	52	52.5
Present	47	47.5
Physical activity		
More active (MET score ≥640)	52	52.5
Less active (MET score <640)	47	47.5
Body mass index		
<23 kg/m ²	23	23.2
≥23 kg/m ²	76	76.8
FFQ-derived dietary classification		
Healthy (score ≥302.48)	57	57.6
Unhealthy (score <302.48)	42	42.4

Notes: MET, metabolic equivalent of task; FFQ, food-frequency questionnaire. Activity and dietary categories use sample-based thresholds as described in Methods.

Bivariate analysis indicated statistically significant associations between diabetes status and age, education, family history, physical activity, BMI, and FFQ-derived dietary classification, whereas sex was not significantly associated ($p = 0.239$). Diabetes was recorded in 56 of 88 respondents aged ≥35 years (63.6%), compared with 1 of 11 younger respondents (9.1%; OR = 17.500; 95% CI: 2.141–143.053; $p = 0.001$). The proportion with diabetes was 69.7% among respondents with lower education and 33.3% among those with higher education (OR = 4.600; 95% CI: 1.881–11.248; $p = 0.001$).

The study enrolled 99 internal medicine outpatients in 2026. Of these, 57 (57.6%) had documented diabetes mellitus and 42 (42.4%) did not. Most respondents were aged ≥35 years (88.9%), were women (62.6%), had lower educational attainment (66.7%), and had a BMI ≥23 kg/m² (76.8%). Family history of diabetes was reported by 47 participants (47.5%). Slightly more than half were in the more-active physical-activity category (52.5%) and in the higher-FFQ-score category labeled as a healthy dietary pattern (57.6%) (Table 1).

Diabetes was recorded in 43 of 47 respondents with a family history (91.5%) and 14 of 52 without a family history (26.9%), corresponding to an OR of 29.179 (95% CI: 8.843–96.278; $p < 0.001$). Among less-active respondents, 33 of 47 (70.2%) had diabetes, compared with 24 of 52 (46.2%) more-active participants (OR = 2.750; 95% CI: 1.200–6.303; $p = 0.027$). Among participants with BMI ≥23 kg/m², 49 of 76 (64.5%) had diabetes, compared with 8 of 23 (34.8%) in the lower-BMI group (OR = 3.403; 95% CI: 1.279–9.051; $p = 0.022$). Finally, diabetes was observed in 42 of 57 individuals (73.7%) classified as having a healthy

dietary pattern, compared with 15 of 42 (35.7%) classified as having an unhealthy dietary pattern (OR for the latter category relative to the former =

0.198; 95% CI: 0.084–0.471; $p < 0.001$). This counterintuitive finding warrants caution in the interpretation of the dietary measure (Table 2).

Table 2. Bivariate associations between participant characteristics and diabetes status

Variable / category	No diabetes n (%)	Diabetes n (%)	Total n (%)	p-value	Crude OR (95% CI)
Age					
<35 years	10 (90.9)	1 (9.1)	11 (11.1)	0.001	Reference
≥35 years	32 (36.4)	56 (63.6)	88 (88.9)		17.500 (2.141–143.053)
Sex					
Male	19 (51.4)	18 (48.6)	37 (37.4)	0.239	—
Female	23 (37.1)	39 (62.9)	62 (62.6)		—
Educational attainment					
Higher	22 (66.7)	11 (33.3)	33 (33.3)	0.001	Reference
Lower	20 (30.3)	46 (69.7)	66 (66.7)		4.600 (1.881–11.248)
Family history					
Absent	38 (73.1)	14 (26.9)	52 (52.5)	<0.001	Reference
Present	4 (8.5)	43 (91.5)	47 (47.5)		29.179 (8.843–96.278)
Physical activity					
More active (MET ≥640)	28 (53.8)	24 (46.2)	52 (52.5)	0.027	Reference
Less active (MET <640)	14 (29.8)	33 (70.2)	47 (47.5)		2.750 (1.200–6.303)
BMI					
<23 kg/m ²	15 (65.2)	8 (34.8)	23 (23.2)	0.022	Reference
≥23 kg/m ²	27 (35.5)	49 (64.5)	76 (76.8)		3.403 (1.279–9.051)
FFQ-derived dietary pattern					
Healthy (score ≥302.48)	15 (26.3)	42 (73.7)	57 (57.6)	<0.001	Reference
Unhealthy (score <302.48)	27 (64.3)	15 (35.7)	42 (42.4)		0.198 (0.084–0.471)

Notes: OR, odds ratio; CI, confidence interval; BMI, body mass index; FFQ, food-frequency questionnaire. Percentages within the diabetes-status columns shown for each category are row percentages. The family-history percentages have been recalculated directly from the source counts (4/47 and 43/47); see pre-submission verification notes.

According to the reported model-building sequence, all seven candidate variables—age, sex, educational attainment, family history, physical activity, BMI, and dietary pattern—were initially considered. Dietary pattern was removed first (reported $p = 0.808$), followed by sex ($p = 0.569$), physical activity ($p = 0.404$), and age ($p = 0.270$). The final reported model retained educational attainment, family history of diabetes, and BMI (Table 3).

In this final model, lower educational attainment was associated with higher odds of diabetes (aOR = 8.310; 95% CI: 2.043–33.810; $p = 0.003$). Family history showed the largest reported adjusted association (aOR = 37.221; 95% CI: 9.064–152.844; $p < 0.001$), although its confidence interval was wide. BMI ≥23 kg/m² remained in the model but was not statistically significant at the 0.05 level (aOR = 3.619; 95% CI: 0.865–15.138; $p = 0.078$).

Table 3. Final multivariable logistic regression model for diabetes mellitus

Predictor	Regression coefficient (B)	p-value	Adjusted OR (95% CI)
Lower educational attainment	2.118	0.003	8.310 (2.043–33.810)
Family history of diabetes	3.617	<0.001	37.221 (9.064–152.844)
BMI ≥23 kg/m ²	1.286	0.078	3.619 (0.865–15.138)
Intercept	–3.483	<0.001	0.031*

Notes: OR, odds ratio; CI, confidence interval; BMI, body mass index. *The intercept OR ($\exp[-3.483] \approx 0.031$) was arithmetically derived from the reported coefficient because the source table displayed 0.000; this correction requires verification against the original SPSS output.

The manuscript reported a Nagelkerke pseudo-R² value of approximately 0.62 and a Hosmer–Lemeshow test p -value of 0.392. These indices were presented as indicating model explanatory performance and no detected lack of fit,

respectively, although the precise model to which the pseudo-R² applies should be verified. Using the reported intercept and all three predictor coefficients, the fitted probability for a hypothetical respondent with lower education, a

family history of diabetes, and BMI ≥ 23 kg/m² is approximately 97%. This is a model-based estimate for that covariate profile within the analyzed sample, rather than a prospectively validated estimate of disease risk. The wide interval around the family-history aOR indicates substantial uncertainty in the magnitude of association.

Discussion

This study investigated demographic, familial, anthropometric, and behavioral factors associated with diabetes mellitus among adult outpatients at Sungai Lilin General Hospital. Age, education, family history, physical activity, BMI, and dietary classification showed statistically significant bivariate associations, whereas sex did not. In the final adjusted model, family history and lower educational attainment remained statistically significant, with family history showing the largest aOR. Given the cross-sectional design, the findings describe differences in prevalent diabetes status rather than causal risk.

The bivariate association with age accords with Suci (2023) and Nurvitasari et al. (2025), who described higher diabetes occurrence in older groups. Aging may involve reduced insulin sensitivity, changes in pancreatic beta-cell function, declining physical activity, and loss of muscle mass, all of which can affect glucose metabolism. Nevertheless, age was excluded during multivariable modeling in this study, indicating that its bivariate association did not persist as an independently retained predictor under the reported selection strategy. Thus, the present results should not be interpreted as demonstrating an independent age effect.

No statistically significant association was observed between sex and diabetes status, consistent with reports by Rohmatulloh et al. (2024) in Batu and Lavenia (2025) among working-age adults in Medan. Both men and women can be affected by dietary behaviors, excess body weight, physical inactivity, and genetic susceptibility. The World Health Organization (2023) also identifies several behavioral, metabolic, and familial determinants of diabetes. Although sex-related differences in hormonal profiles, body composition, and lifestyle may affect susceptibility, this study did not detect an association for sex in the sample analyzed.

Educational attainment was associated with diabetes status both before and after adjustment. This observation is in line with Oktavia et al. (2022) and Faizal (2024). Education may shape health literacy, access to prevention messages, and the adoption of dietary and physical-activity behaviors. Notoatmojo (2011) suggested that educational attainment can influence health-related knowledge and awareness. However, education may also be a marker of socioeconomic circumstances and access to care, which were not comprehensively measured here. Accordingly, an association between lower education and diabetes should not be interpreted as proof that education itself causes the condition.

Family history was strongly associated with diabetes in both analyses. Related associations have been reported by Lasmawati et al. (2023) and Nuryantini et al. (2024). Diabetes has an important hereditary component, and genetic susceptibility may affect insulin secretion and insulin sensitivity. Family members may also share diets, activity patterns, and other environmental exposures. The observed aOR of 37.221 is numerically large, but the 95% CI of 9.064–152.844 is wide, indicating limited precision. This is particularly relevant because only four individuals with a family history were classified as not having diabetes in the study sample.

Fitriani et al. (2024) discuss familial susceptibility and report illustrative risk figures of approximately 15% when one parent has diabetes and up to 75% when both parents are affected. Such figures depend on the population and study methods and should not be generalized as fixed individual probabilities. The current study confirms an association within its particular outpatient sample but cannot separate genetic susceptibility from the shared environment, and its odds ratio should not be interpreted as a 37-fold increase in prospective risk.

Physical activity was associated with diabetes status at the bivariate stage, consistent with findings by Oktavia et al. (2022), Pratiwi et al. (2025), and Azhima et al. (2025). Regular movement can support glucose uptake by skeletal muscle, insulin sensitivity, weight control, and metabolic health. Resistance and aerobic activities may increase muscular glucose utilization and support glycemic control. Physical activity ranges from light everyday movement to moderate and

vigorous exercise, including walking, cycling, swimming, running, and structured exercise programs. For people with diabetes, activities such as walking, yoga, and appropriate foot exercises have also been discussed as supportive strategies (Fitriyani et al., 2025). Exercise should be tailored to clinical capacity, and gradual progression may be appropriate. In the present data, physical activity was not retained in the final regression model, and the sample-median GPAQ cutoff limits comparability with other populations.

Higher BMI was associated with diabetes in the unadjusted analysis, broadly consistent with Hikmah et al. (2023) and Fitriani et al. (2024). Increased adiposity, particularly visceral fat, is associated with insulin resistance and impaired glucose metabolism (Azhima et al., 2025). Obesity is multifactorial, arising from genetic, behavioral, physiological, and socioeconomic influences, and is associated with several NCDs, including hypertension, type 2 diabetes, cardiovascular disease, osteoarthritis, and some cancers (Makmun et al., 2023). Nevertheless, the final model's BMI estimate did not achieve statistical significance ($p = 0.078$), and the study's dichotomization at 23 kg/m² should be distinguished from diagnostic classification of obesity.

The association between dietary pattern and diabetes status was more difficult to interpret. Earlier studies by Dianti et al. (2025) and Doru et al. (2023) identified dietary associations with diabetes. Nutritional patterns high in refined sugars and excess energy can contribute to weight gain and glucose dysregulation, whereas nutritionally diverse diets rich in vegetables, fruits, whole grains, and lean proteins may support general metabolic health (Dwitanti & Muharramah, 2025). In the present study, however, the group labeled as having a healthy dietary pattern had a higher observed proportion of diabetes than the group labeled as having an unhealthy pattern. The FFQ score appears to emphasize dietary diversity and frequency rather than quantified total sugar or calorie intake. As respondents with diabetes may modify their eating habits after diagnosis, reverse causation is also possible. The source data therefore do not support a simple interpretation that the reported "healthy" score increased diabetes risk or that an unhealthy diet was protective.

For broader context, the source manuscript cited a report indicating prediabetes in approximately one in five adolescents aged 12–18 years and one in four young adults aged 19–34 years in the United States (Kemenkes RI, 2022). Other cited literature suggested higher diabetes occurrence after age 40 (Saputra & Hanyani, 2025) and described ages 35–45 years as a period of physiological transition associated with aging-related changes (Nora et al., 2025). Mechanisms discussed in aging research include oxidative stress and metabolic alterations. An example involving genetic growth-hormone receptor deficiency has been cited as illustrating the complexity of pathways related to cancer, diabetes, and aging (AFAR, 2016). These reports provide contextual discussion but do not establish mechanisms underlying the associations observed in this study.

Dietary diversity is often emphasized in balanced-nutrition recommendations because nutrient-dense foods can help achieve adequate macro- and micronutrient intake. A diet dominated by excess energy, sugar, or fat may contribute to obesity and insulin resistance, but the variety of foods consumed does not by itself quantify dietary quality or glycemic impact. A person may report a diverse diet that is also high in added sugar. Accordingly, the FFQ's item composition, weighting, validity, and interpretation of the 302.48 cutoff should be reported before dietary conclusions are drawn. The contrasting crude association and subsequent exclusion from the adjusted model further support conservative interpretation.

Additional studies reviewed in the source manuscript have reported substantial associations with family history. Permatasari and Umami (2025) reported approximately sixfold higher diabetes risk among women of reproductive age with a family history, whereas Baequny et al. (2026) reported an almost threefold difference among adolescents. Ulya et al. (2023) emphasized the relevance of parental diabetes to metabolic-disease prevention among women of reproductive age. These studies suggest that family history is potentially informative across age groups, although estimates vary with population, outcome definitions, and analytic approach.

Inherited susceptibility may involve beta-cell function and insulin sensitivity, and the source

literature noted possible differences between maternal and paternal transmission, including proposed genetic and intrauterine mechanisms. Figures cited by Ulya et al. (2023) included approximately 10%–30% differences for some maternal-history comparisons, 15% when one parent has diabetes, 75% when both do, 10% for affected siblings, and up to 90% concordance in identical twins. These heterogeneous estimates should not be presented as universally applicable probabilities without examining their primary evidentiary basis. Nonetheless, they illustrate why family history can provide useful information during preventive counseling and screening.

The study authors interpreted age-related deterioration in physiological function, oxidative stress, and reduced glucose utilization as possible explanations for age differences. They also proposed that sex-related biological variation may interact with other exposures rather than operating as a single direct determinant. Lower education was considered relevant to awareness of diabetes risk and preventive behavior, while family history was linked to inherited predisposition and shared habits. These mechanisms are plausible interpretive considerations rather than pathways established by the present cross-sectional data.

The authors further suggested that low physical activity may reduce insulin sensitivity and energy expenditure, whereas regular activity can facilitate glucose use and support muscle health. Higher BMI may indicate increased adiposity and a higher likelihood of insulin resistance. Regarding diet, they acknowledged that the FFQ did not directly calculate glucose or total caloric intake, so dietary variety alone may not correspond to lower metabolic risk. Because household members may share dietary, activity, and lifestyle patterns, familial clustering of diabetes can reflect both hereditary and environmental influences. Outpatient education may therefore benefit from taking family context into account.

Several limitations affect interpretation. Purposive sampling of 99 participants from a single specialist outpatient clinic restricts generalizability to the wider community. The sampling calculation used a 10% margin of error and does not itself justify the stability of a seven-predictor logistic model. Several estimates had wide confidence intervals, particularly for family history and age. Physical

activity and dietary exposures were categorized by sample-specific median or mean cutoffs, which can lose information and produce difficult-to-interpret groups. Medical-record diagnoses may be affected by reporting practices, and respondent-reported family history and lifestyle data are subject to recall and classification error. Because exposure measurement and diabetes status were evaluated contemporaneously, reverse causality and residual confounding remain possible. The source manuscript did not report a missing-data flow diagram, detailed model diagnostics, or an ethics approval identifier.

In clinical practice, the findings support consideration of family history and educational needs when designing individualized outpatient counseling, screening communication, and risk-factor assessment. Collaboration between healthcare facilities and educational institutions could strengthen educational programs, early detection, community empowerment, and behavior-change interventions. Such activities should be evaluated prospectively rather than assuming that associations observed in this cross-sectional sample demonstrate intervention effectiveness.

Conclusion and Recommendation

In this cross-sectional study of 99 outpatients, age, educational attainment, family history of diabetes, physical activity, BMI, and FFQ-derived dietary classification were associated with diabetes status in bivariate analyses, whereas sex was not. In the final multivariable model, family history and lower educational attainment remained significantly associated with diabetes status. Although family history produced the largest aOR, its wide confidence interval warrants cautious interpretation; BMI was not statistically significant after adjustment. These findings identify potentially useful characteristics for context-specific patient assessment but do not establish causal relationships.

Further studies should investigate preventive and health-promotion approaches to diabetes control using larger and more representative samples and improved exposure measurement. Partnerships between educational institutions and health services may facilitate health education, risk screening, community empowerment, and behavioral interventions designed to strengthen awareness and self-management. Longitudinal and intervention studies are needed to evaluate

whether such strategies improve clinically relevant outcomes.

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Declaration on the Use of AI

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Data sharing is not applicable to this article.

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