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Metabolic Risk Burden, Lifestyle Characteristics, and Diabetes Self-Care Awareness among Adults Attending a Diabetes Screening Camp

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KEYWORDS

Diabetes Mellitus, Type 2; Mass Screening; Obesity; Dyslipidemias; Self Care

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Abstract

Aim and Background:
Diabetes mellitus is frequently accompanied by obesity, dyslipidemia, unhealthy lifestyle practices, and inadequate self-care awareness, all of which increase the risk of long-term complications. This study aimed to evaluate glycemic status, anthropometric risk, lipid-related cardiometabolic burden, lifestyle characteristics, blood glucose monitoring behavior, healthcare follow-up, and diabetes education/support access among adults attending a diabetes screening camp in Malappuram district, Kerala, India.

Materials and Methods:
This cross-sectional screening included 364 consenting adult participants attending a tertiary care centre-based diabetes screening camp. Data were collected on age, sex, body mass index, HbA1c, fasting blood sugar, lipid profile, medication history, family history of diabetes, tobacco and alcohol use, diet plan, exercise, blood glucose monitoring frequency, healthcare-provider visits, and diabetes education/support access. Participants were classified as strict normoglycemic, prediabetes/high-risk, or diabetes-range glycemia/known diabetes based on HbA1c, fasting blood sugar, and diabetes medication status. Statistical analysis included descriptive statistics, Kruskal-Wallis tests, chi-square tests, Spearman correlation, and multivariable logistic regression.

Results:
Among 364 participants, 200 were female (54.9%) and 164 were male (45.1%). The mean age was 44.91 ± 15.77 years and mean BMI was 26.04 ± 4.60 kg/m². Overall, 218 participants (59.9%) were obese by Asian BMI cut-offs. Based on metabolic-risk classification, 108 participants (29.7%) were strict normoglycemic, 62 (17.0%) had prediabetes/high-risk glycemia, and 194 (53.3%) had diabetes-range glycemia/known diabetes. Participants with diabetes-range glycemia/known diabetes showed significantly higher age, BMI, HbA1c, fasting blood sugar, total cholesterol, triglycerides, VLDL, non-HDL cholesterol, lipid ratios, and dyslipidemia score, with lower HDL levels. Self-care indicators were suboptimal: only 22.5% followed a diet plan, 18.7% reported exercise, 23.1% performed regular monthly/weekly blood glucose monitoring, 18.4% had regular healthcare-provider visits, and 21.4% had access to diabetes education/support. Increasing age and BMI were independently associated with diabetes-range glycemia/known diabetes, while diabetes-range glycemia/known diabetes was strongly associated with high dyslipidemia burden.

Conclusions:
Adults attending this diabetes screening camp showed a substantial burden of glycemic abnormality, obesity, dyslipidemia, and inadequate structured self-care practices. Screening programmes should therefore move beyond glucose testing alone and incorporate BMI assessment, lipid-risk evaluation, lifestyle counselling, blood glucose monitoring education, referral linkage, and follow-up support for complication prevention.

INTRODUCTION

Diabetes mellitus is a major public-health challenge because it is often asymptomatic in the early stages but progressively increases the risk of cardiovascular disease, kidney disease, retinopathy, neuropathy, foot complications, and premature mortality [1]. The burden is especially relevant in India, where the ICMR–INDIAB national study reported that diabetes and other metabolic non-communicable diseases are more prevalent than previously estimated, with substantial coexistence of obesity, dyslipidemia, hypertension, and prediabetes across regions [1-2]. Therefore, diabetes screening should not be limited to identifying raised blood glucose alone; it should also characterize the broader cardiometabolic and behavioral-risk profile of the screened population [3]. In public-health settings, diabetic and lifestyle screening helps identify not only individuals requiring further clinical confirmation but also those who may benefit from early lifestyle counselling, monitoring, and preventive care.

Lifestyle practices and self-care behaviors are central to diabetes prevention and complication reduction. Diet modification, physical activity, medication adherence, regular blood-sugar monitoring, periodic clinical follow-up, and screening for complications are essential components of diabetes care [1,4]. However, access to diabetes education and structured self-management support remains uneven, particularly in resource-limited or semi-urban populations. Diabetes self-management education and support improve knowledge, self-care practices, and engagement with preventive services, making them important indicators of public-health preparedness [4-6].

In this context, the present study analyzed adults who attended a diabetes screening camp at a tertiary care centre in Malappuram district, Kerala, India. The objective was to describe the glycemic status, anthropometric risk, lipid-related cardiometabolic burden, lifestyle practices, blood-sugar monitoring behavior, healthcare follow-up, and access to diabetes education or support services among screened participants. This approach allows the cohort to be interpreted from a public-health perspective, focusing on metabolic-risk burden, awareness gaps, and indicators relevant to diabetes complication prevention.

Materials and Methods

Study design and setting

This was a cross-sectional screening-cohort analysis conducted among adults who attended a tertiary care center in Malappuram district, Kerala, India. The analytical emphasis was the public-health characterization of a screened population in terms of glycemic status, anthropometric risk, lipid-related cardiometabolic burden, lifestyle practices, blood-sugar monitoring behavior, regular healthcare follow-up, and access to diabetes education or support services. The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and relevant Indian Council of Medical Research ethical guidelines for biomedical and health research involving human participants. All participants were handled with due care, privacy, and respect throughout the screening and data-collection process. Before enrolment, each participant was informed about the purpose, merit, procedures, and voluntary nature of the study. Only participants who provided written informed consent were recruited, and data were collected only from consenting individuals.

Study population and data source

The study recruited 364 consenting adult participants. Data were collected on age, sex, body mass index (BMI), glycated hemoglobin (HbA1c), fasting blood sugar (FBS), lipid profile, medication history, family history of diabetes, tobacco and alcohol exposure, diet plan, exercise, blood-sugar monitoring frequency, regular healthcare-provider visits, and access to diabetes education or support services. These data were used to describe the clinical, metabolic, lifestyle, and diabetes-awareness characteristics of the screening cohort.

Operational definitions

Participants were reclassified into metabolic-risk categories using HbA1c, FBS, and diabetes medication status. Strict normoglycemia was defined as HbA1c <5.7%, FBS <100 mg/dL, and no diabetes medication use. Prediabetes/high-risk status

was defined as HbA1c 5.7-6.4% or FBS 100-125 mg/dL, without meeting diabetes-range criteria and without diabetes medication use. Diabetes-range glycemia/known diabetes was defined as HbA1c >=6.5%, FBS >=126 mg/dL, or use of diabetes medication. These thresholds are consistent with American Diabetes Association diagnostic classification criteria [7,8].

BMI was categorised using Asian/Asian-Indian risk-sensitive cut-offs: 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 [3]. Lipid abnormalities were defined as total cholesterol >=200 mg/dL, triglycerides >=150 mg/dL, HDL <40 mg/dL, VLDL >=30 mg/dL, and LDL >=100 mg/dL. A dyslipidemia score was calculated as the number of abnormal lipid parameters present, ranging from 0 to 5. Dyslipidemia burden was categorised as low (0-1 abnormality), moderate (2-3 abnormalities), or high (4-5 abnormalities) [4].

Blood-sugar monitoring was analysed in two ways: as a detailed frequency variable (never, rarely, occasional, yearly, monthly, weekly) and as simplified binary variables. Any monitoring was defined as any response other than never. Regular monitoring was defined as monthly or weekly monitoring. Diabetes self-care and public-health awareness indicators included diet plan, exercise, regular monitoring, regular healthcare-provider visit, and diabetes education/support access. These variables were interpreted as self-care and awareness indicators rather than causal exposures because cross-sectional screening data cannot establish temporality.

Ethical Approval

The study protocol was reviewed and approved by the Srinivas University Ethics Committee (SUEC), Srinivas University, Mangalore, Karnataka, India (Protocol No. 13/AHS/EC/2024). The approval was valid from 18 March 2024 to 17 March 2026.

Statistical analysis

The statistical analysis was done in Jamovi version 2.6.19. Continuous variables were summarised using mean ± standard deviation and, where relevant, median with interquartile range. Categorical variables were summarised as frequency and percentage. Group comparisons across the three metabolic-risk categories were performed using Kruskal-Wallis tests for continuous variables because several biochemical variables were non-normally distributed, and chi-square tests were used for categorical variables. Cramer's V was reported as the effect size for categorical comparisons. Among confirmed/likely diabetic participants, controlled diabetes was defined as HbA1c <7%, and uncontrolled diabetes was defined as HbA1c >=7%; these subgroups were compared using Mann-Whitney U tests and chi-square tests.

Spearman correlation analysis was used to assess relationships between glycemic variables and cardiometabolic-risk indices. Binary logistic regression models were fitted to identify factors associated with Diabetes-range glycemia/known diabetes, high dyslipidemia burden, and uncontrolled diabetes among confirmed/likely diabetic participants. Regression results are presented as odds ratios (ORs) with 95% confidence intervals (CIs). A two-tailed p-value <0.05 was considered statistically significant. Statistically significant self-care variables were interpreted cautiously to avoid causal overstatement. Diabetes self-management education/support was considered clinically relevant because structured education supports diabetes self-care and complication prevention [6-9].

Results

Characteristics of the screened cohort

A total of 364 adults attending the diabetes screening camp were included in the analysis. The cohort consisted of 200 females (54.9%) and 164 males (45.1%). The mean age was 44.91 ± 15.77 years, and the mean BMI was 26.04 ± 4.60 kg/m². 218 participants (59.9%) were obese and 63 (17.3%) were overweight, indicating a high anthropometric-risk burden in the screened population.

Table 1. Overall characteristics of adults attending the diabetes screening camp.

Characteristic	Value
Total participants (n)	364
Female (n)	200 (54.9%)
Male (n)	164 (45.1%)
Age, years	44.91 ± 15.77
BMI (kg/m²)	26.04 ± 4.60
HbA1c (%)	5.91 ± 1.06
FBS (mg/dL)	119.49 ± 44.79
Total cholesterol (mg/dL)	200.20 ± 42.96
Triglycerides (mg/dL)	169.79 ± 54.74

HDL (mg/dL)	39.70 ± 8.70
LDL (mg/dL)	122.96 ± 37.48
VLDL (mg/dL)	34.53 ± 10.80
Obese (Asian BMI)	218 (59.9%)
Positive family history of diabetes	115 (31.6%)
Use of tobacco products	112 (30.8%)
Alcohol use	103 (28.3%)
Following a diet plan	82 (22.5%)
Exercise	68 (18.7%)
Any blood-sugar monitoring	261 (71.7%)
Regular monthly/weekly monitoring	84 (23.1%)
Regular healthcare-provider visit	67 (18.4%)
Diabetes education/support access	78 (21.4%)

Note. Continuous variables are presented as mean ± SD; categorical variables are presented as n (%).

Metabolic-risk classification of the cohort

When participants were reclassified using HbA1c, FBS, and diabetes medication status, 108 participants (29.7%) were classified as strict normoglycemic, 62 (17.0%) as prediabetes/high-risk, and 194 (53.3%) as Diabetes-range glycemia/known diabetes. Overall, 256 participants (70.3%) had either high-risk glycemic status or Diabetes-range glycemia/known diabetes, demonstrating a substantial metabolic-risk burden among individuals presenting for screening.

Table 2. Metabolic-risk classification of the screened cohort.

Metabolic-risk category	Operational definition	n (%)
Strict normoglycemic	HbA1c <5.7%, FBS <100 mg/dL, and no diabetes medication	108 (29.7%)
Prediabetes/high-risk	HbA1c 5.7-6.4% or FBS 100-125 mg/dL; not diabetes-range and no diabetes medication	62 (17.0%)
Diabetes-range glycemia/known diabetes	HbA1c >=6.5%, FBS >=126 mg/dL, or diabetes medication use	194 (53.3%)

Note. FBS = fasting blood sugar; HbA1c = glycated hemoglobin.

Anthropometric, glycemic, and lipid-risk profile across metabolic-risk categories

Clear gradients were observed across metabolic-risk groups. Confirmed/likely diabetic participants were older and had higher BMI, HbA1c, FBS, total cholesterol, triglycerides, VLDL, non-HDL cholesterol, TG/HDL ratio, TC/HDL ratio, LDL/HDL ratio, and dyslipidemia score compared with strict normoglycemic participants. HDL was lower in the Diabetes-range glycemia/known diabetes group. LDL showed only a borderline difference across groups. These findings indicate clustering of glycemic and lipid abnormalities in the screened cohort, consistent with increased cardiometabolic-risk burden rather than an isolated glucose abnormality.

Table 3. Anthropometric and biochemical characteristics across metabolic-risk categories.

Variable	Strict normoglycemic (n=108)	Prediabetes/high-risk (n=62)	Diabetes-range glycemia / known diabetes (n=194)	p-value
Age, years	38.78 ± 15.92	40.81 ± 17.32	49.63 ± 13.55	<0.001
BMI, kg/m^2	24.62 ± 4.66	26.70 ± 4.19	26.61 ± 4.53	0.001

HbA 1c, %	4.90 ± 0.31	5.24 ± 0.45	6.68 ± 0.83	<0.001
FBS, mg/dL	82.89 ± 9.11	106.46 ± 7.89	144.03 ± 47.94	<0.001
Total cholesterol, mg/dL	184.64 ± 37.26	187.05 ± 36.71	213.06 ± 43.80	<0.001
Triglycerides, mg/dL	147.27 ± 48.43	154.96 ± 38.08	187.05 ± 56.77	<0.001
HDL, mg/dL	40.86 ± 9.36	42.00 ± 8.28	38.33 ± 8.23	0.003
VLDL, mg/dL	29.32 ± 10.03	30.38 ± 8.75	38.76 ± 10.04	<0.001
LDL, mg/dL	123.66 ± 39.81	113.62 ± 37.69	125.55 ± 35.76	0.053
Non-HDL cholesterol, mg/dL	143.78 ± 34.09	145.05 ± 35.50	174.74 ± 43.78	<0.001
TG/HDL ratio	3.76 ± 1.37	3.79 ± 1.03	5.13 ± 2.11	<0.001
TC/HDL ratio	4.68 ± 1.07	4.59 ± 1.17	5.82 ± 1.88	<0.001
LDL/HDL ratio	3.09 ± 0.91	2.79 ± 1.08	3.40 ± 1.20	<0.001
Dyslipidemia score	2.28 ± 1.17	2.23 ± 1.00	3.48 ± 1.17	<0.001

Note. Values are mean ± SD. p-values are from Kruskal-Wallis tests. FBS = fasting blood sugar; HDL = high-density lipoprotein; LDL = low-density lipoprotein; VLDL = very-low-density lipoprotein; TG = triglycerides; TC = total cholesterol.

Lifestyle-risk and diabetes self-care indicators

In the total cohort, a positive family history of diabetes was reported by 115 participants (31.6%). Tobacco product use and alcohol use were reported by 112 (30.8%) and 103 (28.3%) participants, respectively. Structured lifestyle practices were low: only 82 participants (22.5%) reported following a diet plan and 68 (18.7%) reported exercise. These findings suggest that behavioral-risk exposure and limited structured lifestyle practice coexisted within the screening cohort.

Self-care and awareness indicators were also suboptimal. Although 261 participants (71.7%) reported some form of blood-sugar monitoring, only 84 (23.1%) reported regular monthly or weekly monitoring. Regular healthcare-provider visits were reported by 67 participants (18.4%), and access to diabetes education/support was reported by 78 (21.4%).

Table 4. Lifestyle, monitoring, healthcare follow-up, and diabetes education indicators across metabolic-risk categories.

Indicator	Strict normoglycemic (n=108)	Prediabetes/high-risk (n=62)	Diabetes-range glycemia/known diabetes (n=194)	p-value	Cramer's V
Positive family history of diabetes	29 (26.9%)	21 (33.9%)	65 (33.5%)	0.449	0.066
Use of toba	27 (25.0%)	12 (19.4%)	73 (37.6%)	0.0	0.164

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Alcohol use	22 (20.4%)	18 (29.0%)	63 (32.5%)	0.081	0.118
Following a diet plan	19 (17.6%)	22 (35.5%)	41 (21.1%)	0.021	0.145
Exercise	6 (5.6%)	11 (17.7%)	51 (26.3%)	<0.001	0.232
Any blood-sugar monitoring	66 (61.1%)	47 (75.8%)	148 (76.3%)	0.014	0.153
Regular monthly/weekly monitoring	19 (17.6%)	15 (24.2%)	50 (25.8%)	0.263	0.086
Regular healthcare-provider visit	11 (10.2%)	9 (14.5%)	47 (24.2%)	0.007	0.165
Access to diabetes education/support	19 (17.6%)	10 (16.1%)	49 (25.3%)	0.160	0.100

Note. Values are n (%). p-values are from chi-square tests. Cramer's V represents categorical effect size.

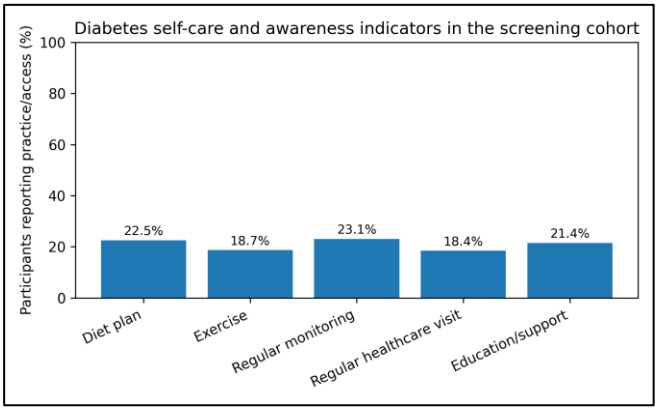

Figure 2. Diabetes self-care and awareness indicators in the screening cohort.

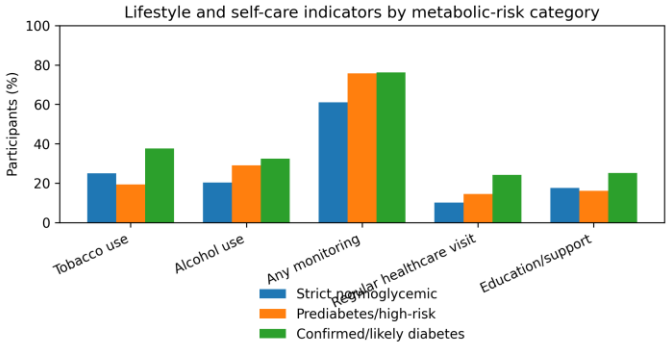

Figure 3. Lifestyle and self-care indicators across metabolic-risk categories.

Blood-sugar monitoring frequency

Detailed analysis of blood-sugar monitoring showed that 28.3% of participants never monitored blood sugar, while 23.9% monitored occasionally and 22.3% monitored monthly. Weekly monitoring was rare, reported by only 0.8% of participants. Although any monitoring was significantly more frequent in prediabetes/high-risk and Diabetes-range glycemia/known diabetes groups, regular monthly/weekly monitoring remained low and did not differ significantly across groups.

Table 5. Blood-sugar monitoring frequency across metabolic-risk categories.

Monitoring frequency	Strict normoglycemic (n=108)	Prediabetes/high-risk (n=62)	Diabetes-range glycemia/known diabetes (n=194)	p-value

Never	42 (38.9 %)	15 (24.2%)	46 (23.7 %)	0.136
Rarely	16 (14.8 %)	8 (12.9%)	24 (12.4 %)	
Occasional	18 (16.7 %)	14 (22.6%)	55 (28.4 %)	
Yearly	13 (12.0 %)	10 (16.1%)	19 (9.8%)	
Monthly	18 (16.7 %)	15 (24.2%)	48 (24.7 %)	
Weekly	1 (0.9%)	0 (0.0%)	2 (1.0%)	

Note. Values are n (%). p-value is from chi-square test across all monitoring-frequency categories.

Dyslipidemia burden across metabolic-risk categories

High dyslipidemia burden, defined as four to five abnormal lipid parameters, was present in 20 strict normoglycemic participants (18.5%), 8 prediabetes/high-risk participants (12.9%), and 115 confirmed/likely diabetic participants (59.3%). Dyslipidemia burden differed significantly across metabolic-risk categories ($p<0.001$), with a marked shift toward high burden among confirmed/likely diabetic participants.

Glycemic-control subgroup analysis among confirmed/likely diabetic participants

Among the 194 confirmed/likely diabetic participants, 140 (72.2%) had HbA1c <7% and 54 (27.8%) had HbA1c >=7%. Participants with uncontrolled diabetes were older, had higher FBS, and had a higher dyslipidemia score than those with HbA1c <7%. Positive family history of diabetes was more common in the uncontrolled subgroup. Regular monitoring, healthcare visits, and access to education/support were numerically higher among uncontrolled participants but did not reach statistical significance.

Table 6. Characteristics of controlled and uncontrolled glycemic subgroups among confirmed/likely diabetic participants.

Variable	Controlled HbA1c <7 (n=140)	Uncontrolled HbA1c >=7 (n=54)	p-value
Age, years	47.78 ± 13.07	54.44 ± 13.70	0.005
BMI, kg/m²	26.50 ± 4.50	26.90 ± 4.64	0.390
FBS, mg/dL	137.07 ± 34.04	162.09 ± 69.79	0.005
Total cholesterol, mg/dL	210.05 ± 46.59	220.88 ± 34.74	0.084
Triglycerides, mg/dL	185.70 ± 59.48	190.56 ± 49.42	0.386
HDL, mg/dL	37.91 ± 8.00	39.40 ± 8.78	0.277
VLDL, mg/dL	38.00 ± 10.23	40.72 ± 9.34	0.056
LDL, mg/dL	125.93 ± 38.36	124.55 ± 28.22	0.989
Non-HDL cholesterol, mg/dL	172.14 ± 46.46	181.48 ± 35.43	0.097
TG/HDL ratio	5.16 ± 2.24	5.07 ± 1.74	0.573
Dyslipidemia score	3.35 ± 1.26	3.83 ± 0.84	0.024
Positive family history	39 (27.9 %)	26 (48.1%)	0.012
Use of tobacco products	52 (37.1 %)	21 (38.9%)	0.952
Alcohol use	45 (32.1 %)	18 (33.3%)	1.000
Following a diet plan	26 (18.6 %)	15 (27.8%)	0.226
Exercise	39 (27.9 %)	12 (22.2%)	0.537
Regular monitoring	35 (25.0 %)	15 (27.8%)	0.831
Regular healthcare-provider visit	29 (20.7 %)	18 (33.3%)	0.099
Diabetes education/support access	31 (22.1 %)	18 (33.3%)	0.155

Note. Continuous variables are mean ± SD and compared using Mann-Whitney U tests. Categorical variables are n (%) and compared using chi-square tests.

Correlation analysis

Spearman correlation analysis showed that HbA1c had positive correlations with triglycerides, TG/HDL ratio, and dyslipidemia score. FBS was also positively correlated with triglycerides and dyslipidemia score. BMI had a weak but statistically significant correlation with dyslipidemia score, but not with TG/HDL ratio. These findings support the presence of glycemic-lipid clustering in the screened cohort.

Table 7. Selected Spearman correlations among glycemic and cardiometabolic-risk indicators.

Relationship	Spearman rho	p-value
HbA1c vs FBS	0.713	<0.001
HbA1c vs triglycerides	0.402	<0.001
HbA1c vs TG/HDL ratio	0.387	<0.001
HbA1c vs dyslipidemia score	0.472	<0.001
FBS vs triglycerides	0.297	<0.001
FBS vs dyslipidemia score	0.367	<0.001
Age vs dyslipidemia score	0.259	<0.001
BMI vs dyslipidemia score	0.120	0.022

Note. Spearman correlation was used because several variables were non-normally distributed.

Regression analysis

In multivariable logistic regression, increasing age and BMI were significantly associated with Diabetes-range glycemia/known diabetes. Exercise also showed a positive association with Diabetes-range glycemia/known diabetes; however, this should be interpreted as likely post-diagnosis lifestyle modification rather than a causal risk factor. For high dyslipidemia burden, Diabetes-range glycemia/known diabetes was the strongest independent predictor after adjustment for age, BMI, sex, tobacco use, alcohol use, diet plan, and exercise. Among confirmed/likely diabetic participants, older age and positive family history were associated with uncontrolled HbA1c, while exercise showed an inverse association with uncontrolled status.

Table 8. Multivariable logistic regression models for Diabetes-range glycemia/known diabetes, high dyslipidemia burden, and uncontrolled HbA1c.

Outcome	Predictor	Adjusted OR	95% CI	p-value
Diabetes-range glycemia/known diabetes	Age, per year	1.04	1.03 - 1.06	<0.001
	BMI, per kg/m²	1.07	1.02 - 1.13	0.010
	Male sex	1.50	0.90 - 2.49	0.117
	Family history of diabetes	1.12	0.68 - 1.86	0.653
	Use of tobacco products	1.71	0.97 - 3.01	0.062
	Alcohol use	0.72	0.40 - 1.32	0.293
	Following a diet plan	0.65	0.35 - 1.21	0.175
	Exercise	3.11	1.55 - 6.23	0.001

High dyslipidemia burden	Diabetes-range glycemia/known diabetes	6.17	3.64 - 10.46	<0.001
	Age, per year	1.02	1.00 - 1.04	0.015
	BMI, per kg/m²	1.01	0.96 - 1.07	0.622
	Male sex	0.79	0.47 - 1.34	0.381
	Use of tobacco products	1.41	0.80 - 2.49	0.230
	Alcohol use	0.75	0.41 - 1.37	0.351
	Following a diet plan	1.14	0.61 - 2.14	0.687
	Exercise	1.17	0.61 - 2.22	0.641
Uncontrolled HbA1c >=7 among diabetics	Age, per year	1.04	1.01 - 1.07	0.009
	BMI, per kg/m²	1.04	0.96 - 1.13	0.298
	Male sex	0.84	0.41 - 1.72	0.638
	Family history of diabetes	2.64	1.26 - 5.54	0.010
	Diabetes medication use	1.20	0.50 - 2.90	0.680
	Following a diet plan	2.02	0.81 - 5.01	0.129
	Exercise	0.26	0.09 - 0.71	0.009
	Regular monitoring	1.13	0.51 - 2.50	0.768
	Regular healthcare visit	1.68	0.69 - 4.12	0.254
	Education/support access	1.88	0.82 - 4.29	0.133

Note. OR = odds ratio; CI = confidence interval. Each outcome model includes all listed predictors within that model. Interpretation of exercise-related associations should account for cross-sectional design and probable post-diagnosis behaviour change.

Discussion

The present screening-cohort analysis demonstrates a substantial metabolic and public-health risk burden among adults attending a diabetes screening camp in Malappuram district, Kerala. When participants were reclassified using HbA1c, fasting blood sugar, and antidiabetic medication history, only 29.7% were strict normoglycemic, while 17.0% had prediabetes/high-risk glycemia and 53.3% had diabetes-range glycemia or known diabetes. This pattern supports the value of screening-centre datasets for identifying not only known diabetes but also clinically important high-risk glycemic states. The finding is consistent with the ICMR–

INDIAB national data, which showed that diabetes, prediabetes, obesity, and dyslipidaemia represent a major and interlinked metabolic non-communicable disease burden in India [11].

A key observation in this cohort was the clustering of glycemic abnormality with anthropometric and lipid-related cardiometabolic risk. Participants with diabetes-range glycemia or known diabetes had higher BMI, total cholesterol, triglycerides, VLDL, non-HDL cholesterol, TG/HDL ratio, and dyslipidaemia score than strict normoglycemic participants. This is important because diabetes screening should not be interpreted as a glucose-only exercise. The ICMR–INDIAB report similarly highlighted that metabolic disorders in India frequently coexist rather than occur in isolation, reinforcing the need for integrated screening that includes obesity and lipid-risk assessment [11].

The lifestyle-risk profile also suggests an important public-health gap. Tobacco use was significantly higher among participants with diabetes-range glycemia or known diabetes, while alcohol exposure showed a rising but statistically non-significant trend across metabolic-risk groups. Diet-plan adherence and exercise were reported by only a minority of participants overall. Interestingly, exercise was more frequently reported among diabetic participants. This should not be misinterpreted as a risk factor for diabetes; rather, it likely reflects post-diagnosis behavioural modification among individuals already aware of their diabetic status. This interpretation is supported by Indian diabetes self-care literature, where lifestyle practices often remain inconsistent even among known diabetic patients despite awareness of their importance [12].

The most policy-relevant finding was the mismatch between metabolic burden and structured self-care behaviour. Although 71.7% of participants reported some form of blood-sugar monitoring, only 23.1% reported regular monthly or weekly monitoring. Similarly, only 18.4% reported regular healthcare-provider visits, and only 21.4% had access to diabetes education or support services. These findings parallel the "Diab-at-ease" screening-camp study by Kumar et al., where many diabetic participants showed treatment compliance but had important gaps in practical diabetes knowledge, glucometer use, and awareness of correct glucose values [13]. Together, these findings suggest that screening camps should not stop at detection; they should also provide structured counselling, monitoring education, referral linkage, and follow-up pathways.

The present results also align with national evidence showing persistent gaps in the diabetes care continuum. Mathur et al. reported that, among adults with diabetes in India, awareness, treatment, and control remained suboptimal in the National NCD Monitoring Survey [14]. Varghese et al. further showed that diagnosis, medication use, and glycemic control vary substantially across India, with care-continuum performance influenced by age, socioeconomic position, and geography [15]. In this context, the low proportion of regular monitoring and healthcare follow-up in the present cohort indicates that local screening programmes must be strengthened as entry points into continuous diabetes care rather than being treated as one-time testing events.

Among participants with diabetes-range glycemia or known diabetes, uncontrolled glycemic status was associated with older age and family history of diabetes. This may indicate a subgroup with greater biological susceptibility, longer disease duration, or poorer treatment response; however, the absence of data on duration of diabetes, treatment adherence, and complications limits causal interpretation. Similarly, the study did not directly assess retinopathy, nephropathy, neuropathy, cardiovascular disease, or foot complications. Therefore, the findings should be interpreted as indicators of complication-risk and prevention-readiness gaps, not as direct evidence of diabetic complications.

This study has practical implications. A diabetes screening camp can identify a large pool of individuals with diabetes-range glycemia, prediabetes/high-risk status, obesity, dyslipidaemia, and poor self-care preparedness. Integrating lipid assessment, BMI-based risk classification, lifestyle counselling, education on glucose monitoring, referral to healthcare providers, and follow-up reminders may improve the public-health value of such camps. The major strength of this study is its real-world screening-centre design with simultaneous assessment of biochemical, anthropometric, lifestyle, and awareness-related variables. Its limitations include cross-sectional design,

single-centre recruitment, lack of confirmatory repeat testing for newly detected diabetes-range values, and absence of direct complication assessment. Despite these limitations, the study provides useful evidence that diabetes screening programmes should move beyond detection toward structured risk communication, self-care education, and complication-prevention linkage.

Conclusion

The present cross-sectional screening-cohort study demonstrates a substantial burden of metabolic risk among adults attending a diabetes screening camp. The study also highlights an important gap between metabolic risk and self-care preparedness. Despite a considerable proportion of participants showing abnormal glycemic and lipid profiles, structured lifestyle practices, regular blood glucose monitoring, routine healthcare-provider visits, and access to diabetes education or support services remained low. These findings suggest that screening camps should function not only as detection points but also as entry points for risk communication, lifestyle counselling, self-management education, referral linkage, and follow-up care. Overall, the findings support the need for integrated diabetes screening models that combine glycemic evaluation with BMI assessment, lipid-risk profiling, behavioral-risk assessment, and structured diabetes self-care education.

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