SCREENING FOR THE RISK OF TYPE 2 DIABETES MELLITUS USING THE FINNISH DIABETES RISK SCORE (FINDRISC) AMONG OUTPATIENT DEPARTMENT VISITORS AT A TERTIARY CARE CENTRE, SHIVAMOGGA

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ABSTRACT

Background: Type 2 diabetes mellitus (T2DM) is a major public health concern, with a large proportion of cases remaining undiagnosed until complications develop. The Finnish Diabetes Risk Score (FINDRISC) is a simple, validated, non-invasive tool for identifying individuals at increased risk of developing T2DM.

Objectives: To assess the risk of type 2 diabetes mellitus using the FINDRISC questionnaire and determine its association with socio-demographic characteristics among outpatient attendees at a tertiary care centre.

Methods: A hospital-based cross-sectional study was conducted among 185 adult outpatient department attendees at a tertiary care teaching hospital in Shivamogga, Karnataka, from June 2025 to July 2026. Participants were selected using convenient sampling. Data were collected using a pretested structured questionnaire incorporating the FINDRISC tool and standard anthropometric measurements. Data were analysed using SPSS version 21.0, and associations were assessed using the Chi-square test or Fisher's exact test.

Results: The mean age of participants was 43.89 ± 14.68 years, and the mean FINDRISC score was significantly higher among women than men ($p=0.019$). Overall, 28.0% of participants had moderate-to-very high diabetes risk. Higher FINDRISC scores were significantly associated with advancing age, obesity, increased waist circumference, physical inactivity, antihypertensive medication use, family history of diabetes, and marital status ($p<0.05$).

Conclusion: The FINDRISC questionnaire is a practical and effective screening tool for identifying individuals at increased risk of T2DM in outpatient settings and may facilitate early lifestyle interventions and diabetes prevention.

Keywords: Finnish Diabetes Risk Score; Risk assessment; Screening; Type 2 diabetes mellitus

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INTRODUCTION

Diabetes Mellitus is a chronic metabolic disorder characterized by persistent hyperglycaemia. Type 2 Diabetes Mellitus (T2DM) contributes to around 90–95% of all cases of DM which often goes undiagnosed until complications develop. Identifying high risk individuals at an early stage is useful in targeting preventive strategies effectively thereby reducing the disease burden.[1] The world is witnessing an alarming increase in the prevalence of diabetes. In 2021 the estimated number of people (aged 20–79 years) living with diabetes was 537 million and is predicted to increase to 783 million by 2045.[2] In India, the number of adults with diabetes is estimated to be around 74 million in 2021 and is predicted to increase to nearly 125 million by 2045.[3] The increase in prevalence has been ascribed to the imbalances associated with rapid urbanization, population ageing, increased sedentary life style, unhealthy dietary habits,

obesity, and genetics.[4] As T2DM develops insidiously and can be asymptomatic for many years before obvious symptoms appear, population screening has an important role in predicting those at high risk of the disease. Several non-invasive screening methods have been devised, namely the Indian Diabetes Risk Score (IDRS), the Diabetes Risk Test devised by the American Diabetes Association, the Australian Type 2 Diabetes Risk Assessment Tool (AUSDRISK) and the Finnish Diabetes Risk Score (FINDRISC).[5,6] One such example is FINDRISC[5], which is a simple, validated and inexpensive questionnaire-based tool that predicts the likelihood of developing T2DM in the future using eight variables including age, body mass index, waist circumference, level of physical activity, frequency of intake of fruits and vegetables, use of antihypertensive medication, personal history of high blood glucose and family history of diabetes. This tool has been shown to have good accuracy of prediction in different populations and is useful for opportunistic screening in general outpatient and primary care settings.[6] Although the prevalence rate of diabetes mellitus has escalated over the last two decades, data related to use of FINDRISC among outpatient visitors in tertiary care hospitals, particularly in Karnataka, India are still sparse. Screening for diabetes risk in the healthy population has the potential to enable early identification, focused lifestyle interventions, prompt referral for confirmatory testing, and the institution of preventive measures. In this context, the current study aims to assess the risk of type 2 DM using FINDRISC and to determine the association between the risk of type 2 DM with sociodemographic details among adult outpatient department attendees at a tertiary care centre at Shivamogga.

METHODOLOGY

After obtaining approval from the Institutional Ethics Committee (IEC-SUIMS/52/Feb-2025), this cross-sectional study was conducted among outpatient department (OPD) visitors attending a tertiary care teaching hospital in Shivamogga, Karnataka, India, between June 2025 and July 2026. Participants aged ≥20 years who were willing to provide written informed consent were included in the study, while individuals with previously diagnosed type 2 diabetes mellitus and those with mental health disorders were excluded. A convenient sampling technique was employed for participant recruitment.

The sample size was calculated using the standard formula for estimating a single proportion, $n = Z^2P(1-P)/d^2$, considering a prevalence of type 2 diabetes mellitus of 11.4% reported by Anjana et al.,[7] a 95% confidence level (Z = 1.96), and an absolute precision of 5%. The minimum required sample size was 163, which was increased to 180 after accounting for a 10% non-response rate.

Data were collected through face-to-face interviews using a predesigned and pretested structured questionnaire. The questionnaire comprised two sections: the first captured sociodemographic characteristics, while the second consisted of the Finnish Diabetes Risk Score (FINDRISC) questionnaire[5], a validated screening tool developed by Lindström and Tuomilehto for assessing the risk of developing type 2 diabetes mellitus. The FINDRISC tool evaluates eight parameters, namely age, body mass index (BMI), waist circumference, physical activity, daily consumption of fruits and vegetables, use of antihypertensive medication, history of elevated blood glucose, and family history of diabetes.

Anthropometric measurements were obtained following standard procedures. Height was measured using a calibrated stadiometer to the nearest 0.1 cm, with participants standing barefoot in the Frankfurt plane. Body weight was measured using a calibrated digital weighing scale to the nearest 0.1 kg with participants wearing light clothing and no footwear. Body mass index was calculated as weight in kilograms divided by the square of height in metres (kg/m^2). Waist circumference was measured using a non-stretchable measuring tape at the midpoint between the lower margin of the last palpable rib and the iliac crest, in accordance with World Health Organization recommendations, and recorded to the nearest 0.1 cm.

Data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 21.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as frequencies, percentages, means, and standard deviations. Associations between categorical variables were assessed using the Chi-square test or Fisher's exact test, wherever appropriate. A p-value of <0.05 was considered statistically significant.

RESULTS

The association between gender and baseline characteristics of the study participants is presented in Table 1. The mean age of the participants was 43.89 ± 14.68 years, with males having a slightly higher mean age than females. Most participants were from rural areas (69.7%), consumed a non-vegetarian diet (85.4%), and reported no addictions (77.8%) or comorbidities (80.5%). The mean FINDRISC score was significantly higher among women compared to men (9.45 ± 4.08 vs. 8.09 ±

3.63; p = 0.019), while no significant gender differences were observed for the other baseline characteristics.

Table 1: Baseline Characteristics of Study Participants by Gender (N = 185)

Sl no	Variables	Men	Women	Total	p-value
1	**Subjects %**	85	100	185	
2	**Age, Mean(SD)**	46.29 ±15.45	41.84± 13.7	43.89± 14.68	0.39
3	**Area of residence**				0.529
	Rural	59(31.9%)	70(37.8%)	129(69.7%)	
	Urban	26(14.1%)	30(16.2%)	56(30.3%)	
4	**Type of diet**				0.09
	Veg	8(4.3%)	19(10.3%)	27(14.6%)	
	Non-veg	77(41.6%)	81(43.8%)	158(85.4%)	
5	**Habits**				**0.000***
	Alcohol	15(8.1%)	1(0.5%)	16(8.6%)	
	Smoking	22(11.9%)	0	22(11.9%)	
	Tobacco Chewing	0	3(1.6%)	3(1.6%)	
	Nil habits	48(25.9%)	96(51.9%)	144(77.8%)	
6	**Co morbidities**				0.720
	Nil	69(37.3%)	80(43.2%)	149(80.5%)	
	Hypertension	13(7%)	17(9.2%)	30(16.2%)	
	Cardiovascular disease	3(1.6%)	2(1.1%)	5(0.5%)	
	Cancer	0	1(0.5%)	1(0.5%)	
7	**Socio-economic Status**				0.417
	Class 1	16(8.6%)	16(8.6%)	32(17.3%)	
	Class 2	26(14.1%)	25(13.5%)	51(27.6%)	
	Class 3	29(15.3%)	34(18.4%)	63(34.1%)	
	Class4	13(7%)	19(10.3%)	32(17.3%)	
	Class5	1(0.5%)	6(3.2%)	7(3.8%)	
8	**FINDRISC score**	8.09± 3.63	9.45±4.08	8.83±3.9	**0.019***

*p value <0.05 is considered as statistically significant.

The association between diabetes risk factors and FINDRISC score categories is presented in Table 2. Higher FINDRISC scores were significantly associated with advancing age (p = 0.007), increased BMI (p < 0.001), larger waist circumference (p < 0.001), physical inactivity (p = 0.035), use of antihypertensive medication (p = 0.001), and a positive family history of diabetes (p < 0.001). Participants with obesity (BMI >30 kg/m²) and elevated waist circumference were more frequently represented in the high-risk categories. Follow-up recommendations also showed a significant association with FINDRISC score categories (p < 0.001), with annual screening and periodic HbA1c monitoring being recommended predominantly for participants in the high and very high risk groups. However, no significant association was observed between FINDRISC score categories and a history of high blood glucose levels (p = 0.149).

TABLE 2: Evaluation of participants according to FINDRISC diabetic risk score (N=185)

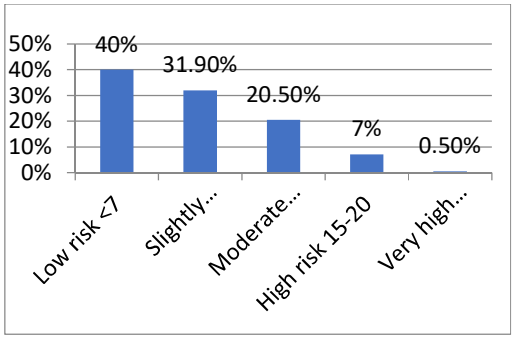
Variables	Low risk <7 (n=74)	Slightly elevated 7-11 (n=59)	Moderate risk 12-14 (n=38)	High risk 15-20 (n=13)	Very high risk >20 (n=1)	P value
Age (yrs)						**0.007***
< 45yrs	51(27.6)	25(13.5)	17(9.2)	4(2.2)	0	
45-54yrs	15(8.1)	16(8.6)	12(6.5)	6(3.2)	0	
55-64 yrs	6(3.2)	7(3.8)	3(1.6%)	2(1.1)	0	
>64 yrs	2 (1.1)	11 (5.9)	6 (3.2)	1 (0.5)	1 (0.5)	
BMI						**0.000***
<25 kg/m2	60(32.4)	36(19.5)	12(6.5)	0	0	
25-30	12(6	16(8	18(9.	4(2	0	

kg/m2	.5)	.6)	7)	.2)		
>30 kg/m2	2(1.1)	7(3.8)	8(4.3)	9(4.9)	1(0.5)	
Waist Circumference						**0.000***
<94cm for men/<80cm for women	32(17.3)	17(9.1)	7(3.8)	2(1.1)	0	
94-102cm for men/80-88cm for women	37(20)	34(18.3)	28(9.7)	3(1.6)	0	
>102cm for men/>88cm for women	15(7.8)	19(10.2)	18(9.7)	10(5.4)	1(0.5)	
Physical activity < 30 mins	34(18.4)	17(9.2)	11(5.9)	1(0.5)	0	**0.035***
History of antihypertensive drugs	6(3.2)	9(4.9)	11(5.9)	6(3.2)	1(0.5)	**0.001***
History of high blood glucose	1(0.5)	2(1.1)	3(1.6)	2(1.1)	0	0.149
Diabetes in Family						**0.000***
No history	51(27.6)	32(17.3)	11(5.9)	3(1.6)	0	
1st/2nd degree relatives	23(12.4)	27(14.6)	27(14.6)	10(5.4)	1(0.5)	
Follow up recommendations						**0.000***
Not recommended	74(40)	58(31.4)	38(20.5)	1(0.5)	0	
Recommended 3-5 years with HbA1c	0	0	0	12(6.5)	0	
Annual Screening	0	1(0.5)	0	0	1(0.5)	

*p value <0.05 is considered as statistically significant.

The distribution of participants according to the Finnish Diabetes Risk Score (FINDRISC) showed that 40.0% were at low risk, 31.9% at slightly elevated risk, 20.5% at moderate risk, 7.0% at high risk, and 0.5% at very high risk of developing type 2 diabetes mellitus within the next 10 years, as shown in Figure 1.

Figure 1: Distribution of Finnish Diabetes Risk Score (FINDRISC) in the study population (n=185)



The association between socio-demographic characteristics and FINDRISC diabetic risk score categories is presented in Table 3. A higher proportion of participants in the low-risk category (<7) were males (20.5%) and residents of rural areas (27.0%). Non-vegetarian diet was the predominant dietary pattern across all risk categories. Marital status showed a statistically significant association with FINDRISC score categories (p = 0.009), whereas gender (p = 0.460), area of residence (p = 0.542), type of diet (p = 0.877), habits (p = 0.982), and socioeconomic status (p = 0.624) did not demonstrate any significant association with diabetes risk categories.

Table 3: Association between the socio-demographic characteristics and the FINDRISC diabetic risk score category

Variables	**Low risk <7 (n=74)**	**Slightly elevated 7-11 (n=59)**	**Moderate risk 12-14 (n=38)**	**High risk 15-20 (n=13)**	**Very high risk >20 (n=1)**	**P value**
Gender						0.460
Male	38(2	28(1	15(8.	4(2.	0	

	0.5)	5.1)	1)	2)		
Female	36(19.5)	31(16.8)	23(12.4)	9(4.9)	1(0.5)	
Area of Residence						0.542
Rural	50(27)	43(23.2)	26(14.1)	10(5.4)	0	
Urban	24(13)	16(8.6)	12(6.5)	3(1.6)	1(0.5)	
Type of diet						0.877
Vegetarian	10(5.4)	9(4.9)	7(3.8)	1(0.5)	0	
Non-vegetarian	64(34.6)	50(27)	31(16.8)	12(6.5)	1(0.5)	
Marital status						**0.009***
Married	23(12.4)	7(3.8)	3(1.6)	1(0.5)	0	
Unmarried	51(27.6)	52(28.1)	35(18.9)	12(6.5)	1(0.5)	
Habits						0.982
Nil	57(30.8)	45(24.3)	30(16.2)	11(5.9)	1(0.5)	
Alcohol	8(4.3)	5(2.7)	2(1.1)	1(0.5)	0	
Smoking	8(4.3)	7(3.8)	6(3.2)	1(0.5)	0	
Tobacco	1(0.5)	2(1.1)	0	0	0	
Socio-economic status						0.624
Class I	14(7.6)	9(4.9)	7(3.8)	2(1.1)	0	
Class II	21(11.4)	18(9.7)	5(2.7)	7(3.8)	0	
Class III	23(12.4)	18(9.7)	3(1.6)	1(0.5)	1(0.5)	
Class IV	12(6.5)	12(6.5)	7(3.8)	1(0.5)	0	
Class V	4(2.2)	2(1.1)	1(0.5)	0	0	

*p value <0.05 is considered as statistically significant.

DISCUSSION

The present hospital-based cross-sectional study demonstrates that the Finnish Diabetes Risk Score (FINDRISC) is a practical, non-invasive, and feasible tool for identifying individuals at increased risk of type 2 diabetes mellitus (T2DM) in a tertiary care outpatient setting. Nearly one-third of participants (28%) were categorized as having a moderate-to-very high risk of developing T2DM within the next 10 years, emphasizing the vital role of opportunistic screening in routine clinical encounters. With rapidly increasing burden of diabetes in India and the high proportion of undiagnosed cases, implementing validated, non-invasive risk tools like FINDRISC can facilitate early lifestyle counselling and timely referral for diagnostic testing prior to the onset of overt clinical disease.

The study population had a mean age of 43.89 ± 14.68 years, with a female representation of 54.1%. Although male participants had a marginally higher mean age than females, this difference was not statistically significant. The majority of participants resided in rural areas, reflecting the primary catchment demographic of the tertiary care facility. These demographic patterns broadly align with findings by Sheikh et al.[8], who similarly observed a female predominance among adults evaluated with FINDRISC, albeit in a relatively older cohort. Likewise, studies by Doddamani et al. [9] and Hamedi et al. [10] reported mean participant ages ranging from 45 to 52 years, reinforcing that middle-aged adults represent the primary demographic for opportunistic diabetes risk assessment. The slightly younger mean age in our cohort likely reflects the inclusive sampling of all eligible outpatient attendees rather than limiting enrollment to older age groups. Furthermore, while hospital-based outpatient populations carry an inherent health-seeking selection bias, the high representation of rural attendees underscores the utility of simple, questionnaire-based tools in resourceconstrained primary and secondary care environments where access to routine laboratory screening remains limited.

The overall mean FINDRISC score in our study was 8.83 ± 3.90, with women exhibiting significantly higher mean scores than men ($p = 0.019$). Overall, 14 participants (7.6%) were classified into the high or very high risk categories, while 28% fell within the combined moderate-to-very high risk spectrum. These proportions are comparable to those reported by Chamorro et al.[11], who noted that 30.9% of their cohort fell into moderate-to-very high risk categories. Similarly, Sheikh et al. [8] reported that 11.24% of participants achieved a FINDRISC score ≥14, while Viitasalo et al. [12] and Gyberg et al. [13] observed high-risk prevalence rates of 12.9% and 8.4%, respectively. Although minor variations across studies stem from regional and demographic differences, these collective data confirm that FINDRISC effectively

stratifies outpatient populations to highlight those who warrant prioritized metabolic evaluation.

Because individual score components directly determine FINDRISC risk categories, analyzing their distribution provides insight into the primary risk drivers within this population. Age was significantly associated with higher risk categories ($p = 0.007$). This expected pattern reflects the well-established pathophysiology of T2DM, wherein advancing age correlates with progressive decline in β-cell function, reduced peripheral insulin sensitivity, and cumulative exposure to metabolic stressors. The strong alignment between age distribution and risk categories reflects the construct validity of the tool within this setting.

Excess adipose tissue deposition proved to be among the most prominent drivers of high FINDRISC scores. Both body mass index (BMI) and waist circumference demonstrated marked statistically significant associations across risk strata ($p < 0.001$). Participants with elevated BMI and central adiposity were disproportionately represented in the moderate and high-risk categories. These observations mirror findings by Doddamani et al.[9], who identified obesity as a leading contributor to elevated FINDRISC scores. Furthermore, large-scale epidemiological data from the ICMR-INDIAB study by Anjana et al. [7] identified general obesity and abdominal adiposity as the primary modifiable determinants of diabetes among Indian adults. Similarly, the Chennai Urban Rural Epidemiology Study (CURES) by Mohan et al. [14] highlighted the key role of central obesity in T2DM risk, reinforcing the value of simple anthropometric measurements in routine risk screening.

Physical inactivity was likewise significantly associated with higher risk classification ($p = 0.035$). Participants engaging in less than 30 minutes of daily physical activity were significantly more likely to fall into elevated risk tiers. Regular physical activity enhances skeletal muscle glucose uptake, improves insulin sensitivity, and aids weight maintenance, directly mitigating T2DM progression. This finding aligns with the foundational work of Lindström and Tuomilehto [5] during the initial derivation of FINDRISC, as well as Indian studies by Doddamani et al.[9] and Anjana et al.[7], which underscored physical inactivity as a critical modifiable target for primary prevention.

Antihypertensive medication usage was strongly associated with higher FINDRISC categories ($p = 0.001$). Hypertension frequently clusters with abdominal obesity and dyslipidemia as part of the metabolic syndrome, reflecting underlying insulin resistance. Sheikh et al. [8] similarly reported a higher prevalence of hypertension among individuals with elevated FINDRISC scores, while the ICMR-INDIAB study emphasized the frequent co-occurrence of hypertension and hyperglycemia in the Indian population[7], underscoring the need for routine diabetes screening in hypertensive clinic attendees.

A family history of diabetes showed a robust association with higher risk categories ($p < 0.001$), with participants reporting affected first- or second-degree relatives being significantly over-represented in the moderate-to-high risk strata. Consistent findings have been documented by Sheikh et al.[8], Doddamani et al.[9], and Pawar et al.[15] This strong relationship reflects shared genetic susceptibility alongside common familial lifestyle, dietary, and environmental risk factors.

In contrast to other parameters, a history of elevated blood glucose did not show a statistically significant association with FINDRISC categories in this sample. This finding likely stems from low baseline awareness, a small absolute number of participants with prior testing, and under-reporting due to limited routine blood glucose screening in the catchment population. Nevertheless, individuals with prior transient hyperglycemia remain at high risk and warrant ongoing biochemical surveillance regardless of their overall questionnaire score.

Interestingly, marital status demonstrated a significant association with risk categories, whereas baseline place of residence, dietary pattern, lifestyle habits, and socioeconomic status did not show significant univariate differences. A similar relationship regarding marital status was reported by Ture et al. [16] However, as noted by Karimi et al. [17], such associations in unadjusted analyses are frequently confounded by age, body weight, and age-related lifestyle changes rather than marital status itself. Given the cross-sectional nature of this study without multivariable adjustment, this finding should be interpreted with caution and explored further in prospective cohorts.

Overall, these findings affirm that FINDRISC is a simple, cost-effective, and practical first-line screening instrument suitable for routine outpatient settings in India. Because it relies entirely on non-invasive parameters, FINDRISC can be administered rapidly in busy outpatient departments without immediate laboratory support. Early identification of high-risk individuals enables clinicians to initiate targeted lifestyle modification, manage cardiovascular risk factors, and arrange timely biochemical testing using fasting plasma glucose or HbA1c.

CONCLUSION

The present study demonstrates that the FINDRISC questionnaire is a simple, valid, and practical tool for identifying individuals at increased risk of type 2 diabetes mellitus in outpatient settings. Its routine use can facilitate early risk detection, promote timely lifestyle interventions, and support diabetes prevention at the primary care level.

STRENGTHS AND LIMITATIONS

While this study benefits from using a standardized risk assessment tool, objective anthropometric measurements, and a real-world outpatient sample, certain limitations should be noted. The cross-sectional design precludes establishing causal relationships, convenient sampling from a single tertiary care centre may limit broader generalizability, and risk scores were evaluated without baseline biochemical confirmation like fasting glucose or HbA1c.

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