ORIGINAL RESEARCH ARTICLE

Prevalence of Diabetes Mellitus and Its Associated Factors among Registered Female Sex Workers in Belagavi, Karnataka, India: A Cross-Sectional Study Using Capillary Blood Glucose Screening

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ABSTRACT

Background: Diabetes mellitus (DM) is an emerging public health concern among marginalized populations such as female sex workers (FSWs), who often have limited access to non-communicable disease screening despite regular engagement with HIV programs. The objectives were to estimate diabetes prevalence and its associated factors among registered female sex workers in Belagavi.

Methods: A facility-linked cross-sectional study was conducted among 306 registered female sex workers selected by simple random sampling. Data were collected using structured interviews. Random capillary blood glucose (RCBG) levels were measured using a standardized glucometer. Diabetes was defined as self-reported diagnosed diabetes or RCBG ≥200 mg/dL. Associations were assessed using Chi-square/Fisher's exact tests.

Results: Diabetes prevalence was 5.9% (n=18; 95% CI: 3.5%-9.2%), including 8 previously diagnosed and 10 newly detected cases. Prediabetes prevalence was 16.3% (n=50; 95% CI: 12.5%-20.8%). Significant associations were observed between glucose status and age, marital status, tobacco use, alcohol use, hypertension, and work-related mental stress ($p<0.05$).

Conclusion: Diabetes (5.9%) and prediabetes (16.3%) were prevalent among female sex workers and were significantly associated with age, marital status, tobacco use, alcohol use, hypertension, and work-related mental stress. These findings highlight the need to integrate routine diabetes screening and targeted lifestyle interventions into existing programs for FSWs.

Keywords: Diabetes Mellitus, Female Sex Workers, Prevalence, Blood Glucose, India

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INTRODUCTION

Diabetes Mellitus (DM) is a group of metabolic disorders characterized by the presence of hyperglycaemia resulting from defects in insulin secretion, insulin action, or both.[1] The IDF Diabetes Atlas, 11th Edition (2025) reported that about 589 million adults (20-79 years) worldwide were living with diabetes in 2024, which is projected to rise to 853 million by 2050 due to aging populations, rapid urbanization, and lifestyle changes. Nearly 43% of global cases remain undiagnosed, leading to complications, 3.4 million diabetes-related deaths, and healthcare costs exceeding USD 1 trillion in 2024. India contributes significantly to this global burden, with 89.8 million adults (20-79 years) having diabetes, with an age-standardized prevalence of 10.5%, which is projected to reach 156.7 million (12.8%) by 2050.[2]

The ICMR-INDIAB national cross-sectional study reported an overall prevalence of 7.3% across 15 states, with higher rates in urban areas, especially in southern states like Karnataka.[3] Studies from coastal Karnataka report prevalence rates as high as 16% among adults.[4] A 2016 study in rural Hubballi, Karnataka, found a 22% diabetes prevalence and a 14.7% prediabetes prevalence among the population. Using the Indian Diabetic Risk Score (IDRS), the study highlighted a high burden of previously undetected and uncontrolled diabetes in the region.[5]

Belagavi district shares similar sociodemographic and epidemiological characteristics with other high-burden regions in Karnataka. However, data on diabetes among vulnerable groups, especially female sex workers (FSWs), remain scarce. FSWs, defined as women who exchange sexual services for income, represent a key marginalized group with significant health vulnerabilities.[6] Programmatic mapping by NACO confirms a substantial FSW population in Karnataka.[7] These women often face intersecting challenges such as stigma, discrimination, violence, and limited access to healthcare, leading to poorer physical and mental health outcomes.[8,9]

Most research and public health programs on FSWs in India focus on HIV and sexually transmitted infections (STIs). However, emerging evidence shows an increasing burden of NCDs in this population.[10] A study from Eastern India reported a 3% diabetes prevalence, 14% hypertension, and 55% obesity among FSWs, indicating a substantial but often overlooked NCD burden.[11] Socio-behavioral vulnerabilities poor diet, stress, lack of healthcare access, sedentary lifestyle, and stigma can further amplify diabetes risk.[12]

Despite their regular engagement with HIV prevention and care programs, FSWs often miss NCD screening opportunities. In Belagavi, where local data are absent, understanding the diabetes burden among FSWs is essential to inform targeted and integrated health interventions. This study aimed to estimate the prevalence of diabetes mellitus among registered female sex workers in Belagavi. It also assessed the association of glucose status with sociodemographic, behavioral, and clinical factors, including hypertension and mental stress.

METHODOLOGY

The present study was a facility-linked, NGO-based cross-sectional study conducted from March 2025 to March 2026. The study was carried out at the Belagavi Integrated Rural Development Society (BIRDs), a non-governmental organization located in Belagavi, Karnataka.

The study participants comprised registered female sex workers (FSWs) affiliated with BIRDs NGO. Female sex workers aged 18–57 years who provided informed consent were included in the study. Participants who were severely ill or unable to undergo the study procedures at the time of recruitment were excluded.

The source population consisted of all FSWs registered with BIRDs NGO, Belagavi, Karnataka, with a total of 350 individuals recorded in the registry. Among the eligible participants approached for the study, 306 consented to participate and successfully completed the study.

Sample Size:

$$n = \frac{N \cdot Z_{\alpha/2}^2 \cdot p(1-p)}{d^2(N-1) + Z_{\alpha/2}^2 \cdot p(1-p)}$$

The sample size was calculated using the finite population proportion formula described by Lwanga and Lemeshow[13], considering a total population of 350 registered FSWs, an expected diabetes prevalence of 6.3% from a previous Karnataka study[14], an absolute precision (d) of 0.009 (equivalent to 15% relative precision of the assumed prevalence of 6.3%), and a 95% confidence level ($Z\alpha/2 = 1.96$). The calculated minimum sample size after finite population correction was 306 participants.

A simple random sampling technique was employed to select study participants from the registry of female sex workers

Data collection: Ethical clearance was obtained from the Institutional Ethics Committee of Jawaharlal Nehru Medical College (JNMC), Belagavi (IEC Approval No: MDC/JNMCIEC/224). Permission to conduct the study was also obtained from the BIRDs NGO authorities. Written informed consent was obtained from all participants prior to data collection. The study was retrospectively registered with the Clinical Trials Registry of India (CTRI) (Registration No. CTRI/2025/11/097918). Participant recruitment had commenced before CTRI registration; therefore, the study was registered retrospectively. The registration was completed prior to data analysis and manuscript preparation to enhance transparency and ensure compliance with reporting requirements for observational studies.

Data were collected through face-to-face interviews conducted by a trained female investigator using a structured questionnaire administered in Kannada, in order to minimize interviewer and measurement bias. The study questionnairewas developed by the authors based on a literature review and covered socio-demographic details, diabetes screening/history, lifestyle factors, and economic burden. Selected items were adapted from a previously published study on sex workers in Mumbai.[15] The tool was pilot-tested on 30 unregistered FSWs to assess clarity and feasibility, and necessary modifications were made based on pilot findings. Random capillary blood glucose (RCBG) was measured at a random (non-fasting) time using a PMBJP (Pradhan Mantri Bhartiya Janaushadhi Pariyojana)-supplied digital glucometer (Drug Code: 8122), manufactured by Sensa Core Medical Instrumentation Pvt. Ltd., Hyderabad, India. The device was calibrated daily using a control solution according to the manufacturer's instructions. The PMBJP glucometer complied with ISO 15197:2013, which requires that at least 95% of glucose meter results fall within ±15 mg/dL of the reference method for glucose concentrations <100 mg/dL and within ±15% for concentrations ≥100 mg/dL.[16] However, capillary glucose measurements may differ from venous plasma glucose measurements because of physiological and analytical variability.[17] Therefore, RCBG was used as a screening tool rather than a confirmatory diagnostic method in this study.[18] Height was measured using a stadiometer (cm) and weight using a calibrated digital weighing scale (kg). Body mass index (BMI) was calculated as weight (kg)/height (m^2) and categorized according to WHO Asia-Pacific guidelines.[19]

Operational definitions:

Female sex workers (FSWs): women aged 18-57 years whose primary livelihood involves exchanging sexual services for money or gifts, registered with BIRDs NGO.

Diabetes mellitus: Defined as either known diabetes (self-reported physician-diagnosed diabetes or current use of anti-diabetic medication) or screen-detected probable diabetes (RCBG ≥200 mg/dL) among participants without a prior diagnosis of diabetes.[20] This represents a screening-based classification and does not constitute a confirmed diagnosis as per ADA/WHO criteria.[21]

Prediabetes: Defined as RCBG 140-199 mg/dL and considered a field-based screening approximation, not a standard diagnostic classification.[21]

Alcohol use was defined as current use at the time of survey.

Tobacco use was defined as current use of any form (smokeless or smoked), with duration recorded in years.

Data Processing and statistical analysis: Data were coded and entered in Microsoft Excel, and further analysis was done using IBM SPSS Statistics for Windows, Version 26.0. Descriptive statistics (frequencies and percentages) summarized participant characteristics and diabetes prevalence. Inferential analysis was performed using the Chi-square test/Fisher's exact test to assess associations between diabetes and variables (alcohol use, education, BMI category, etc.). Exact 95% confidence intervals for prevalence estimates were calculated using the Clopper-Pearson method. The dataset was checked for completeness before analysis, and no significant missing data were identified. A p-value <0.05 was considered statistically significant.

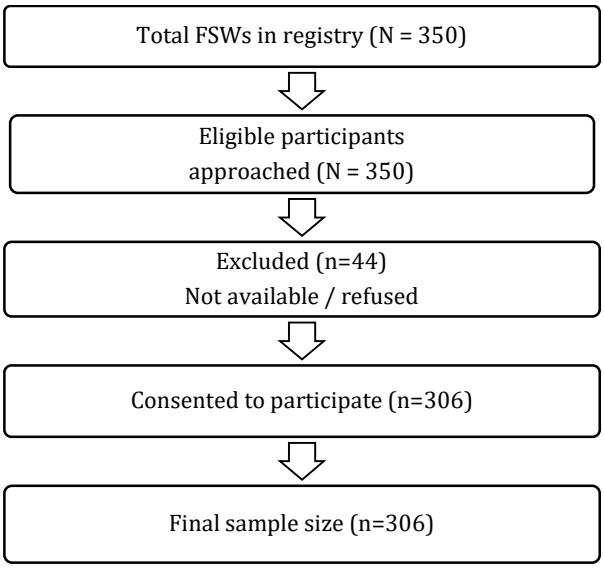

Figure 1: Flow Diagram of Study Participants

RESULTS

Out of 306 participants, 238 (77.8%) had normal glucose levels, 50 (16.3%) had prediabetes, and 18 (5.9%) had diabetes. Among the 18 diabetes cases, 8 were previously diagnosed (self-reported or on treatment), and 10 were screen-detected probable diabetes cases based on RCBG ≥200 mg/dL (Table 1).

Table 1: Prevalence of Diabetes Mellitus among registered FSWs (n=306)

Glucose level	Frequency (n)	Percentage (%) [95% CI]
Normal range	238	77.8 (72.8-82.2)
Prediabetes	50	16.3 (12.5-20.8)
Diabetes	18	5.9 (3.5-9.2)
Total	306	100%

Note: Values in parentheses represent 95% confidence intervals calculated using the Clopper-Pearson exact method.

Age, marital status, and economic status showed statistically significant associations with glucose levels among participants (p<0.05). Type of family, residence, religion, caste category, education level, current living arrangement, duration of sex work, and

client volume were not significantly associated with glucose levels (p>0.05) (Table 2).

Chronic illnesses and work-related mental illness showed statistically significant associations with glucose levels among participants (p<0.05). Among participants with hypertension, 46.2% had prediabetes and 38.5% had diabetes. Among participants with HIV/AIDS, 37.5% had prediabetes and 37.5% had diabetes. Participants with other comorbidities were predominantly normoglycemic (80.0%), while 20.0% had diabetes. Work-related mental illness was also significantly associated with glucose levels (p<0.05) (Table 4).

Table 2: Association of Socio-demographic and Occupational Variables with Glucose Levels among Participants (n=306)

Variable	Glucose level			Total (n=306)	p-Value
	Normal range (n=238) (%)	Prediabetes (n=50) (%)	Diabetes (n=18) (%)		
Age					
18 - 27	100 (87.0)	13 (11.30)	2 (1.70)	115	**0.001***
28 - 37	101 (82.10)	21 (17.10)	1 (0.80)	123	
38 - 47	34 (64.20)	13 (24.50)	6 (11.30)	53	
48 - 57	3 (20.0)	3 (20.0)	9 (60)	15	
Marital Status					
Single	28 (82.4)	6 (17.6)	0 (0.0)	34	**0.008***
Married	131 (79.9)	26 (15.9)	7 (4.30)	164	
Divorced	21 (80.8)	4 (15.4)	1 (3.8)	26	
Widowed	24 (57.1)	10 (23.8)	8 (19.0)	42	
Separated	34 (85.0)	4 (10.0)	2 (5.0)	40	
Religion					
Hindu	202 (77.7)	41 (15.8)	17 (6.5)	260	0.463
Muslim	24 (80.0)	5 (16.7)	1 (3.3)	30	
Christian	7 (63.6)	4 (36.4)	0 (0.0)	11	
Other	5 (100)	0 (0.0)	0 (0.0)	5	
Caste Category					
SC	68 (75.60)	17 (18.90)	5 (5.60)	90	0.806
ST	47 (79.7)	9 (15.30)	3 (5.10)	59	
OBC	73 (74.50)	18 (18.40)	7 (7.10)	98	
General	50 (84.70)	6 (10.20)	3 (5.10)	59	
Education					
Illiterate	73 (76.0)	14 (14.6)	9 (9.4)	96	0.737
Primary	101(77.1)	25(19.1)	5(3.8)	131	
Secondary	42 (82.4)	7(13.7)	2(3.9)	51	
Higher Secondary	16 (80.0)	3 (15.0)	1 (5.0)	20	
Graduate and above	6 (75.0)	1 (12.5)	1 (12.5)	8	
Family Type					
Joint	33 (75.0)	8 (18.2)	3 (6.8)	44	0.889
Nuclear	205 (78.2)	42 (16.0)	15 (5.7)	262	
Economic Status					
BPL	234 (78.3)	49 (16.4)	16 (5.4)	299	**0.035***
APL	4 (57.10)	1 (14.3)	2 (28.6)	7	
Residential Status					
Urban	84 (80.0)	14 (13.3)	7 (6.7)	105	0.456
Rural	86 (72.9)	25 (21.2)	7 (5.9)	118	
Semi-urban	68 (81.9)	11 (13.3)	4 (4.8)	83	
Current Living Arrangement					
Alone	28 (84.80)	4 (12.10)	1 (3.00)	33	0.311
With Family	110 (80.90)	16 (11.80)	10 (7.40)	136	
With Children	58 (74.40)	17 (21.80)	3 (3.80)	78	
With Other Sex Workers	42 (71.20)	13 (22.00)	4 (6.80)	59	
Duration of sex work					
0-5 years	24 (100)	0 (0.00)	0 (0.00)	24	0.86
6-10 years	110 (76.40)	27 (18.80)	7 (4.90)	144	
11-15 years	31 (83.80)	3 (8.10)	3 (8.10)	37	
16-20 years	32 (68.10)	12 (25.50)	3 (6.40)	47	
21-25 years	41 (75.90)	8 (14.80)	5 (9.30)	54	
Client's volume (weekly)					
0-5 person	114 (78.60)	25 (17.20)	6 (4.10)	145	0.052
6-10 people	99 (78.00)	20 (15.70)	8 (6.30)	127	
11-15 people	25 (73.50)	5 (14.70)	4 (11.80)	34	

Note: p-value was computed using Chi-square test/Fisher's exact test. *p<0.05 considered statistically significant.

Table 3: Association of Lifestyle Factors and Glucose Level among participants (n=306)

Variable	Glucose level			Total (n=306)	p-Value
	Normal range (n=238) (%)	Prediabetes (n=50) (%)	Diabetes (n=18) (%)		
Tobacco use					
Yes	56 (69.10)	14 (17.30)	11 (13.60)	81	**0.002***
No	182 (80.90)	36 (16.0)	7 (3.10)	225	
Duration of Tobacco Use					
0-5 years	10 (66.70)	3 (20.00)	2 (13.30)	15	**0.001***
6-10 years	31 (81.60)	5 (13.20)	2 (5.30)	38	
11-15 years	9 (50.00)	5 (27.80)	4 (22.20)	18	
16-20 years	6 (60.00)	1(10.00)	3 (30.00)	10	
Alcohol use					
Yes	73 (66.40)	26 (23.60)	11 (10.0)	110	**0.001***
No	165 (84.20)	24 (12.20)	7 (3.60)	196	
Physical Activity					
Daily	17 (81.0)	3 (14.30)	1 (4.8)	21	0.573
Occasionally	70 (80.50)	12 (13.80)	5 (5.70)	87	
Rarely	91 (81.20)	15 (13.40)	6 (5.40)	112	
Never	60 (69.80)	20 (23.30)	6 (7.0)	86	
BMI Category					
Under weight	19 (67.90)	6 (21.40)	3 (10.70)	28	0.479
Normal	102 (81.60)	19 (15.20)	4 (3.20)	125	
Overweight	48 (76.20)	9 (14.30)	6 (9.50)	63	
Obese	69 (76.70)	16 (17.80)	5 (5.60)	90	
Dietary habits					
Balanced	114 (79.70)	22 (15.40)	7 (4.90)	143	0.416
High carbohydrate	40 (87.00)	5 (10.90)	1 (2.20)	46	
High sugar/fat	11 (68.80)	3 (18.80)	2 (12.50)	16	
Irregular meals	73 (72.30)	20 (19.80)	8 (7.90)	101	
Daily Tea/Coffee (Cups)					
1	55 (74.30)	10 (13.50)	9 (12.20)	74	**0.03***
2	94 (77.00)	24 (19.70)	4 (3.30)	122	
3	59 (88.10)	7 (10.40)	1 (1.50)	67	
4	30 (69.80)	9 (20.90)	4 (9.30)	43	
Sweetening Agent					
with sugar	175 (74.20)	46 (19.50)	15 (6.40)	236	**0.048***
with jaggery	47 (90.40)	2 (3.80)	3 (5.80)	52	
without sugar/jaggery	16 (88.90)	2 (11.10)	0 (0.00)	18	
Sweet timing					
Before the start of the meal	109 (79.00)	21 (15.20)	8 (5.80)	138	0.804
At the end of the meal	84 (74.30)	21 (18.60)	8 (7.10)	113	
No habit	45 (81.80)	8 (14.50)	2 (3.60)	55	
Rice consumption					
1 Time	12 (85.70)	0 (0.00)	2 (14.30)	14	0.353
2 Time	108 (80.60)	21 (15.70)	5 (3.70)	134	
3 Time	114 (74.50)	28 (18.30)	11 (7.20)	153	
4 Time	4 (80.00)	1 (20.00)	0 (0.00)	5	

Note: p-value was computed using Chi-square test/Fisher's exact test. *p<0.05 considered statistically significant.

Table 4: Association of Selected Comorbidities and Mental Health Status by Glucose Level among Participants (n=306)

Variable	Glucose level			Total (n=306)	p-Value
	Normal range (n=238) (%)	Prediabetes (n=50) (%)	Diabetes (n=18) (%)		
Chronic Illnesses					
Hypertension	2 (15.40)	6 (46.20)	5 (38.50)	13	**0.001***
HIV/AIDS	2 (25.00)	3 (37.50)	3 (37.50)	8	
Other Comorbidities	4 (80.00)	0 (0.00)	1 (20.00)	5	
Work-related Mental Stress					
Yes	43 (62.3)	15 (21.7)	11 (15.9)	69	**0.001***
No	134 (86.5)	18 (11.6)	3 (1.9)	155	
Don't know	26 (66.7)	11 (28.6)	2 (5.1)	39	
Don't want to answer	35 (81.4)	6 (14.0)	2 (4.7)	43	

Note: p-values were computed using the Chi-square test/Fisher's exact test. *p<0.05 considered statistically significant. Due to small cell sizes, TB (n=2), kidney disease (n=1), and other conditions (n=2) were combined into a single category labelled "Other comorbidities" for analysis. Chronic illness categories were mutually exclusive; each participant was classified into only one comorbidity category.

Table 5. Univariable and multivariable logistic regression analysis of factors associated with prediabetes (n=288)

Category	Unadjusted OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age group (years)				
18-27	1.00 (reference)	-	1.00 (reference)	-
28-37	1.60 (0.76-3.37)	0.217	1.69 (0.79-3.64)	0.179
38-47	2.94 (1.24-6.96)	**0.014**	2.78 (1.12-6.91)	**0.028**
48-57	7.69 (1.40-42.17)	**0.019**	5.67 (0.93-34.43)	0.059
Marital status				
Married	1.00 (reference)	-	1.00 (reference)	-
Unmarried	1.13 (0.61-2.08)	0.695	0.99 (0.51-1.92)	0.974
Economic status				
BPL	1.00 (reference)	-	1.00 (reference)	-
APL	1.19 (0.13-10.91)	0.875	1.43 (0.15-13.79)	0.757
Tobacco use				
Yes	1.00 (reference)	-	1.00 (reference)	-
No	1.26 (0.64-2.51)	0.504	1.10 (0.51-2.39)	0.81
Alcohol use				
Yes	1.00 (reference)	-	1.00 (reference)	-
No	0.41 (0.22-0.76)	**0.005**	0.41 (0.21-0.81)	**0.011**
Tea/coffee consumption				
<2 cups/day	1.00 (reference)	-	1.00 (reference)	-
>2 cups/day	0.79 (0.41-1.51)	0.472	0.88 (0.44-1.76)	0.712
Sweetening agent				
With sugar/jaggery	1.00 (reference)	-	1.00 (reference)	-
Without sugar/jaggery	0.58 (0.13-2.60)	0.475	0.67 (0.14-3.17)	0.616
Work-related Mental Stress				
Yes	1.00 (reference)	-	1.00 (reference)	-
No	0.52 (0.26-1.03)	0.059	0.64 (0.30-1.36)	0.246

Note: OR = Odds Ratio; aOR = Adjusted Odds Ratio; CI = Confidence Interval; BPL = Below Poverty Line; APL = Above Poverty Line. Crude ORs were obtained from bivariate binary logistic regression analyses. Variables with $p < 0.20$ in the bivariate analysis were included in the adjusted logistic regression model. The first category of each variable was used as the reference category. Hypertension was excluded from the adjusted model because of sparse data and model instability.

Participants aged 38-47 years had higher odds of prediabetes than those aged 18-27 years (aOR=2.78; 95% CI: 1.12-6.91; p=0.028). Participants who did not consume alcohol had lower odds of prediabetes than alcohol users (aOR=0.41; 95% CI: 0.21-0.81; p=0.011). No significant associations were observed for marital status, economic status, tobacco use, tea/coffee consumption, sweetening agent use, mental stress, or the other age groups (Table 5).

DISCUSSION

The present cross-sectional study assessed the prevalence of diabetes mellitus among 306 registered female sex workers (FSWs) in Belagavi district. The prevalence of diabetes was 5.9% (n=18), including 8 previously diagnosed and 10 screen-detected probable diabetes cases**,** and prediabetes prevalence was 16.3%. Significant associations were observed between glucose status and socio-demographic factors such as age and marital status, behavioral factors including tobacco and alcohol use, and clinical conditions such as hypertension and work-related mental stress. However, occupational characteristics related to sex work were not significantly associated with glucose levels.

The prevalence of diabetes observed in this study (5.9%) was higher than that reported among FSWs in Eastern India (3%).[11] However, it remains lower than estimates from the general adult population in Karnataka, which range from 16% in coastal regions in urban populations. [4] The findings are comparable to national estimates from the ICMR-INDIAB study (7.3%).[3] The observed prediabetes prevalence of 16.3% indicates a substantial burden of glucose dysregulation in this vulnerable population. However, this estimate should be interpreted with caution, as prediabetes was identified using random capillary blood glucose (RCBG)-based screening rather than standard diagnostic criteria such as fasting plasma glucose, oral glucose tolerance testing, or HbA1c. Therefore, direct comparisons with prevalence estimates reported by the International Diabetes Federation (IDF)[2] and other studies using standard diagnostic methods may not be appropriate. The lower prevalence of diabetes observed in this study compared to the general adult population in Karnataka may be explained by several factors. First, the study population comprised relatively younger individuals, which may have contributed to a lower overall prevalence. Second, inclusion of only registered FSWs affiliated with an NGO may introduce selection bias. Third, underdiagnosis cannot be ruled out due to limited access to routine non-communicable disease screening in marginalized populations. Finally, the use of random capillary blood glucose as a screening tool rather than confirmatory diagnostic tests may have affected the accuracy of prevalence estimation.

Increasing age showed a strong association with diabetes, consistent with established evidence linking advancing age with declining β-cell function and in-

creasing insulin resistance commonly observed among South Asian populations.[22] In the present study, widowed or separated participants had a higher prevalence of diabetes, possibly reflecting the impact of chronic psychosocial stress and reduced social support affecting metabolic health. In the present study, behavioral risk factors such as tobacco and alcohol consumption were significantly associated with diabetes, consistent with known biological mechanisms affecting insulin resistance and glucose metabolism. Similar findings were reported in a study assessing the risk of non-communicable diseases among sex workers in India, which identified substance use as an important contributor to NCD risk.[15]

In the present study, participants below the poverty line had a higher prevalence of diabetes, which may reflect limited healthcare access and delayed diagnosis. This finding differs from NFHS-based analyses showing higher prevalence among wealthier groups, suggesting contextual variation in marginalized populations.[23] Hypertension showed a significant association with diabetes status in the present study. This finding reflects the clustering of cardiometabolic risk factors characteristic of metabolic syndrome, which has been widely documented among urban slum women in Karnataka.[24] Additionally, in the present study, work-related mental stress was significantly associated with diabetes. Chronic psychological stress may influence glucose regulation through neuroendocrine mechanisms involving prolonged cortisol secretion, thereby increasing susceptibility to diabetes.[25] As this study is cross-sectional, the observed associations cannot establish causality; however, the findings suggest an interaction between biological, behavioral, and social determinants contributing to non-communicable disease risk among FSWs.

In the adjusted analysis, participants aged 38-47 years had significantly higher odds of prediabetes compared with those aged 18-27 years (aOR=2.78; 95% CI: 1.12-6.91; p=0.028). Participants aged 48-57 years also had higher odds of prediabetes; however, the association did not reach statistical significance (aOR=5.67; 95% CI: 0.93-34.43; p=0.059). Alcohol use remained significantly associated with prediabetes after adjustment for potential confounders. Participants who did not consume alcohol had lower odds of prediabetes compared with alcohol users (aOR=0.41; 95% CI: 0.21-0.81; p=0.011).

No statistically significant association was observed between BMI and diabetes. The BMI distribution showed that 28 (9.2%) participants were underweight, 125 (40.8%) had normal BMI, and 90 (29.4%) were either overweight or obese. Although a substantial proportion of participants were overweight or obese, the lack of statistical significance may be due to the small number of diabetes cases (n=18), limiting statistical power and increasing the possibility of a Type II error. Additionally, the South Asian thin-fat phenotype may attenuate or obscure the usual association between BMI and diabetes risk, because South Asians can develop diabetes at relatively lower BMI and with greater central adiposity.[26] Similarly, occupational variables such as duration of sex work and client volume were not significantly associated with glucose levels. The lack of association may be due to the relative homogeneity of occupational exposure and limited statistical power.

From a public health perspective, the identification of a substantial proportion of prediabetes (16.3%) represents an important opportunity for early prevention and intervention in this vulnerable population. Integrating opportunistic screening for diabetes and prediabetes into existing National AIDS Control Organisation (NACO) and State AIDS Control Society (SACS) outreach programmes for FSWs could facilitate early detection. Targeted interventions such as lifestyle counselling, dietary modification, tobacco and alcohol cessation, and promotion of physical activity can be delivered through peer educators and outreach workers. Strengthening referral linkages for confirmatory testing and follow-up care is essential to prevent progression to diabetes.

Strengths and Limitations

This study is among the first to assess diabetes prevalence among FSWs in Belagavi. It included a well-defined sampling frame, and data collection by trained female investigators likely improved response accuracy.

The cross-sectional design precludes causal inference. Diabetes and prediabetes were identified using random capillary blood glucose (RCBG), a screening rather than diagnostic tool. Fasting status was not recorded, glucose values may have been influenced by recent food intake, and confirmatory testing was not performed for newly detected cases; therefore, reported prevalence estimates may include false positives and should not be considered definitive. Behavioral variables were self-reported and susceptible to recall and social desirability bias. The small number of diabetes cases (n=18) limited statistical power and reduced the stability of multivariable logistic regression, increasing the risk of overfitting and imprecise odds ratio estimates. As participants were recruited from FSWs registered with BIRDs NGO, findings may not be generalizable to unregistered or hidden FSWs in Belagavi or elsewhere in Karnataka. Small numbers in some comorbidity categories and predictor groups reduced the precision and stability of subgroup and adjusted analyses; consequently, hypertension could not be retained in the final model, and related findings should be interpreted cautiously.

Conclusion

A considerable burden of diabetes (5.9%) and prediabetes (16.3%) was observed among female sex

workers in Belagavi. Significant bivariate associations were observed with age, marital status, tobacco use, alcohol use, hypertension, and mental stress. The high prevalence of prediabetes highlights a critical window for prevention. Integrating screening and preventive interventions for both diabetes and prediabetes into existing outreach programmes for FSWs may help reduce the future burden of non-communicable diseases in this population.

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Availability of Data: The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

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