Mediterranean Journal of Pharmacy & Pharmaceutical Sciences
ISSN: 2789-1895 online
www.medjpps.com
doi: 10.5281/zenodo.21833707
ISSN: 2958-3101 print

ORIGINAL RESEARCH article

Impact of cardiovascular risk screening in an academic institution, Benghazi, Libya

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Received: 13-04-2026, **Accepted**: 02-08-2026, **Published online:** 07-08-2026

HOW TO CITE THIS

Elferjany SM, et al. Impact of cardiovascular risk screening in an academic institution, Benghazi, Libya. Mediterr J Pharm Pharm Sci. 2026; 6(3): 40-49. [Article number: 260]. https://doi.org/10.5281/zenodo.21833707

Keywords: Academic institution, cardiovascular disease, cardiovascular risk, Libyan International University

Abstract: Cardiovascular disease (CVD) is a leading cause of mortality in Libya, driven by obesity, hypertension, diabetes, and smoking. Inadequate screening contributes to the widespread undiagnosed status of risk factors, with university staff particularly vulnerable due to occupational and lifestyle factors. This study aimed to assess the prevalence of cardiovascular risk factors, evaluate risk awareness, and determine the impact of a pharmacist-led screening intervention on behavioral intentions among employees in an academic institution in Benghazi, Libya. A cross-sectional interventional study was conducted among 179 university employees. Data were collected in two phases. In the baseline phase, participants completed questionnaires on demographics, lifestyle, medical history, and CVD awareness, followed by clinical measurements. After pharmacist-led counseling and personalized feedback, post-intervention assessments of awareness and behavioral intentions were performed. Participants were mostly female (62.6%), aged 20-35 years (61.5%), and Libyan (89.9%). The most prevalent undiagnosed CVD risk factors were dyslipidemia (66.5%), overweight (63.1%), and hypertension (20.7%). Post-screening awareness was high (mean score 9.06/10), especially for obesity (99.4%) and hypertension (97.2%). The pharmacist-led intervention strongly improved lifestyle intentions: increasing physical activity (97.8%), improving diet (98.9%), attending regular check-ups (92.2%), and using digital monitoring (91.6%). Significant associations were found between socio-demographic factors and CVD risks, as well as between lifestyle habits and clinical outcomes. A high prevalence of undiagnosed CVD risk factors exists among university employees despite good awareness levels. Pharmacist-led workplace screening effectively increased intentions to adopt healthier behaviors, supporting the integration of clinical pharmacists into wellness programs to reduce the CVD burden in Libya.

Introduction

Cardiovascular diseases (CVDs) remain the leading cause of mortality worldwide, accounting for more than 17 million deaths annually, with over 75.0% occurring in low- and middle-income countries [1, 2]. In North Africa and the Middle East, the burden of CVD is increasing due to the rising prevalence of hypertension, diabetes, obesity, smoking, physical inactivity, and unhealthy dietary patterns [2]. Libya reflects these trends, with high

rates of obesity, diabetes, hypertension, and dyslipidemia contributing substantially to preventable cardiovascular morbidity and mortality [3-5]. Despite the growing burden, cardiovascular screening and prevention programs in Libya remain limited because of healthcare system challenges and political instability, resulting in many undiagnosed cases until complications occur [6]. Early detection through cardiovascular risk screening has been shown to improve awareness and control of modifiable risk factors, with the INTERHEART study demonstrating that most myocardial infarctions are linked to preventable factors such as smoking, hypertension, diabetes, obesity, and dyslipidemia [7, 8].

Academic institutions represent practical settings for screening programs, as university employees are often exposed to sedentary lifestyles, occupational stress, and unhealthy behaviors. Previous studies have reported high rates of obesity, hypertension, and physical inactivity among university staff [9, 10], while low awareness and engagement in screening have also been observed in North African populations [11]. Pharmacist-led interventions have demonstrated effectiveness in improving cardiovascular risk detection, patient counseling, and disease management [12]. Therefore, this study aims to implement and evaluate a pharmacist-led cardiovascular risk screening program among university staff in Benghazi, Libya, to assess the prevalence of modifiable risk factors and support future institutional and national prevention strategies.

Materials and methods

Study design: This study employed a cross-sectional interventional design to assess the impact of cardiovascular risk factor screening among employees of the Libyan International University (LIMU) in Benghazi. Data were collected at a single point in time to establish baseline prevalence of risk factors, awareness levels, and behavioral intentions. A cross-sectional interventional study of 179 employees at LIMU in Benghazi was conducted. The pharmacist-led intervention consisted of a single 20-30-minute individualized screening and education session delivered immediately after baseline clinical measurements. Sessions included personalized feedback on results, risk interpretation using visual aids, and brief motivational counseling on modifiable factors (e.g., diet, physical activity, smoking cessation). Post-intervention assessments occurred immediately after the session. The intervention includes a pharmacist-led screening and education session, with pre- and post-assessment of awareness and behavioral outcomes.

Study setting: The study is conducted at LIMU, Benghazi, Libya. The target setting is the workplace environment, which offers a unique platform for health promotion and structured screening. University employees represent a diverse group with varied lifestyles and health profiles. This makes academic institutions a suitable site for identifying risk factors and implementing preventive interventions.

Study population and sampling: The study population includes all categories of LIMU employees: administrative, academic, and support staff. Inclusion criteria were current employment at LIMU and consent to participate. Exclusion criteria include staff with a diagnosed cardiovascular condition already under specialist management. A convenience sampling approach is used to maximize recruitment within the study's timeframe. Previous health-related studies in institutional settings have successfully applied this method [13, 14].

Data collection tool: Data were collected using a structured questionnaire specifically designed for this study and adapted from validated instruments employed in previous cardiovascular risk assessments [15, 16]. The final instrument comprised seven sections: (1) demographic information, including age, gender, nationality, and marital status to establish baseline characteristics for stratification and subgroup analysis; (2) socioeconomic and educational factors, such as education level and employment status, to evaluate the influence of socioeconomic background on cardiovascular risk factors and awareness; (3) lifestyle and behavioral habits, encompassing

smoking history, alcohol consumption, physical activity (classified according to World Health Organization criteria), and dietary patterns to capture modifiable behavioral risk factors associated with CVS development; (4) medical and family history, including self-reported diagnoses of hypertension, diabetes, dyslipidemia, or cardiovascular disease, as well as family history of cardiovascular conditions to assess genetic predisposition; (5) clinical measurements, comprising blood pressure, fasting blood glucose, lipid profile (total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglycerides), body mass index, and waist circumference, all were obtained using standardized protocols and validated devices; (6) cardiovascular risk awareness, assessed via a validated 10-item questionnaire measuring participants' knowledge of major risk factors (obesity, smoking, hypertension, elevated cholesterol, diabetes, physical inactivity, poor diet, family history, aging/menopause, and alcohol consumption), with yes/no responses coded as 1 or 0 to generate a total awareness score ranging from 0 to 10, and (7) behavioral intentions following screening, evaluating participants' willingness to adopt preventive measures, including dietary improvements, increased physical activity, smoking cessation, attendance at medical follow-ups, and utilization of digital health monitoring.

Data collection was conducted in two phases. In Phase 1 (baseline), participants completed the demographic, lifestyle, medical history, and awareness sections of the questionnaire, followed by clinical measurements performed by trained pharmacists using standardized equipment. In Phase 2 (post-intervention), after receiving pharmacist-led counseling and personalized feedback, participants again completed the awareness and behavioral intention sections to enable pre- and post-screening comparisons. The questionnaire underwent rigorous face and content validation by experts in clinical pharmacy and public health. Additionally, a pilot test involving five LIMU employees was conducted to assess clarity, reliability, and cultural appropriateness, with feedback incorporated to refine the instrument before full implementation.

Trained clinical pharmacists (with prior certification in cardiovascular risk assessment and standardized measurement protocols) performed all clinical measurements. Training included hands-on workshops on standardized blood pressure measurement (using validated automated devices per WHO guidelines), anthropometric assessments (BMI, waist circumference), and point-of-care or laboratory lipid/glucose testing, with inter-rater reliability checks.

Behavioral intentions were assessed only by post-intervention (as a measure of immediate impact), while awareness was assessed both pre- and post-screening. Pre-post changes in awareness scores were analyzed using paired t-tests ($p < 0.05$). Due to the single-session design, behavioral intentions were evaluated as post-intervention self-reported willingness to change.

In this study, "awareness" refers to participants' self-reported recognition of specific CVD risk factors (measured via the 10-item questionnaire). "Knowledge" encompasses the factual understanding assessed within these items. "Behavior" primarily reflects self-reported behavioral intentions post-intervention, as a proximal indicator of potential lifestyle change, consistent with health behavior models (e.g., Theory of Planned Behavior). Actual long-term behavior change was not measured due to the cross-sectional design.

Ethical considerations: This study was conducted in full compliance with the ethical principles of the Declaration of Helsinki. Ethical approval was obtained from the Research Ethics Committee of our University, Benghazi, Libya (Approval No: MCP-2025-00420). Participation was entirely voluntary, and written informed consent was obtained from all participants before their enrollment. Participants were explicitly informed of their right to withdraw from the study at any time without any negative consequences. Confidentiality and privacy were rigorously maintained through data coding, anonymization, and secure storage of all study records in accordance with institutional and international data protection standards.

Statistical analysis: Data were encoded and analyzed using IBM SPSS Statistics for Windows, version 28.0. Both descriptive and inferential statistical techniques were employed. Descriptive statistics, including frequencies, percentages, means, and standard deviations, were utilized to summarize the prevalence of cardiovascular risk factors, levels of awareness, and behavioral outcomes. Inferential statistics were applied to assess associations between variables and to evaluate the effects of the intervention, with the level of statistical significance set at $p < 0.05$.

Results

This results section presents findings from the analysis of n = 179 participants, based on coded data from the Excel file and SPSS Version 28. Descriptive statistics include frequencies, percentages, means, standard deviations, and 95% confidence intervals (CIs) for proportions. Inferential statistics include chi-square tests for categorical associations, ANOVA, or t-tests for group differences in continuous variables, with p-values of significance ($p < 0.05$).

Sample characteristics: More than half (110; 61.5%) of the participants were primarily aged 20-35 years, and female (62.6%). Most of the sample (161; 89.9%) under investigation were Libyans, and more than half (96; 53.6%) were single and holding a bachelor's degree (102; 57.0%). More than three-quarters (142; 79.3%) of the sample were reported to be on full-time employment status during the study period. Table 1 summarizes the demographic and socioeconomic characteristics of participants.

Table 1: Demographic and socioeconomic characteristics of participants

Variable	Category	Frequency (%) n = 179
Age group	20 - 25	34 (19.0)
	26 - 25	42 (23.5)
	31 - 35	34 (19.0)
	36 - 40	24 (13.4)
	41 - 45	16 (08.9)
	46 - 50	11 (06.1)
	> 50	18 (10.1)
Gender	Female	112 (62.6)
	Male	67 (37.4)
Nationality	Libyan	161 (89.9)
	Non-Libyan	18 (10.1)
Marital status	Single	96 (53.6)
	Married	73 (40.8)
	Divorced	06 (03.4)
	Widowed	04 (02.2)
Education level	Bachelor's degree	102 (57.0)
	Master's degree	53 (29.6)
	Doctoral degree	22 (12.3)
	Other	02 (01.1)
Employment status	Full-time	142 (79.3)
	Part-time	27 (15.1)
	Temporary/contract	05 (02.8)
	(Missing/other)	05 (02.8)

Prevalence of undiagnosed CVD risk factors among LIMU staff: Dyslipidemia had the highest prevalence at 67.0% (95% CI: 60.2 - 73.9), followed by overweight at 63.1% (95% CI: 56.1 - 70.2) in the sample under investigation during the study period. However, undiagnosed dyslipidemia was reported by 66.5% (95% CI: 59.6 - 73.4), hypertension by 20.7% (95% CI: 14.7 - 26.6), and diabetes 8.9% (95% CI: 4.8 - 13.1) over the study period. Interestingly, a sedentary lifestyle was reported by 38.5% (95% CI: 31.4 - 45.7) of the participants, and family history of CVD was reported by more than three-quarters, 78.2% (95% CI: 72.2 - 84.3), in the studied sample (**Table 2**).

Table 2: Prevalence of undiagnosed and overall CVD risk factors (n = 179)

Risk Factor	Prevalence (%) (95% CI)	N Yes
Hypertension	41.3 (34.1 - 48.6)	74
Undiagnosed hypertension	20.7 (14.7 - 26.6)	37
Diabetes	22.3 (16.2 - 28.4)	40
Undiagnosed diabetes	08.9 (04.8 - 13.1)	16
Dyslipidemia	67.0 (60.2 - 73.9)	120
Undiagnosed dyslipidemia	66.5 (59.6 - 73.4)	119
Obesity (BMI ≥ 30)	28.5 (21.9 - 35.1)	51
Overweight (BMI ≥ 25)	63.1 (56.1 - 70.2)	113
Abdominal obesity	27.4 (20.8 - 33.9)	49
Current smoker	07.8 (03.9 - 11.8)	14
Alcohol consumption	00.0 (00.0 - 00.0)	0.0
Sedentary lifestyle	38.5 (31.4 - 45.7)	69
Low fruit/vegetable intake	15.1 (09.8 - 20.3)	27
High fried/fast food intake	29.6 (22.9 - 36.3)	53
High salt intake	06.1 (02.6 - 09.7)	11
Family history of CVD	78.2 (72.2 - 84.3)	140

Assessment of awareness of CVD risk factors before and after screening: The mean awareness score post-screening was 9.06 ± 1.40 out of 10. Agreement was highest for obesity at 99.4% (95% CI: 98.3-100.0) and high blood pressure at 97.2% (95% CI: 94.8-99.6), and lowest for diabetes at 76.0% (95% CI: 69.7-82.2). **Table 3** summarizes the proportion agreeing "Yes" to each risk factor. Post-screening awareness was high, with a mean score of 9.06 ± 1.40 out of 10, particularly for obesity (99.4%) and high blood pressure (97.2%). Despite high post-screening awareness, a substantial burden of undiagnosed CVD risk factors persisted, highlighting a critical awareness-diagnosis gap.

Table 3: Proportion agreeing "yes" to each risk factor (n = 179)

Item	Proportion (95% CI)
Obesity increases risk	99.4 (98.3 - 100)
Smoking increases risk	91.6 (87.6 - 95.7)
High blood pressure leads to problems	97.2 (94.8 - 99.6)
High cholesterol increases risk	92.2 (88.2 - 96.1)
Diabetes increases chance	76.0 (69.7 - 82.2)
Physical inactivity increases risk	91.1 (86.9 - 95.2)
Diet high in fat/sugar increases risk	96.1 (93.2 - 98.9)
Family history affects risk	88.8 (84.2 - 93.4)
Aging/menopause increases risk in women	85.5 (80.3 - 90.6)
Alcohol use increases risk	88.3 (83.6 - 93.0)

Evaluation of pharmacist-led intervention on lifestyle behaviors: Post-screening intentions were 97.8% (95% CI: 95.6 - 99.9) for increasing physical activity, 98.9% (95% CI: 97.3 - 100.0) for improving diet, 92.2% (95% CI: 88.2 - 96.1) for regular check-ups, 91.6% (95% CI: 87.6 - 95.7) for digital monitoring, and 64.9% (95% CI: 49.5 - 80.2) for quitting/reducing smoking among smokers (n = 37) (**Table 4**).

Table 4: Behavioral post-screening intentions

Behavior	Proportion (%) (95% CI)	n Applicable
Increase physical activity	97.8 (95.6 - 99.9)	179
Improve diet	98.9 (97.3 - 100.0)	179
Quit/reduce smoking	64.9 (49.5 - 80.2)	37
Attend regular medical check-ups	92.2 (88.2 - 96.1)	179
Use digital/remote monitoring	91.6 (87.6 - 95.7)	179

Associations between sociodemographic factors and CVD risk factors: As summarized in **Table 5**, age was associated with hypertension ($p = 0.001$), dyslipidemia ($p = 0.007$), diastolic BP ($p = 0.011$), and waist circumference ($p = 0.002$). gender was associated with hypertension ($p = 0.001$), diabetes ($p < 0.001$), current smoking ($p < 0.001$), and fasting blood glucose ($p < 0.001$). marital status was associated with diabetes ($p = 0.002$) and family history of CVD ($p = 0.030$). education level was associated with obesity ($p = 0.030$) and awareness score ($p = 0.023$).

Table 5: Selected significant p-values for associations

Demographic	Risk factor/example outcome	p-value
Age	Hypertension	0.001
Age	Dyslipidemia	0.007
Age	Diastolic BP	0.011
Age	Waist circumference	0.002
Gender	Hypertension	0.001
Gender	Diabetes	< 0.001
Gender	Current smoker	< 0.001
Gender	Fasting blood glucose	< 0.001
Marital status	Diabetes	0.002
Marital status	Family CVD	0.030
Education	Obesity	0.030
Education	Awareness score	0.023

Associations between lifestyle habits and clinical outcomes: Sedentary lifestyle was associated with HDL ($p = 0.023$) and total cholesterol ($p = 0.060$). High intake of fried/fast food was associated with fasting blood glucose ($p = 0.022$) and waist circumference ($p = 0.048$). Physical activity level was associated with total cholesterol ($p = 0.006$) and fasting blood glucose ($p = 0.035$).

Discussion

The present study revealed a substantial burden of cardiovascular risk factors among the 179 participants, including dyslipidemia (67.0%), hypertension (41.3%), diabetes (22.3%), obesity (28.5%), overweight (63.1%), abdominal obesity (27.4%), sedentary lifestyle (38.5%), and strong family history of CVD (78.2%). These

findings align with rising non-communicable disease trends in the MENA region and Libyan national data on overweight (≈56.8%), obesity (29%) [1], hypertension (≈25%), and insufficient physical activity (≈45%) [2, 17]. Diabetes prevalence (22.3%) was consistent with national estimates [3, 4]. Hypertension exceeded national figures and remains a leading contributor to global cardiovascular morbidity and mortality [12]. In Libya, it frequently coexists with diabetes, increasing risk and complicating management [3, 5]. Its presence in an educated workforce indicates that risk factors extend beyond typical high-risk groups, underscoring the need for screening in apparently healthy individuals. Libyan hospital data identify diabetes and hypertension as the main controllable risk factors for coronary artery disease [5].

Dyslipidemia was the most prevalent risk factor (67.0%). The INTERHEART study identified abnormal lipids as a principal reversible risk factor for CVS, with modifiable factors accounting for over 90.0% of myocardial infarction risk [7]. These high rates may result from dietary habits, sedentary occupations, and limited screening, with 66.5% of cases undiagnosed. Obesity (28.5%) and overweight (63.1%) were consistent with rising MENA trends [18]. Obesity promotes metabolic syndrome, which drives hypertension, diabetes, and dyslipidemia, while abdominal obesity (27.4%) further elevates risk via visceral fat effects. Overall, modifiable cardiovascular risk factors are highly prevalent even among apparently healthy working adults. The strong family history of CVD (78.2%) further elevates the risk profile. Multiple unknown medical conditions were identified, including 66.5% undiagnosed dyslipidemia, 20.7% undiagnosed hypertension, and 8.9% undiagnosed diabetes. These findings highlight deficiencies in preventive healthcare services in Libya. The high proportion of undiagnosed dyslipidemia likely stems from its asymptomatic nature, consistent with patterns in low- and middle-income countries where individuals often seek care only after complications arise [12]. Undiagnosed hypertension delays treatment and increases the risk of stroke and heart disease. These results demonstrate the value of opportunistic screening in accessible settings such as workplaces. Community-based screening programs improve early detection and risk awareness [8], supporting the feasibility and necessity of pharmacist-led preventive services in Libya, where conventional healthcare access may be constrained.

Participants demonstrated high awareness of cardiovascular risk factors after screening (mean score 9.06 ± 1.40 out of 10), with strong recognition of obesity (99.4%) and high blood pressure (97.2%) as risk factors, though diabetes awareness was lower (76.0%). Despite this, unhealthy behavior persisted: 38.5% led sedentary lifestyles, 29.6% frequently consumed fried or fast foods, and 15.1% ate insufficient fruits and vegetables. This awareness-behavior gap is well-documented, in which knowledge does not translate into behavior change [19, 20] due to unsupportive environments, work restrictions, and cultural dietary norms. Similar patterns exist in regional communities [21]. The findings highlight the need for educational programs combined with environmental and policy changes in Libyan universities to address sedentary work. They also reveal an awareness-diagnosis gap, with high rates of undetected risk factors (e.g., 66.5% undiagnosed dyslipidemia).

The pharmacist-led intervention produced strong behavioral intentions toward lifestyle modification. Nearly all participants (97.8%) were ready to increase physical activity, and 98.9% planned to improve dietary habits. More than 90.0% intended to complete regular health checks (92.2%) and use digital remote monitoring (91.6%). Among smokers, 64.9% wanted to quit or reduce smoking. Although this cross-sectional study did not measure long-term change, the strong intentions align with evidence that pharmacist-led counseling effectively bridges knowledge to action and improves clinical outcomes [22, 23]. Pharmacists' accessibility enables personalized counseling that improves glycemic control, blood pressure, and lipid profiles [22, 23]. Similar workplace assessments in Brazil and Portugal increased awareness and motivation [9, 10]. Although intentions do not guarantee long-term change, they represent a crucial first step. This study illustrates how pharmacist-led models can promote preventive health actions in resource-limited settings such as Libya.

The present study revealed significant associations between sociodemographic characteristics and CVD risk factors. Age was significantly associated with hypertension ($p < 0.001$), dyslipidemia ($p = 0.007$), diastolic blood pressure ($p = 0.011$), and waist circumference ($p = 0.002$), consistent with age-related vascular stiffening, endothelial dysfunction, and increased adiposity [12]. Females had higher metabolic risk factors, while males showed higher smoking rates, mirroring Libyan population patterns [5]. Marital status correlated with diabetes and family history of CVD. Educational attainment was associated with obesity ($p = 0.030$) and CVD awareness ($p = 0.023$), highlighting the role of health literacy [17]. Lifestyle factors also influenced risk: sedentary behavior and frequent fried/fast food consumption were associated with unfavorable lipid and glycemic parameters ($p = 0.006 - 0.048$), consistent with international evidence [7]. Overall, both non-modifiable (age, gender) and modifiable (diet, activity, smoking) factors drive cardiovascular risk in this population. Targeted interventions tailored to demographic and behavioral characteristics may reduce CVD burden.

***Strengths and limitations**:* This study is the first pharmacist-led cardiovascular screening initiative among university employees in Libya and provides valuable data on cardiovascular risk factors, lifestyle behaviors, and CVD awareness. Strengths include standardized assessment tools, objective clinical measurements, and evaluation of both clinical and behavioral outcomes. However, several limitations should be acknowledged. The cross-sectional design precludes causal inference, and the small sample size with convenience sampling from a single institution limits generalizability. In addition, self-reported variables are subject to recall bias, and the absence of a control group further restricts evaluation of the screening approach. Future multicenter longitudinal studies with larger and more diverse populations are needed to confirm these findings and assess changes in cardiovascular risk over time.

***Conclusion**:* This study identified the high prevalence of modifiable cardiovascular risk factors among university employees, particularly dyslipidemia and hypertension, with a substantial proportion previously undiagnosed. These findings underscore the importance of routine workplace-based cardiovascular screening programs for early detection and management in Libya. Although participants showed relatively good awareness of CVS risk factors, unhealthy lifestyle behaviors remained common, highlighting a gap between knowledge and practice. The pharmacist-led intervention improved awareness and willingness to adopt healthier behaviors, particularly dietary modification and increased physical activity. Overall, the findings support integrating clinical pharmacists into workplace wellness and preventive health initiatives as a feasible and potentially cost-effective approach to reducing the CVS burden and promoting cardiovascular health in Libya.

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Acknowledgments: The authors would like to thank the administration and employees of our university for their cooperation and participation in the study. The authors also express their appreciation to all individuals who contributed to the cardiovascular screening activities and data collection process.

Authors' contributions: ARA: Conceptualization, methodology, data analysis, writing the original draft, and editing the final manuscript draft. SME, MNK, & SIS: Writing, reviewing, editing, and approval of the final draft of the manuscript. All authors reviewed and approved the final manuscript and agreed to be equally accountable for all aspects of the work.

Conflict of interest: The authors declare the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Ethical issues: The authors have considered ethical issues, including plagiarism, informed consent, data fabrication or falsification, and double publication or submission.

Data availability statement: The raw data that support the findings of this article are available from the corresponding author upon reasonable request.

Declaration of GenAI Use: The authors acknowledge the use of AI-assisted tools solely for language refinement and editorial clarity. All substantive content, conceptual analysis, interpretation of findings, organization of sections, and final wording were generated, verified, and revised manually by the authors, who take full responsibility for the accuracy, originality, and integrity of the manuscript.