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Original Article

Regional Assessment of Obstructive Sleep Apnea Among Adults in Northeastern Romania

Nica-Badea Delia[1], Hassan Noor[2]*, Luminita Fritea[3]

[1]Department of Orthodontics, Faculty of Dental Medicine, "Grigore T. Popa" University of Medicine and Pharmacy, 700115 Iasi, Romania.
[2]Department of Orthodontics, Aldent University, 1005 Tirana, Albania.
[3] Department of Orthodontics, Faculty of Dental Medicine, University of Medicine, Tirana (UMT), 1005 Tirana, Albania.

***E-mail** ✉ Hassannoor.ro@yahoo.com

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ABSTRACT

Obstructive sleep apnea (OSA) disrupts normal sleep patterns and has wide-ranging effects on overall health, including physical, oral, and mental well-being. This study aimed to determine whether the STOP-Bang and Epworth Sleepiness Scale questionnaires can reliably identify adults at risk for OSA in the northeastern region of Romania prior to surgery. A cohort of 222 adults completed both the STOP-Bang and Epworth questionnaires. Responses were analyzed using chi-squared tests, ANOVA, and Student's t-tests to examine associations between risk factors and OSA indicators. Participants with elevated BMI, age exceeding 50 years, or increased neck circumference were more likely to be flagged as high-risk by the STOP-Bang questionnaire. The Epworth questionnaire indicated that daytime sleepiness occurred more frequently among those with obesity or existing medical conditions. Strong links were observed between OSA and age, obesity, and comorbidities, while gender showed a limited impact on risk. The findings suggest that both the STOP-Bang and Epworth questionnaires are practical and efficient tools for preoperative OSA screening. Their results correlate closely with established risk factors and may help identify patients at higher risk of sleep apnea-related complications.

Keywords: Obstructive sleep apnea, Screening, STOP-Bang, Epworth sleepiness scale

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Introduction

Obstructive sleep apnea (OSA) is a condition in which breathing repeatedly stops during sleep because of upper airway collapse, causing multiple awakenings as the person attempts to restore airflow. Detecting OSA at an early stage is important, since unrecognized cases may worsen when exposed to anesthetics, opioids, or sedatives. Common predisposing elements include advancing years, male sex, the menopausal transition, structural irregularities, genetic background, cigarette smoking, alcohol habits, and excess weight. Untreated OSA often produces complaints such as nighttime gasping, morning cephalalgia, and persistent daytime drowsiness, and is strongly linked with cardiovascular disorders, depressive states, and other medical problems [1–4].

OSA contributes to adverse consequences including cardiovascular morbidity, metabolic disease such as diabetes, and increased death rates [1, 5–17]. Although the overall prevalence is estimated at 2–7%, the condition frequently goes unrecognized—especially among surgical candidates—thus heightening postoperative complications [3–12].

Screening OSA in various healthcare contexts, even within dentistry, can be achieved using brief assessment tools such as STOP-Bang, STOP, Berlin, or the P-SAP index [11, 12, 18, 19]. Since unrecognized cases carry elevated perioperative risks [7, 20–22], the

STOP-Bang test is particularly advantageous: it merges clinical symptoms with demographic criteria, making it faster and more convenient compared with other instruments [23–25]. The present study therefore aimed to assess how well the STOP-Bang and Epworth questionnaires function as preoperative screening strategies to pinpoint individuals predisposed to severe OSA in the Northeastern Romanian population [26-29].

Materials and Methods

Study design and population

This investigation followed a cross-sectional format and was carried out from January 2022 to January 2023 after receiving authorization from the Ethics Committee of "Grigore T. Popa" University of Medicine and Pharmacy, Iași, Romania (Approval No. 188/25 May 2022). The protocol adhered to the principles of the Helsinki Declaration.

The research initially considered 350 individuals who were patients in private dental clinics located in Northeastern Romania. Eligible participants were adults over 40 years old, both male and female, who consented to completing questionnaires and who demonstrated one or more risk indicators for obstructive sleep apnea (e.g., excess body mass, poor or fragmented sleep, daytime tiredness, or persistent lethargy). Exclusion applied to those with incomplete survey data, absence of OSA-related risk factors, or residence outside the target geographic region.

At enrollment, the purpose of the study and its procedures were explained. Returning a completed questionnaire signified acceptance to participate. Data collection remained anonymous, participation was voluntary, and no personal identifiers were retained.

From each patient's clinical file, additional measures were noted, including dento-maxillary anomaly classification, neck circumference (cm), and body mass index (BMI). The BMI, calculated from weight and height, was interpreted using the following cutoffs: <18.5 (underweight), 18.5–24.9 (normal), 25–29.9 (overweight), and ≥30 (obese) [30].

Instruments

Data collection was performed using two validated questionnaires.

STOP-bang questionnaire

STOP-Bang is a brief screening tool recognized for its high sensitivity in detecting obstructive sleep apnea [6]. Initially developed to identify at-risk surgical patients, it has since been validated across different demographic groups [31-34].

The instrument consists of 8 binary questions (Yes/No). A total of 0–2 positive responses indicates low probability, 3–4 corresponds to intermediate probability, and 5–8 reflects high probability of OSA. The risk classification is also considered elevated when at least 2 of the first 4 items are positive; in men with ≥2 positive answers among the first 4 combined with BMI > 35 kg/m²; or when ≥2 of the first 4 items are positive together with a neck circumference >43 cm in males or >41 cm in females [31-34].

Epworth questionnaire—daytime sleepiness scale (ESS)

Daytime somnolence is a frequent manifestation of OSA, and the Epworth Sleepiness Scale (ESS) is one of the most common methods to quantify it. The instrument is valued both for its impact on assessing quality of life and for its ability to indicate risks such as traffic accidents caused by unintended sleep episodes [34-37].

The ESS presents 8 everyday situations. Participants assign a score that reflects the probability of dozing: 0 = never, 1 = slight chance, 2 = moderate chance, and 3 = high chance. The overall score is calculated as the sum of all answers. Interpretation is as follows: 10–17 points signal clinically relevant sleepiness, values above 18 point to severe somnolence, and any score exceeding 10 warrants referral to a specialist in sleep disorders [37].

Statistical analysis

All statistical work was performed using SPSS software, version 26.0 (Windows). The findings are expressed through frequency distributions, averages, and standard deviations. To compare groups, both ANOVA and Student's *t*-test were applied. A p-value of 0.05 was adopted as the significance threshold [38-40].

Results and Discussion

Participant characteristics

From the 350 distributed questionnaires, 222 were completed properly and included in the analysis. Demographic evaluation showed that 59% of respondents were male. The mean age was 61.25 years (SD = 7.165), with the youngest participant aged 42 and the oldest 75. Most participants (68%) came from urban backgrounds, while 56.3% reported higher socio-economic standing **(Table 1)**.

Table 1. Demographic profile of the participants.

Variable	Count	Percentage
Age	61.25 ± 7.17 years (Range: 42–75)	–
Gender		
Female	91	41.0%
Male	131	59.0%
Living Area		
City	151	68.0%
Countryside	71	32.0%
Socio-economic Status		
High	125	56.3%
Medium	68	30.6%
Low	29	13.1%
Participants with OSA		
Absent	190	85.6%
Present	32	14.4%
BMI Classification		
Normal (<25 kg/m²)	1	0.5%
Overweight (25–30 kg/m²)	75	33.8%
Obese (>30 kg/m²)	146	65.8%
Participants with Other Diseases		
None	15	6.8%
Present	207	93.2%

STOP-bang questionnaire findings

Data from the STOP-Bang survey revealed that participants' risk of obstructive sleep apnea was highly associated with obesity and existing health conditions, whereas gender had little effect. Symptoms such as loud snoring, excessive daytime sleepiness, and confirmed sleep apnea were much more frequent in participants with higher BMI or comorbidities ($p < 0.01$). High blood pressure showed a notable link to coexisting health issues ($p = 0.009$). Individuals older than 50 years tended to have both higher BMI and additional medical conditions ($p = 0.000$). A neck circumference greater than 41 cm occurred most often in men, obese participants, and those with comorbidities. Among participants identified as high-risk for OSA, 74.7% were obese, while 56% had comorbid conditions **(Table 2)**.

Table 2. STOP-Bang questionnaire responses categorized by gender, BMI, and coexisting conditions.

Characteristic	Gender	BMI	Comorbid Conditions
Female	**Male**	**Normal Weight**	**Overweight**
Loud Snoring			
No	35.2%	24.6%	100.0%
Yes	64.8%	75.4%	
p-value	0.085	0.000	0.000
Daytime Fatigue or Sleepiness			
No	33.7%	40.2%	
Yes	66.3%	59.8%	100.0%
p-value	0.263	0.000	0.000
Diagnosed Sleep Apnea			
No	51.6%	47.3%	
Yes	48.4%	52.7%	100.0%
p-value	0.492	0.000	0.006
Hypertension			

No	62.1%	51.9%	100.0%
Yes	37.9%	48.1%	
p-value	0.098	0.251	0.012
Age Over 50			
No	3.1%	9.2%	100.0%
Yes	96.9%	90.8%	
p-value	0.048	0.000	0.000
Neck Circumference			
<40 cm	54.3%	66.7%	100.0%
>41 cm	45.7%	33.3%	
p-value	0.063	0.000	0.002
Obstructive Sleep Apnea Risk			
Low (0–2 "Yes")	17.2%	18.5%	100.0%
Medium (3–4 "Yes")	29.0%	34.2%	
High (5–8 "Yes")	53.8%	47.3%	
p-value	0.576	0.000	0.002

Multinomial regression **(Table 3)** highlighted several significant predictors of OSA. Being female (β = 0.80, p = 0.000), younger than 50 years (β = 5.45, p = 0.000), and having higher BMI (β = 10.1, p = 0.000) all increased the likelihood of OSA. Age and BMI had a major effect on OSA risk. Participants over 50 were 5.5 times more likely to have OSA (Exp(B) = 5.455, CI: 1.614–18.441, p = 0.006), while age did not significantly influence the moderate-risk group (p = 0.062). Overweight participants (BMI 25–30) showed a 1.7-fold higher chance of OSA, increasing to over 10-fold in obese participants (BMI ≥ 30; Exp(B) = 10.147, CI: 4.422–23.283, p = 0.000).

Table 3. Estimated risk of OSA based on age, BMI, and STOP-Bang risk categories.

Risk Category	Variable	Coefficient (B)	Standard Error	Wald Statistic	Significance (p)	Odds Ratio (Exp(B))	95% Confidence Interval
Low OSA risk	Constant	−1.360	0.208	42.690	0.000	–	–
	Age >50 years	1.697	0.621	7.453	0.006	5.455	1.614 – 18.441
Moderate OSA risk	Constant	−0.633	0.160	15.705	0.000	–	–
	Age >50 years	1.103	0.592	3.471	0.062	3.013	0.944 – 9.616
Moderate OSA risk	Constant	−1.080	0.190	32.245	0.000	–	–
	BMI category: Overweight (25–30)	0.529	0.000	–	–	1.698	1.698 – 1.698
	BMI category: Obese (≥30)	2.317	0.424	29.901	0.000	10.147	4.422 – 23.283

Epworth sleepiness scale (ESS) findings

Responses from the Epworth Sleepiness Scale, which evaluates the tendency to doze off during routine activities, indicated a strong relationship with BMI and comorbid conditions, while gender had a less pronounced effect. When reading, 62.6% of women and 38.2% of men reported a moderate likelihood of falling asleep, which was significantly associated with obesity (39.7%) and coexisting health issues (27.1%, p = 0.000). Watching television led to moderate drowsiness in 56% of overweight participants and 63.7% of obese participants, with clear differences based on sex, BMI, and comorbidities (p = 0.000) [30]. In low-stimulation public settings, women reported drowsiness more frequently (78%), also linked to higher BMI and comorbid conditions. During long drives, 60.4% of women and 35.1% of men reported a strong chance of dozing, particularly among participants with obesity or comorbidities (p = 0.000). Post-meal sleepiness was observed more often in women (62.6%) and correlated with high BMI and comorbidities. While less frequent, sleepiness while conversing was significantly associated with BMI.

Sleepiness during breaks while driving was also more commonly reported in participants with obesity and comorbid conditions (p = 0.000) **(Table 4)**.

Table 4. Distribution of ESS responses according to sex, BMI, and comorbidities.

Activity	Gender	BMI	Associated Pathologies
Female	**Male**	**Normal Weight**	**Overweight**
Reading a Book or Newspaper			
Never Fall Asleep	3.0%	9.1%	100.0%
Slight Chance of Falling Asleep	14.5%	25.8%	
Moderate Chance of Falling Asleep	60.8%	36.7%	
High Chance of Falling Asleep	21.7%	28.4%	
p-value	0.003	0.000	0.000
Watching Television			
Never Fall Asleep	3.0%	9.1%	100.0%
Slight Chance of Falling Asleep		17.3%	
Moderate Chance of Falling Asleep	50.2%	37.5%	
High Chance of Falling Asleep	46.8%	36.2%	
p-value	0.000	0.000	0.000
Sitting Inactive in a Public Setting (e.g., Cinema, Meeting)			
Never Fall Asleep	3.0%	25.8%	100.0%
Slight Chance of Falling Asleep	3.0%	17.3%	
Moderate Chance of Falling Asleep	76.2%	44.8%	
High Chance of Falling Asleep	17.8%	12.1%	
p-value	0.000	0.000	0.000
As a Passenger in a Vehicle for ≥1 Hour			
Never Fall Asleep	1.5%	9.1%	100.0%
Slight Chance of Falling Asleep	4.0%	33.6%	
Moderate Chance of Falling Asleep	33.7%	22.8%	
High Chance of Falling Asleep	60.8%	34.5%	
p-value	0.000	0.000	0.000
Resting in Bed After Lunch			
Never Fall Asleep	3.0%	9.1%	100.0%
Slight Chance of Falling Asleep	14.5%	25.8%	
Moderate Chance of Falling Asleep	60.8%	36.7%	
High Chance of Falling Asleep	21.7%	28.4%	
p-value	0.003	0.000	0.000
Conversing While Seated			
Never Fall Asleep	54.2%	60.3%	
Slight Chance of Falling Asleep	43.6%	29.8%	100.0%
Moderate Chance of Falling Asleep	2.2%	9.9%	
High Chance of Falling Asleep			
p-value	0.042	0.000	0.159
Sitting After a Non-Alcoholic Meal			
Never Fall Asleep	33.7%	33.6%	100.0%
Slight Chance of Falling Asleep	29.0%	31.3%	
Moderate Chance of Falling Asleep	37.3%	35.1%	

High Chance of Falling Asleep			
p-value	0.917	0.000	0.000
Driving at a Brief Traffic Stop			
Never Fall Asleep	34.8%	42.7%	100.0%
Slight Chance of Falling Asleep	43.3%	34.4%	
Moderate Chance of Falling Asleep	21.9%	22.9%	
p-value	0.331	0.000	0.000

When examining obstructive sleep apnea (OSA) risk in relation to dento-maxillary anomaly (ADM) classification using STOP-Bang scores, it becomes evident that higher ADM classes correspond to greater OSA risk. For participants with class I ADM, the distribution showed 18.1% at low risk, 34.7% at medium risk, and 47.2% at high risk. In class II, the portion of individuals at high risk increased to 60%, while those at low risk decreased to 17.5%. Among class III participants, the high-risk category encompassed 68.4%, leaving only 7.9% in the low-risk group **(Figure 1)**.

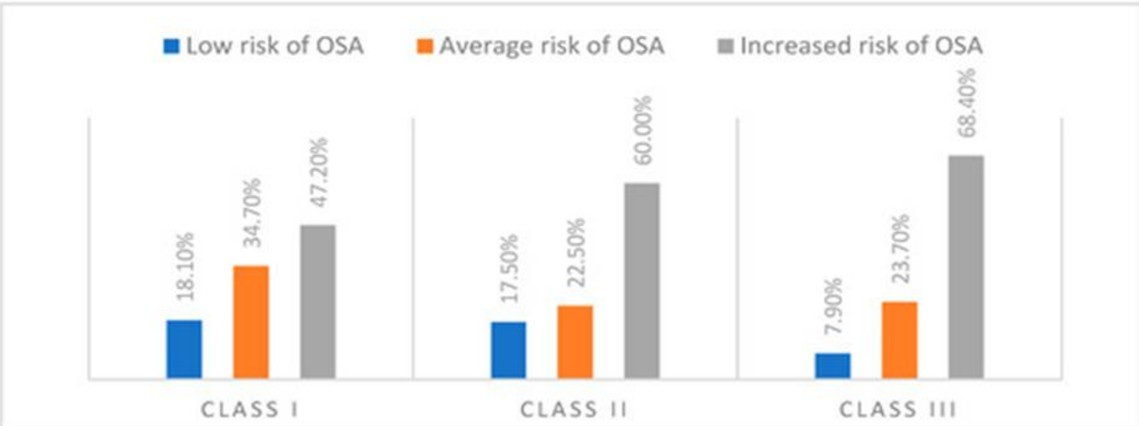

Figure 1. OSA risk levels determined by STOP-Bang questionnaire across ADM categories.

Assessment of daytime sleepiness through the Epworth questionnaire also revealed subtle differences according to ADM severity. Moderate sleepiness, corresponding to scores of 8–9, was relatively stable across the classes, ranging from 20.8% in class I to 15.8% in class III. Low sleepiness levels (scores 0–7) were similar across groups, with a slight uptick observed in class III (13.2%) **(Figure 2)**.

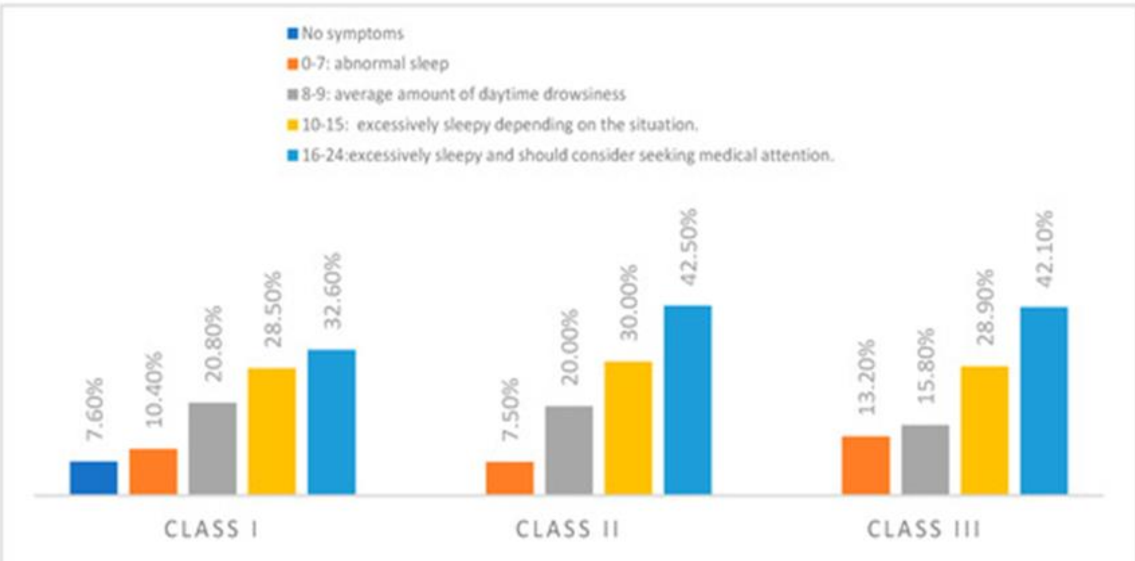

Figure 2. Distribution of Epworth questionnaire–measured daytime sleepiness across ADM classes.

Most prior studies on obstructive sleep apnea (OSA) have concentrated on patient populations in clinical settings. This research, however, focused on adults from northeastern Romania—a region that is rarely represented in the literature—evaluating how well the STOP-Bang and Epworth questionnaires predict OSA risk in a general population. Additionally, the study highlights how dental professionals could play a more active role in early OSA detection, presenting a new interdisciplinary perspective [41-43].

Important predictors

The analysis confirmed that several risk factors remain strong indicators of OSA. Among them, obesity, older age, and larger neck circumference—assessed via the STOP-Bang tool—stood out as particularly relevant. High Epworth scores further indicated pronounced daytime sleepiness, a classic feature of OSA [25, 36].

Certain health conditions, including high blood pressure, diabetes, menopause, and craniofacial anomalies, were linked to a greater likelihood of OSA [25, 44-50]. Findings from this study support previous evidence, showing that hypertension and related comorbidities are common among those with OSA, particularly in severe cases, with these links being statistically meaningful.

Sex differences also influenced OSA patterns. While overall STOP-Bang scores suggested gender had a modest impact, regression analysis identified female sex as a notable predictor. This may reflect differences in how symptoms are experienced and reported, as women more often report fatigue, insomnia, and mood disturbances, influenced in part by hormonal fluctuations [4, 51-54]. In men older than 55, OSA frequently co-occurs with obesity, diabetes, cardiovascular disease, and increased pharyngeal collapsibility [53, 55–57].

Obesity was confirmed as the single most powerful predictor of OSA. It affects both the intensity of symptoms and overall risk, and there is a cyclical relationship in which OSA promotes metabolic disturbances and reduced activity, leading to further weight gain. A higher BMI and ENT-related issues were also found to worsen disease severity [58-62].

Performance and practical application of screening questionnaires

In this study, both the STOP-Bang and Epworth questionnaires proved to be useful tools for identifying obstructive sleep apnea (OSA). STOP-Bang was particularly effective in estimating overall risk, whereas the Epworth questionnaire was more sensitive to the extent of daytime sleepiness experienced by participants. The strength of STOP-Bang became more evident in cases with larger score differences, highlighting that daytime effects such as fatigue and impaired functioning often provide more reliable indicators than nocturnal symptoms alone [62].

Previous investigations have shown that STOP-Bang retains strong predictive capability. Scores greater than 3 signal higher perioperative risk, and rising scores are generally associated with more severe manifestations of OSA. Despite the differing weight of individual items, the instrument's simplicity allows for rapid, dependable screening [25, 63-66].

Craniofacial features and their role in OSA risk

Research using cephalometric measurements has demonstrated that certain craniofacial characteristics—including micrognathia, retruded mandibles, and underdeveloped maxillae—can contribute to upper airway obstruction, particularly in patients who are not obese [67–72]. In the current analysis, OSA risk tended to rise progressively from class I to class III dento-maxillary anomalies. Although daytime sleepiness was more noticeable in classes II and III, these differences did not reach statistical significance. Class II malocclusions, often linked to a retruded mandible, are known to decrease airway dimensions [73, 74], while class III anomalies may disrupt airway openness due to skeletal misalignment [75].

One of the study's strengths is the integration of OSA screening into dental settings. Dentists, who regularly assess craniofacial structure, are well positioned to recognize early anatomical signs of OSA, such as retrognathia or enlarged neck circumference. Incorporating these tools into routine dental examinations can enhance early detection and facilitate timely referral for patients who might otherwise go undiagnosed.

Limitations of the study

Several factors limit the interpretation of these findings. The primary restriction was the absence of objective diagnostic confirmation, as participants were evaluated only through self-administered questionnaires (STOP-Bang and Epworth) without polysomnography. While these tools help identify individuals at potential risk, they cannot replace a full sleep study. Additionally, the study included only adults above 40 years from northeastern Romania, which narrows the extent to which results can be generalized. Moreover, the cross-sectional design prevents any determination of causality, emphasizing the need for follow-up studies to monitor changes in OSA risk over time.

Suggestions for future research

Future studies should focus on validating the STOP-Bang and Epworth tools against polysomnographic outcomes within Romanian populations to assess diagnostic accuracy. Expanding participant diversity to include younger age groups and individuals from different regions would enhance generalizability. Incorporating OSA screening into routine dental visits should also be investigated, leveraging dentists' role in assessing craniofacial anatomy for early detection. Longitudinal research is necessary to evaluate the impact of interventions—such as referral to specialists, CPAP therapy, or weight management—on high-risk participants. Additionally, cephalometric assessments could provide further insight into how craniofacial anatomy contributes to OSA susceptibility.

Conclusion

This research highlights the usefulness of both the STOP-Bang questionnaire and the Epworth Sleepiness Scale for identifying individuals at risk of obstructive sleep apnea (OSA). The STOP-Bang tool proved highly effective in predicting risk by integrating key demographic and clinical indicators, including age, body mass index, and neck circumference. In contrast, the Epworth scale offered a clear measure of daytime sleepiness and its practical effects on daily functioning. Owing to their simplicity, ease of use, and accessibility, these assessments are particularly well-suited for implementation in dental practice, allowing clinicians to detect at-risk patients early and ensure they are referred for comprehensive evaluation without delay.

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