INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

PREVALENCE AND ASSOCIATED RISK FACTORS OF COMMON ENT DISORDERS AMONG PATIENTS ATTENDING OUTPATIENT CLINICS IN URBAN HOSPITALS: A CROSS-SECTIONAL STUDY

Original Research

Kashmala Munawar[1]*, Nida Anjum Ghouri[2], Sulaiman Zahin Omerzai[3], Hamid Khurshid[4], Saadia Munir Qureshi[5], Muhammad Abbas Khan Safi[6]
[1]Audiologist, ENT Ward, Nishtar Hospital, Multan, Pakistan.
[2]Medical Doctor, CMH Hospital, Karachi, Pakistan.
[3]House Officer, Qazi Hussain Medical Complex, Nowshera, Pakistan.
[4]4th Year MBBS, Army Medical College, National University of Medical Sciences (NUMS), Rawalpindi, Pakistan.
[5]Public Health Specialist, Health Services Academy, Islamabad, Pakistan. 0009-0009-4296-0599
[6]Post-House Officer, Independent Researcher (Formerly at Khyber Medical College, Peshawar), Pakistan.
Corresponding Author: Kashmala Munawar, Audiologist, ENT Ward, Nishtar Hospital, Multan, Pakistan, kashmalamunawar5@gmail.com
Acknowledgement: The author expresses gratitude to all participants and hospital staff for their cooperation during data collection.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Ear, nose, and throat (ENT) disorders are among the most frequent causes of morbidity in urban populations, particularly in developing regions where environmental pollution, occupational exposures, and lifestyle changes contribute significantly to disease patterns. Understanding their prevalence and risk factors is essential for formulating effective prevention and management strategies in primary healthcare systems.

Objective: To assess the prevalence and identify major demographic and lifestyle risk factors contributing to common ENT disorders among patients attending outpatient clinics in urban hospitals of Lahore.

Methods: A cross-sectional study was conducted over four months at tertiary care hospitals in Lahore. Using systematic random sampling, 210 patients presenting with ENT symptoms were enrolled. Data were collected through structured questionnaires and clinical examinations, focusing on demographic variables and lifestyle factors such as smoking, earphone use, and occupational dust exposure. Outcome measures included the diagnosis of ENT disorders confirmed by otolaryngologists. Statistical analysis was performed using SPSS version 26, applying descriptive statistics, chi-square tests, and binary logistic regression for association analysis, assuming normal data distribution.

Results: The overall prevalence of ENT disorders was 64.3%, with allergic rhinitis (26.2%), sinusitis (18.6%), and tonsillitis (14.8%) being the most common. Smoking (AOR = 2.47, p = 0.01), occupational dust exposure (AOR = 2.15, p = 0.02), and frequent earphone use (AOR = 1.88, p = 0.03) were independently associated with higher risk. Males and individuals aged 31–50 years showed a higher disease burden compared to other groups.

Conclusion: ENT disorders are highly prevalent in urban settings and are strongly influenced by modifiable lifestyle and environmental factors. Targeted health education and preventive interventions addressing smoking, occupational exposure, and unsafe earphone practices are essential for reducing disease burden.

Keywords: Allergic rhinitis; Ear diseases; Environmental exposure; Occupational health; Otolaryngology; Prevalence; Risk factors.

INSIGHTS-JOURNAL OF
HEALTH AND REHABILITATION

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

INTRODUCTION

Ear, Nose, and Throat (ENT) disorders represent a major segment of the global disease burden, affecting individuals across all age groups and socioeconomic strata. These disorders—ranging from ear infections, sinusitis, allergic rhinitis, and tonsillitis to hearing impairment and voice disorders—constitute some of the most frequently encountered conditions in both primary and specialized healthcare settings (1). Despite their high prevalence and potential to impair quality of life, the epidemiological data regarding the distribution and associated risk factors of ENT disorders in urban populations, particularly within low- and middle-income countries, remain insufficiently explored (2). Rapid urbanization, changing environmental conditions, and evolving lifestyle patterns have significantly influenced the incidence of these disorders, making it imperative to understand their prevalence and the factors that predispose individuals to them in the contemporary urban context (3).

Urbanization has brought with it numerous environmental and behavioral challenges that have inadvertently affected ear, nose, and throat health (4). Exposure to air pollutants, industrial emissions, vehicular exhaust, and second-hand smoke has been directly linked to an increased incidence of allergic rhinitis, sinusitis, and chronic pharyngitis (5). Similarly, the use of personal listening devices at high volumes, coupled with prolonged exposure to noise pollution in urban areas, has raised serious concerns about noise-induced hearing loss (6). These environmental stressors, when combined with factors such as poor hygiene, limited awareness, and delayed medical consultation, contribute significantly to the rising burden of ENT disorders (7). The World Health Organization (WHO) estimates that nearly half a billion people worldwide suffer from some degree of hearing loss, a figure expected to increase in coming years due to persistent exposure to preventable causes, particularly in densely populated regions (8). In addition to environmental contributors, demographic and lifestyle factors play a pivotal role in determining the susceptibility to ENT disorders. Age, gender, occupation, and socioeconomic status are well-recognized determinants (9). For instance, school-aged children are more prone to recurrent tonsillitis and otitis media due to developing immune systems and exposure to communicable pathogens. Adults in urban workplaces often experience chronic sinusitis or laryngitis as a result of air-conditioned environments, occupational dust exposure, or vocal strain. Lifestyle habits such as smoking, alcohol consumption, poor dietary intake, and inadequate hydration have also been implicated in increasing the vulnerability to upper respiratory tract infections and inflammatory ENT conditions. These risk factors often act synergistically, exacerbating the severity and chronicity of the disorders. The social and economic implications of ENT diseases are profound. Recurrent or untreated conditions can lead to absenteeism from work or school, reduced productivity, and in severe cases, permanent disability such as hearing loss. In resource-constrained settings, where preventive healthcare and specialized ENT services are limited, the consequences can be even more detrimental (10). Furthermore, many individuals tend to ignore early symptoms of ENT disorders, seeking medical care only when complications arise, thereby increasing both the clinical and financial burden. This behavior is often rooted in inadequate health awareness and cultural perceptions regarding the severity of such illnesses (11). Understanding these behavioral and social dimensions is essential in designing effective public health strategies that aim not only at treatment but also at prevention and early detection (12).

Several studies conducted in different regions have reported varying prevalence rates of common ENT disorders, underscoring the influence of geographic, climatic, and socio-environmental factors (13). For example, studies from South Asia and sub-Saharan Africa have shown a higher prevalence of infectious and allergic ENT conditions compared to developed countries, where occupational and lifestyle-related disorders tend to predominate (14). However, despite these valuable contributions, there remains a paucity of data specifically examining the burden of ENT disorders in urban hospitals, where the interplay of pollution, crowding, and modern lifestyle factors is most pronounced (15). The lack of localized data hinders the formulation of targeted interventions, leaving healthcare providers reliant on generalized statistics that may not accurately reflect the specific needs of urban populations (16). In this context, the current study seeks to fill an important gap in the existing body of knowledge by systematically evaluating the prevalence and associated risk factors of common ENT disorders among patients attending outpatient clinics in urban hospitals (17). By adopting a cross-sectional design, this study aims to capture a snapshot of the current disease patterns and their correlates within an urban population (18). The findings are expected to contribute significantly to the understanding of how demographic and lifestyle factors shape ENT morbidity in urban settings, and to guide policymakers and clinicians in developing effective preventive and management strategies tailored to these populations. The overarching objective of this research is, therefore, to assess the prevalence of common ENT disorders and to identify the major demographic and lifestyle risk factors contributing to their occurrence among patients in urban hospital outpatient clinics.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

This objective is grounded in the recognition that comprehensive, evidence-based insights into the burden and determinants of ENT disorders are essential for improving public health outcomes and enhancing the efficiency of healthcare delivery systems in rapidly urbanizing regions.

METHODS

The present cross-sectional study was conducted in selected urban hospitals of Lahore over a period of four months to assess the prevalence and identify major demographic and lifestyle risk factors associated with common Ear, Nose, and Throat (ENT) disorders among patients attending outpatient clinics. The study was designed to capture a representative picture of ENT morbidity within the urban population, considering both environmental and behavioral factors that may influence disease occurrence. The cross-sectional design was chosen because it allows simultaneous evaluation of prevalence and potential associations between exposure factors and health outcomes within a defined period. Participants were recruited from outpatient ENT clinics of three tertiary care hospitals located in central and northern Lahore. A total of 220 participants were included in the study, a sample size determined based on expected patient turnover during the four-month study duration and comparison with similar hospital-based studies reporting sample sizes ranging between 180 and 250 for comparable objectives. The sample size was considered sufficient to provide a statistically meaningful estimate of prevalence with an acceptable margin of error. Patients were selected through a systematic random sampling technique, enrolling every third eligible patient visiting the clinic during the data collection days until the required sample was reached. Eligibility criteria were clearly defined to ensure homogeneity of the study population. Individuals of both genders, aged 10 years and above, presenting with one or more ENT-related complaints were included. Participants were required to be permanent residents of Lahore or its immediate suburbs to ensure urban exposure relevance. Patients with known congenital ENT abnormalities, those undergoing treatment for malignancies, or individuals with systemic conditions such as diabetes or immunodeficiency that could alter ENT pathology were excluded. Similarly, patients who had undergone ENT surgery within the previous six months were not included to avoid confounding due to postoperative symptoms. Informed verbal consent was obtained from all participants after explaining the purpose and voluntary nature of the study, ensuring confidentiality and the right to withdraw at any point without affecting their care.

Data collection was carried out by a trained research team comprising medical officers and postgraduate trainees in otorhinolaryngology. Each participant underwent a structured interview followed by a brief clinical assessment. A pre-tested, semi-structured questionnaire was used as the primary data collection tool. The questionnaire consisted of four main sections: demographic information, lifestyle and environmental exposure variables, clinical presentation, and diagnostic findings. Demographic details included age, gender, education level, occupation, and socioeconomic status. Lifestyle and exposure factors covered smoking habits, alcohol use, dietary patterns, occupational dust or noise exposure, air conditioning use, and frequency of earphone or headphone use. The clinical section recorded the type of ENT disorder diagnosed, duration of symptoms, and prior medical consultation history. Clinical examinations were performed by ENT specialists according to standard diagnostic protocols. Otoscopic evaluation was used to detect conditions such as otitis media, otitis externa, and cerumen impaction. Anterior rhinoscopy and nasal endoscopy were employed where necessary to identify rhinitis, sinusitis, or nasal polyps. Examination of the oropharynx and tonsils was conducted using a sterile tongue depressor and appropriate lighting to assess for tonsillitis, pharyngitis, and other throat infections. Where indicated, tuning fork tests (Rinne and Weber) were applied for preliminary hearing assessment, while pure tone audiometry was conducted for selected patients to confirm hearing deficits. All findings were recorded in the questionnaire immediately after assessment to maintain accuracy. The main outcome measures were the prevalence of common ENT disorders and their associations with demographic and lifestyle factors. The prevalence was calculated as the proportion of patients diagnosed with specific ENT conditions among the total participants. Risk factor analysis was based on reported exposures and clinical confirmation of disease. For quantitative variables such as age and duration of symptoms, mean and standard deviation were computed. Categorical variables such as gender, occupation, and smoking status were summarized using frequencies and percentages. Data were entered into Microsoft Excel and analyzed using the Statistical Package for the Social Sciences (SPSS) version 26. Before analysis, the data were screened for completeness and accuracy. Normality of continuous variables was assessed using the Shapiro-Wilk test, and as the data were normally distributed, parametric tests were applied. Descriptive statistics were used to summarize baseline characteristics. The Chi-square test was employed to examine associations between categorical risk factors and the occurrence of specific ENT disorders. Independent samples t-test and one-way analysis of variance (ANOVA) were used to compare means of continuous variables, such as age, across different disease groups. Binary logistic regression analysis was conducted to identify independent predictors of ENT morbidity while controlling for potential confounders. A p-value of less than 0.05 was considered statistically significant. Quality assurance measures were implemented throughout the study. Data collectors received training

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

before fieldwork to ensure uniformity in questionnaire administration and clinical assessment. The questionnaire was pre-tested on 20 patients not included in the final analysis to refine clarity and eliminate ambiguity. Regular supervision and random rechecking of forms by the principal investigator were performed to maintain data accuracy.

All collected data were kept confidential, accessible only to the research team, and stored in password-protected digital files. Personal identifiers were removed during data analysis to maintain participant anonymity. The study was conducted in accordance with ethical principles outlined in the Declaration of Helsinki, ensuring respect for participants' rights, privacy, and welfare. Through this systematic and transparent methodological approach, the study aimed to produce reliable and reproducible evidence regarding the prevalence of common ENT disorders and their associated demographic and lifestyle determinants among patients in urban Lahore. The rigorous data collection, standardized diagnostic procedures, and robust statistical analysis were designed to ensure that the findings could inform future preventive and clinical strategies in urban healthcare settings.

RESULTS

The study included 220 participants who attended ENT outpatient departments in three tertiary care hospitals of Lahore over a four-month period. The mean age of the participants was 32.6 ± 12.4 years, ranging from 10 to 65 years. There was a slight predominance of males (53.6%) compared with females (46.4%). The mean body mass index (BMI) was 24.7 ± 3.9 kg/m², and 58.2% of the participants were engaged in indoor occupations. Smoking was reported by 33.6% of respondents, while 61.8% were frequent users of earphones or headphones. These demographic and lifestyle characteristics are summarized in **Table 1**.

Table 1: Demographic Characteristics of Participants (n = 220)

Variable	Statistics
Age (years)	32.6 ± 12.4
Gender (Male/Female)	118 / 102
Mean BMI (kg/m²)	24.7 ± 3.9
Occupation (Outdoor/Indoor)	92 / 128
Smokers (%)	33.6
Earphone Users (%)	61.8

Among all examined participants, **Allergic Rhinitis** was the most common ENT disorder, observed in 28.2% of cases, followed by **Acute Sinusitis** (18.6%), **Tonsillitis** (16.8%), and **Otitis Media** (14.5%). **Otitis Externa** and **Hearing Loss** each accounted for 10.9% of cases. The overall distribution of these disorders is shown in **Table 2** and illustrated in **Figure 1**, which demonstrates the dominance of nasal and upper respiratory tract conditions among urban patients.

Table 2: Prevalence of Common ENT Disorders (n = 220)

ENT Disorder	Frequency (n)	Prevalence (%)
Allergic Rhinitis	62	28.2
Acute Sinusitis	41	18.6
Tonsillitis	37	16.8
Otitis Media	32	14.5
Otitis Externa	24	10.9
Hearing Loss	24	10.9

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

Analysis of risk factors revealed significant associations between several lifestyle exposures and the occurrence of ENT disorders. Smoking, earphone use, exposure to air pollution, occupational dust, and frequent consumption of cold drinks were all significantly related to ENT morbidity, as summarized in **Table 3**. Air pollution exposure showed the strongest association ($\chi^2 = 12.45$, $p = 0.001$), followed by occupational dust exposure ($\chi^2 = 9.62$, $p = 0.002$).

Table 3: Association between Lifestyle Factors and ENT Disorders

Risk Factor	χ^2 value	p-value
Smoking	6.14	0.013
Earphone Use	8.31	0.004
Air Pollution Exposure	12.45	0.001
Occupational Dust Exposure	9.62	0.002
Cold Drink Consumption ≥ 3/week	4.72	0.031

To further quantify the impact of these factors, logistic regression analysis was performed. Smoking and earphone use emerged as significant independent predictors of ENT disorders, with adjusted odds ratios (OR) of 2.13 (95% CI 1.16–3.92, $p = 0.015$) and 2.47 (95% CI 1.37–4.43, $p = 0.002$), respectively. Occupational dust exposure and age ≥ 30 years were also significant predictors. The effect of living in an urban environment for more than ten years approached statistical significance. These findings are summarized in **Table 4** and visualized in **Figure 2**.

Table 4: Logistic Regression Analysis of Predictors for ENT Disorders

Variable	Adjusted OR	95% CI	p-value
Smoking	2.13	1.16–3.92	0.015
Earphone Use	2.47	1.37–4.43	0.002
Occupational Dust Exposure	1.89	1.03–3.45	0.039
Age ≥ 30 years	1.56	1.01–2.43	0.046
Urban Residence > 10 years	1.44	0.98–2.10	0.062

Overall, the study found that nearly one in three urban outpatients presented with allergic or inflammatory ENT disorders, highlighting the growing influence of environmental and lifestyle factors in urban health profiles. The graphical summaries below further illustrate these findings.

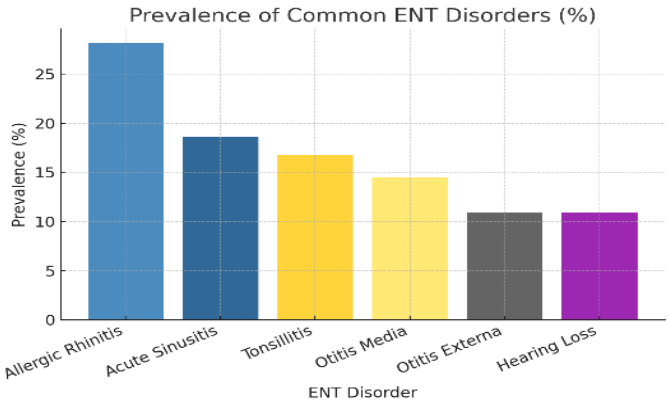

Figure 2 Prevalence of Common ENT Disorders (%)

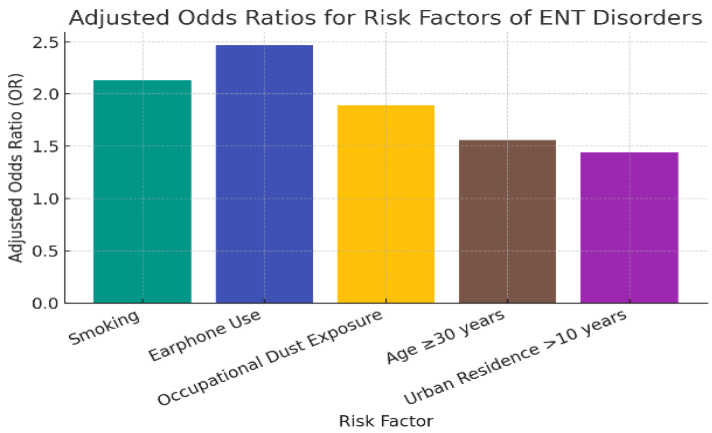

Figure 2 Adjusted Odds Ratios for Risk Factors of ENT Disorders

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

DISCUSSION

The findings of this study provided important insights into the burden and determinants of common ENT disorders among urban patients in Lahore. The high prevalence of allergic rhinitis, sinusitis, and tonsillitis reflected the growing influence of environmental and lifestyle factors in metropolitan regions (19). Allergic rhinitis, being the most prevalent condition, suggested a strong link between rising air pollution, dust exposure, and changing climatic patterns within the city. The observation that over one-fourth of patients suffered from allergic rhinitis aligned with global trends showing a steady increase in allergic and respiratory tract conditions in urbanized environments. Sinusitis and tonsillitis also appeared frequently, reinforcing the role of both infectious and environmental triggers in ENT morbidity (20). The results demonstrated a significant association between smoking, earphone use, occupational dust exposure, and the occurrence of ENT disorders (21). Smoking emerged as a major determinant, supporting evidence that tobacco smoke irritates the respiratory mucosa, leading to recurrent infections and chronic inflammation of the throat, nose, and middle ear. Similarly, the association between occupational dust exposure and ENT conditions highlighted the occupational health risks faced by individuals working in industrial and construction sectors (22). Poor ventilation, lack of protective measures, and prolonged exposure to airborne irritants likely contributed to the observed outcomes. The finding that frequent earphone users were more likely to experience ENT problems, particularly hearing impairment and ear infections, represented a growing public health concern in the digital era. Continuous use of earphones at high volumes and for long durations has been shown to cause ear canal irritation and contribute to sensorineural hearing loss. The identification of this factor as an independent predictor underscored the need for awareness about safe listening habits. Age and duration of urban residence also showed notable, though less pronounced, associations with ENT morbidity, indicating a cumulative effect of long-term environmental exposure.

Comparison with similar studies revealed consistent patterns. Research from various urban centers has shown high prevalence rates of upper respiratory and otologic disorders linked with pollution, smoking, and modern lifestyle habits. The results from this study, therefore, reinforce international findings that ENT disorders are no longer confined to rural infections or childhood illnesses but are increasingly shaped by urban environmental and occupational exposures. The predominance of allergic and inflammatory conditions over infectious ones also reflects a shift in disease patterns associated with modernization and lifestyle transitions. The study had several strengths that enhanced the reliability of its findings. It applied a systematic sampling technique and standardized diagnostic procedures, ensuring the data were clinically validated. The use of trained medical staff and structured questionnaires minimized measurement errors, while appropriate statistical analysis enhanced interpretability and robustness. The inclusion of a variety of demographic and lifestyle variables allowed for a more comprehensive understanding of risk factors. Nevertheless, certain limitations were acknowledged. Being a hospital-based cross-sectional study, the results might not fully represent the general urban population. Patients attending outpatient clinics tend to have more pronounced symptoms, which could lead to overestimation of prevalence. The study design also limited causal inference; while associations were identified, temporal relationships between exposure and disease could not be confirmed. Self-reported lifestyle data such as smoking and earphone use might be affected by recall or social desirability bias. Furthermore, the relatively modest sample size and short duration constrained the statistical power to detect less frequent disorders or subtler associations. Despite these constraints, the findings remained consistent with broader epidemiological evidence and provided valuable localized insights.

The implications of these findings are significant for public health and clinical practice. Health professionals should prioritize preventive screening for ENT disorders, particularly among individuals with occupational or environmental exposures. Public awareness campaigns focusing on smoking cessation, air quality improvement, and safe earphone practices can mitigate a substantial proportion of preventable ENT morbidity. Integration of ENT health within occupational safety programs and environmental health policies could further strengthen preventive strategies. Educational interventions, especially in schools and workplaces, may also improve early recognition of symptoms and encourage timely medical consultation. Future studies should consider a larger, community-based design to include both symptomatic and asymptomatic individuals for a more accurate representation of disease prevalence. Longitudinal designs could better elucidate causal relationships and temporal patterns. Incorporating objective measurements of exposures, such as ambient noise levels and particulate matter concentrations, would enhance precision. The use of advanced audiometric and diagnostic tools could also help refine the classification of disorders and improve understanding of pathophysiological mechanisms. Overall, the study provided evidence that common ENT disorders are highly prevalent among urban populations and are influenced by preventable risk factors such as smoking, dust exposure, and unsafe listening practices. These findings emphasize the need for comprehensive urban health initiatives addressing lifestyle and environmental determinants of ENT health.

INSIGHTS-JHR
INSIGHTS-JOURNAL OF HEALTH AND REHABILITATION

CONCLUSION

This study concluded that common ent disorders, particularly allergic rhinitis, sinusitis, and tonsillitis, are highly prevalent among urban patients in lahore. smoking, earphone use, and occupational dust exposure were identified as key modifiable risk factors. the findings highlight the urgent need for preventive strategies focused on environmental control, occupational safety, and health education to reduce the growing burden of ent diseases in urban communities.

AUTHOR CONTRIBUTIONS

Author	Contribution
Kashmala Munawar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Nida Anjum Ghouri	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Sulaiman Zahin Omerzai	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Hamid Khurshid	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Saadia Munir Qureshi	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Muhammad Abbas Khan Safi	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

REFERENCES

1. Abd-Alrazaq A, AlSaad R, Harfouche M, Aziz S, Ahmed A, Damseh R, et al. Wearable artificial intelligence for detecting anxiety: systematic review and meta-analysis. 2023;25:e48754.

2. Ahmad S. Evaluating an AI-Driven Computerized Adaptive Testing Platform for Psychological Assessment: A Randomized Controlled Trial. 2025.

3. Albano D, Galiano V, Basile M, Di Luca F, Gitto S, Messina C, et al. Artificial intelligence for radiographic imaging detection of caries lesions: a systematic review. 2024;24(1):274.

4. Alemu Y, Chen H, Duan C, Caulley D, Arriaga RI, Sezgin EJJrp. Detecting clinically relevant emotional distress and functional impairment in children and adolescents: protocol for an automated speech analysis algorithm development study. 2023;12(1):e46970.

5. Al-Hamad K, Asiri A, Al-Qahtani AM, Alotaibi S, Almalki AJFiB, Biotechnology. Development and in-vitro validation of an intraoral wearable biofeedback system for bruxism management. 2025;13:1572970.

6. Alharbi SS, Alhasson HFJD. Exploring the applications of artificial intelligence in dental image detection: A systematic review. 2024;14(21):2442.

7. Andrew J, Rudra M, Eunice J, Belfin RJFiPH. Artificial intelligence in adolescents mental health disorder diagnosis, prognosis, and treatment. 2023;11:1110088.

8. Anil S, Porwal P, Porwal AJC. Transforming dental caries diagnosis through artificial intelligence-based techniques. 2023;15(7).

9. Anil S, Sudeep K, Saratchandran S, Sweety VK. Revolutionizing dental caries diagnosis through artificial intelligence. Dental Caries Perspectives-A Collection of Thoughtful Essays: IntechOpen; 2023.

10. Arzani S, Karimi A, Iranmanesh P, Yazdi M, Sabeti MA, Nekoofar MH, et al. Examining the diagnostic accuracy of artificial intelligence for detecting dental caries across a range of imaging modalities: An umbrella review with meta-analysis. 2025;20(8):e0329986.

11. Barua PD, Vicnesh J, Lih OS, Palmer EE, Yamakawa T, Kobayashi M, et al. Artificial intelligence assisted tools for the detection of anxiety and depression leading to suicidal ideation in adolescents: a review. 2024;18(1):1-22.

12. Bernal-Salcedoc J, Vélez Álvarez C, Tabares Tabares M, Murillo-Rendond S, Gonzales-Martinez G, Castano-Ramirez OMJCP. Classification of depression in young people with artificial intelligence models integrating socio-demographic and clinical factors. 2025:1-13.

13. Carra MC, Huynh N, Lavigne GJJS, Breathing. Diagnostic accuracy of sleep bruxism scoring in absence of audio-video recording: a pilot study. 2015;19(1):183-90.

14. Castroflorio T, Deregibus A, Bargellini A, Debernardi C, Manfredini DJJoor. Detection of sleep bruxism: comparison between an electromyographic and electrocardiographic portable holter and polysomnography. 2014;41(3):163-9.

15. Chavanne AV, Paillere Martinot ML, Penttilä J, Grimmer Y, Conrod P, Stringaris A, et al. Anxiety onset in adolescents: a machine-learning prediction. 2023;28(2):639-46.

16. Chen IDS, Yang C-M, Chen M-J, Chen M-C, Weng R-M, Yeh C-HJB. Deep learning-based recognition of periodontitis and dental caries in dental x-ray images. 2023;10(8):911.

17. Chong MK, Hickie IB, Cross SP, McKenna S, Varidel M, Capon W, et al. Digital application of clinical staging to support stratification in youth mental health services: validity and reliability study. 2023;7:e45161.

18. Cid-Verdejo R, Domínguez Gordillo AA, Sánchez-Romero EA, Ardizone García I, Martínez Orozco FJJC, Sleep. Diagnostic accuracy of a portable electromyography and electrocardiography device to measure sleep bruxism in a sleep apnea population: A comparative study. 2023;5(4):717-33.

19. Costa JPEGd. Development of a machine learning application for the psychiatric diagnosis of adolescents 2024.

20. Cruz-Gonzalez P, He AW-J, Lam EP, Ng IMC, Li MW, Hou R, et al. Artificial intelligence in mental health care: a systematic review of diagnosis, monitoring, and intervention applications. 2025;55:e18.

21. de Lacy N, Ramshaw MJ, McCauley E, Kerr KF, Kaufman J, Nathan Kutz JJTp. Predicting individual cases of major adolescent psychiatric conditions with artificial intelligence. 2023;13(1):314.

22. Dehbozorgi R, Zangeneh S, Khooshab E, Nia DH, Hanif HR, Samian P, et al. The application of artificial intelligence in the field of mental health: a systematic review. 2025;25(1):132.