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Systematic Review

Exploring the Association between Periodontitis and Erectile Dysfunction: A Systematic Review

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Abstract

Periodontitis (PD) remains a global public health problem. Evidence revealed that PD contributes to the development of systemic diseases, including effects on men's sexual health such as erectile dysfunction (ED). Objective: To review and explore the association between PD and ED. Methods: Following PRISMA guidelines, a systematic review of studies published in Scopus, PubMed, ScienceDirect, and Google Scholar was conducted. A comprehensive literature search until February 2024 by combining several keywords and applying eligibility criteria was performed. JBI critical appraisal checklist was employed for quality assessment. Results: A total of 15 studies involving 216,753 subjects aged between 18 and 85 years old were included. The included articles consisted of 9 cross-sectional studies, 5 case-control studies, and 1 RCT. Of the 15 studies, 13 of them statistically demonstrated a significant association between PD and ED, and the other two did not; however, they showed that there is a significant relationship between the severity of PD and the severity of ED. Six studies reported odds ratios (OR) ranging from 1.60 to 3.35. Most of the PD diagnostic methods used are objective, and only one study used color Doppler ultrasound to diagnose ED. Summary: According to the findings, a significant association between PD and ED is evident. Additionally, dentists and general practitioners must be aware of the interconnection between these diseases, enabling them to provide comprehensive education to patients, particularly concerning the prevention and management of periodontal disease.

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1. Introduction

Periodontal disease encompasses pathological condition affecting the periodontium, the tooth-supporting tissue, including the gingiva, alveolar bone, cementum, and periodontal ligament.[1] Meanwhile, periodontitis (PD) is an inflammatory condition that most commonly affects the periodontium, in which damage to the periodontal ligament and alveolar bone tissue follows, and manifests as gum inflammation, pain, halitosis, and loose teeth.[2] This disease is multifactorial, but bacterial biofilms on the tooth surface are the main cause of PD.[3]

As per the World Health Organization, severe periodontal disease is prevalent among 19% of adults population globally.[4] In addition, epidemiological study reported that in the USA as many as 42.2% of the population was affected by PD and 7.8% experienced severe PD,[5] and as many as 74.1% of the population in Indonesia have PD.[6]

Since becoming a global public health problem, understanding of the etiopathogenesis of PD has undergone major developments, including the mechanisms and interactions between PD and systemic diseases,[7] including diabetes,[8] cardiovascular disease,[9] renal disease,[10] metabolic syndrome,[11] rheumatoid arthritis,[12] cancer,[13] respiratory disease,[14] pregnancy complication,[15,16] and sexual problem.[17] This is caused by an increase in systemic acute phase protein levels, coagulation factors, plasma antibody levels, neutrophils, C-reactive protein (CRP), and various cytokines.[18,19]

Erectile dysfunction (ED) is considered to be positively correlated with PD, which is possibly caused by an inflammatory response during periodontitis characterized by an increase in proinflammatory mediators, including CRP, metalloproteinases (MMP), interleukins, and tumor necrosis factor (TNF)-α.[7] ED is delineated as a condition of male sexual dysfunction marked by the incapability of the penis to attain or sustain an erection deemed satisfactory for fulfilling sexual activity, which is caused by vascular, neurological, psychological, and/or hormonal factors, and is associated with several other systemic conditions.[20–22] An epidemiological study conducted in eight countries stated that ED affects 37.2% to 48.6% of men in Brazil, Italy, China, Spain, Germany, France, England and the USA.[23] Meanwhile, a cohort study of 17,250 prostate cancer patients highlighted that the occurrence of ED increased from 10% to 79% across the age range spanning from 40 to 80 years, which increased sharply if there were comorbidities such as diabetes, obesity and hypertension.[24] Also, globally, the prevalence of ED is estimated to be in the range of 3-76.5%.[25]

Various studies have suggested various risk factors that correlate with the development of ED, including age, obesity, diabetes, cigarette and alcohol consumption, anxiety, depression, insomnia, hypertension, peripheral vascular disorders, stroke, coronary heart disease, myocardial infarction, hypercholesterolemia, adiponectin, and low physical activity.[26–30] Interestingly, apart from these risk factors, evidence suggests that oral health has an influence on sexual health, such as ED, sperm motility, and the timing of fertilization.[31] Furthermore and more specifically, other studies indicated a direct link between poor periodontal tissue condition and the onset of ED in men.[32,33]

Several studies have been undertaken to explore the direct relationship and influence of PD on the incidence of sexual dysfunction, in this context ED. Globally, the prevalence of both diseases is still quite high, thus studies regarding intervention and prevention continue to be carried out. Since several reports revealed that PD is closely related to systemic diseases, including ED, related research continues to be carried out to prevent the worsening of PD which has a systemic impact on health, one of which is believed to be a risk factor for the development of ED. Therefore, the objective of this study is to systematically and comprehensively synthesize, review and summarize previous studies pertaining to the association between PD and ED.

2. Method

Research Question

Using PRISMA guidelines, a systematic review of previously published studies was conducted. In the present study, the PICO framework was utilized to address the research questions. The main question in this study was "Do men (P) with periodontitis (I) compared to healthy men without periodontitis (C) have a higher risk of experiencing erectile dysfunction (O)?".

Literature Search Protocol

A systematic and comprehensive search of articles published in Scopus, PubMed, ScienceDirect, and Google Scholar until February 2024 was performed. In the literature search, the terms periodontal disease, periodontitis, erectile

dysfunction, sexual dysfunction, and impotence were used and amalgamated through the utilization of Boolean operators AND and OR.

Eligility Criteria

This study includes original articles that report the association of PD with the incidence of ED. In the study selection process, those were considered for inclusion if they met the inclusion criteria requirements, including clinical studies, involving patients with PD and ED status examinations, manuscripts in English or other languages as long as an English translation version is available, and full text or open access. Meanwhile, exclusion criteria include experimental studies, review articles, letters to editors, commentaries, and editorials. All studies published up to February 2024 were considered for selection and review in this study, and no restrictions on publication year were applied.

All studies were quality assessed to determine the risk of bias. In this systematic review, we used the JBI critical appraisal checklist. Two independent authors (FMR and AWA) conducted the evaluation of study quality and the synthesis of study findings. Every dispute and difference of opinion was resolved through in-depth discussion and careful decision making.

Data Extraction

After selecting studies using specified criteria and passing a quality assessment, data extraction and synthesis were then conducted using tables to summarize important information regarding several aspects, including the author(s) and country of the study, design, participants and their ages, diagnostic methods of PD and ED, and conclusions of the included studies. Finally, a qualitative analysis regarding the association between PD and the occurrence of ED was systematically described.

3. Result

Quality Assessment

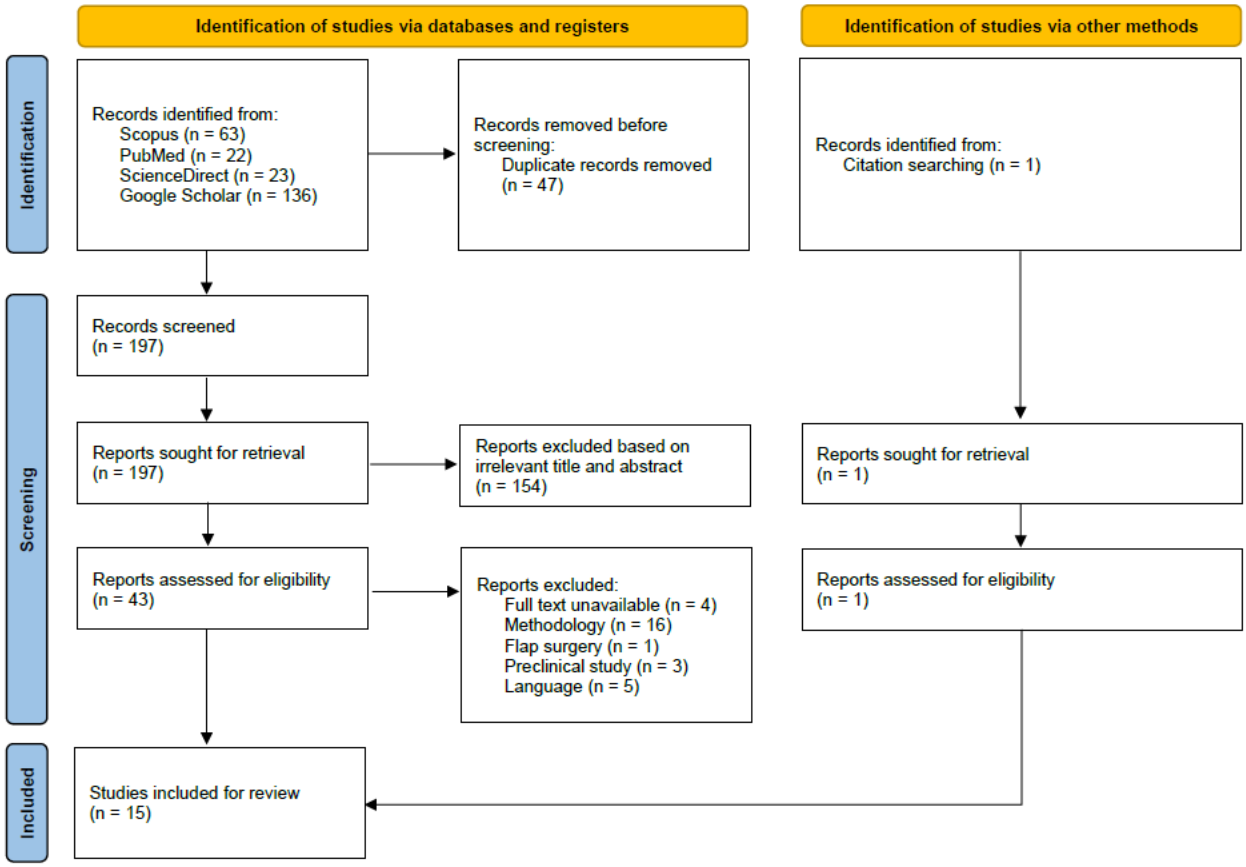

Figure 1. PRISMA flow chart.

Study Selection

After removing duplicate entries, literature searches yielded a total of 197 articles in the Scopus, PubMed, ScienceDirect, and Google Scholar databases using predetermined keyword combinations. Of the 197 records, 154 studies were eliminated due to irrelevance to this research, remaining 43 reports. We then screened for eligibility, resulting in 29 articles being excluded for several reasons such as unavailability of the full article, methodology that did not meet the inclusion criteria, interventions in the form of flap surgery, preclinical studies, and English language manuscripts were not available. A search from other sources was carried out, and 1 article was found through a citation search. Finally, 15 articles fulfilled the eligibility criteria and were selected in this study for further in-depth review.

Characteristics of Included Studies

A total of 216,753 participants were included from 15 included articles, consisting of 9 cross-sectional studies, 5 case-control studies, and 1 randomized controlled trial study, with participant counts ranging from 41 to 197,136 across the included studies. **Table 1** provides a comprehensive summary of the characteristics of all included studies.

Table 1. Characteristics and summary of included studies.

Author(s) and Country	Design	Participants	PD Diagnostic Method	ED Diagnostic Method	Results
Zadik et al.[34] Israel	Cross-sectional	305 men aged 39.5 ± 6.7 years	Bitewing radiography of posterior teeth	SHIM	ED had a correlation with PD.
Sharma et al.[35] India	Cross-sectional	70 men aged 35.3 ± 3.64 years	Probing depth, PAL	SHIM, color Doppler ultrasound for penis	PD was positively associated with ED, but not statistically significant.
Keller et al.[36] Taiwan	Case-control	197,136 men, divided into 32,856 men with ED and 164,280 controls, average age 49.3 years	ICD-9-CM Dental examination, sulcus probing, and radiograph	ICD-9-CM IIEF	A significant association between PD patients and ED exists. The relationship was stronger in the <30-year-old and >69-year-old populations.
Eltas et al.[37] Turkey	RCT	120 men aged 30-40 years	PI, BOP, probing depth, CAL	IIEF	Periodontal treatment contributes positively to the improvement of ED.
Oğuz et al.[38] Turkey	Cross-sectional	162 men, divided into 80 men with ED and 82 men without ED, aged 30-40 years	PI, BOP, probing depth, CAL	IIEF	PD was significantly associated with ED in patients aged 30-40 years.
Matsumoto et al.[39] Japan	Cross-sectional	88 men aged 50.9 ± 16.6 years	Self-check sheet	IIEF-5	ED was associated with PD as a result of endothelial dysfunction and PD-related changes in the systemic inflammatory response.
Tsao et al.[40] China	Case-control	15,315 men, divided into 5,105 men with ED and 10,210 controls, aged 48.3 ± 12.5 years	ICD-9-CM	ICD-9-CM	ED patients were more likely to be diagnosed with PD, and this association was stronger in the population aged <30 years.
Uppal et al.[41] India	Cross-sectional	53 men aged 25-40 years	PPD, bitewing radiography of posterior teeth	SHIM	PD was positively associated with ED.

Author(s) and Country	Design	Participants	PD Diagnostic Method	ED Diagnostic Method	Results
Chou et al.[42] Taiwan	Cross-sectional	1,932 men aged 21.65 ± 2.609 years	Dental examination	IIEF-5	Statistically, patients with PD are more likely to experience ED.
Martín et al.[43] Spain	Case-control	158 men, divided into 80 men with ED and 78 controls, aged 18-70 years	PPD, CAL, BOP	IIEF	There was a positive relationship where ED patients experience worse periodontal conditions.
Alenzi[44] Saudi Arabia	Cross-sectional	983 men aged 39.1 ± 12.2 years	Dental examination	SHIM	ED and PD were significantly related.
Huang et al.[45] China	Case-control	202 men, divided into 100 men with ED and 102 control men, aged 32.6 ± 5.7 years	CPITN index	IIEF	There was a positive association where the more severe the patient has PD, the higher the incidence of ED.
Kamaludin et al.[46] Malaysia	Cross-sectional	74 men aged 30-70 (52.4 ± 10.9) years	BPE score	IIEF-5	ED often occurs in those who have PD and have never had dental scaling.
Mohd Sood et al.[47] Malaysia	Cross-sectional	41 men aged 27-59 (40.7 ± 11.39) years	PI, BOP, PPD, CAL	IIEF-5	PD and ED were positively related as evidenced by patients with ED having poor periodontal conditions as indicated by the CAL and BOP indices.
Diouf et al.[48] Senegal	Case-control	114 men, divided into 38 men with ED and 76 controls, aged 18-80 years	PI, BOP, CAL, PD, furcation involvement	IIEF-5	PD was not associated with ED, but PD severity was significantly associated with ED severity.

Abbreviation: BOP, bleeding on probing; BPE, basic periodontal examination; CAL, clinical attachment loss; CPITN, Community Periodontal Index of Treatment Needs; ICD-9-CM, International Classification of Disease, Ninth Revision, Clinical Modification; IIEF, International Index of Erectile Function; PAL, periodontal attachment level; PI, plaque index; PPD, probing pocket depth; SHIM, Sexual Health Inventory for Men.

4. Discussion

According to the findings of the review in the encompassed studies, controversy regarding the relationship between PD and ED still persists. Of the 15 studies included, 13 studies revealed a significant relationship, as evidenced by the results of studies by Zadik et al. (p=0.004 in mild ED and p=0.007 in severe ED),[34] Keller et al. (p<0.001; OR=3.35, 95% CI=3.25-3.45),[36] Eltas et al. (p<0.05),[37] Oğus et al. (p<0.01; OR=3.29, 95% CI=1.36-9.55),[38] Matsumoto et al. (p=0.0415),[39] Tsao et al. (p<0.001; OR=1.79, 95% CI=1.64-1.96),[40] Uppal et al. (p=0.000),[41] Chou et al. (p<0.001; OR=1.6, 95% CI=1.280-2.009),[42] Martin et al. (p=0.03; OR=2.17, 95% CI=1.06-4.43),[43] Alenzi et al. (p<0.001),[44] Huang et al. (p=0.003; OR=2.755, 95% CI=1.400-5.423),[45] Kamaludin et al. (p<0.001),[46] and Mohd Sood et al. (p=0.031).[47] Meanwhile, two others concluded that there was no significant relationship, namely research by Sharma et al. (p=0.128)[35] and Diouf et al. (p=0.411; OR=1.52, 95% CI=0.55-4.16).[48] As far as this systematic review study was conducted, only fifteen articles were relevant and included.

This shows that studies regarding the relationship between PD and sexual health, in this context ED, are still limited.

As previously mentioned, two studies[35,48] reported an insignificant relationship between PD and ED. However, interestingly, Sharma et al. observed a progressive elevation in both the mean probing depth and periodontal attachment level (PAL) in tandem with the severity of ED. Furthermore, although the study by Diouf et al. showed no significant relationship; however, they demonstrated that maximum clinical attachment loss (CAL) exhibited a significant correlation with ED (p=0.045), and the severity of maximum CAL was also notably linked to the severity of ED (p=0.037).

The use of the definition of PD to diagnose PD in participants was different. In determining the diagnosis of PD, fourteen studies performed a clinical examination through visual examination and radiography with a variety of different diagnostic methods. There was one study that used a periodontal disease self-check sheet,[39] allowing for a high bias in determining the diagnosis of PD because it asked patients to examine and determine the condition of their own periodontal health. In two studies that diagnosed PD using dental bitewing radiography,[34,41] PD was defined by measuring alveolar-bone loss, identified as a minimum of one site on the jaw with a distance ≥6 mm between cemento-enamel junction (CEJ) and alveolar bone crest. Meanwhile, two of the 15 studies, in diagnosing PD, used the International Classification of Disease, Ninth Revision, Clinical Modification (ICD-9-CM) classification.[36,40] Additionally, no studies considered patients with gingivitis for inclusion in the study, where gingivitis is considered an inflammatory condition that initiates PD.[49] Differences in concepts in classification and diagnostic methods used are believed to influence the differences in results from these studies, especially in one study which used a self-check sheet to determine periodontal conditions, increasing the possibility of patients with PD being in the control patient group, and vice versa. Therefore, forthcoming investigations may contemplate adopting the new 2017 consensus classification for the diagnosis of PD, stated in the study.[50]

Differences in methods for diagnosing ED also exist. The IIEF and SHIM questionnaires were used to identify patients with ED in twelve studies.[34,37–39,41–48] Two studies[36,40] used the ICD-9-CM classification in determining the diagnosis of ED. Only one study[35] used the color Doppler ultrasound method as an addition to the SHIM questionnaire in determining ED in subjects.

Regarding methods for diagnosing ED, the conclusion of a study states that the IIEF/SHIM questionnaire cannot be used as a standard for diagnosing the severity of ED.[51] Although ED is generally measured using this questionnaire, filling out the questionnaire by patients themselves increases bias in the final results because it is based on the patient's subjective perception. In addition, in some countries, such as countries on the Asian continent, many people still consider sexual topics to be sensitive and taboo,[52] which may influence some patients in filling out the questionnaire. Meanwhile, the use of color Doppler ultrasound is more common and more objective in measuring ED in patients,[53] which was only applied in research conducted by Sharma et al..[35] In addition, specific examinations other than color Doppler ultrasound use hormonal and biochemical levels.[54] Interestingly, of all the studies encompassed within this systematic review, one case-control study[43] measured testosterone, CRP, total cholesterol, triglycerides, HDL, glucose, and HbA1c levels in subjects.

Referring to the cause, several mechanisms related to the progression of ED include psychological factors, neurological processes, hormonal imbalances, and vascular conditions. Endothelial dysfunction itself represents an initial phase of vascular impairment.[55] A factor that explains endothelial dysfunction is due to disruption of the nitric oxide (NO) mechanism. Studies conducted in rats by Zuo et al.[56] explained that systemic inflammation resulting from PD causes a decrease in eNOS expression and NOS activity in penile cavernous tissue. This is in accordance with the statement of Gratzke et al.[57] where endothelial dysfunction, which has previously been referred to as early stage vascular damage, occurs due to a decrease in NO bioavailability caused by a decrease in eNOS expression or activity, or an increase in NO removal. This, when endothelial dysfunction occurs in the penis, causes ED.

Although remain unclear, PD and ED are believed to have a positive correlation, since both diseases predispose to endothelial dysfunction.[58] It appears that inflammation contributes to the etiopathogenesis of atherogenesis which in turn causes ED.[59] Furthermore, the mechanism

underlying PD in increasing the incidence of ED is thought to be associated with a substantial increase in CRP and interleukin (IL)-6 levels.[60] A meta-analysis study also reported that ED patients had significantly higher CRP levels.[61] It was proven in one case-control study that included examination of CRP levels, reporting that in case patients, CRP levels exhibited a significant elevation compared to those observed in control patients (p=0.02).[43] Therefore, inflammation from PD is believed to contribute to ED, with elevated CRP levels reported in one of the studies incorporated in this study.

One of the 15 included studies conducted an intervention in the form of periodontal treatment in patients with ED, concluding that periodontal treatment had a significant effect on improving ED.[37] Several other studies also support these findings,[60,62–64] with periodontal treatment significantly reducing total oral bacteria and improving inflammatory biomarkers, including reduced levels of CRP and IL-6, possibly resulting in improved endothelial dysfunction. Based on these findings, we believe that periodontal treatment contributes to the improvement of ED through reducing inflammatory mediators caused by PD and improving endothelial dysfunction, confirmed by one study that reported improvement of ED after patients received periodontal treatment.

A review study has a high chance of bias; therefore, this systematic review acknowledges publication bias as a limitation. In addition, there is a diversity of results from the included studies, a small number of related studies which cannot represent the global population, differences in concepts and methods in diagnosing PD, and the use of self-assessment checklists in most studies which causes controversy and high subjectivity, are all limitations in this study. Nonetheless, our study provides a perspective for future research, considering the limitations of the study, particularly in regard to conducting meta-analysis study to ascertain the association between PD and ED, further research regarding periodontal treatment interventions to change the condition of ED, as well as similar studies with larger samples and rigorous methods, especially the use of standardized and objective diagnostic methods.

5. Summary

According to the findings, a significant association between PD and ED is evident. It is believed that the inflammatory processes associated with PD contributes to the emergence of ED, yet the exact underlying mechanism remains unclear. The scarcity of research and the complexity of the association between PD and ED suggest that future rigorous studies should be conducted. Additionally, dentists and general practitioners must be aware of the interconnection between these diseases, enabling them to provide comprehensive education to patients, particularly concerning the prevention and management of periodontal disease.

Author's Contribution

All authors played a role in shaping the final manuscript. The first author gathered and processed data, analyzed and interpreted data, drafted the manuscript, and created figures. The second and third authors contributed to outlining the main conceptual ideas of the research and providing critical revisions to the article.

Conflict of Interest

The authors assert that there are no conflicts of interest concerning this research.

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References

1. Gasner NS, Schure RS. Periodontal Disease. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2024 Apr 9]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK554590/
2. Botirovna SJ, Qizi ZMA, Qizi RSB. Dental periodontitis. Texa Jour of Medi Scie. 2021 Dec 18;3:38–9. [Journal]
3. Mehrotra N, Singh S. Periodontitis. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2019 [cited 2024 Feb 9]. Available from: http://www.ncbi.nlm.nih.gov/books/NBK541126/
4. World Health Organization. Oral Health. 2020. Available from: https://www.who.int/health-topics/oral-health
5. Eke PI, Borgnakke WS, Genco RJ. Recent Epidemiologic Trends in Periodontitis in

the USA. Periodontology 2000. 2020 Feb;82(1):257–67. [Pubmed]
6. Penelitian dan Pengembangan Kesehatan Kementerian Kesehatan RI. Riset Kesehatan Dasar 2018 [Internet]. 2018 [cited 2024 Jan 26]. Available from: https://layanandata.kemkes.go.id/katalog-data/riskesdas/ketersediaan-data/riskesdas-2018
7. Isola G, Santonocito S, Lupi SM, Polizzi A, Sclafani R, Patini R, et al. Periodontal Health and Disease in the Context of Systemic Diseases. Brzozowski T, editor. Mediators of Inflammation. 2023 May 13;2023:1–19. [Pubmed]
8. Liccardo D, Cannavo A, Spagnuolo G, Ferrara N, Cittadini A, Rengo C, et al. Periodontal Disease: A Risk Factor for Diabetes and Cardiovascular Disease. IJMS. 2019 Mar 20;20(6):1414. [Pubmed]
9. Naderi S, Merchant AT. The Association Between Periodontitis and Cardiovascular Disease: an Update. Curr Atheroscler Rep. 2020 Oct;22(10):52. [Pubmed]
10. Deschamps-Lenhardt S, Martin-Cabezas R, Hannedouche T, Huck O. Association between Periodontitis and Chronic Kidney Disease: Systematic Review and Meta‐Analysis. Oral Diseases. 2019 Mar;25(2):385–402. [Pubmed]
11. Gobin R, Tian D, Liu Q, Wang J. Periodontal Diseases and the Risk of Metabolic Syndrome: An Updated Systematic Review and Meta-Analysis. Front Endocrinol. 2020 Jun 9;11:336. [Pubmed]
12. De Oliveira Ferreira R, De Brito Silva R, Magno MB, Carvalho Almeida APCPS, Fagundes NCF, Maia LC, et al. Does Periodontitis Represent A Risk Factor for Rheumatoid Arthritis? A Systematic Review and Meta-Analysis. Therapeutic Advances in Musculoskeletal. 2019 Jan;11:1759720X1985851. [Pubmed]
13. Kavarthapu A, Gurumoorthy K. Linking Chronic Periodontitis and Oral Cancer: A Review. Oral Oncology. 2021 Oct;121:105375. [Pubmed]
14. Gomes-Filho IS, Cruz SSD, Trindade SC, Passos-Soares JDS, Carvalho-Filho PC, Figueiredo ACMG, et al. Periodontitis and respiratory diseases: A systematic review with meta-analysis. Oral Diseases. 2020 Mar;26(2):439–46. [Pubmed]
15. Jakovljevic A, Sljivancanin Jakovljevic T, Duncan HF, Nagendrababu V, Jacimovic J, Aminoshariae A, et al. The Association Between Apical Periodontitis and Adverse Pregnancy Outcomes: A Systematic Review. Int Endodontic J. 2021 Sep;54(9):1527–37. [Pubmed]
16. Ridho FM, Algifnita AO, Pramaztri NN, Laksono EP, Allifiah BPN, Mahesa A. Periodontitis as a Risk Factor of Preeclampsia in Pregnancy: A Scoping Review. IIMJ [Internet]. 2024;5(2). Available from: https://journal2.unusa.ac.id/index.php/IIMJ/article/view/5316
17. Lecaplain B, Badran Z, Soueidan A, Prud'homme T, Gaudin A. Periodontitis, Erectile Dysfunction, Reproductive Hormones, and Semen Quality: A Systematic Review. Andrology. 2021 May;9(3):769–80. [Pubmed]
18. Martínez-García M, Hernández-Lemus E. Periodontal Inflammation and Systemic Diseases: An Overview. Front Physiol. 2021 Oct 27;12:709438. [Pubmed]
19. Hegde R, Awan KH. Effects of periodontal disease on systemic health. Disease-a-Month. 2019 Jun;65(6):185–92. [Pubmed]
20. NIH Consensus Conference. NIH Consensus Development Panel on Impotence. JAMA. 1993;270(1):83–90. [Pubmed]
21. Rew KT, Heidelbaugh JJ. Erectile Dysfunction. American Family Physician. 2016;94(10):820–8. [Pubmed]
22. Wessells H, Joyce GF, Wise M, Wilt TJ. Erectile Dysfunction. Journal of Urology. 2007 May;177(5):1675–81. [Journal]
23. Goldstein I, Goren A, Li VW, Tang WY, Hassan TA. Epidemiology Update of Erectile Dysfunction in Eight Countries with High Burden. Sexual Medicine Reviews. 2020 Jan 1;8(1):48–58. [Pubmed]
24. Pellegrino F, Sjoberg DD, Tin AL, Benfante NE, Briganti A, Montorsi F, et al. Relationship Between Age, Comorbidity, and the Prevalence of Erectile Dysfunction. European Urology Focus. 2023 Jan;9(1):162–7. [Pubmed]
25. Kessler A, Sollie S, Challacombe B, Briggs K, Van Hemelrijck M. The Global Prevalence of Erectile Dysfunction: A Review. BJU International. 2019 Oct;124(4):587–99. [Pubmed]
26. Weber MF, Smith DP, O'Connell DL, Patel MI, Souza PL, Sitas F, et al. Risk Factors for Erectile Dysfunction in A Cohort of 108 477 Australian Men. Medical Journal of Australia. 2013 Jul;199(2):107–11. [Pubmed]

27. Xiong Y, Zhang F, Zhang Y, Wang W, Ran Y, Wu C, et al. Insights into Modifiable Risk Factors of Erectile Dysfunction, A Wide-Angled Mendelian Randomization Study. Journal of Advanced Research. 2024 Apr;58:149–61. [Pubmed]
28. Safarinejad M. Prevalence and Risk Factors for Erectile Dysfunction in A Population-Based Study in Iran. Int J Impot Res. 2003 Aug 1;15(4):246–52. [Pubmed]
29. Molina-Vega M, Asenjo-Plaza M, Banderas-Donaire M, Hernández-Ollero M, Rodríguez-Moreno S, Álvarez-Millán J, et al. Prevalence of and Risk Factors for Erectile Dysfunction in Young Nondiabetic Obese Men: Results from A Regional Study. Asian J Androl. 2020;22(4):372. [Pubmed]
30. Nguyen HMT, Gabrielson AT, Hellstrom WJG. Erectile Dysfunction in Young Men—A Review of the Prevalence and Risk Factors. Sexual Medicine Reviews. 2017 Oct;5(4):508–20. [Pubmed]
31. Eastham J, Seymour R. Is Oral Health A Risk Factor for Sexual Health? Dent Update. 2015 Mar 2;42(2):160–5. [Pubmed]
32. Connolly L. The Effects of Oral Health on Erectile Dysfunction. BDJ Team. 2022 Jan 21;9(1):29–31. Available from: https://www.nature.com/
33. Singh V, Nettemu S, Nettem S, Hosadurga R, Nayak S. Oral Health and Erectile Dysfunction. J Hum Reprod Sci. 2017;10(3):162. [Pubmed]
34. Zadik Y, Bechor R, Galor S, Justo D, Heruti RJ. Erectile Dysfunction Might Be Associated with Chronic Periodontal Disease: Two Ends of the Cardiovascular Spectrum. The Journal of Sexual Medicine. 2009 Apr 1;6(4):1111–6. [Pubmed]
35. Sharma A, Pradeep AR, Raju P. A. Association Between Chronic Periodontitis and Vasculogenic Erectile Dysfunction. Journal of Periodontology. 2011 Dec;82(12):1665–9. [Pubmed]
36. Keller JJ, Chung S, Lin H. A nationwide population-based study on the association between chronic periodontitis and erectile dysfunction. J Clinic Periodontology. 2012 Jun;39(6):507–12. [Pubmed]
37. Eltas A, Oguz F, Uslu MO, Akdemir E. The Effect of Periodontal Treatment in Improving Erectile Dysfunction: A Randomized Controlled Trial. J Clinic Periodontology. 2013 Feb;40(2):148–54. [Pubmed]
38. Oğuz F, Eltas A, Beytur A, Akdemir E, Uslu MÖ, Güneş A. Is There a Relationship Between Chronic Periodontitis and Erectile Dysfunction? The Journal of Sexual Medicine. 2013 Mar 1;10(3):838–43. [Pubmed]
39. Matsumoto S, Matsuda M, Takekawa M, Okada M, Hashizume K, Wada N, et al. Association of ED with Chronic Periodontal Disease. Int J Impot Res. 2014 Jan;26(1):13–5. [Pubmed]
40. Tsao CW, Liu CY, Cha TL, Wu ST, Chen SC, Hsu CY. Exploration of The Association between Chronic Periodontal Disease and Erectile Dysfunction From A Population-Based View Point. Andrologia. 2014;47(5):513–8. [Pubmed]
41. Uppal RS, Bhandari R, Singh K. Association between Erectile Dysfunction And Chronic Periodontitis: A Clinical Study. Indian J Dent Res. 2014;25(4):430. [Pubmed]
42. Chou MH, Liu CY, Yang MH, Chou YC, Wu ST, Cha TL, et al. Chronic Periodontal Disease Correlated with Sezual Function in Young Males. Formosan Journal of Surgery. 2018;51(5):175–9. [Pubmed]
43. Martín A, Bravo M, Arrabal M, Magán-Fernández A, Mesa F. Chronic Periodontitis Is Associated with Erectile Dysfunction. A Case–Control Study in European Population. J Clinic Periodontology. 2018 Jul;45(7):791–8. [Pubmed]
44. Alenzi MJS. Prevalence of Erectile Dysfunction and Associated Risk Factors among Patients with Chronic Periodontitis Attending Various Dental Clinics. Bahrain Medical Bulletin. 2020;42(4):257–60.
45. Huang N, Li C, Sun W, Yang Y, Tang Q, Xiao F. Association Between Chronic Periodontal Disease and Erectile Dysfunction: A Case–Control Study. Am J Mens Health. 2022 Mar;16(2):155798832210847. [Pubmed]
46. Kamaludin H, Kwong JCK, Marmuji LZ, Abidin KZ. Prevalence of Periodontitis in Erectile Dysfunction Patients. AOS. 2022 Aug 3;17(Supp. 1):73–84. [Journal]
47. Mohd Sood Z, Nik-Azis NM, Baharin B, Md Zainuddin Z, Razali M, Hussaini HM. An Insight into the Role of Periodontitis as a Potential Risk Factor for Development of Erectile Dysfunction. AOS. 2022 Aug 3;17(Supp. 1):107–18. [Journal]
48. Diouf A, Ndjidda Bakari W, Sounlin MH, Diallo AM, Thiam D, Guirassy ML, et al. Periodontitis as a Risk Factor for Organic

Erectile Dysfunction: A Case-Control Study in A Sub-Saharan Population. J Adv Periodontol Implant Dent. 2023 Nov 8;15(2):80–5. [Pubmed]
49. Trombelli L, Farina R, Silva CO, Tatakis DN. Plaque ‐ Induced Gingivitis: Case Definition and Diagnostic Considerations. J Clinic Periodontology [Internet]. 2018 Jun;45(S20). Available from: https://onlinelibrary.wiley.com/doi/10.1111/jcpe.12939
50. Tonetti MS, Greenwell H, Kornman KS. Staging and Grading of Periodontitis: Framework and Proposal of A New Classification and Case Definition. Journal of Periodontology. 2018 Jun;89(S1):S159–72. [Pubmed]
51. Elnashar A, Gadallah AM, Abdelaal AA, Soliman IF, Youssef MAFM. Can the International Index of Erectile Function (IIEF-5) be Used as A Diagnostic Tool to The Severity of Vasculogenic Erectile Dysfunction? Middle East Fertility Society Journal. 2012 Jun;17(2):101–4. [Journal]
52. Ismail K, Hamid SRA. Communication about Sex-Reproductive Health Issues with Adolescents: A Taboo among Malaysian Parents? European Journal of Social Sciences Education and Research. 2016 Mar 16;6(1):26–40. [Journal]
53. Ma M, Yu B, Qin F, Yuan J. Current approaches to the diagnosis of vascular erectile dysfunction. Transl Androl Urol. 2020 Apr;9(2):709–21. [Journal]
54. Mazzilli F. Erectile Dysfunction: Causes, Diagnosis and Treatment: An Update. JCM. 2022 Oct 30;11(21):6429. [Pubmed]
55. De Leonardis F, Colalillo G, Finazzi Agrò E, Miano R, Fuschi A, Asimakopoulos AD. Endothelial Dysfunction, Erectile Deficit and Cardiovascular Disease: An Overview of the Pathogenetic Links. Biomedicines. 2022 Aug 1;10(8):1848. [Pubmed]
56. Zuo Z, Jiang J, Jiang R, Chen F, Liu J, Yang H, et al. Effect of Periodontitis on Erectile Function and Its Possible Mechanism. The Journal of Sexual Medicine. 2011 Sep 1;8(9):2598–605. [Pubmed]
57. Gratzke C, Angulo J, Chitaley K, Dai Y tian, Kim NN, Paick JS, et al. Anatomy, Physiology, and Pathophysiology of Erectile Dysfunction. The Journal of Sexual Medicine. 2010 Jan 1;7(1_Part_2):445–75. [Pubmed]
58. Kulshrestha R, Ray Chaudhuri G, Bhattacharya K, Dutta S, Sengupta P. Periodontitis as an Independent Factor in Pathogenesis of Erectile Dysfunction. Biomed Pharmacol J. 2020 Mar 28;13(1):01–4. [Journal]
59. Bizzarro S, Loos BG. The Link between Periodontitis and Erectile Dysfunction: a Review. Br Dent J. 2019 Oct;227(7):599–603. [Pubmed]
60. Tonetti MS, D'Aiuto F, Nibali L, Donald A, Storry C, Parkar M, et al. Treatment of Periodontitis and Endothelial Function. N Engl J Med. 2007 Mar;356(9):911–20. [Pubmed]
61. Liu G, Zhang Y, Zhang W, Wu X, Jiang H, Huang H, et al. Novel Predictive Risk Factor for Erectile Dysfunction: Serum High ‐ Sensitivity C ‐ Reactive Protein. Andrology. 2022 Sep;10(6):1096–106. [Pubmed]
62. Piconi S, Trabattoni D, Luraghi C, Perilli E, Borelli M, Pacei M, et al. Treatment of Periodontal Disease Results in Improvements in Endothelial Dysfunction and Reduction of The Carotid Intima ‐ Media Thickness. FASEB j. 2009 Apr;23(4):1196–204. [Pubmed]
63. Seinost G, Wimmer G, Skerget M, Thaller E, Brodmann M, Gasser R, et al. Periodontal Treatment Improves Endothelial Dysfunction in Patients with Severe Periodontitis. American Heart Journal. 2005 Jun;149(6):1050–4. [Pubmed]
64. Blum A, Kryuger K, Mashiach Eizenberg M, Tatour S, Vigder F, Laster Z, et al. Periodontal Care May Improve Endothelial Function. European Journal of Internal Medicine. 2007 Jul;18(4):295–8. [Pubmed]