



Periodontal Health and Psychiatric Disorders

Steve Kisely^{1,2,3}

Accepted: 25 June 2023 / Published online: 21 July 2023
© The Author(s) 2023

Abstract

Purpose of Review People with mental illness are vulnerable to periodontal diseases. Explanations include the direct effects of the psychiatric illness, side effects of psychotropic medication, lifestyle (e.g., alcohol, tobacco, and other substance use), shared risk factors, and difficulties with activities of daily living and access to dental care.

Recent Findings Latest findings confirm the bi-directional relationship between periodontal disease and both psychiatric illness and substance use disorders (SUDs). On one hand, individuals with psychiatric illness and SUDs are at increased risk of developing periodontal disease, the strongest association being for SUDs and severe mental illnesses. On the other hand, periodontal disease may contribute to the development or exacerbation of psychiatric illness and SUDs through the systemic effects of chronic inflammation.

Summary There are complex and bi-directional interactions between dental pathology and psychiatric illnesses/ SUDs that include a wide range of interconnected biological, behavioral, and psychosocial factors.

Keywords Periodontal disease · Periodontitis · Severe mental illness · Common mental disorders · Substance use disorders · Inflammation

Introduction

Poor oral health is linked to various chronic conditions, but until recently, less attention has been given to the links between psychiatric disorders and dental disease [1••]. This is despite the adverse effects on chewing, speech, and psychosocial functioning [2]. People with mental illness (MI) are vulnerable to dental diseases as a result of many causes including difficulties with activities of daily living, access to dental care, the direct effects of the psychiatric illness, side effects of psychotropic medication, and lifestyle factors (e.g., alcohol, tobacco, and other substance use) [1••, 3, 4].

Periodontal disease is one of two main dental diseases that are relevant to people with mental illness, the other being caries [1••, 4]. Dental caries is caused by bacterial fermentation of dietary carbohydrates that leads to destruction of tooth and eventually loss (edentulism). By contrast, periodontal disease is an inflammatory disorder caused by the accumulation and dysbiosis of bacterial biofilm, affecting tissues surrounding and supporting teeth [1••]. Symptoms include gingival swelling, redness, bleeding, bone resorption, and formation of periodontal pockets. Ultimately, it can lead to edentulism and poor quality of life. There are also links with long-term illnesses such as diabetes, cardiovascular disease, and respiratory diseases, in part because of common risk factors such as tobacco and alcohol use [1••]. There is a bi-directional relationship between periodontal and long-term inflammatory diseases with both having shared risk factors, resulting in a cycle that reinforces and accentuates inflammation (Fig. 1).

Treatment for periodontal disease typically involves a combination of good oral hygiene practices (such as brushing and flossing regularly), professional dental cleaning, and, in severe cases, surgical intervention [5]. For individuals with co-occurring psychiatric disorders, it may also be important to improve oral hygiene and consider the role of

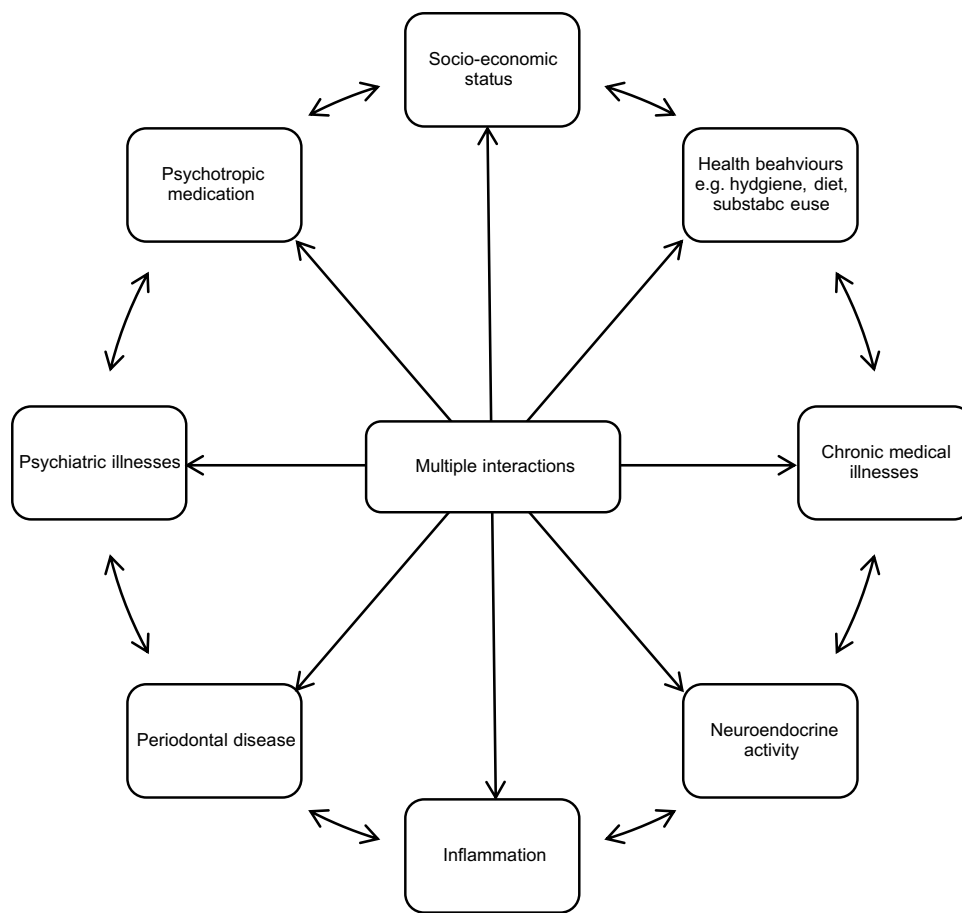
✉ Steve Kisely
s.kisely@uq.edu.au

¹ The University of Queensland School of Medicine, Brisbane, Qld, Australia

² Metro South Health Service, Level 4, Building 1, Princess Alexandra Hospital, Ipswich Road, Woolloongabba, Qld 4102, Australia

³ Departments of Psychiatry, Community Health and Epidemiology, Dalhousie University, Halifax, Nova Scotia, Canada

Fig. 1 Interrelationships between periodontal disease, lifestyle, inflammation, chronic medical illness, psychotropic medication, and socio-economic variables



psychotropic medication [1••, 6]. Additionally, tobacco use cessation programs may be helpful for individuals with psychiatric disorders who smoke and therefore are at increased risk of periodontal disease [1••].

This review reports on recent epidemiological and biological findings on the link between periodontal disease and mental illness.

Epidemiology

Although there have been several systematic reviews of the topic, most have focused on particular examples of psychiatric illness and one or two key oral health problems without integration of findings to enable comparisons between different psychiatric disorders [7–13]. However, there have been several recent reviews that have addressed this issue.

The first was an umbrella review of the links between psychiatric or substance use disorders (SUD) and periodontal disease, caries, erosion, or edentulism [1••]. In contrast to the consistent association between caries and SUD or severe mental illness (SMI), findings for periodontal disease were

more equivocal. For instance, there were no studies of severe mental illness, while findings for common mental disorders such as anxiety or depression were mixed. As an example, while two meta-analyses found significant associations between periodontal disease and anxiety [10], this was weak in one of them, and this disappeared when only good-quality studies were analyzed [11]. Similarly, depression showed significant links with periodontal disease in only one out of four meta-analyses, largely because of two studies from China [10]. The significance of the findings disappeared after these studies were removed [10]. The strongest findings were for substance use, particularly cannabis, where two of the three reviews found significant results. However, even in this case, a third review of only better-quality studies did not report significant results [12].

The second review also included observational studies as well as systematic reviews on the association between periodontal disease and anxiety, depression, and PTSD [14••]. This found that most evidence was for an association with depression, followed by anxiety, especially in studies that included a comparison with controls. In the case of depression, the authors also identified a cohort study that matched

12,000 incident cases of periodontal disease with 50,832 periodontal healthy controls [15•]. After adjustment for sex, age, and comorbid conditions, the group with periodontal disease had nearly a two-fold greater likelihood of developing depression over the following 5 to 11 years, suggesting that this was a risk factor for subsequent depression [15•].

The evidence for the link between PTSD and periodontal disease was weaker than for the other two conditions, as there were no systematic reviews but only individual observational studies with varying methodologies and contradictory results for both adults and children [14••].

Neither of these studies included SMI. However, a subsequent systematic review investigated periodontal disease in people with schizophrenia, schizoaffective disorder, bipolar affective disorder, and other psychoses [16••]. This included data on 4404 people with psychiatric illness and 95,411 controls. SMI was associated with a four-fold increase in the prevalence of periodontal disease compared to the general population, as well as roughly three times the risk of having shallow or deep pockets [16••].

All the above reviews noted study limitations in terms of wide variations in population, psychiatric diagnostic criteria, and periodontal disease, as well as statistical heterogeneity where this was measured [1••, 14••, 16]. In particular, there was an absence of standard diagnostic criteria for periodontal disease [16••], which was measured in several ways. These included bleeding on probing (BoP), the periodontal probing depth (PPD), clinical attachment loss (CAL), and the Community Periodontal Index of Treatment Needs (CPITN or CPI) [17, 18].

Each method had drawbacks. For instance, the most widely used measure, the CPI, gives a single score based on an ascending hierarchy of bleeding, calculus, and PPD, thereby possibly underestimating the prevalence of disease by ignoring the presence of symptoms from lower down the order, such as bleeding. In addition, PPD may not be an accurate indicator of tissue destruction [18].

The Effect of Mental Health on Periodontal Disease

There are a number of explanations for how psychiatric disorders may predispose to periodontal disease. These include poor oral hygiene and the side effects of medication [4, 16••]. For instance, less than 40% of people with severe mental illness clean their teeth twice daily compared to three-quarters of the general population [19]. Rates of flossing or mouthwash use are even lower [19].

In addition, many psychotropic medications can cause dry mouth, as do illicit agents such as opiates and psychostimulants. Dry mouth (or xerostomia), in turn, predisposes

to both caries and periodontal disease. In addition, methadone can also worsen comorbid dental decay because of the sugary content.

As noted previously, other contributors include socio-economic disadvantage lifestyle such as alcohol, tobacco, and substance use, as well as barriers to affordable and timely access to dental care (Fig. 1). For instance, dentistry is often excluded from universal healthcare meaning that this population must rely on a limited range of overstretched and limited publicly funded services including dental hospitals and community clinics. However, these are mainly restricted to metropolitan areas, have restricted opening times, and often operate on a first-come, first-served basis presenting barriers to people with mental illness or from regional and remote areas [20]. This is exacerbated by the longstanding separation of dental care from other health services. As a result, people with SMI are significantly less likely to visit the dentist than the general population and, [19] if they do, less likely to be adherent with treatment [4]. Dental professionals may also be unprepared to spend additional time in explaining planned procedures and making people with mental illness feel comfortable. This is exacerbated by the lack of dentists who have received additional training in the care of vulnerable groups [21]. In addition to limits on time and communication barriers, avoidance and dismissive behaviors by dental staff may lead to stigmatization of people with mental illness and further hinder optimal delivery of dental care [21, 22].

In contrast to the above findings, there is emerging evidence that one class of psychotropic, the antidepressants, may protect against periodontal disease [23]. In a retrospective study of 582 people with periodontal disease, antidepressants were associated with reduced markers of severity including less clinical attachment loss and increased alveolar bone levels [23]. However, when analyzed by antidepressant class, only selective serotonin reuptake inhibitors (SSRIs) or the use of multiple classes were associated with improved periodontal outcomes [23]. The explanation is unclear but may be due to the anti-inflammatory and immunomodulatory effects of antidepressants, especially SSRIs [23].

The Effect of Periodontal Disease on Mental Health

Although psychiatric illness is the more obvious cause of the association between oral and mental health, there may also be evidence of bi-directionality given longitudinal findings of a higher incidence of subsequent depression in people with periodontal disease. This raises the question of how periodontal diseases can affect the central nervous system and, specifically, mental health (Fig. 1).

For instance, psychiatric illnesses and disorders may cause dysregulation of both sympathoadrenal and medullary hypothalamic-pituitary-adrenal axes along with the associated cascades of hormonal, neurotransmitter, and inflammatory mediators [24]. This may result in oral microbiome dysbiosis, altered immune responses, changes to salivary phenotype, and tooth grinding, all of which predispose to periodontal diseases (Fig. 1) [4, 25].

Furthermore, there is now a greater understanding of the effects of gut microbiota on psychiatric illness [14••]. These microbiotas are organized into biofilms, which are matrix-embedded microbial populations that adhere to each other and related surfaces. Dysbiosis in these biofilms can disturb the balance between different bacteria and may lead to inflammation, ultimately driving the development of periodontal disease. Direct invasion of the brain by periodontal bacteria via the bloodstream or cranial nerves may follow including the breakdown of the blood-brain barrier by lipopolysaccharides as well as the activation of microglia and subsequent neuroinflammation by pro-inflammatory cytokines [26]. Exosomes from cells, which act as mediators of intercellular communication, may also play a role in transmitting inflammation from the oral cavity to the central nervous system (CNS) thereby affecting function and behavior [14••, 27].

Periodontal diseases can also induce chronic systemic inflammation through raised C-reactive protein (CRP) and cytokine levels mediated by lipopolysaccharides from the outer membrane of associated gram-negative bacteria [4, 28, 29••]. These, in turn, may predispose to several psychiatric illnesses including depression, anxiety, and schizophrenia [30•, 31, 32].

Discussion

This paper provides an update on the links between periodontal disease and mental health. Until recently, this has been an under-researched area compared to other oral health problems such as caries [1••]. There may be several reasons for this. One is that dental decay is a more common and widely recognized dental problem than periodontal disease. Another is that the connection between dental decay and mental illness is more straightforward than that between periodontal disease and mental illness. Dental decay is caused by bacteria in the mouth that produce acids that erode the teeth, and this process can lead to pain and discomfort that can impact mental health. In contrast, periodontal disease involves inflammation and infection of the gums and other tissues that support the teeth, and the relationship between this condition and mental health is more complex and less well understood. Related to this is the lack of a standard definition of periodontal disease [1••, 16••].

Additionally, some researchers may have focused on dental decay rather than periodontal disease because it is typically easier to treat and prevent. For example, dental decay can often be addressed through simple interventions such as filling cavities, while periodontal disease may require more extensive treatment such as scaling and root planing or surgery [5].

Latest findings confirm the bi-directional relationship between periodontal disease, psychiatric illness, and substance use disorders. On one hand, individuals with psychiatric illness and substance use disorders are at increased risk of developing periodontal disease. For example, individuals with SMI, depression, or anxiety may neglect their oral hygiene, which can lead to the development of gum disease [1••]. Substance use can also increase the risk of periodontal disease, as drug and alcohol use can impair immune function and make it easier for bacteria to grow and cause infection [1••, 33]. People with mental illness also face barriers to recovering the appropriate dental care. Although psychotropic medication generally exacerbates oral health problems [6], there is emerging evidence that some anti-depressants are associated with reduced severity of periodontal disease possibly through anti-inflammatory effects [23].

On the other hand, periodontal disease may also contribute to the development or exacerbation of psychiatric illness and substance abuse disorders. Chronic inflammation, which is a hallmark of periodontal disease, has been linked to the development of various psychiatric disorders, including schizophrenia, anxiety, and depression. In addition, the pain and discomfort associated with periodontal disease can lead to substance abuse as individuals try to manage their symptoms with drugs or alcohol.

It is important to note that while there seems to be a bi-directional association between periodontal disease and psychiatric illness and substance abuse disorders, the exact nature of this relationship is still not fully understood. More research is needed to better understand the mechanisms underlying this association and to develop effective strategies for addressing both periodontal disease and psychiatric illness and substance use disorders [14••]. In particular, there is the need for greater standardization of the diagnostic criteria for periodontal disease [16••]. However, it is clear that individuals with these conditions should be screened for periodontal disease and receive appropriate dental care so as to improve their overall health and quality of life. It is also important for people with mental illness to prioritize their oral health and work with their healthcare providers to manage their conditions and medications appropriately. Regular dental visits and good oral hygiene, including daily brushing and flossing, can help avoid and manage periodontal disease.

Conclusion

There are complex and bi-directional interactions between dental pathology and psychiatric illnesses that include a wide range of interconnected biological, behavioral, and psychosocial factors.

Funding Open Access funding enabled and organized by CAUL and its Member Institutions

Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Human and Animal Rights and Informed Consent This article does not enclose studies performed in human or animal subjects performed by any of the present authors.

Open Access This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article's Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article's Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <http://creativecommons.org/licenses/by/4.0/>.

References

Papers of particular interest, published recently, have been highlighted as:

- Of importance
- Of major importance

1. •• Choi J, Price J, Ryder S, Siskind D, Solmi M, Kisely S. Prevalence of dental disorders among people with mental illness: an umbrella review. *Aust N Z J Psychiatry*. 2022;56(8):949–63. <https://doi.org/10.1177/00048674211042239>. **An umbrella review of systematic reviews of the association between psychiatric disorders and dental pathology including periodontal disease.**
2. Mirza I, Day R, Phelan M, Wulff-Cochrane V. Oral health of psychiatric in-patients: a point prevalence survey of an inner-city hospital. *Psychiatric Bull*. 2001;25(4):143–5. <https://doi.org/10.1192/pb.25.4.143>.
3. Kisely S. No Mental Health without Oral Health. *Canad J Psychiat Revue Canad Psychiat*. 2016;61(5):277–82. <https://doi.org/10.1177/0706743716632523>.
4. Joury E, Kisely S, Watt R, Ahmed N, Morris A, Fortune F, et al. Mental disorders and oral diseases: future research directions. *J Dental Res*. 2023;102(1):5–12.
5. Kwon T, Lamster IB, Levin L. Current concepts in the management of periodontitis. *Int Dental J*. 2021;71(6):462–76.
6. Cockburn N, Pradhan A, Taing M, Kisely S, Ford P. Oral health impacts of medications used to treat mental illness. *J Affect Disord*. 2017;223:184–93.
7. Kisely S, Baghaie H, Lalloo R, Siskind D, Johnson NW. A systematic review and meta-analysis of the association between poor oral health and severe mental illness. *Psycho Med*. 2015;77(1):83–92. <https://doi.org/10.1097/PSY.000000000000135>.
8. Chisini LA, Cademartori MG, Francia A, Mederos M, Grazioli G, Conde MC, Correa MB, et al. Is the use of Cannabis associated with periodontitis? A systematic review and meta-analysis. *J Period Res*. 2019;54(4):311–7.
9. Beck JD, Offenbacher S. Systemic effects of periodontitis: epidemiology of periodontal disease and cardiovascular disease. *J Periodontol*. 2005;76(11 Suppl):2089–100. <https://doi.org/10.1902/jop.2005.76.11-S.2089>.
10. Liu F, Wen Y-F, Zhou Y, Lei G, Guo Q-Y, Dang Y-H. A meta-analysis of emotional disorders as possible risk factors for chronic periodontitis. *Medicine*. 2018;97(28):1–9.
11. Zheng DX, Kang XN, Wang YX, Huang YN, Pang CF, Chen YX, et al. Periodontal disease and emotional disorders: a meta-analysis. *J Clin Periodontol*. 2020;48(2):180–204. <https://doi.org/10.1111/jcpe.13395>.
12. Yazdani M, Armoon B, Noroozi A, Mohammadi R, Bayat AH, Ahounbar E, et al. Dental caries and periodontal disease among people who use drugs: a systematic review and meta-analysis. *BMC Oral Health*. 2020;20(1):44. <https://doi.org/10.1186/s12903-020-1010-3>.
13. Araújo MM, Martins CC, Costa LCM, Cota LOM, Faria RLAM, Cunha FA, et al. Association between depression and periodontitis: a systematic review and meta-analysis. *J Clin Periodontol*. 2016;43(3):216–28.
14. •• Martínez M, Postolache TT, García-Bueno B, Leza JC, Figuero E, Lowry CA, et al. The role of the oral microbiota related to periodontal diseases in anxiety, mood and trauma-and stress-related disorders. *Front Psychiat*. 2022;2650. **A comprehensive review of the bi-directional relationship between periodontal disease and psychiatric illnesses including possible mechanisms such as oral microbiota.**
15. • Hsu C-C, Hsu Y-C, Chen H-J, Lin C-C, Chang K-H, Lee C-Y, et al. Association of periodontitis and subsequent depression: a nationwide population-based study. *Medicine*. 2015;94(51). **Large study that showed that periodontal disease preceded depression lending support to a bi-directional relationship.**
16. •• Cai V, Ng CP, Zhao J, Siskind D, Kisely S. A systematic review and meta-analysis of the association between periodontal disease and severe mental illness. *Psychos Med*. 2022;84(7):836–47. **Most recent systematic review of the association between severe mental illness and periodontal disease.**
17. Leroy R, Eaton KA, Savage A. Methodological issues in epidemiological studies of periodontitis-how can it be improved? *BMC Oral Health*. 2010;10:1–7.
18. Baelum V, Papananou PN. CPITN and the epidemiology of periodontal disease Commentary. *Commun Dent Oral Epidemiol*. 1996;24(6):367–8.
19. Turner E, Berry K, Aggarwal VR, Quinlivan L, Villanueva T, Palmier-Claus J. Oral health self-care behaviours in serious mental illness: a systematic review and meta-analysis. *Acta Psychiatrica Scand*. 2022;145(1):29–41.
20. Carlisle K, Larkins S, Croker F. Disparities in dental health of rural Australians: hospitalisation rates and utilisation of public dental services in three communities in North Queensland. *Rural Remote Health*. 2017;17(1):1–10.
21. Pradhan A, Slade GD, Spencer AJ. Access to dental care among adults with physical and intellectual disabilities: residence

- factors. *Aust Dent J.* 2009;54(3):204–11. <https://doi.org/10.1111/j.1834-7819.2009.01120.x>.
22. Cumella S, Ransford N, Lyons J, Burnham H. Needs for oral care among people with intellectual disability not in contact with Community Dental Services. *J Intellect Disabil Res.* 2000;44(Pt 1):45–52. <https://doi.org/10.1046/j.1365-2788.2000.00252.x>.
 23. Hakam AE, Duarte PM, Mbadu MP, Aukhil I, da Silva HDP, Chang J. Association of different antidepressant classes with clinical attachment level and alveolar bone loss in patients with periodontitis: a retrospective study. *J Periodontal Res.* 2022;57(1):75–84. <https://doi.org/10.1111/jre.12939>.
 24. Stein DJ, Benjet C, Gureje O, Lund C, Scott KM, Poznyak V, et al. Integrating mental health with other non-communicable diseases. *BMJ.* 2019;364:l295. <https://doi.org/10.1136/bmj.l295>.
 25. Gomaa N, Tenenbaum H, Glogauer M, Quiñonez C. The biology of social adversity applied to oral health. *J Dental Res.* 2019;98(13):1442–9. <https://doi.org/10.1177/0022034519876559>.
 26. Frister A, Schmidt C, Schneble N, Brodhun M, Gonnert FA, Bauer M, et al. Phosphoinositide 3-kinase γ affects LPS-induced disturbance of blood-brain barrier via lipid kinase-independent control of cAMP in microglial cells. *Neuromol Med.* 2014;16(4):704–13. <https://doi.org/10.1007/s12017-014-8320-z>.
 27. Tobón-Arroyave SI, Celis-Mejía N, Córdoba-Hidalgo MP, Isaza-Guzmán DM. Decreased salivary concentration of CD9 and CD81 exosome-related tetraspanins may be associated with the periodontal clinical status. *J Clin Periodontol.* 2019;46(4):470–80. <https://doi.org/10.1111/jcpe.13099>.
 28. Lafon A, Pereira B, Dufour T, Rigouby V, Giroud M, Béjot Y, et al. Periodontal disease and stroke: a meta-analysis of cohort studies. *Eur J Neurol.* 2014;21(9):1155–61. <https://doi.org/10.1111/ene.12415>.
 29. ●● Makkar H, Reynolds MA, Wadhawan A, Dagdag A, Merchant AT, Postolache TT. Periodontal, metabolic, and cardiovascular disease: exploring the role of inflammation and mental health. *Pteridines.* 2018;29(1):124–63. **Comprehensive review of the role of immune activation in the relationships between periodontal disease, cardiometabolic disease and psychiatric illnesses.**
 30. ● Costello H, Gould RL, Abrol E, Howard R. Systematic review and meta-analysis of the association between peripheral inflammatory cytokines and generalised anxiety disorder. *BMJ Open.* 2019;9(7):e027925. <https://doi.org/10.1136/bmjopen-2018-027925>. **A systematic review and meta-analysis of the association between inflammation and generalised anxiety disorder.**
 31. Kirkpatrick B, Miller BJ. Inflammation and schizophrenia. *Schizophr Bull.* 2013;39(6):1174–9. <https://doi.org/10.1093/schbul/sbt141>.
 32. Raison CL, Capuron L, Miller AH. Cytokines sing the blues: inflammation and the pathogenesis of depression. *Trends Immunol.* 2006;27(1):24–31. <https://doi.org/10.1016/j.it.2005.11.006>.
 33. Baghaie H, Kisely S, Forbes M, Sawyer E, Siskind DJ. A systematic review and meta-analysis of the association between poor oral health and substance abuse. *Addiction (Abingdon, England).* 2017;112(5):765–79. <https://doi.org/10.1111/add.13754>.

Publisher's Note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.