Title: Oral health self-care behaviours in serious mental illness: A systematic review and meta-analysis.

Authors: Elizabeth Turner, [1,2] Professor Katherine Berry, [1,2] Dr Vishal Aggarwal, [3] Dr Leah Quinlivan, [1,2] Timothy Villanueva, [4] Dr Jasper Palmier-Claus. [5,6]

Corresponding Author: Dr Jasper Palmier-Claus

Senior Lecturer in Clinical Psychology & Principal Clinical Psychologist

Spectrum Centre for Mental Health Research & Lancashire and South Cumbria NHS Foundation Trust

Division of Health Research, Faculty of Health and Medicine

Health Innovation One, Sir John Fisher Drive

Lancaster University,

Lancaster,

LA1 4YW

Contact number: 01524 663086

Contact email: J.palmier-claus@lancaster.ac.uk

Affiliations:

[1] Division of Psychology & Mental Health, The University of Manchester, Manchester, UK

[2] Greater Manchester Mental Health NHS Foundation Trust, Manchester, UK

[3] School of Dentistry, Faculty of Medicine and Health, The University of Leeds, Leeds, UK

[4] Mersey Care NHS Foundation Trust, Liverpool, UK

[5] The Spectrum Centre for Mental Health Research, Faculty of Health & Medicine, Lancaster University, Lancaster, UK

[6] Lancashire & South Cumbria NHS Foundation Trust, Lancashire, UK

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Abstract (240 words)

Aim To understand the relationship between serious mental illness and oral health self-care behaviours using meta-analytic methods and a narrative synthesis of available literature.

Method The review followed the Preferred Reporting Items for Systematic Reviews and Meta-analyses guidelines [PROSPERO reference: CRD42020176779]. Search terms pertaining to serious mental illness and oral health were entered into EMBASE, PsycINFO, Medline and CINAHL. Eligible studies included a sample of people with a serious mental illness and a quantitative measure of an oral health self-care behaviour (e.g. dental visits, toothbrushing). The Effective Public Health Practice Project tool was utilised to appraise the quality of the literature. Studies in the meta-analysis contained a non-clinical or general population comparator sample.

Results People with a serious mental illness were significantly less likely to visit the dentist (OR 0.46, 95% *CI* 0.32-.065, $p>0.001$) or brush their teeth (OR 0.19, 95% *CI* 0.08-0.42, $p<0.001$) when compared to non-clinical comparator samples. Few studies explored other oral health self-care behaviours (e.g. flossing, mouth-washing etc.), but uptake was generally low in people with a serious mental illness. The study quality of included studies was variable.

Conclusions The research showed a reduced uptake of oral health self-care behaviours in people with a serious mental illness. Sub-optimal oral health can negatively impact on physical, social and psychological functioning. Further research is needed to understand the reasons for low rates of oral health self-care behaviours in this population.

3-5 key words: Oral health, psychotic disorders, bipolar disorders, dental care.

Summations

- People with a serious mental illness were less likely to visit the dentist.
- They were also less likely to brush their teeth.
- There was limited evidence around the use of dental floss and mouthwash

Limitations

- The quality of the available literature was variable.
- Few studies explored the use of dental floss and mouth wash.
- Research typically did not distinguish between routine and emergency dental visits.

Introduction

There is evidence that people with a serious mental illness (SMI; i.e. psychosis, bipolar disorder) experience worse oral health outcomes than the general population. [1] For example, past research has indicated that people with SMI are 2.8 to 3.4 times as likely to be edentulous (complete loss of all teeth) and have significantly higher rates of decayed, missing or filled teeth (DMFT) or surfaces (DMFS) in comparison to the general population. [2-4] Suboptimal oral health can have a detrimental impact on physical and psychological functioning. [5] The oral cavity plays a crucial role in the overall well-being of a person and damage thereof can cause considerable suffering by affecting basic and essential functions like eating and speaking. [6] Severe caries (tooth decay) leads to pain, discomfort, disfigurement, acute and chronic infections, and eating and sleeping disruption as well as a higher risk of hospitalisation, high treatment costs and lost workdays. [7] Research suggests that there is a link between poor oral health and chronic disease, such as diabetes and cardiovascular diseases. [8, 9] The ability to smile can also be affected [5], which can impact on self-esteem [10] and the ability to socialise with others. [6]

The reasons for poor oral health outcomes in people with SMI are likely complex and may include higher rates of drug misuse, [11] smoking, [12] and medication side effects (e.g. xerostomia). [13] Poor oral health in this population may also be due to reduced levels of oral health self-care behaviours (e.g. dental care, toothbrushing). Some, but not all, studies have suggested that people with a SMI are less likely to attend routine dental visits and, when they do, are more likely to have teeth extracted rather than filled [2-4]. This could explain the high rate of edentulous in this population. An increased focus on preventative practices has improved oral health outcomes in the general population. [14] Further research is needed to understand levels of oral health behaviours in people with SMI, which could inform future presentation and intervention strategies, leading to better outcomes. It may help to understand oral health inequalities in people with SMI.

Aims of the study

The aim of this review was to better understand utilisation of oral health self-care behaviours in people with SMI. It used meta-analytic methods to synthesise the size and consistency of differences in oral health self-care behaviours between people with a SMI and non-clinical comparator samples. It also aimed to narratively review studies without a non-clinical comparator sample to better summarise the existing literature.

Material and methods

This review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-analyses standards with a protocol published on PROSPERO [CRD42020176779].

Eligibility criteria

The inclusion criteria were: i) a case-control, cohort, cross-sectional, longitudinal and epidemiological design study; ii) publication in an English language peer reviewed academic journal; and iii) a quantitative measure of an oral health self-care behaviour. We defined oral health self-care behaviours as actions that individuals take to improve or preserve good oral health. [14] This included owning a toothbrush, dental care attendance, and frequency of tooth-brushing.

Studies were required to include a sample of at least 75% of people diagnosed with a SMI in accordance with the Diagnostic and Statistical Manual (DSM-III or later) or International Classification of Disease (ICD-9 or ICD-10) criteria. SMI is a contentious, but widely used term often including a range of diagnoses such as personality disorders, major depression disorder and dementia. [2, 3] However, for the purpose of this review SMI has been defined as the collective term for people with a diagnosis of a psychotic or a bipolar spectrum disorder to maintain consistency with the UK-based National Institute for Health and Care Excellence (NICE) guidance and the majority of past literature [15] Specific diagnostic criteria included schizophrenia, schizophreniform, schizoaffective disorder, delusional disorder, bipolar I and bipolar II. Participants who met the operational criteria for an early intervention service for first episode psychosis were included to allow for diagnostic uncertainty in younger age groups. For the purpose of the meta-analysis, eligible studies were required to include valid comparator group (e.g. general population sample, non-clinical comparator).

Screening Procedure

Systematic searches were conducted in Medline, EMBASE, PsycINFO and CINAHL to identify peer-reviewed articles published between January 1980 and April 2020. Search terms were entered in blocks relating to serious mental illness (severe mental or serious mental or chronic mental or schizo* or psychoti* or psychos* or hallucinat* or paranoi* or bipolar or mania or manic) and oral health (oral health or oral hygiene or tooth* or teeth* or dent*). The

search terms were developed based on the authors' clinical experience and relevant past reviews. [2-4, 16] In cases where papers were unavailable or the data was insufficient to confirm eligibility or generate an effect size, information was requested from the primary or corresponding author. The first author (ET) screened the reference lists of eligible articles, citing articles, and relevant reviews. [2-4, 16] Ten percent (805 studies) of titles and abstracts were double rated by another author (TV), with high levels of agreement (k= 0.84). At least two of the authors screened each of the full articles to confirm eligibility with discrepancy resolved through consensus.

Data extraction

Relevant study information (e.g. study design, sample size, type of sample) was extracted by the first author (ET). For the meta-analysis, outcome data was independently extracted by two authors (ET and JPC) to calculate an effect size (ICC = 0.95, p>0.001). If multiple time points were presented (e.g. dental visit within one year and dental visit within two years), the lower timescale analysis was selected to ensure consistency. When possible, we extracted analyses that controlled for covariates (e.g. adjusted odds ratios).

Quality assessment

An adapted version of the Effective Public Health Practice Project (EPHPP) tool [17] was used to evaluate the overall quality of the included articles due to its suitability for assessing public health focused quantitative studies. The EPHPP has demonstrated good construct and content validity and interrater reliability. [18] Consistent with previous review papers, [19 20] the tool was adapted to account for the observational design of eligible studies. Domains that were not considered relevant (design; blinding; intervention integrity; withdrawals and drop-outs) to the included studies were omitted. The design domain pertained to randomisation procedures for intervention evaluations and was therefore not relevant to the reviewed literature and excluded.

The adapted version of the EPHPP consisted of four domains: selection bias, confounders, data collection methods and analyses. Each domain was rated as strong, moderate or weak and from this, a global rating was derived based on ratings in each domain. In the original EPHPP, analyses ratings were not used to calculate the global rating. However, consistent with previous adaptations [21] a decision was made to include analyses scores in the overall global rating as appropriateness of analysis was deemed to be integral to the quality of the study. Articles were

rated by two authors (ET and TV; 79% agreement) and, in cases of discrepancy, consensus was reached with input from a third author.

Statistical analysis

Meta-analysis

We used Comprehensive Meta-Analysis (CMA, v3) [22] to generate effect sizes and conduct analysis for all outcomes with K>3. Study effect sizes were transformed into odds ratios and a random effects model was utilised as statistical heterogeneity was expected across studies. [23] Heterogeneity was explored through use of the Q-test and I^2 statistic and a sensitivity analysis was conducted to assess whether any individual study had great influence over the overall effect size.

Narrative synthesis

In order to appraise the wider literature in this area, all studies without a comparator group were narratively synthesised using the Synthesis Without Meta-Analysis (SWiM) [24] guidelines. Outcomes were grouped according to oral health self-care behaviours and the corresponding literature was tabulated using the population, intervention, comparator and study type (PICOS) framework to summarise the literature and explore clinical heterogeneity. A weighted average was calculated for key outcomes, using all available data, even those without a clinical comparator**.**

Results

The PRISMA flowchart (Figure 1.) displays the screening process. Thirty-three studies [25-57] were eligible for inclusion. The total sample comprised of 446,932 people with a SMI and 6,284,176 controls. Further information was provided by seven authors [26, 29, 35, 38, 44, 48, 57] to either confirm eligibility or produce an effect size. Table 1 displays the descriptive information on the included studies.

Quality appraisal

Findings from the quality assessment are summarised in Table 2. Six studies obtained strong scores, seven moderate and 20 weak. Limitations of the methodology predominantly related to data collection as outcome measures used were typically not validated and the reliability of the measures was poor. Studies tended to have a broader focus than oral health self-care

behaviours. Therefore, the analysis in this area tended to be basic (e.g. percentages) and did not account for confounders, leading to higher rates of weak ratings.

Dental service use

Twenty-three studies reported data on dental visiting behaviour. These studies were of mixed quality. However, more than half of the studies entered into the meta-analysis were of strong quality. Studies were conducted in Europe (52%, K=12), North America (26%, K=6), Asia (13%, K=13), South America (4%, K=1) and Australasia (5%, K=1). Sixteen studies focused on people with a psychotic disorder, one on bipolar disorder and six on mixed SMI samples. A weighted average of data from eight [28, 33, 40, 41, 43, 45, 52, 57] cross-sectional and case control studies indicated that 34% of participants with SMI had visited the dentist in the previous year. One epidemiological study [47] indicated that 43% of participants had visited the dentist within one year.

Two studies had higher rates of dental attendance compared to the rest of the literature, potentially explained by their samples of people with early psychosis [25] (80% within 2 years) and bipolar disorder [29] (85% within 2 years). Data was split into diagnostic groups (psychotic disorders and bipolar disorder) in one study [37], which looked at dental attendance across a five-year period. Although levels of attendance were high across both groups, they were greater in bipolar disorder (79% in comparison to 68%). One small-scale cross-sectional study [57] explored the impact of a partnership between mental health and dental services and found that 90% of individuals with a SMI had attended the dentist within one year. Baseline data was not provided to explore the difference between outcomes before and after the integration of services.

Dental Service Use Meta-Analysis

Nine studies [29, 30, 33, 36, 41, 43, 47, 52, 55] of mostly strong quality explored dental service usage in comparison to a non-clinical comparator and were analysed using random effects meta-analysis (Figure 2). One study [25] was omitted from this analysis as the measure of dental service use was not consistent across the case sample and non-clinical comparator. The analysis (Figure 2) showed an overall OR of 0.46 (95% *CI* 0.32-.065, p>0.001), indicating that individuals with a SMI were significantly less likely to access dental services in comparison to non-clinical controls. Separate analyses were conducted to explore differences between case-control and epidemiological studies. Although, statistically there was no significant difference in the strength of effect sizes between the two types of study (Q(1)= 0.70 p = 0.400), the five case-

control studies (OR 0.32, 95% *CI* 0.08-1.29, *p*=0.109) indicated no significant difference in dental service usage between SMI in comparison to non-clinical controls, whereas the four epidemiological studies (OR 0.60, 95% *CI* 0.38-0.96, *p*=.003) did show a significant difference between these populations.

The Q-test and I^2 statistic were used to explore statistical heterogeneity. Results indicated high levels of statistical heterogeneity across studies ($Q(8)= 2097.61$, $p<.001$, $I^2 = 99.62$), suggesting that the strength of the relationship between SMI and dental service use was highly variable across studies. A sensitivity analysis, which removed each study in turn to explore the impact on the overall effect size, the results indicated that one study [43] exerted some influence over the overall effect size (OR 0.65, 95% *CI* 0.46-0.93, *p*=.019).

[Figure 2 goes around here]

Oral hygiene

Toothbrushing Frequency

Twenty-one studies provided data on toothbrushing frequency. An even proportion of studies were conducted in Europe and Asia (43%, K=9) and the remaining studies were conducted in North America (9%, K=2) and Australasia (4%, K=1). Fifteen studies were conducted in people with a psychotic disorder only (75%, K=15), whereas six (25%, K=6) studies were conducted in mixed SMI samples. A weighted average of 10 studies [25, 26, 39, 40, 43, 51-54, 56] indicated that only 39% of people with a SMI brushed their teeth twice a day.

The results and measures used to assess toothbrushing frequency were greatly variable. Results indicated that toothbrushing habits were often reduced in inpatient samples of people diagnosed with schizophrenia. Two studies [38, 56] found that the uptake of toothbrushing behaviours was low in 50% of participants. Similarly, in one study, "habitual brushing" (undefined) was recorded in only 22% of participants. [27] In mixed SMI inpatient samples [43, 46, 54] participants were more likely to clean their teeth. Studies of better quality [38, 56] were more likely to report reduced toothbrushing behaviours.

Toothbrushing Frequency Meta-Analysis

Five case-control studies [25, 39, 43, 52, 56] of predominantly weak quality included a non-clinical comparator group and were entered into a random effects meta-analysis (Figure 3) to produce an overall effect size. Outcomes for two studies were dichotomised to generate an effect size. [43, 56] The overall effect size (OR 0.19, 95% *CI* 0.08-0.42, $p<0.001$) suggested that people with a SMI were significantly less likely to brush their teeth than controls.

The Q-test and I^2 statistic ($Q(4)= 23.13$, $p<.001$) indicated high levels of heterogeneity. 82% of the variance was due to statistical heterogeneity. A sensitivity analyses was conducted to identify outliers. The results indicated that two studies [25, 39] exerted some influence over the overall effect size. When one study [25] was removed the effect size reduced to OR 0.07, *CI* 0.01-0.55, $p = 0.012$. Similar effects were observed when the other study [39] was removed (OR 0.06 *CI* 0.01-0.44, $p = 0.005$). However, the effects of neither study were great enough to impact overall statistical significance.

[Figure 3 goes around here]

Toothbrush ownership and maintenance

Two studies of weak quality reported on toothbrush ownership [25, 44] and found similar levels in people with a SMI (70% and 66%). Results from three studies [26, 27, 43] of weak to moderate quality indicated variable levels of toothbrush maintenance in people with a SMI. One study [43] suggested that only 1.8% of people with SMI changed their toothbrush every three months, but this was higher at 33% in a second study. [26] A key difference between these two studies was that one study [43] included an inpatient sample and the other [26] (which indicated a much higher rate of upkeep) included an outpatient sample. A third study of weak quality [27] found that 25% of subjects "maintained their hygiene tools" over an unspecified timescale.

Toothbrush technique

Three studies of moderate to weak quality investigated toothbrushing technique [26, 43, 56] and found between 72.6% and 98.2% of people with a SMI used the incorrect brushing technique. Agarwal and colleagues [26] defined the correct technique as sulcular (also known as bass), which has been found to be more effective. [58] The other studies did not define the correct tooth brushing technique and are therefore difficult to interpret.

Materials used for oral health self-care behaviours

Two studies [26, 50] of weak and moderate quality explored the uptake of oral hygiene tools in people with a SMI. Both were conducted in India with participants diagnosed with schizophrenia. Results indicated that 21.6% of participants used a tongue cleaning aid. [26] One study [50] highlighted that 34% of the sample used their finger to clean their teeth.

Flossing frequency

In three studies [45, 52, 57] of weak quality, uptake of flossing behaviour ranged from 11%-20%. One study [52] found that flossing behaviour was 50% lower in an sample with SMI compared to non-clinical controls. No studies investigated flossing technique.

Mouthwash

Three studies [40, 45, 57] of weak quality explored the uptake of mouthwash in people with a SMI. In one study [40] 4.7% of participants reported that their oral care routine solely consisted of using mouthwash. One study [45] found that 23% of individuals with SMI used mouthwash as part of their oral care routine, which was similar to a non-clinical comparator group. A further study [57] found that 35% of people with a SMI used mouthwash, but there was no non-clinical comparator group.

Discussion

This is the first meta-analysis to comprehensively explore the uptake of oral health behaviours in people with SMI. We systematically reviewed 33 studies comprised of 446,932 people with a SMI and 6,284,176 controls. Findings indicated that people with SMI are significantly less likely to access dental services and frequently brush their teeth than the general population. There is also some tentative evidence to suggest that other behaviours such as flossing, mouth washing and ownership and maintenance of materials for oral health self-care behaviours are low in individuals with a SMI.

Recent research has suggested that people with a SMI are more likely to experience sub-optimal oral health in comparison to the general population. [2-4] This review builds on existing literature by finding that oral health self-care behaviours are significantly reduced in people with a SMI. Results indicate that between 34-43% of people with a SMI visit the dentist at least annually. This is stark contrast to past research indicating that approximately 61% of the general population visit the dentist at least once per year. [59] Similarly, the finding that 39% of individuals with a SMI clean their teeth twice a day is much lower than what is typically recorded for the general population. [60] More research is needed to ascertain the difference between SMI and the general population when key confounders (e.g. socio-economic status, access to dental care) are considered. Two of the included studies [36, 55] controlled for income and access to dental care and found similarly low rates of dental service utilisation in SMI. Research in non-clinical samples has indicated an association between dental behaviours and outcomes. [61] However, further research is required to establish whether the uptake of oral health self-care behaviours mediates the relationship between SMI and oral health outcomes.

Overall, the quality of the literature was variable with a high number of studies receiving a weak rating on the EPHPP tool. Outcomes of interest were seldom the focal point of included studies. Therefore, outcome measures were often unvalidated and analyses typically neglected to include key confounders (e.g. severity of illness, socio-economic status, access to dental care). It is also noteworthy that some studies used survey data as the comparator group and did not employ matching criteria. Although the quality of the available literature was variable, we were able to extract descriptive data from the majority of identified studies.

In the available literature, mental health diagnoses were often retrieved from the medical notes and in some cases the method of confirming diagnoses was unstated. Further information was required from some authors to ascertain the diagnostic system used. Future studies should

address this issue by ensuring that diagnoses are determined through more rigorous processes. Maintenance behaviours and dental attendance were poorly defined in the majority of studies. Most failed to distinguish between routine and emergency care. This is important given that people with a SMI may be more likely to utilise emergency care in crisis and less likely to attend routine dental visits. [30] Future research should carefully define dental visiting to provide a better understanding of pathways to care.

The literature predominantly focused on individuals with a psychotic disorder. However, one study [29] explored dental visiting behaviours in people with a diagnosis of bipolar disorder only, where there were high rates of dental attendance similar to the control group. High rates of dental attendance were also found across a longer time period in a study that separately assessed dental attendance in bipolar disorder and psychotic disorders. [37] It is possible therefore that dental visiting behaviours may not be as disrupted in people with bipolar disorder. No studies looked at toothbrushing in bipolar disorder, which poses as an important area for future research.

Only a limited number of studies could be statistically analysed using meta-analytic methods as the majority did not include a non-clinical comparator. Consequently, post-hoc analyses were not conducted to assess selection and publication bias. [62, 63] Substantial levels of heterogeneity reduce confidence in the size of the effect produced. The observed heterogeneity may have been due to differences in methods and quality across the included studies. Study design had an impact on the dental visiting results. Statistically, there was no difference between case-control and epidemiological findings. However, when analysed separately, epidemiological studies indicated a significant difference between dental visiting in people with a SMI compared to controls, whereas case-control studies did not.

We restricted our inclusion criteria to peer-reviewed papers published in the English language which may have introduced bias. Studies with significant findings may be more likely to be published, which could skew the results to significant findings. [64] Accessing English language publications may also reduce diversity across study samples. Requests for further information to confirm diagnoses or generate an effect size were sent to multiple authors and responses were only received by seven authors, which limited the ability to include some studies.

The disparity between the physical health of people with a SMI and the general population has been well documented. [65, 66] Growing evidence suggests disparities exist in oral health. [2-4, 67] The reasons for this are likely to be multifactorial and may include medication, [68, 69] systemic

issues, [70, 71] and personal capability [72]. Literature indicates that education alone does not improve oral health outcomes in this client group, despite guidance published by the British Society of Disability and Oral Health (BSDH). [71] One study [25] adapted the checklist from BSDH guidelines and found no significant improvements between the intervention and control group. Similarly, a Cochrane review [10] did not provide evidence to suggest that education alone would improve outcomes in people with a SMI. National guidelines in the UK and Australia [73, 74] have indicated a need for increased oral health support for people with complex and early psychosis promoting assessment, monitoring and additional support to maintain oral health. This review indicates that such guidelines should be adopted more broadly to include all people who experience psychosis. However, further research is needed to better understand what factors impact on oral health self-care behaviours to ensure interventions and support is targeted accordingly.

Conclusion

In conclusion, findings from this review indicate that oral health self-care behaviours are reduced in people with an SMI. Further research is needed to explore which factors affect the uptake of behaviours and how mental health difficulties are a risk factor for poor oral health outcomes. The recent Lancet Commission [65] called for better integration of mental and physical care. The results from this review indicate that this should also encompass dental care to meet the wide-ranging and complex needs of this client group to ensure effective early screening, monitoring and intervention in oral health.

References

1. Palmier-Claus JE, Shiers D, French P, Harris R, Laverty L. Oral health in psychosis: An unmet need. *Schizophr Res*. Feb 2019;204:442. doi:10.1016/j.schres.2018.09.011
2. Kisely S, Quek LH, Pais J, Lalloo R, Johnson NW, Lawrence D. Advanced dental disease in people with severe mental illness: systematic review and meta-analysis. *Br J Psychiatry*. Sep 2011;199(3):187-93. doi:10.1192/bjp.bp.110.081695
3. 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. *Psychosom Med*. Jan 2015;77(1):83-92. doi:10.1097/psy.0000000000000135
4. Yang M, Chen P, He MX, et al. Poor oral health in patients with schizophrenia: A systematic review and meta-analysis. *Schizophr Res*. Nov 2018;201:3-9. doi:10.1016/j.schres.2018.04.031
5. Baiju RM, Peter E, Varghese NO, Sivaram R. Oral Health and Quality of Life: Current Concepts. *J Clin Diagn Res*. Jun 2017;11(6):ZE21-ZE26. doi:10.7860/JCDR/2017/25866.10110
6. Allen PF. Assessment of oral health related quality of life. *Health Qual Life Outcomes*. Sep 8 2003;1:40. doi:10.1186/1477-7525-1-40
7. Sheiham A. Oral health, general health and quality of life. *Bull World Health Organ*. Sep 2005;83(9):644. doi:/S0042-96862005000900004
8. Kane SF. The effects of oral health on systemic health. *Gen Dent*. Nov-Dec 2017;65(6):30-34.
9. Peres MA, Macpherson LMD, Weyant RJ, et al. Oral diseases: a global public health challenge. *Lancet*. Jul 20 2019;394(10194):249-260. doi:10.1016/S0140-6736(19)31146-8
10. Khokhar MA, Khokhar WA, Clifton AV, Tosh GE. Oral health education (advice and training) for people with serious mental illness. *Cochrane Database Syst Rev*. Sep 8 2016;9:CD008802. doi:10.1002/14651858.CD008802.pub3
11. Bahorik AL, Newhill CE, Queen CC, Eack SM. Under-reporting of drug use among individuals with schizophrenia: prevalence and predictors. *Psychol Med*. Jan 2014;44(1):61-9. doi:10.1017/s0033291713000548
12. Cook BL, Wayne GF, Kafali EN, Liu Z, Shu C, Flores M. Trends in smoking among adults with mental illness and association between mental health treatment and smoking cessation. *Jama*. Jan 8 2014;311(2):172-82. doi:10.1001/jama.2013.284985
13. Okamoto A, Miyachi H, Tanaka K, Chikazu D, Miyaoka H. Relationship between xerostomia and psychotropic drugs in patients with schizophrenia: evaluation using an oral moisture meter. *J Clin Pharm Ther*. Dec 2016;41(6):684-688. doi:10.1111/jcpt.12449
14. PHE. Delivering better oral health: an evidence-based toolkit for prevention. 2014. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/605266/Delivering_better_oral_health.pdf
15. NICE. Improving the physical health of people with serious mental illness: A quality improvement approach. https://www.nice.org.uk/sharedlearning/improving-the-physical-health-of-people-with-serious-mental-illness-a-quality-improvement-approach
16. Palmier-Claus JE, Berry K, Bucci S, Mansell W, Varese F. Relationship between childhood adversity and bipolar affective disorder: systematic review and meta-analysis. *Br J Psychiatry*. Dec 2016;209(6):454-459. doi:10.1192/bjp.bp.115.179655
17. Thomas BH, Ciliska D, Dobbins M, Micucci S. A process for systematically reviewing the literature: providing the research evidence for public health nursing interventions. *Worldviews Evid Based Nurs*. 2004;1(3):176-84. doi:10.1111/j.1524-475X.2004.04006.x
18. Armijo-Olivo S, Stiles CR, Hagen NA, Biondo PD, Cummings GG. Assessment of study quality for systematic reviews: a comparison of the Cochrane Collaboration Risk of Bias Tool and the Effective Public Health Practice Project Quality Assessment Tool: methodological research. *J Eval Clin Pract*. Feb 2012;18(1):12-8. doi:10.1111/j.1365-2753.2010.01516.x

19. Degnan A, Berry K, Humphrey C, Bucci S. The relationship between stigma and subjective quality of life in psychosis: A systematic review and meta-analysis. *Clin Psychol Rev*. Apr 2021;85:102003. doi:10.1016/j.cpr.2021.102003
20. Longden E, Branitsky A, Moskowitz A, Berry K, Bucci S, Varese F. The Relationship Between Dissociation and Symptoms of Psychosis: A Meta-analysis. *Schizophr Bull*. Mar 18 2020;46(5):1104-13. doi:10.1093/schbul/sbaa037
21. Degnan A, Berry K, Sweet D, Abel K, Crossley N, Edge D. Social networks and symptomatic and functional outcomes in schizophrenia: a systematic review and meta-analysis. *Soc Psychiatry Psychiatr Epidemiol*. Sep 2018;53(9):873-888. doi:10.1007/s00127-018-1552-8
22. *Comprehensive Meta-Analysis Version 3.* . Version 3. 2013.
23. Borenstein M, Hedges LV, Higgins JP, Rothstein HR. A basic introduction to fixed-effect and random-effects models for meta-analysis. *Res Synth Methods*. Apr 2010;1(2):97-111. doi:10.1002/jrsm.12
24. Campbell M, McKenzie JE, Sowden A, et al. Synthesis without meta-analysis (SWiM) in systematic reviews: reporting guideline. *Bmj*. Jan 16 2020;368:l6890. doi:10.1136/bmj.l6890
25. Adams CE, Wells NC, Clifton A, et al. Monitoring oral health of people in Early Intervention for Psychosis (EIP) teams: The extended Three Shires randomised trial. *Int J Nurs Stud*. Jan 2018;77:106-114. doi:10.1016/j.ijnurstu.2017.10.005
26. Agarwal D, Kumar A, B CM, et al. Effectiveness of oral health education on oral hygiene status among schizophrenic patients: A randomized controlled study. *Spec Care Dentist*. May 2019;39(3):255-261. doi:10.1111/scd.12373
27. Hsieh CJ, Pan FC. Rebuilding the dental hygiene habits of the hospitalized patients with schizophrenia. . *International Journal of Medical, Health, Biomedical, Bioengineering and Pharmaceutical Engineering* 2011;5(10):501-503.
28. Corridore D, Guerra F, La Marra C, Di Thiene D, Ottolenghi L. Oral Health Status and Oral Health-Related Quality of Life in Italian Deinstitutionalized Psychiatric Patients. *Clin Ter*. Mar-Apr 2017;168(2):e77-e83. doi:10.7417/CT.2017.1987
29. Cunha FA, Cota LOM, Cortelli SC, et al. Periodontal condition and levels of bacteria associated with periodontitis in individuals with bipolar affective disorders: A case-control study. *J Periodontal Res*. Feb 2019;54(1):63-72. doi:10.1111/jre.12605
30. Denis F, Goueslard K, Siu-Paredes F, et al. Oral health treatment habits of people with schizophrenia in France: A retrospective cohort study. *PLoS One*. 2020;15(3):e0229946. doi:10.1371/journal.pone.0229946
31. Denis F, Hamad M, Trojak B, et al. Psychometric characteristics of the "General Oral Health Assessment Index (GOHAI) » in a French representative sample of patients with schizophrenia. *BMC Oral Health*. Apr 11 2017;17(1):75. doi:10.1186/s12903-017-0368-3
32. Denis F, Milleret G, Wallenhorst T, Carpentier M, Rude N, Trojak B. Oral health in schizophrenia patients: A French Multicenter Cross-Sectional Study. *Presse Med*. Feb 2019;48(2):e89-e99. doi:10.1016/j.lpm.2018.06.018
33. Dickerson FB, McNary SW, Brown CH, Kreyenbuhl J, Goldberg RW, Dixon LB. Somatic healthcare utilization among adults with serious mental illness who are receiving community psychiatric services. *Med Care*. Apr 2003;41(4):560-70. doi:10.1097/01.Mlr.0000053440.18761.F0
34. Eltas A, Kartalcı S, Eltas SD, Dündar S, Uslu MO. An assessment of periodontal health in patients with schizophrenia and taking antipsychotic medication. *Int J Dent Hyg*. May 2013;11(2):78-83. doi:10.1111/j.1601-5037.2012.00558.x
35. Eskelinen S, Sailas E, Joutsenniemi K, Holi M, Koskela TH, Suvisaari J. Multiple physical healthcare needs among outpatients with schizophrenia: findings from a health examination study. *Nord J Psychiatry*. Aug 2017;71(6):448-454. doi:10.1080/08039488.2017.1319497
36. Gandré C, Coldefy M. Disparities in the Use of General Somatic Care among Individuals Treated for Severe Mental Disorders and the General Population in France. *Int J Environ Res Public Health*. May 12 2020;17(10)doi:10.3390/ijerph17103367

37. Xiong GL, Iosif AM, Bermudes RA, McCarron RM, Hales RE. Preventive medical services use among community mental health patients with severe mental illness: the influence of gender and insurance coverage. . *Journal of clinical psychiatry* 2010;12(5)
38. Gurbuz O, Alatas G, Kurt E, Dogan F, Issever H. Periodontal health and treatment needs among hospitalized chronic psychiatric patients in Istanbul, Turkey. *Community Dent Health*. Mar 2011;28(1):69-74.
39. Hede B, Petersen PE. Self-assessment of dental health among Danish noninstitutionalized psychiatric patients. *Spec Care Dentist*. Jan-Feb 1992;12(1):33-6. doi:10.1111/j.1754-4505.1992.tb00405.x
40. Tredget J, Sze TW. Raising awareness of oral health care in patients with schizophrenia. . *Nursing Times* 2019;115(12):21-25.
41. Janardhanan T, CI C, S K, BF R. Dental care and associated factors among older adults with schizophrenia. . *The Journal of the American Dental Association*. 2011;142(1):57-65.
42. Patrick J, H., Pruchno RA. Mothers' perceptions of service use and unmet service needs for their adult offspring with chronic mental illness. . *Psychiatric Annals* 1996;26(12):757-765.
43. Jovanovic S, Milovanovic SD, Gajic I, Mandic J, Latas M, Jankovic L. Oral health status of psychiatric in-patients in Serbia and implications for their dental care. *Croat Med J*. Oct 2010;51(5):443-50. doi:10.3325/cmj.2010.51.443
44. Lynch U, Lazenbatt A, Freeman R, Lynch G, Neill EO. Making equity a reality: oral health promotion in a psychiatric setting. *Int J Psychiatr Nurs Res*. Jan 2005;10(2):1078-92.
45. McCreadie RG, Stevens H, Henderson J, et al. The dental health of people with schizophrenia. *Acta Psychiatr Scand*. Oct 2004;110(4):306-10. doi:10.1111/j.1600-0447.2004.00373.x
46. Ngo DYJ, Thomson WM, Subramaniam M, Abdin E, Ang KY. The oral health of long-term psychiatric inpatients in Singapore. *Psychiatry Res*. Aug 2018;266:206-211. doi:10.1016/j.psychres.2018.05.048
47. Nielsen J, Munk-Jorgensen P, Skadhede S, Correll CU. Determinants of poor dental care in patients with schizophrenia: a historical, prospective database study. *J Clin Psychiatry*. Feb 2011;72(2):140-3. doi:10.4088/JCP.09m05318yel
48. Pelletier JF, Lesage A, Boisvert C, Denis F, Bonin JP, Kisely S. Feasibility and acceptability of patient partnership to improve access to primary care for the physical health of patients with severe mental illnesses: an interactive guide. *Int J Equity Health*. Sep 14 2015;14:78. doi:10.1186/s12939-015-0200-0
49. Salsberry PJ, Chipps E, Kennedy C. Use of general medical services among Medicaid patients with severe and persistent mental illness. *Psychiatr Serv*. Apr 2005;56(4):458-62. doi:10.1176/appi.ps.56.4.458
50. Singh A, Mittal P, Goel P, Purohit BM, Thukral R. Severity of illness and extra pyramidal symptoms as predictors for oral diseases among patients with schizophrenia. *Acta Odontol Scand*. Apr 2017;75(3):220-226. doi:10.1080/00016357.2017.1278789
51. Singh A, Purohit BM, Mittal P. Periodontal predicaments and associated risk factors among patients with schizophrenia. *Neurology, Psychiatry and Brain Research*. 2019/06/01/ 2019;32:36-41. doi:https://doi.org/10.1016/j.npbr.2019.03.008
52. Stiefel DJ, Truelove EL, Menard TW, Anderson VK, Doyle PE, Mandel LS. A comparison of the oral health of persons with and without chronic mental illness in community settings. *Spec Care Dentist*. Jan-Feb 1990;10(1):6-12. doi:10.1111/j.1754-4505.1990.tb01079.x
53. Nayak SU, Keshava PK, Shenoy R. Effect of psychiatric illness on oral tissue, gingival and periodontal health among non-institutionalized psychiatric patients of Mangalore, India. . *Archives of Psychiatry and Psychotherapy* 2020;(2):45-51.
54. Tani H, Uchida H, Suzuki T, et al. Dental conditions in inpatients with schizophrenia: a large-scale multi-site survey. *BMC Oral Health*. Aug 18 2012;12:32. doi:10.1186/1472-6831-12-32

55. Teng PR, Lin MJ, Yeh LL. Utilization of dental care among patients with severe mental illness: a study of a National Health Insurance database. *BMC Oral Health*. Sep 1 2016;16(1):87. doi:10.1186/s12903-016-0280-2
56. Đorđević V, Jovanović M, Stefanović V, et al. Assessment of periodontal health among inpatients with schizophrenia. . *Vojnosanitetski pregled* 2019;0(0):18-18.
57. Wieland B, Lau G, Seifert D, Siskind D. A partnership evaluation: public mental health and dental services. *Australas Psychiatry*. Dec 2010;18(6):506-11. doi:10.3109/10398562.2010.498512
58. Janakiram C, Taha F, Joe J. The Efficacy of Plaque Control by Various Toothbrushing Techniques-A Systematic Review and Meta-Analysis. . *Journal of Clinical & Diagnostic Research,* . 2018;12(11)
59. CDC. National Health Nutrition and Examination Survey. . 2020. https://wwwn.cdc.gov/Nchs/Nhanes/2017-2018/OHQ_J.htm#OHQ
60. NHS. Adult Dental Health Survey. 2020. https://digital.nhs.uk/data-and-information/publications/statistical/adult-dental-health-survey/adult-dental-health-survey-2009-summary-report-and-thematic-series
61. Broadbent JM, Zeng J, Foster Page LA, Baker SR, Ramrakha S, Thomson WM. Oral Health-related Beliefs, Behaviors, and Outcomes through the Life Course. *J Dent Res*. Jul 2016;95(7):808-13. doi:10.1177/0022034516634663
62. Dalton JE, Bolen SD, Mascha EJ. Publication Bias: The Elephant in the Review. *Anesth Analg*. Oct 2016;123(4):812-3. doi:10.1213/ANE.0000000000001596
63. Mavridis D, Salanti G. How to assess publication bias: funnel plot, trim-and-fill method and selection models. *Evid Based Ment Health*. Feb 2014;17(1):30. doi:10.1136/eb-2013-101699
64. Mlinarić A, Horvat M, Šupak Smolčić V. Dealing with the positive publication bias: Why you should really publish your negative results. *Biochem Med (Zagreb)*. Oct 15 2017;27(3):030201. doi:10.11613/bm.2017.030201
65. Firth J, Siddiqi N, Koyanagi A, et al. The Lancet Psychiatry Commission: a blueprint for protecting physical health in people with mental illness. *Lancet Psychiatry*. Aug 2019;6(8):675-712. doi:10.1016/S2215-0366(19)30132-4
66. Moore S, Shiers D, Daly B, Mitchell AJ, Gaughran F. Promoting physical health for people with schizophrenia by reducing disparities in medical and dental care. *Acta Psychiatr Scand*. Aug 2015;132(2):109-21. doi:10.1111/acps.12431
67. Matevosyan NR. Oral health of adults with serious mental illnesses: a review. *Community Ment Health J*. Dec 2010;46(6):553-62. doi:10.1007/s10597-009-9280-x
68. Cockburn N, Pradhan A, Taing MW, Kisely S, Ford PJ. Oral health impacts of medications used to treat mental illness. *J Affect Disord*. Dec 1 2017;223:184-193. doi:10.1016/j.jad.2017.07.037
69. Hu KF, Ho PS, Chou YH, Tsai JH, Lin CR, Chuang HY. Periodontal disease and effects of antipsychotic medications in patients newly diagnosed with schizophrenia: a population-based retrospective cohort. *Epidemiol Psychiatr Sci*. Sep 17 2019;29:e49. doi:10.1017/S204579601900043X
70. Scrine C, Durey A, Slack-Smith L. Providing oral care for adults with mental health disorders: Dental professionals' perceptions and experiences in Perth, Western Australia. *Community Dent Oral Epidemiol*. Feb 2019;47(1):78-84. doi:10.1111/cdoe.12427
71. Griffiths J, Jones V, Leeman I, et al. Oral health care for people with mental health problems guidelines and recommendations. . British Society for Disability and Oral Health 2000.
72. Villadsen DB, Sorensen MT. Oral Hygiene - A Challenge in Everyday Life for People with Schizophrenia. *Issues Ment Health Nurs*. Aug 2017;38(8):643-649. doi:10.1080/01612840.2017.1316328
73. NICE. Rehabilitation for adults with complex psychosis. https://www.nice.org.uk/guidance/ng181
74. EPGWG. Australian clinical guidelines for early psychosis. Orygen Youth Health; 2016.

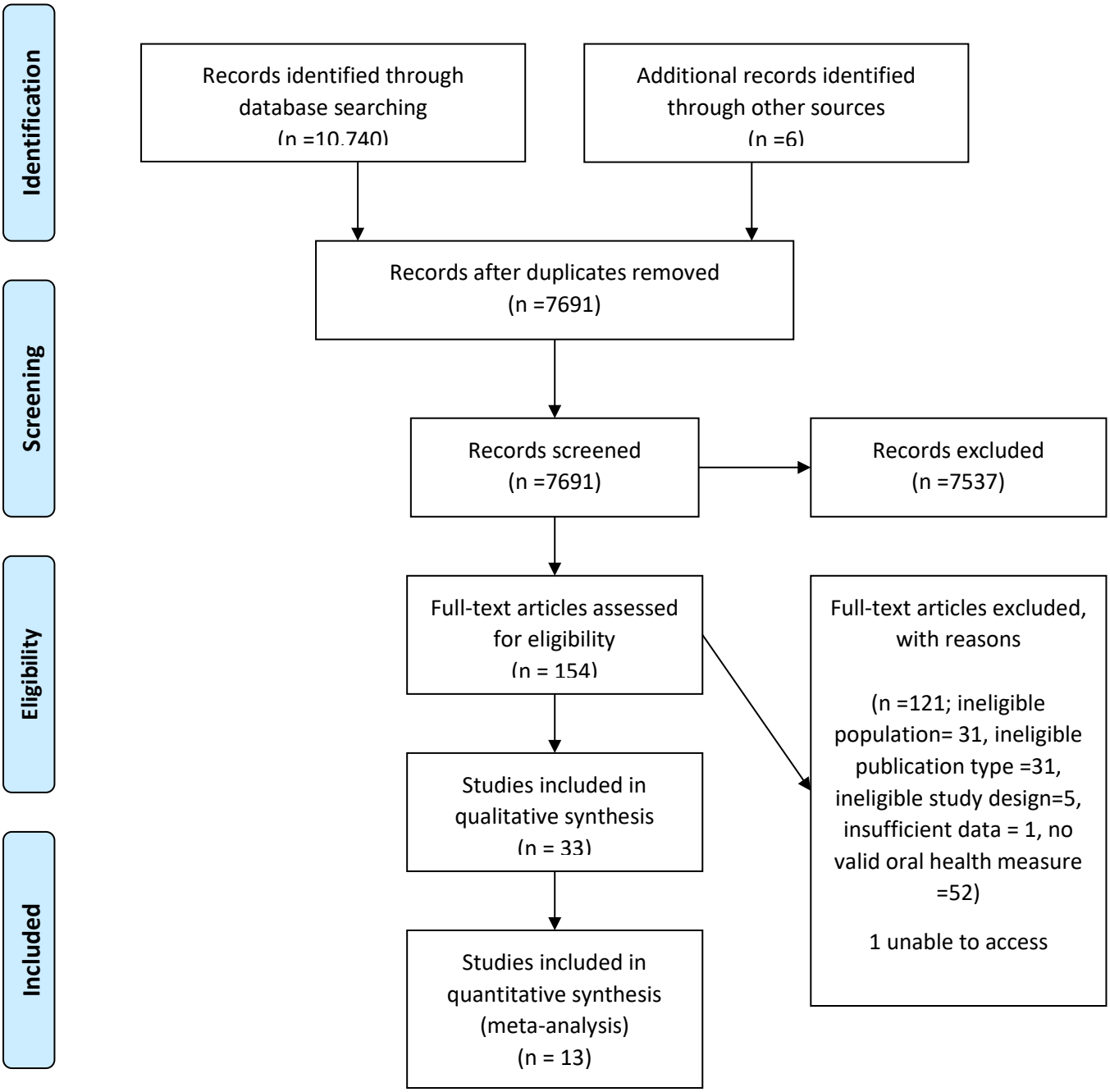

Figure 1. PRISMA Flow Diagram of article screening.

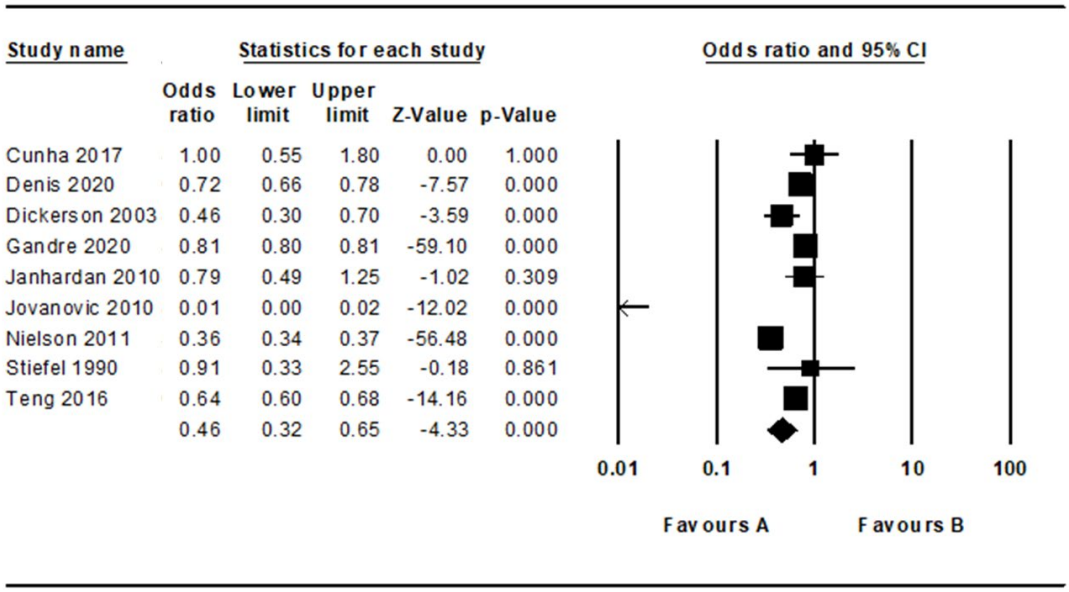

Figure 2. Forest plot with individual effect sizes for studies comparing access to dental services in people with severe mental illness to non-clinical comparator samples.

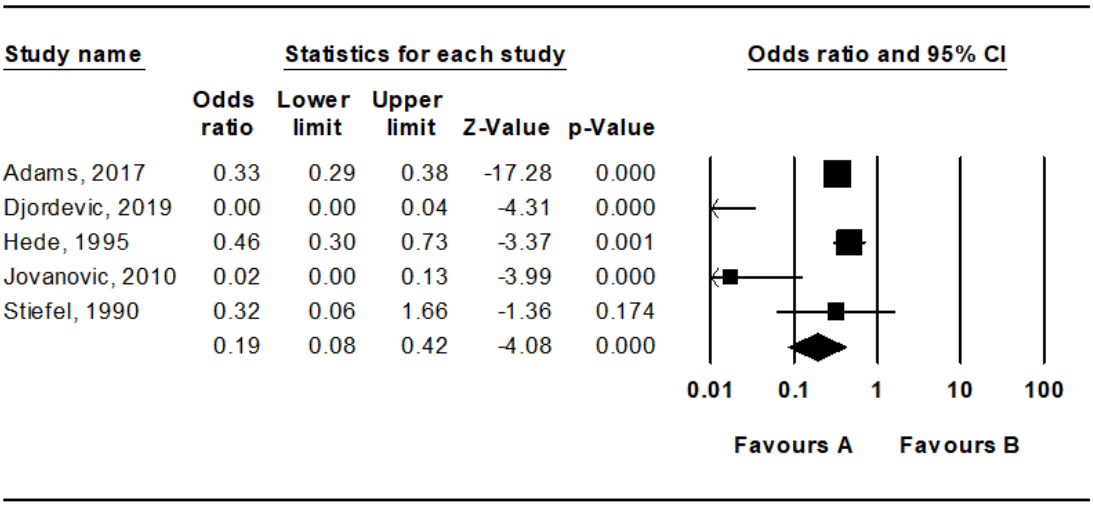

Figure 3. Forest plot with individual effect sizes for studies comparing rates of toothbrushing in people with severe mental illness to non-clinical comparator samples.

Table 1. Descriptive information on included studies.

Study ID	Study design	Population-Diagnosis	Status	Country	Sample size	Comparator Type	Outcome
Adams 2017	Clustered RCT, baseline data	First episode psychosis	Outpatient	UK	Case: 1248 Control: 17849	Adult Dental Health Survey (ADHS)	Dental service use, toothbrush frequency, technique and ownership
Agarwal, 2019	RCT, Baseline data	Schizophrenia	Outpatient	India	111	N/A	Toothbrushing frequency, technique, maintenance of toothbrush, aid for cleaning tongue and mode for cleaning teeth
Corridore, 2017	Cross-sectional	Schizophrenia, schizoaffective, borderline personality disorder	Therapeutic community	Italy	67	N/A	Dental service usage and toothbrushing frequency
Cunha 2017	Case-control	Bipolar disorder	Outpatient	Brazil	Case: 176 Control: 176	Existing study datasets	Dental service use
Denis, 2017	Cross-sectional	Schizophrenia	Inpatient and outpatient	France	90	N/A	Dental service usage and toothbrushing frequency
Denis, 2019	Cross-sectional	Schizophrenia	Inpatient and outpatient	France	109	N/A	Dental service usage and toothbrushing frequency
Denis 2020	Epidemiological	Schizophrenia	Inpatient and outpatient	France	Case: 2,213 Control: 578,006	General population database	Dental service usage (scaling)
Dickerson, 2003	Case control	Schizophrenia, schizoaffective disorder	Outpatient	US	Case: 100 Control: 2705	National health and nutrition survey	Dental service usage

Djordevic, 2019	Case control	Schizophrenia	Inpatient	Serbia	Case: 190 Control: 190	Community sample of patients with localised or generalised chronic periodontitis	Toothbrush frequency and technique
Eltas, 2013	Cross-sectional	Schizophrenia	Outpatient	Turkey	53	N/A	Toothbrush frequency
Eskelinen, 2017	Cross-sectional	Schizophrenia, schizoaffective disorder, other schizophrenia spectrum disorder	Outpatient	Finalnd	275		Dental service use
Gandre, 2020	Epidemiological	Psychotic and bipolar disorder	Outpatient and inpatient	France	Case: 413,437 Control: 1,240,311	French national health data system	Dental service use
Gurbuz, 2011	Cross-sectional	Schizophrenia	Inpatient	Turkey	330		Toothbrushing frequency
Hede, 1992	Case-control	Schizophrenia, reactive psychosis, manic depression	Outpatient	Denmark	Case: 84 Control: 2548	General population survey	Dental service use and toothbrushing frequency
Hsieh, 2011	Pre-test post-test design, baseline data	Schizophrenia	Inpatient	Taiwan	100	N/A	Toothbrush frequency and maintenance of toothbrush
Janhardanan, 2011	Case control	Schizophrenia	Outpatient	US	Case: 198 Control: 113	Community comparison group	Dental service usage
Jovanovic, 2010	Case-control	Schizophrenia, NOS psychosis, schizoaffective disorder, persistent psychotic disorder, bipolar disorder	Inpatient	Serbia	Case: 186 Control: 186	Community comparison group	Dental service use, toothbrush frequency, technique and maintenance of toothbrush
Lynch , 2005	Cross-sectional	Schizophrenia, other	Inpatient	Northern Ireland	65	N/A	Toothbrush ownership
McCreadie, 2004	Case-control	Schizophrenia	Outpatient	Scotland	Case: 93 Control: 28,471	General population survey	Dental service usage, toothbrushing frequency,

							flossing, mouthwash use
Nayak, 2020	Cross-sectional	Schizophrenia, mania	Outpatient	India	250	N/A	Toothbrush frequency
Ngo, 2018	Cross-sectional	Schizophrenia, Intellectual Disability, other	Inpatient	Singapore	191		Toothbrushing frequency
Nielson, 2011	Epidemiological	Schizophrenia	Inpatient and outpatient	Denmark	Case: 21,417 Control: 3,790,446	National health insurance database	Dental service use
Pelletier, 2015	Cross-sectional	Schizophrenia, schizotypal disorder, delusional disorder	Outpatient	Canada	146		Toothbrushing frequency
Patrick, 1996	Cross-sectional	Schizophrenia	Outpatient	US	353	N/A	Dental service use
Salsberry, 2005	Cross-sectional	Schizophrenia, schizophreniform, schizoaffective disorder, delusional disorder, ICD-9 – Paranoid disorders	Outpatient	US	230		Dental service use
Singh, 2017	Cross-sectional	Schizophrenia	Outpatient	India	71		Dental service use, toothbrushing frequency, mode and material for cleaning teeth
Singh, 2019	Cross-sectional	Schizophrenia	Outpatient	India	156		Dental service use, toothbrushing frequency, mode and material for cleaning teeth
Stiefel, 1990	Case control	Schizophrenia, bipolar disorder,	Outpatient	US	Case: 37 Control: 29	Community comparison group	Dental service use, toothbrushing

		other non-organic, personality disorder					frequency and flossing.
Tani, 2012	Cross-sectional	Schizophrenia, schizoaffective disorder, delusional disorder, acute and transient psychotic disorder	Inpatient	Japan	523	N/A	Toothbrushing frequency
Teng, 2016	Epidemiological	Schizophrenia, delusional disorders	Inpatient and outpatient	Taiwan	Case: 4298 Control: 623,175	National insurance research database	Dental service use
Tredget, 2019	Cross-sectional	Schizophrenia	Outpatient	Wales	106	N/A	Dental service usage, toothbrush frequency and mouthwash use
Wieland, 2010	Cross-sectional	Schizophrenia, schizoaffective disorder, bipolar disorder, schizotypal personality disorder	Outpatient	Australia	20		Dental service use, toothbrushing frequency, flossing and mouthwash use
Xiong, 2010	Cross-sectional	Bipolar, psychotic disorder	Outpatient	US	170	N/A	Dental service usage

Table 2. Quality assessment.

Study ID	Selection Bias	Confounders	Data collection	Analysis	Global rating
Adams 2017	Moderate	Weak	Weak	Moderate	Weak
Agarwal, 2019	Moderate	Moderate	Weak	Strong	Moderate
Corridore, 2017	Weak	Weak	Weak	Moderate	Weak
Cunha 2017	Moderate	Moderate	Weak	Strong	Moderate
Denis, 2017	Moderate	Strong	Weak	Strong	Moderate
Denis, 2019	Weak	Strong	Weak	Strong	Weak
Denis 2020	Strong	Strong	Strong	Strong	Strong
Dickerson, 2003	Moderate	Strong	Moderate	Strong	Strong
Djordevic, 2019	Moderate	Moderate	Weak	Strong	Moderate
Eltas, 2013	Moderate	Weak	Weak	Moderate	Weak
Eskelinen, 2017	Moderate	Weak	Weak	Strong	Weak
Gandre, 2020	Strong	Strong	Strong	Strong	Strong
Gurbuz, 2011	Moderate	Moderate	Weak	Moderate	Moderate
Hede, 1992	Moderate	Weak	Weak	Weak	Weak
Hsieh, 2011	Weak	Weak	Weak	Weak	Weak
Janhardanan, 2011	Moderate	Strong	Weak	Moderate	Moderate
Jovanovic, 2010	Moderate	Weak	Weak	Strong	Weak
Lynch , 2005	Weak	Weak	Weak	Weak	Weak
McCreadie, 2004	Moderate	Weak	Weak	Weak	Weak
Nayak, 2020	Weak	Weak	Weak	Moderate	Weak
Ngo, 2018	Strong	Weak	Weak	Moderate	Weak

Nielson, 2011	Strong	Moderate	Strong	Strong	Strong
Patrick, 1996	Weak	Weak	Weak	Moderate	Weak
Pelletier, 2015	Weak	Weak	Weak	Weak	Weak
Salsberry, 2005	Strong	Strong	Strong	Moderate	Strong
Singh, 2017	Moderate	Weak	Weak	Strong	Weak
Singh, 2019	Moderate	Weak	Weak	Strong	Weak
Stiefel, 1990	Moderate	Weak	Weak	Moderate	Weak
Tani, 2012	Moderate	Weak	Weak	Strong	Weak
Teng, 2016	Strong	Strong	Strong	Strong	Strong
Tredget, 2019	Moderate	Weak	Weak	Weak	Weak
Wieland, 2010	Weak	Weak	Weak	Weak	Weak
Xiong, 2010	Moderate	Strong	Weak	Moderate	Moderate