

# Assessment of psychological distress in patients with tooth loss: A systematic review of Assessment Tools

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## **Abstract**

**Aims.** To systematically review the available evidence on screening tools to detect psychological distress in patients with tooth loss and technically successful removable dentures (RD).

**Methods.** A structured search strategy was used to complete a standard systematic search of the electronic database without any time limit and/or language restriction. Hand searching of journals and reference lists was also completed. Only quantitative studies using a validated measuring tool to screen for psychological distress in adults with significant tooth loss were included. An assessment of the quality and validity of the psychological screening tools was undertaken.

## **Results.**

From the original 3,150 studies identified, only eight studies were found to meet the selection criteria. All eight studies used the same questionnaire to screen for emotional distress of tooth loss. In addition, one study also used the PHQ-9 to screen for the association of depression with tooth loss. Six studies identified a significant emotional distress related to tooth loss, however two studies reported no significant link. The questionnaire used was assessed to be at high-risk of measurement bias, as the development and validation process was not clear. There was also lack of well-defined control groups in all studies.

**Conclusion.** Tooth loss could cause psychological distress in some patients. To-date, there is a lack of available tools that are suitable or validated to screen and measure psychological distress in patients with tooth loss. Further research is required to develop tools to identify and measure such impact and to recommend suitable interventions when needed.

**Key words:** tooth loss, psychological distress, removable dentures, and screening.

## **Introduction**

Adult Oral Health in the UK has been gradually improving and the prevalence of tooth loss has been in decline in the last 30 years. Nevertheless, it is estimated that 6% of the population remain edentulous, a further 14% have experienced significant tooth loss (>11 tooth loss) and “one in every five” adults have removable dentures (either partial or complete) (1). Previous research has shown that tooth loss can have a significant impact on both general and oral health-related quality of life (2). Edentulous or partially dentate patients may require either removable dentures (RD) or osseointegrated dental implants to restore their dentition. RD can restore function and provide a relatively non-invasive treatment option for management of tooth loss. Whilst some patients cope and adapt well with tooth loss and RD, others experience emotional distress as they have less psychological resilience and ability to adapt to changes (3). Davis et al.(3), reported that tooth loss could cause significant emotional and psychological distress in some patients, despite being successful denture wearers ).

Screening tools have widely been used to assess depression, anxiety and distress in patients with various medical conditions, such as amputations, artificial prosthesis replacements, chronic illness, cancer and palliative care (4). The possibility of implementing some of the available tools could be considered to screen and measure psychological distress in patients with tooth loss. There are many screening tools available in the literature.

### ***Screening tools***

To-date, there are many screening tools which measure symptoms of depression, emotional distress, and psychological disorder in patients with different chronic systemic diseases. Within the scope of the present systematic review we will discuss the available screening tools in relation to their suitability for the assessment of emotional distress in patients with tooth loss.

*Zung Self-Rating Depression Scale (ZSDS)*. ZSDS is a self-reporting questionnaire to screen for symptoms of depression (5). The psychometric properties of the ZSDS have been validated with a sensitivity range of 79%-100% and specificity range of 55-57% (25-27).

*Distress Thermometer (DT)*. The Distress Thermometer (DT) is a single item visual analogue scale developed to screen for distress in oncology patients (6). While a systematic review by Stewart-Knight et al (7) concluded that further research is need

to validate the DT, another recent systematic review by O'Donnell (8) concluded that this tool is a rapid and effective way to screen for psychological distress in cancer patients . The use of a single item tool to screen and measure emotional distress in patients with tooth loss is unlikely to capture all the dimensions of a possible psychological disorder (30-31).

*Generalised Anxiety Disorder Assessment (GAD-7):* GAD-7 is a seven-item questionnaire developed by Spitzer et al (9). At the threshold of  $\geq 10$  the GAD has a sensitivity of 89% and specificity of 82% (10). However the GAD-7 fails to measure all dimensions of emotional distress. Therefore, it is not suitable for patients with chronic medical conditions, such as tooth loss (9).

*General Health Questionnaire (GHQ).* The GHQ created by Goldberg and Williams, is used to screen for minor psychiatric disorders (11). It has four versions: GHQ-60, GHQ-30, GHQ-28 and a brief version GHQ-12 (with a number of items 60, 30, 28 and 12 respectively). GHQ-12 had a variation in sensitivity and specificity between different cities for a given threshold value (sensitivity range was from 68.0 to 93.5% and the specificity range from 59 to 93%) (12). Although GHQ is widely used to screen psychiatric disorders, this tool is not suitable to screen for psychological distress in patients with tooth loss since the questionnaire is not sensitive for long-standing psychological distress as in the case of tooth loss (11).

*Hospital Anxiety and Depression Scale (HADS).* HADS was developed to screen anxiety and distress in a hospital setting (13). It is one of the most commonly used tools to screen depression and anxiety (14). The sensitivity and specificity for HADS was approximately 80% (15). However Cosco et al (16) concluded in a recent systematic review of 50 studies that the HADS has an inconsistent structure with serious psychometric problems. In addition, Coyne et al. (17) recommend abandoning HADS, as these authors reported that this tool fails to match anxiety and depression subscales. Therefore, the use of HADS is not suitable to measure psychological distress in patients with tooth loss.

*Depression, Anxiety and Stress Scales (DASS).* DASS measures the negative emotional symptoms (Depression, anxiety and stress) (18). DASS-21 is preferred over other screening tools to screen for psychological distress in patients with tooth loss, as this tool has extensively been validated for its psychometric properties (19, 20) and

also been assessed clinically (20, 21). DASS is able to identify and differentiate degree of depression from anxiety and stress (19). However, further validation is needed before implementation of DASS in patients with tooth loss.

*WHO-(Five) Well-Being Index.* WHO-5 is a brief screening tool designed to measure the “wellbeing” in primary care (22). Topp et al. (46) concluded in a recent systematic review that the WHO-5 has adequate validity to screen for depression and it could be used as a measuring tool in clinical trials with average sensitivity and specificity of 86% and 81% respectively. The WHO-5 has been validated to screen for depression in elderly populations (23, 24), in chronic illness such as Parkinson’s disease (25) and in patients with diabetes (26, 27). However, the WHO-5 is not ideal to measure psychological distress caused by tooth loss as it only screen depressive symptoms but not anxiety and distress (22).

*Patient Health Questionnaire (PHQ-9).* The PHQ-9 is a self-assessment questionnaire to monitor and measure depressive disorders (28). The PHQ-9 also rates the frequency of the symptoms. The PHQ-9 has nine items, which use the diagnostic criteria of the DSM-IV. A threshold of  $\geq 10$  indicates major depression with sensitivity and a specificity of 88%. The PHQ-9 has been validated to screen and measure for depression in primary care (29) either for patients with coronary heart disease (30) or for patients with cerebral vascular accidents (31) or for diabetic patients (32). However the PHQ-9 fails to screen or measure anxiety or distress. Therefore, additional tools are required to screen for those dimensions of emotional disorder (28).

The loss of teeth with the use of RD is recognised as a major life event that would require the patient to adapt functionally and psychologically (33). Many patients fail to cope and endure significant emotional and psychological distress, despite being successful denture wearers (3). Identification and measurement of these negative emotional symptoms is important since they could cause social and physical disability and in turn have a significant impact on the quality of life (2). Some studies also report stressful life events may trigger depression in vulnerable patients (34). Therefore, a psychological screening tool would be beneficial for identification, measurement and outcome purposes.

The current systematic review aimed to assess available evidence for validated screening tools, which measure emotional distress in patients with tooth loss.

## **Methods**

### ***Data sources and searches***

The study protocol was registered with the National Institute of Health Research Database (Registration I.D. CRD42017082125). A comprehensive search was conducted to identify potentially relevant studies by exploring a range of electronic databases (Medline via Ovid, Scopus, and Embase). Additionally, a Google scholar and reference search were undertaken to identify any other relevant published work. The search was carried out without applying any time limits (up to 12/2017) or language restrictions. Table S2 shows a list of keywords used in the search process.

### ***Study selection***

The PICOS (Table 1) tool was used to formulate an effective search strategy by defining the selection criteria based on a range of clinical questions relative to the participant, intervention, comparison, outcomes and study design (31). Participants were adults ( $\geq 18$  years of age), of any ethnic group who were edentulous or with significant tooth loss ( $< 9$  remaining teeth, as defined by GBOD; 10). The interventions included undergoing replacement with technically successful removable dentures (RD). A control group of adults participants ( $\geq 18$ ), who were either edentulous or with significant tooth loss ( $< 9$  remaining teeth) and without any replacement prosthesis i.e RD. Outcomes included assessing psychological distress due to treatment with RD or due to no treatment using a validated tool.

The study design included both quantitative and qualitative (randomised controlled clinical trials, non-RCTs, cross-sectional, prospective and retrospective). Furthermore, studies that involved replacement of tooth loss either with dental implants or unsatisfactory dentures were excluded.

Based on these selection criteria, the titles and abstracts were examined independently by two examiners (ZK, AB) and any disagreements were resolved according to a predefined strategy, using consensus and arbitration as appropriate. If however, the disagreement could not be resolved, then a third investigator (MF) agreed to be approached to help reach consensus.

### ***Data Extraction and Quality Assessment***

The relevant titles and abstracts of articles were independently collected and then double-checked by a second examiner (AB). Studies not meeting the inclusion criteria were recorded under 'Characteristics of excluded studies' along with their reasons for

exclusion in Table S3. Subsequently, full texts were independently reviewed by two examiners (ZK, AB). The references cited in the included studies were further checked.

### ***Risk of bias***

Two authors assessed independently the risk of bias in the included studies (ZK, AB) and any disagreement was resolved by discussion with a third author (MF). Five domains were scored to quantify the risk of bias: selection bias, measurement bias, interviewer bias, response bias and other potential sources of bias. Subsequently; an overall judgment was made to mark each study as low risk of bias, high risk of bias or unclear.

### ***Data analysis***

Data homogeneity was assessed in regards to the screening tools to measure psychological distress following the management of tooth loss with RD. The significant level was set at of 0.05, using IBM SPSS Statistics 24.0 (SPSS Inc., New York 10504-1722, USA)

## **RESULTS**

### ***Study characteristics***

The search methodology has been reported in line with the PRISMA STATEMENT (36) and presented in Figure 1. The electronic database search identified 3,510 articles, from which 1,059 were excluded as duplicates. The titles and, where necessary abstracts, were examined against the inclusion criteria and 1,043 articles were further excluded under the criteria of exclusion mentioned earlier in data extraction section, leaving a total of 16 studies. Following an examination of the complete text of these studies, a further eight were excluded, since these studies were either related to the invalidated assessment tools to measure psychological distress related to tooth loss (n=5) or failed to meet the selection criteria (n=3). Therefore, only eight texts were included in the current review, all of the included studies had cross-sectional design. The key characteristics of included studies were reported in Table 3.

The eight studies included in this review (3, 11-17) (Table 3) all used the same 24-item questionnaire to measure the emotional impact of tooth loss. Two studies were based in the UK (3, 11), three in India (15-17), one in Hong Kong (14) and two were multi-centre studies including United Kingdom and Hong Kong (12, 13). Six studies recruited participants from dental hospitals and universities, whilst the other two studies

recruited participants from Social Centers and Dental Check Campus (14, 15). Three studies examined the emotional impact of tooth loss in edentulous patients, two studies screened partially dentate participants and two studies examined a group of edentulous and partially dentate patients (Table 3). Only one study compared the emotional impact of tooth loss between completed denture wearers and non-denture wearers (17). Sample size varied from 94 to 400 participants.

One study (16) calculated the power, based on previous studies and it was unclear if a sample size calculation was carried out in any of the other seven included studies. The reported response rate was only available in three studies, as 100% (13), 95% (12) and 73% (16) respectively.

#### ***Risk of bias of the included studies***

A high inter-examiner agreement (IRR of 0.88) was observed with six out of eight studies (Table 4). However these studies had potentially biased selection process since participants were recruited from the Dental Hospitals and Universities. Consequently, these studies had high risk of selection bias as the patients who sought treatment in the Dental Hospital setting or have been referred to the Secondary Dental Care presented with more complicated dental issues.

Two studies (Table 4) recruited participants from the dental check camps and day-time social centres for the older people. This recruitment process is more likely to enrol homogenous sample, which represent the general population. Therefore, the risk of selection bias in these studies was considered to be low.

In addition, four studies (12-15) used trained dental officers to conduct interviews to help complete the questionnaire, as some participants were illiterate. Interviewer and response bias risks are likely to be low in these studies, as the interviewers were independent and trained prior to the study. In the remaining two studies (16, 17), it was unclear if the interviewers had any training prior to the interviews for illiterate participants and therefore the risk of interviewer and response bias could not be excluded. The authors in the remaining two studies (3, 11) requested the participants to complete the questionnaire at home and return their anonymous responses by post. Therefore, the risk of response bias was considered low.

Regarding the study designs, there were no clearly defined control groups in any of the included studies. Whilst a number (n=) of the studies compared tooth loss in

participants who had dentures with those who did not. However, the technical quality of the dentures was unfortunately not described. Without a well-designed control group, it was impossible to conclude whether the emotional distress was present beforehand or as a result of tooth loss. Therefore, the risk of bias was regarded as high in all eight included studies.

The same measurement tool was used in all included studies. This questionnaire was developed and validated in two previous qualitative studies (37, 38). However, the process of how this was developed and validated remains unclear. In addition, some of the questions used to quantify the emotional impact of tooth loss, may lead participants to answer in a specific way (potentially leading questions). i.e. "*Did you find it difficult to accept losing your teeth*". The authors using a negative connotation, such as "*difficult*". The use of more neutral words is recommended to avoid the possible risk of leading questions and inaccurate responses. Although the additional comments space might assist to provide a space to clarify any issues, this would still not be quantified and thus the risk of measurement bias was high. This 24-item questionnaire used explores the functional disability and feelings associated with tooth loss, and this tool measures how the emotional impact of tooth loss affects participants. However this questionnaire is not designed to screen and quantify psychological distress caused by tooth loss.

One study (16) used the Patient Health Questionnaire (PHQ-9) questionnaire, which was a self-assessment questionnaire to monitor and measure depressive disorders (28). The PHQ-9 has been validated to screen and measure depression in primary care (29). However the PHQ-9 fails to either screen or measure anxiety or distress. Therefore, additional tools are required to screen for those dimensions of emotional distress (28).

### ***The effect of tooth loss***

Two studies (3, 39) concluded that significant numbers of patients have difficulties in accepting tooth loss (45% in the edentulous sample, and 52% in the partially dentate sample). The same studies also reported that those patients were reluctant to accept losing tooth/teeth and they were also less self-confident due to their tooth loss. Five other studies mentioned similar outcome (12,13,16,17). On the contrary, two studies (14, 15) reported no significant link between tooth loss and emotional disturbance. The latter studied the emotional impact of tooth loss in the aged North Indian population (400 patients, above the age of 60). There was insignificant link between tooth loss

and emotional disturbance. However, there was a marked impact on functional activities and social interaction. The contradictory results of these studies could be related to the cultural and socioeconomic differences, as tooth loss could be perceived as an inevitable or normal consequence of the aging process in some cultures. Another study (17) compared the impact of tooth loss between patients who have dentures and those who did not have dentures. The authors reported a significant difference in the acceptance of tooth loss between two groups (69.8% of non dentures wearers and 46% for dentures wearers). Tooth loss impact on self-confidence was also different between two groups (39.6% non-denture wearer and 20% denture wearer).

## **Discussion**

To identify, measure and treat psychological distress caused by tooth loss, it is important to understand the dimensions of normal and abnormal adaptation disorders. Psychological distress is defined by the National Comprehensive Cancer Network as “*Unpleasant emotional experience extends along a continuum from common normal feelings of vulnerability, sadness to problems that can become disabling, such as depression, anxiety, panic, social isolation*” [22].

Various questionnaires and tools have been used to detect emotional distress in different acute and chronic medical conditions. The validation and the psychometric properties of those tools have been assessed and validated extensively. However, the performances of questionnaires and tools identified in this review were inadequate to screen for all the dimensions of psychological distress. These tools are limited by the contents of the questionnaires used, lack of focus on the chronic medical and dental conditions such as tooth loss, and inconsistent outcome with psychometric problems.

To screen for psychological distress caused by tooth loss, the tool should identify and differentiate the temporary normal adjustment adaptation from the pathological adjustment disorders by measuring the severity of negative emotional symptoms.

All the studies in the current review used the same measurement tool, which was developed from previous qualitative research. This questionnaire mainly explores the functional disability and feelings associated with tooth loss, designed to measure how widespread the emotional impact of tooth are, however is not designed to screen and quantify psychological distress caused by tooth loss. Therefore, further tools are required for this purpose. Furthermore, many of the participants in the included studies

had activities/functional difficulties, therefore, it would have been very useful if technical quality of dentures was investigated and clarified, to exclude technically unsatisfactory dentures, as a possible cause of functional disability and psychological distress. Therefore, it could be speculated that psychological distress might be related to dysfunctional dentures.

The possible impact of tooth loss for some patients has been demonstrated, yet few tools have been proposed to measure this impact. Measuring and quantifying the psychological impact of tooth loss face many challenges. Firstly, there are many important variables, which may have confounding impact on the measurement. A detailed dental, medical and demographic history should be taken into account to adjust any confounding factors. Secondly, the technical quality of removable dentures should be measured to exclude technically suboptimal dentures as the cause of distress. Thirdly, personality type should be analysed, since this dimension is believed to be related to denture satisfaction/dissatisfaction.

However, as mentioned earlier, the DASS-21 has some advantages over the current available tools and it could be one of the suitable tools to screen and measure psychological distress in patients with tooth loss. Therefore, this tool initially needs to be validated for patients with tooth loss. In addition, a supplemental tool to assess the technical quality of RDs should also be implemented alongside with the DASS-21 to exclude the potential technical faults related to RDs as a causative factor for psychological distress.

To date, the available tools are neither suitable nor validated to screen and measure psychological distress in patients with tooth loss. Based on the available data, the current systematic review was able to demonstrate the limited evidence that significant tooth loss could cause psychological distress. Further research is required to create tools to identify and measure such impact and to recommend suitable interventions.

Table 1: PICOS Research Question Development

|                       | Inclusion criteria  | Exclusion criteria  |
|-----------------------|---|---|
| P – patients/problem  | Adults $\geq 18$ with significant tooth loss                | -History of mental illness (depression, distress or personality disorders)<br>-Replacement with dental implants |
| I - intervention      | Patients who had replacement with technically successful RD | Poor quality RD   |
| C - control           | Patients who had no replacement with RD                     |   |
| O – outcomes measures | Patients' psychological distress caused by tooth loss       | Non validated tool/measure  |
| Study Design          | Quantitative  | Qualitative   |

|  |   |                     |
|--|---|---------------------|
|  | Randomised controlled trials<br>Non-randomized controlled trials<br>Retrospective, prospective, or concurrent cohort studies<br>Cross sectional studies | Opinion, editorials |
| Research Question: Are there available screening tools to detect psychological distress in patients with tooth loss? |   |                     |

Table 3: Key characteristics of included studies

| Study            | Method   | Participants   | Intervention  | Measurement methods    | Outcome measures  |
|------------------|--|--|---|------------------------|---|
| Davis et al (3)  | Location: Department of Prosthetic Dentistry at Guy's, King's and St Thomas' Dental Institute<br>Recruitment period: not reported<br>Funding source: not reported  | 94 edentulous (48M; 46F)<br>Age<br>31-50 (n=7)<br>51-70 (n=40)<br>> 71 (n=47)  | Full removable dental prosthesis replacement (n=92).<br>No removable prosthesis (n=2)   | 24 items questionnaire | Emotional effect /acceptance of tooth loss<br><br>Activity/ functional impairment |
| Davis et al (11) | Location: Department of Prosthetic Dentistry at Guy's, King's and St Thomas' Dental Institute<br>Recruitment period: not reported<br>Funding source: not reported  | 91 partially dentate (38M; 53F)<br>Age<br><30 (n=1)<br>31-50 (n=22)<br>51-70 (n=43)<br>71 (n=25)<br>Anterior teeth missing (78%)<br>Only posterior missing (22%) | Partial denture replacement (n=91)  | 24 items questionnaire | Emotional effect /acceptance of tooth loss<br><br>Activity/ functional impairment |
| Scott et al (12) | Location: Guy's, King's and St Thomas's Dental Institute, London; the Dental School, Dundee, Scotland; and the Faculty of Dentistry, University of Hong Kong<br>Recruitment period: not reported<br>Funding source: not reported | Number participants: 142<br>Edentulous<br>31-15 (n=8)<br>51-17(n=57)<br>>71(n=77)  | Full removable dental prosthesis replacement in all Dundee subjects, in 96% of London subjects and 78% of Hong Kong subjects. | 24 items questionnaire | Emotional effect /acceptance of tooth loss<br><br>Activity/ functional impairment |

| Study                | Method   | Participants   | Intervention   | Measurement methods    | Outcome measures  |
|----------------------|--|--|--|------------------------|---|
| Fiske et al (13)     | Location: Guy's, King's and St Thomas's Dental Institute, London; the Dental School, Dundee, Scotland; and the Faculty of Dentistry, University of Hong Kong<br>Recruitment period: not reported<br><br>Funding source: not reported | (n=149) partially dentate (64M; 86F)<br>Age: <31 years (n=1)<br>31-50 years (n=28)<br>51-70 years (n=89)<br>> 71 years (n=32)<br>Tooth loss: 64% some upper anterior teeth<br>97% some upper posterior<br>39% some lower anterior<br>94% some lower posteriors | Partial removable dental prosthesis<br>88% of Dundee subjects, 81% of London and 50% in Hong Kong subjects.                          | 24 items questionnaire | Emotional effect /acceptance of tooth loss<br><br>Activity/ functional impairment |
| Naik & Pai (15)      | Location: dental check camps in the locality of Uttar Pradesh (North India)<br>Recruitment period: not reported<br><br>Funding source: not reported  | 400 participants (41M; 59F)<br>Age > 60 years<br>Edentulous (n=128)<br>Partially dentate (n=272)<br>Tooth loss<br>Anterior upper (n=10)<br>Posterior upper (n=88)<br>Anterior lower (n=13)<br>Posterior lower (n=96)   | Full removable dental prosthesis (n=128)<br>Partially removable dental prosthesis (n=140)<br>Partial dentate/ no replacement (n=132) | 24 items questionnaire | Emotional effect /acceptance of tooth loss<br><br>Activity/ functional impairment |
| McMillan & Wong (14) | Recruited at day-time social centers for the elderly located through- out Hong Kong<br>Recruitment period: not reported<br>Funding source: University Grant  | 233 participants (80M; 153F)<br>Age 60-80<br>Edentulous (n=65)<br>Partially dentate (n=168)  | Complete removable prosthesis (n=65)<br>Partial removable prosthesis (n=95)<br>No removable prosthesis (n=73)                        | 24 items questionnaire |   |

| Study            | Method  | Participants   | Intervention   | Measurement methods             | Outcome measures  |
|------------------|---|--|--|---------------------------------|---|
| Shah (16)        | Location: Department of Prosthodontics, Govt. Dental College and Hospital. Ahmedabad<br>Recruitment period: Dec 14 – Feb 15<br>Funding source: not reported | 100 participants edentulous (62M; 38F)<br>31-50 years (n=70)<br>51-70 years (n=7)<br>> 71 years (n=23) | Complete removable prosthesis (n=100)                          | 24 items questionnaire<br>PHQ-9 | Emotional effect /acceptance of tooth loss<br>Activity/ functional impairment<br>Depression |
| Anjum et al (17) | Location: Dental hospital at Vikarabad, Telangana<br>Recruitment period: Sep16 – Oct 16<br>Funding source: not reported                                     | 103 participants edentulous (73M;30F)<br>45-55 years (n=39)<br>55-65 years (n=64)                      | Complete removable prosthesis (n=50)<br>No intervention (n=53) | 24 items questionnaire          | Emotional effect /acceptance of tooth loss<br><br>Activity/ functional impairment           |

Table 5: Comparison of included studies

| Factors related to the tooth loss  | Time                       | Davis et al (3) | Davies et al (11) | Scott et al (12) (n=142) |          |         | Fiske et al (13) (n=149) |         |         | McMillan & Wong (14) | Naik & Pai (15) | Shah et al (16) | Anjum et al (17) |
|------------------------------------|----------------------------|-----------------|-------------------|--------------------------|----------|---------|--------------------------|---------|---------|----------------------|-----------------|-----------------|------------------|
|                                    |                            | n=94            | n=91              | Du n=45                  | Lon n=47 | HK n=50 | Du n=50                  | Lo n=49 | HK n=50 | n=233                | n=400           | n=100           | n=103            |
| Difficulty in accepting tooth loss |                            | 42 (45%)        | 48 (53%)          | 63 (44%)                 |          |         | 26%                      | 62%     | 60%     | 51 (22%)             | 92 (23%)        | 58%             | 46%              |
| Time before accepting tooth loss   | Immediately                | 5%              | 4%                | 47%                      | 47%      | 60%     | 51%                      | 23%     | 62%     | 34%                  | 35%             | 14%             | -                |
|                                    | With 6 months              | 12%             | 15%               | 25%                      | 11%      | 20%     | 28%                      | 17%     | 20%     | 54%                  | 53%             | 29%             | -                |
|                                    | Within a year              | 10%             | 6%                | 5%                       | 4%       | 2%      | 4%                       | -       | 6%      | 6%                   | 5%              | 12%             | -                |
|                                    | > a year                   | 38%             | 25%               | 13%                      | 23%      | 12%     | 6%                       | 23%     | 4%      | 4%                   | 3%              | 3%              | -                |
|                                    | Still have not accepted it | 35%             | 50%               | 10%                      | 15%      | 6%      | 11%                      | 37%     | 8%      | 2%                   | 4%              | -               | 16%              |
| Impact on self confidence          | More confidence            | 2%              | -                 | 5%                       | 6%       | 0%      | 2%                       | -       | -       | 1%                   | -               | -               | -                |
|                                    | Confidence unaffected      | 22%             | 22%               | 62%                      | 40%      | 60%     | 62%                      | 37%     | 72%     | 95%                  | 96%             | -               | -                |
|                                    | Less confidence            | 69%             | 76%               | 24%                      | 45%      | 40%     | 26%                      | 59%     | 28%     | 2%                   | -               | 38%             | 20%              |
|                                    | Don't know                 | 7%              | 2%                | 9%                       | 9%       | 0%      | 10%                      | 4%      | -       | 2%                   | 16              | -               | -                |

Table 4: Risk of Bias in the included studies

|                     | Davies<br>et al<br>(3) | Davies<br>et al<br>(11) | Scott<br>et al<br>(12) | Fiske<br>et al<br>(13) | Macmillan<br>& Wong<br>(14) | Naik<br>&<br>Pai<br>(15) | Shah<br>et al<br>(16) | Anjum<br>et al<br>(17) |
|---------------------|------------------------|-------------------------|------------------------|------------------------|-----------------------------|--------------------------|-----------------------|------------------------|
| Selection bias      |                        |                         |                        |                        |                             |                          |                       |                        |
| Measurement<br>bias |                        |                         |                        |                        |                             |                          |                       |                        |
| Interviewer<br>bias | N/A                    | N/A                     |                        |                        |                             |                          |                       |                        |
| Response bias       |                        |                         |                        |                        |                             |                          |                       |                        |
| Other bias*         |                        |                         |                        |                        |                             |                          |                       |                        |

Unknown risk of bias

\* Control bias, denture quality bias

Figure 1: PRISMA Flow Diagram



### PRISMA 2009 Flow Diagram

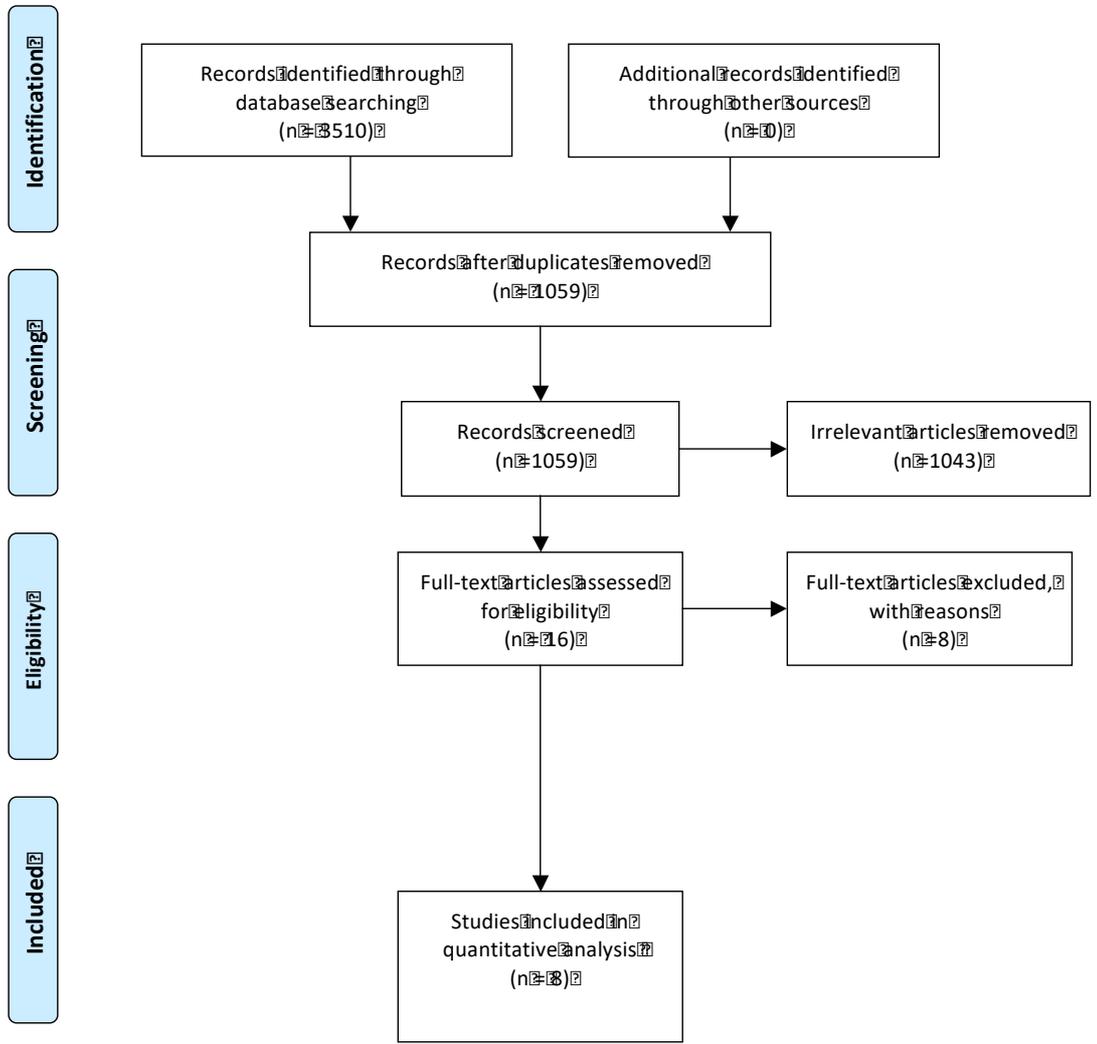


Table S1: Results of electronic database search

| <b>Database</b>        | <b>Keywords</b>  | <b>Result</b> |
|------------------------|--|---------------|
| <b>CCRCRT</b>          | As described in Table 1  | 177           |
| <b>PubMed</b>          | As described in Table 1  | 496           |
| <b>Embase</b>          | As described in Table 1  | 680           |
| <b>Psycho info</b>     | As described in Table 1  | 104           |
| <b>WOS</b>             | As described in Table 1  | 774           |
| <b>Google Scholar</b>  | (1) Tooth loss / edentulous / denture<br>(2) Depression, anxiety, distress, psychological, psychology, emotional | 217           |
| <b>LiLACS</b>          | As described in Table 1  | 465           |
| <b>Scopus</b>          | As described in Table 1  | 597           |
| <b>Other resources</b> | Cross references   |               |
| <b>Total</b>           |  | <b>3510</b>   |
|                        | After removal duplicate  | <b>1059</b>   |

Table S2: Search Strategy

Concept one (Population)

#1 Tooth loss

#2 Teeth loss

#3 Edentulous

#4 Edentulism

#5 Toothless

#6 Denture

#7 prosthesis

#8 Concept one (#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7)

Concept Two (Outcome Measure)

#9 Depression

#10 Anxiety

#11 Distress

#12 Psychological

#13 Psychology

#14 Emotional

#15 Concept two (#9 or #10 or #11 or #12 or #13 or #14)

Concept Three (Assessment):

#16 Screening

#17 Measure

#18 Instrument

#19 Questionnaire

#20 Validation

#21 Scale

#22 Diagnosis

#23 Test

#24 Assessment

#25 Concept Three (#16 or #17 or #18 or #19 or #20 or #21 or #22 or #23 or #24)

#26 (#8 AND #15 AND #25)

Table S3: Characteristics of excluded studies

| <b>Study</b>      | <b>Reasons for exclusion</b>  |
|-------------------|---|
| Dirik et al.,     | Tools not validated to measure psychological distress related to tooth loss |
| Okoje et al.,     | Sample/recruitment not suitable (sample not random)                         |
| Ommerborn et al., | Tools not validated to measure psychological distress related to tooth loss |
| Roohafza et al.,  | Tools not validated to measure psychological distress related to tooth loss |
| Dable et al.,     | Tools not validated to measure psychological distress related to tooth loss |
| Allen et al.,     | Sample/recruitment not suitable (sample exposed to dental implants)         |
| Anttila et al.,   | Tools not validated to measure psychological distress related to tooth loss |
| Hogenius et al.,  | Sample/recruitment not suitable (sample exposed to dental implants)         |



1. Steele JG, Treasure ET, O'Sullivan I, Morris J, Murray JJ. Adult Dental Health Survey 2009: transformations in British oral health 1968[ndash]2009. *British Dental Journal*. 2012;213(10):523-7.
2. Gerritsen AE, Allen PF, Witter DJ, Bronkhorst EM, Creugers NH. Tooth loss and oral health-related quality of life: a systematic review and meta-analysis. *Health and Quality of Life Outcomes*. 2010;8(1):1.
3. Davis DM, Fiske J, Scott B, Radford DR. The emotional effects of tooth loss: a preliminary quantitative study. *Br Dent J*. 2000;188(9):503-6.
4. Plourde A, Moullec G, Bacon SL, Suarthana E, Lavoie KL. Optimizing screening for depression among adults with asthma. *J Asthma*. 2016;53(7):736-43.
5. Zung WW. A SELF-RATING DEPRESSION SCALE. *Arch Gen Psychiatry*. 1965;12:63-70.
6. NCCN. NCCN Clinical Practice Guidelines in Oncology 2016 [Available from: [https://www.nccn.org/professionals/physician\\_gls/f\\_guidelines.asp - supportive](https://www.nccn.org/professionals/physician_gls/f_guidelines.asp - supportive).
7. Stewart-Knight K, Parry R, Abey A, Seymour J. Does the distress thermometer work? A systematic review of the evidence for its use and validity. *BMJ*. 2012;2(1).
8. O'Donnell E. The distress thermometer: a rapid and effective tool for the oncology social worker. *Int J Health Care Qual Assur*. 2013;26(4):353-9.
9. Spitzer RL, Kroenke K, Williams JB, Lowe B. A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern Med*. 2006;166(10):1092-7.
10. Kroenke K, Spitzer RL, Williams JB, Monahan PO, Lowe B. Anxiety disorders in primary care: prevalence, impairment, comorbidity, and detection. *Ann Intern Med*. 2007;146(5):317-25.
11. Goldberg DP, Williams P. A user's guide to the GHQ: Windsor; 1988.
12. Goldberg DP, Gater R, Sartorius N, Ustun TB, Piccinelli M, Gureje O, et al. The validity of two versions of the GHQ in the WHO study of mental illness in general health care. *Psychol Med*. 1997;27(1):191-7.
13. Zigmond AS, Snaith RP. The hospital anxiety and depression scale. *Acta Psychiatr Scand*. 1983;67(6):361-70.
14. Herrmann C. International experiences with the Hospital Anxiety and Depression Scale--a review of validation data and clinical results. *J Psychosom Res*. 1997;42(1):17-41.
15. Bjelland I, Dahl AA, Haug TT, Neckelmann D. The validity of the Hospital Anxiety and Depression Scale. An updated literature review. *J Psychosom Res*. 2002;52(2):69-77.
16. Cosco TD, Doyle F, Ward M, McGee H. Latent structure of the Hospital Anxiety And Depression Scale: a 10-year systematic review. *J Psychosom Res*. 2012;72(3):180-4.
17. Coyne JC, van Sonderen E. No further research needed: abandoning the Hospital and Anxiety Depression Scale (HADS). *J Psychosom Res*. 2012;72(3):173-4.
18. Lovibond PF, Lovibond SH. The structure of negative emotional states: comparison of the Depression Anxiety Stress Scales (DASS) with the Beck Depression and Anxiety Inventories. *Behav Res Ther*. 1995;33(3):335-43.
19. Henry JD, Crawford JR. The short-form version of the Depression Anxiety Stress Scales (DASS-21): construct validity and normative data in a large non-clinical sample. *Br J Clin Psychol*. 2005;44(Pt 2):227-39.
20. Brown TA, Chorpita BF, Korotitsch W, Barlow DH. Psychometric properties of the Depression Anxiety Stress Scales (DASS) in clinical samples. *Behav Res Ther*. 1997;35(1):79-89.
21. Antony MM, Bieling PJ, Cox BJ, Enns MW, Swinson RP. Psychometric properties of the 42-item and 21-item versions of the Depression Anxiety Stress Scales in clinical groups and a community sample. *Psychological Assessment*. 1998;10(2):176.
22. Bech P, Gudex C, Johansen KS. The WHO (Ten) Well-Being Index: validation in diabetes. *Psychother Psychosom*. 1996;65(4):183-90.
23. Allgaier AK, Kramer D, Saravo B, Mergl R, Fejtikova S, Hegerl U. Beside the Geriatric Depression Scale: the WHO-Five Well-being Index as a valid screening tool for depression in nursing homes. *Int J Geriatr Psychiatry*. 2013;28(11):1197-204.
24. Lucas-Carrasco R, Allerup P, Bech P. The Validity of the WHO-5 as an Early Screening for Apathy in an Elderly Population. *Curr Gerontol Geriatr Res*. 2012;2012:171857.
25. Schneider CB, Pilhatsch M, Rifati M, Jost WH, Wodarz F, Ebersbach G, et al. Utility of the WHO-Five Well-being Index as a screening tool for depression in Parkinson's disease. *Mov Disord*. 2010;25(6):777-83.

26. Furuya M, Hayashino Y, Tsujii S, Ishii H, Fukuhara S. Comparative validity of the WHO-5 Well-Being Index and two-question instrument for screening depressive symptoms in patients with type 2 diabetes. *Acta Diabetol.* 2013;50(2):117-21.
27. Hajos TR, Pouwer F, Skovlund SE, Den Oudsten BL, Geelhoed-Duijvestijn PH, Tack CJ, et al. Psychometric and screening properties of the WHO-5 well-being index in adult outpatients with Type 1 or Type 2 diabetes mellitus. *Diabet Med.* 2013;30(2):e63-9.
28. Kroenke K, Spitzer RL, Williams JB. The PHQ-9: validity of a brief depression severity measure. *J Gen Intern Med.* 2001;16(9):606-13.
29. Cameron IM, Crawford JR, Lawton K, Reid IC. Psychometric comparison of PHQ-9 and HADS for measuring depression severity in primary care. *Br J Gen Pract.* 2008;58(546):32-6.
30. Haddad M, Walters P, Phillips R, Tsakok J, Williams P, Mann A, et al. Detecting depression in patients with coronary heart disease: a diagnostic evaluation of the PHQ-9 and HADS-D in primary care, findings from the UPBEAT-UK study. *PLoS One.* 2013;8(10):e78493.
31. de Man-van Ginkel JM, Gooskens F, Schepers VP, Schuurmans MJ, Lindeman E, Hafsteinsdottir TB. Screening for poststroke depression using the patient health questionnaire. *Nurs Res.* 2012;61(5):333-41.
32. van Steenberghe-Weijenburg KM, de Vroeghe L, Ploeger RR, Brals JW, Vloedveld MG, Veneman TF, et al. Validation of the PHQ-9 as a screening instrument for depression in diabetes patients in specialized outpatient clinics. *BMC Health Serv Res.* 2010;10:235.
33. Bergendal B. The relative importance of tooth loss and denture wearing in Swedish adults. *Community dental health.* 1989;6(2):103-11.
34. Kendler KS, Karkowski LM, Prescott CA. Causal relationship between stressful life events and the onset of major depression. *Am J Psychiatry.* 1999;156(6):837-41.
35. SIGN. Scottish Intercollegiate Guidelines Network (SIGN) 2018 [Available from: <http://sign.ac.uk/>].
36. Liberati A, Altman DG, Tetzlaff J, Mulrow C, Gøtzsche PC, Ioannidis JPA, et al. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate healthcare interventions: explanation and elaboration. *BMJ.* 2009;b2700.:339.
37. Fiske J, Davis DM, Frances C, Gelbier S. The emotional effects of tooth loss in edentulous people. *Br Dent J.* 1998;184(2):90-3; discussion 79.
38. Fiske J DDM, Frances C, Gelbier S, editor *The emotional effects of tooth loss The Proceedings of the European Prosthodontic Association* 1997.
39. Davis DM, Fiske J, Scott B, Radford DR. The emotional effects of tooth loss in a group of partially dentate people: a quantitative study. *Eur J Prosthodont Restor Dent.* 2001;9(2):53-7.