The Association of Oral Health Status and socio-economic determinants with Oral Health-Related Quality of Life among the elderly: A systematic review and meta-analysis

Kamal Baniasadi | Bahram Armoon | Peter Higgs | Amir-Hossein Bayat | Mohammad Ali Mohammadi Ghareghani | Morteza Hemmat | Yadolah Fakhri | Rasool Mohammad | Ladan Fattah Moghaddam | Robert J. Schroth

Abstract

Objective: The aim of this study was to determine the relationship between poor Oral Health-Related Quality of Life (OHRQoL) and oral health determinants (e.g., being 75 years of age or greater, marital status, smoking status, denture wearing, depression, low educational level (≤8th grade), poor general health, caries history, tooth-induced pain, decayed, missing filled teeth (DMFT) scores and periodontal diseases) among the elderly.

Methods: Formal search strategies in PubMed, Scopus, Cochrane and Web of Science were performed to identify studies in English published before 1 December 2019. We assessed the impacts of the oral health determinants including being 75 years of age or greater, marital status, smoking status, denture wearing, depression, low educational level (≤8th grade), poor general health, caries history, tooth-induced pain, DMFT scores and periodontal diseases) on OHRQoL among elderly individuals. The data were analysed using Stata 12.0 software.

Results: In total, 19 publications met the inclusion criteria of this meta-analysis. Findings indicate a positive association between low educational level (≤8th grade), marital status, depression, smoking status, denture wearing, poor general health, tooth-induced pain, periodontal diseases and poor OHRQoL among the elderly. We also observed a negative association between DMFT, being older than 75 years of age on poor OHRQoL among the elderly.

Conclusions: This review identified that several oral health determinants were associated with poor OHRQoL. The efficacy of preventive measures and the economic aspects of tooth replacement approaches should be explored in the future. Developing oral healthcare plans and policies with the specific aim of improving OHRQoL among this group is essential.

Keywords: elderly, oral health, quality of life
INTRODUCTION

With global changes in life expectancy, especially in developed countries, there has been a considerable population growth, particularly among people over 65 years of age. Evidence suggests that oral disease is equally as important as other diseases, on individual quality of life and has psycho-social and emotional outcomes, including isolation, depression and unemployment.

Oral health-related quality of life (OHRQoL) is a multidimensional construct which impacts on every aspect of daily activities. Increasingly, OHRQoL is being used as a measure to evaluate oral treatment needs, oral health and the consequences of dental treatment.

Several OHRQoL instruments have been developed to assess an individual’s OHRQoL, including the International Classification of Impairments, Disabilities and Handicaps (ICIDH) and the Oral Health Impact Profile (OHIP). OHIP has been translated into several languages and has been used widely and appears to be very suitable for assessing OHRQoL. Previous studies have often reported poor oral health status among the elderly, and it has also been implied that oral health is closely associated to a range of systemic diseases. Given this OHRQoL must be considered as a fundamental part of general health-related quality of life, because of the impact it has on patients’ expectations, experiences and sociocultural backgrounds.

Previous research with Chilean older people found that poor oral health status is directly associated with worse OHRQoL. The World Health Organization has indicated that an ageing population (those aged 65 and over) will undoubtedly face new challenges in maintaining proper oral health and dentitions.

Oral health is an important factor for general health with previous research reporting that poor health contributes negatively to oral health and ultimately shapes OHRQoL. There is sufficient evidence showing that dental problems are more prevalent in the older people. Locker et al. reported that oral disorders have strong effects on personal satisfaction and well-being, even when they had high rates of physical and mental conditions and physical disabilities. Ageing is a recognized risk factor for periodontitis, and there is epidemiological evidence that a reduction in QoL in the elderly directly contributes to more oral diseases, musculoskeletal disorders, and physical and mental health issues.

The aim of the present study was to determine the relationship between poor OHRQoL and oral health determinants, such as (being 75 years of age or greater, marital status, smoking status, denture wearing, depression, low educational level (≤8th grade), poor general health, caries history, tooth-induced pain, DMFT scores and periodontal diseases) among older people.

METHODS

This systematic review explored the relationship between poor OHRQoL and oral health determinants (being 75 years of age or greater, marital status, smoking status, denture wearing, depression, low educational level (≤8th grade), poor general health, caries history, tooth-induced pain, DMFT scores and periodontal diseases) among older people.

Search strategy and study selection

The research was conducted by extracting the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) characteristics. Articles published before December 2019 in PubMed, Scopus, Web of Science and Cochrane electronic databases were reviewed by independent researchers (AHB and BA). This generated a list of potentially eligible peer-reviewed articles on the oral health determinants associated with reduced OHRQoL in the elderly. The research strategy is outlined in Table 1. EndNote X7 software (Thomson Reuters) was applied to assess the collected references. Duplicate papers were excluded from the study. Two individual reviewers (BA and YF) then evaluated each paper’s title and abstract in terms of the study inclusion and exclusion criteria. Any disagreements between the reviewers were resolved through consensus. A third member of the research team (MH) provided input when necessary. Full texts of the papers were analysed by the reviewers with regard to the study inclusion and exclusion criteria. Finally, a manual search of the included papers reference lists was performed by the researchers.

Inclusion criteria based on PICO

The MESH terms and the PICO model were implemented to develop the search strategy. The following research variables were considered:

- The study participants: the elderly.
- Intervention: oral health determinants, including (being 75 years of age or greater, marital status, smoking status, denture wearing, depression, low educational level (≤8th grade), poor general health, caries history, tooth-induced pain, DMFT scores and periodontal diseases) Comparison: non-elderly populations.
- Outcomes: OHRQoL.

Exclusion criteria

Studies were excluded if (1) they did not present primary data, (2) the full texts of the collected articles were not available, missing or insufficient information was available after contacting the authors, (3) significant heterogeneity between the study groups (outcome variation across the studies) existed, (4) studies reported rare results (eg sex, BMI, systemic diseases which were unable to be considered for the meta-analysis). We also restricted our research to the OHRQoL among elderly.

Outcome measures

The outcome measures of the present research study included all information concerning oral health determinants age, smoking,
dentine or CAL of >2 mm. The Pocket Probing Depth (PPD) or Clinical Attachment Level (CAL) could be applied to evaluate the extent of such harms.

Periodontitis diagnosis could be approved by the PPD thresholds (CAL) could be applied to evaluate the extent of such harms.

Tai 2. Definitions/criteria considered for poor QoL among elderly

Publications comprising self-reports or interview-based data regarding OHRQoL in older peoples were assessed in this review. Furthermore, we included oral health conditions considered as public health issues with a global burden in the present survey. Therefore, data on being 75 years of age or greater, marital status, smoking status, denture wearing, depression, low educational level (≤8th grade), poor general health, caries history, tooth-induced pain, DMFT scores and periodontal diseases were addressed.

To analyse these data, DMFT scores (ie the cumulative number of decayed, missing, and filled permanent teeth) and the DMFS scores (ie the cumulative number of decayed, missing and filled permanent surfaces) were applied; these data were frequently used in the epidemiological studies included. The highest possible DMFT value equals 32 (wisdom teeth are not often considered; max score: 28), and the highest attainable DMFS score equals 148 (or 128 if excluding wisdom teeth).

Prior research defined periodontal disease as the chronic inflammation of the gums. Gingiva-associated reversible gingivitis could harm the tooth and irrevocably destroy the bone, gingiva and periodontal ligaments remaining teeth in place shape periodontitis. The Pocket Probing Depth (PPD) or Clinical Attachment Level (CAL) could be applied to evaluate the extent of such harms. The periodontitis diagnosis could be approved by the PPD thresholds of >3 mm or CAL of >2 mm. A PPD threshold of 4 mm has been suggested by some researchers for this purpose. Decaying bone surrounding teeth of >4–5 mm is generally assumed to facilitate them falling out. The PPDs of 4–5 m and ≥6 mm are defined as shallow and deep pockets, respectively, in evaluations. We included papers investigating all oral disease cases. The most severe oral health condition was defined as presenting with multiple oral diseases. Tooth loss and edentulism was assessed by the study subjects. We excluded studies exploring erosion, xerostomia, temporomandibular dysfunction and those investigating dental outcomes or poor oral health status.

Table 1: Pooled odds ratio of oral health determinants-based defined subgroups

<table>
<thead>
<tr>
<th>Subgroup</th>
<th>Model</th>
<th>Number study</th>
<th>ORs, 95% CI</th>
<th>Weight (%)</th>
<th>Heterogeneity statistic</th>
<th>Degrees of freedom</th>
<th>$p$</th>
<th>$I^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor general health</td>
<td>Fixed</td>
<td>13</td>
<td>2.41, 95% CI (2.01–2.82)</td>
<td>0.42</td>
<td>4.63</td>
<td>12.00</td>
<td>0.97</td>
<td>0.00</td>
</tr>
<tr>
<td>Pain related to teeth</td>
<td>Fixed</td>
<td>8</td>
<td>1.76, 95% CI (1.39–2.12)</td>
<td>0.49</td>
<td>8.79</td>
<td>7.00</td>
<td>0.27</td>
<td>0.20</td>
</tr>
<tr>
<td>Depression</td>
<td>Fixed</td>
<td>4</td>
<td>1.67, 95% CI (1.35–2.00)</td>
<td>0.6</td>
<td>1.72</td>
<td>3.00</td>
<td>0.63</td>
<td>0.00</td>
</tr>
<tr>
<td>Smoking status</td>
<td>Fixed</td>
<td>3</td>
<td>1.65, 95% CI (1.32–1.99)</td>
<td>0.61</td>
<td>1.55</td>
<td>2.00</td>
<td>0.46</td>
<td>0.00</td>
</tr>
<tr>
<td>Systemic problem</td>
<td>Fixed</td>
<td>2</td>
<td>1.46, 95% CI (1.15–1.79)</td>
<td>0.63</td>
<td>0.08</td>
<td>1.00</td>
<td>0.78</td>
<td>0.00</td>
</tr>
<tr>
<td>Wearing denture</td>
<td>Random</td>
<td>14</td>
<td>1.41, 95% CI (1.03–1.80)</td>
<td>4.14</td>
<td>71.54</td>
<td>13.00</td>
<td>&lt;0.001</td>
<td>0.82</td>
</tr>
<tr>
<td>Periodontal disease</td>
<td>Fixed</td>
<td>3</td>
<td>1.38, 95% CI (1.15–1.62)</td>
<td>1.14</td>
<td>2.04</td>
<td>2.00</td>
<td>0.06</td>
<td>0.02</td>
</tr>
<tr>
<td>Caries history</td>
<td>Random</td>
<td>5</td>
<td>1.35, 95% CI (0.6–2.11)</td>
<td>6.17</td>
<td>82.52</td>
<td>4.00</td>
<td>0.00</td>
<td>0.95</td>
</tr>
<tr>
<td>Married</td>
<td>Fixed</td>
<td>3</td>
<td>1.30, 95% CI (1.16–1.45)</td>
<td>2.62</td>
<td>0.34</td>
<td>2.00</td>
<td>0.84</td>
<td>0.00</td>
</tr>
<tr>
<td>Level of education (≤8)</td>
<td>Fixed</td>
<td>5</td>
<td>1.23, 95% CI (1.13–1.34)</td>
<td>5.32</td>
<td>4.47</td>
<td>4.00</td>
<td>0.35</td>
<td>0.10</td>
</tr>
<tr>
<td>Geographic location</td>
<td>Fixed</td>
<td>2</td>
<td>1.14, 95% CI (1.03–1.24)</td>
<td>3.57</td>
<td>1.71</td>
<td>1.00</td>
<td>0.19</td>
<td>0.42</td>
</tr>
<tr>
<td>DMFT</td>
<td>Random</td>
<td>15</td>
<td>0.91, 95% CI (0.87–0.96)</td>
<td>38.95</td>
<td>1436.09</td>
<td>13.00</td>
<td>&lt;0.001</td>
<td>0.99</td>
</tr>
<tr>
<td>Age 75 and above</td>
<td>Random</td>
<td>9</td>
<td>0.78, 95% CI (0.77–0.81)</td>
<td>35.32</td>
<td>186.13</td>
<td>8.00</td>
<td>&lt;0.001</td>
<td>0.96</td>
</tr>
</tbody>
</table>

*p related to heterogeneity statistic.

2.7 Data extraction and study quality assessment

The first author’s name, the year of publication, attributes of the study population, study location and design, and the exposure and outcome variables were collected. In addition, statistical methods, confounding factors, applied adjustments and effect measures were also recorded from the included articles. Further information
was obtained by contacting the corresponding authors when necessary. Predefined excel sheets (Microsoft Office, Version 16) were used to extract and manage the data by two independent reviewers. After conducting the initial review of titles and abstracts, duplicate articles were excluded; 89% consistency in the study inclusion criteria was found. The second phase of the study included choosing the titles and abstracts of the articles as per the study inclusion criteria for further review (agreement level: 95%). The unweighted Kappa was implemented to measure the accuracy between the two reviewers (BA and AB) in evaluating the assessment quality. We defined the agreement levels using the criteria of weak, slight, fair, moderate, substantial and complete equal to 0, 0.01–0.20, 0.21–0.40, 0.41–0.60, 0.61–0.80 and 0.81–1.00, respectively.\textsuperscript{22}

2.8 | Assessment of risk of bias in included studies

Study selection was conducted using methodology quality applying the Critical Appraisal Checklist for observational studies by The Joanna Briggs Institute (JBI).\textsuperscript{33} The categories were specified per a 10-item instrument, including ‘yes’, ‘no’ or ‘unclear’ classifications for cohort and case-control studies. We used an 8-item inventory for cross-sectional studies. The total number of ‘yes’ answers (range: 0–10) was used as the indicators of the total obtained point of each study. The following classification method was applied for the articles: low quality (0–3 scores), medium quality (4–6 scores), and high quality (7–10 scores). The reviewers performed quality checks individually and resolved any disagreements accordingly (Table S2).

2.9 | Data synthesis and statistical analysis

A meta-analysis using pooled odds ratios (ORs) and 95% confidence intervals was conducted to investigate oral health determinants related to poor OHRQoL in the elderly. Additionally, to explore the between-researcher correlation rate, we used Dixon Q-test ($p < 0.05$; $I^2$ statistics; cut-off ≥50%). Furthermore, we measured 95% confidence intervals for the $I^2$ statistics with negative values considered equal to zero. The pooled estimates for managing various sampling methods of the research studies were assessed by a random-effect model.

The heterogeneous studies were recognized by the subgroup analysis approach. A cumulative regression analysis was applied to measure the trend of ORs during the time. To identify publication bias, the reviewers implemented Begg’s and Egger’s publication bias approaches in statistical and graphical modes.\textsuperscript{34,35} The statistical significance level was set at $p < 0.05$. The biological aspect of OHRQoL and social and behavioural variables’ effects were identified by ORs and 95% CI, that is presented on forest plots. The Metan, metareg, metacum and metabias commands were implemented in Stata to assess the data (Stata Corporation).

3 | RESULTS

3.1 | Study selection

Figure 1 demonstrates the review process.

In total, 6276 papers were identified from four databases and from searching the reference lists with 1163 articles selected for full-text review. After a detailed assessment, 19 studies were included.\textsuperscript{3,36–53}

3.2 | Study characteristics

Table S2 depicts the characteristics of the studies concerning the correlations between publications.

3.3 | Synthesis of results/meta-analysis

Several determinants were found to be associated with poor OHRQoL among elderly in studies (See Table 1).

3.4 | Socio-economic status on poor OHRQoL among elderly

3.4.1 | The impact of being ≥75 years of age on poor OHRQoL among elderly

Our findings indicate that five studies\textsuperscript{40,41,45,50,52} evaluated the impact of age at or beyond 75 years on poor OHRQoL. Two studies were conducted in upper-middle-income countries and three in high-income countries. These studies were published between 2007 and 2017, with the sample sizes ranging from 125 to 1277 persons. Three studies were found to be of high quality, and one was assessed as poor quality. All five studies used a cross-sectional design. Table 1 indicates that being aged 75 and above has a negative effect on poor OHRQoL being 0.78 times less likely to have poor OHRQoL (OR = 0.78, 95% CI = 0.77, 0.81). The heterogeneity statistic was 4.63%.

3.4.2 | The impact of depression on poor OHRQoL among elderly

Three studies\textsuperscript{39,47,50} examined the impact of depression on poor OHRQoL all conducted in upper-middle-income countries. These three studies were published between 2012 and 2020, and the sample sizes ranged from 438 to 905 participants. All were cross-sectional studies and were assessed as high quality. A positive association between depression and poor OHRQoL among the elderly was found. Those who had depression symptoms were 1.67 times more likely to have poor OHRQoL (OR = 1.67, 95% CI = 1.35, 2), and the heterogeneity approximated 1.72%. (See Table 1).
3.4.3 | The impact of marital status on poor OHRQoL among elderly

Three studies evaluating the impact of marital status on poor OHRQoL among the elderly were included in our meta-analysis. These studies discussed the impact of marital status as an exposure variable and poor OHRQoL. These studies were published between 2013 and 2016, and the sample sizes ranged between 194 and 872 persons and were of a high quality.

Two studies were conducted in upper-middle-income countries (Brazil) while the other was a high-income country. Two used a cross-sectional study design while the other was a cohort study. As illustrated in Table 1, being married was positively associated with poor OHRQoL. Married participants were 1.30 times more likely to have
poor OHRQoL (OR = 1.30, 95% CI = 1.16, 1.45). The overall heterogeneity was 0.34%.

3.4.4 | The impact of the level of education (≤8) on poor OHRQoL among elderly

We found three studies\(^3\text{9,40,53}\) that evaluated the impact of the level of education (≤grade 8) on poor OHRQoL. All were conducted in high-income countries and published between 2007 and 2012, with sample sizes from 125 to 1301. All three studies were cross-sectional and assessed as high-quality approaches. Table 1 indicates that level of education (≤8) does have an effect on poor OHRQoL; those participants with less than an 8th grade level of education were 1.23 times more likely to have poor OHRQoL (OR = 1.23, 95% CI = 1.13, 1.34). The heterogeneity statistic was 4.47%.

3.4.5 | The impact of poor general health on poor OHRQoL among elderly

Eight studies\(^3\text{8,41,42,45,47,48,50,52}\) evaluated the impact of poor general health on poor OHRQoL among the elderly. Five were conducted in upper-middle-income countries\(^3\text{8,47,48,50,52}\) and three in high-income countries.\(^4\text{1,42,45}\) These studies were published between 2007 and 2020, with sample sizes from 205 to 1277. Four studies were assessed as high-quality approaches\(^3\text{8,42,48,52}\) while four research were categorized as poor quality. Table 1 indicates that poor general health does have an effect on poor OHRQoL among the elderly. Participants with poor general health were 2.41 times more likely to also have poor OHRQoL (OR = 2.41, 95% CI = 2.01, 2.82). The heterogeneity statistic was 4.63%.

3.4.6 | The impact of smoking status on poor OHRQoL among elderly

Two studies\(^4\text{5,50}\) evaluated the impact of smoking status on poor OHRQoL among the elderly. One study was conducted in Brazil\(^5\text{0}\) and one in the United Kingdom.\(^4\text{5}\) These studies were published between 2013 and 2017, with sample sizes of 438\(^5\text{0}\) and 1277\(^4\text{5}\) and both were assessed as high-quality study designs. Table 1 indicates that smoking status does have an effect on poor OHRQoL among the elderly. Participants who had a history of smoking were 1.65 times more likely to also have poor OHRQoL (OR = 1.65, 95% CI = 1.32, 1.99), and the heterogeneity statistic was 1.55%.

3.4.7 | The impact of pain related to teeth on poor OHRQoL among elderly

Three studies\(^4\text{5,48,52}\) evaluated the impact of tooth pain on poor QoL among the elderly. Two of the studies were completed in the upper-middle-income countries, and one in a high-income country. These studies were published between 2013 and 2019, with sample sizes from 228 to 1277. Three studies had high-quality approaches, and all were cross-sectional by design. Table 1 indicates that tooth pain has an effect on poor OHRQoL among participants with those who had pain being 1.76 times more likely to also have poor OHRQoL (OR = 1.76, 95% CI = 1.39, 2.12). The heterogeneity statistic was 8.79%.

3.4.8 | The impact of DMFT on poor OHRQoL among elderly

Eight studies\(^3\text{6,38-42,51,52}\) assessed the impact of DMFT scores on poor OHRQoL, half completed in upper-middle-income countries\(^3\text{6,38,51,52}\) and the other in higher-income countries.\(^3\text{9-42}\) The studies were published between 2007 and 2016, and the sample sizes ranged from 125 to 1,301. Three studies were assessed as high quality\(^3\text{8,42,52}\) and other studies were categorized as poor quality. Seven studies used a cross-sectional design,\(^3\text{8,42,51,52}\) and one was a cohort study.\(^3\text{6}\)

Table 1 shows the negative association between DMFT scores on poor OHRQoL with respondents without caries being 0.91 times more likely to rich high OHRQoL (OR = 0.91, 95% CI = 0.87, 0.96).

3.4.9 | The impact of periodontal diseases on poor QoL

Three studies\(^4\text{,37,48}\) assessed the impact of periodontal disease on poor OHRQoL two from a high-income country\(^4\text{,37}\) and one completed in an upper-middle-income country.\(^4\text{8}\) These cross-sectional studies were published between 2013 and 2019, and the sample sizes ranged from 85 to 228. Two studies were assessed as high quality, and one categorized as weak quality.

Table 1 depicts the positive association between periodontal diseases and poor OHRQoL among the elderly. Those who had periodontal diseases were 1.38 times more likely to be assessed as having a high OHRQoL (OR = 1.38, 95% CI = 1.15, 1.62).

3.4.10 | The impact of wearing dentures on poor OHRQoL

Overall, seven studies\(^3\text{7,39,43,45-47,50}\) assessed the impact of wearing dentures on poor OHRQoL three of which recruited participants from high-income countries,\(^3\text{7,39,45}\) and four in an upper-middle-income country.\(^4\text{3,44,47,50}\) These studies were published between 2012 and 2020, and the sample sizes ranged from 130 to 1,301. Five studies were assessed as high quality,\(^3\text{7,39,43,46}\) and two categorized as the weak quality.

Table 1 shows the positive association between wearing dentures on poor OHRQoL among elderly participants. Respondents
wearing dentures were 1.41 times more likely to report poor OHRQoL (OR = 1.41, 95% CI = 1.03, 1.8).

### 3.5 | Meta-regression analysis

Figure 2 shows the meta-regression between pooled OR of the pooled impact of oral health determinants with Human Development Index (HDI) (A) and year of study (B).

Pooled OR of oral health determinants increased with increasing HDI, insignificantly (Coefficient 2.29, p value = 0.09) (Figure 2A) and also HDI, p value = 0.09; c = 2.29 OR of oral health determinants increased with over time, significantly (Coefficient 2.06, p value = 0.001) (Figure 2B).

The publication bias tests show that there was significant publication bias among studies based on the Egger test (p value = 0.04) and Begg test (p value = 0.002) (Figure 3A,B).

Overall, the results of Meta trim analysis show that pooled ORs of oral health determinants were 0.71, 95% CI (0.49–1.07) (See Figure S1).

Figure 4 indicates that the lowest and highest pooled ORs of oral health determinants among the elderly was observed in Thailand (OR = 21.59) and China (OR = 0.31) (Figure 4A). The highest number of studies were conducted in Brazil (N = 20) with one study found in Israel, Canada and China (Figure 4B).

### 4 | DISCUSSION

The relationship between clinical oral health status and OHRQoL was explored in this meta-analysis.

Our findings show a positive association between low educational level (≤8th grade), being married, depression, smoking status, denture wearing, poor general health, teeth-induced pain, periodontal disease and poor OHRQoL among the elderly individuals. We also observed a negative association between DMFT, being aged 75 and above on poor OHRQoL.

### 4.1 | Clinical determinants and OHRQoL

Active oral disease, including dental caries, affects OHRQoL and is highlighted in the experience of pain which impacts upon a variety of physical tasks. Tooth-induced pain may result in biopsychosocial disabilities meaning that re-orienting oral health services is essential to relieve or prevent pain in older people. As noted above oral health-related quality of life could be associated with the perception of the disease among the elderly who may misinterpret oral disease symptoms and assume no specific intervention is necessary even when experiencing pain.

Tooth loss was correlated with poor OHRQoL in the present survey. This was true in the case of the number of missing teeth ranging from 6 to 17; however, it was not a determinant for those participants with a higher number of missing teeth. The reason for reporting fewer issues associated with a higher number of missing teeth may be explained by the theory of response shift. This theory argues that alternations occurring in individuals in terms of values, internal standards or conceptualizing HRQoL over time, may be due to illness. As they age, individuals are more likely to not consider minor or even severe oral health problems as crucial to well-being. Accordingly, they frequently express a higher level of satisfaction with their oral health, which might be solely due to lower expectation levels.
the elderly might ascribe decreased priorities to oral health, compared with general health and as a result, report fewer adverse effects of oral health than to their general health on QoL.54

The association between the periodontal index and geriatric oral health demonstrated that increased periodontal index scores enhance the geriatric oral health values, suggesting a greater OHRQoL status. These results were inconsistent with those of Wong et al., who indicated no significant correlation between the two variables.58 However, a strong association was detected between loss of attachment (LOA) and GOHAI values. Those with a higher loss of LOA scores demonstrated poorer QHRQoL. A significant number of study participants reported a gingival recession, which could explain the inconsistency between the periodontal index and LOA scores. There was no direct relationship between the periodontal index and GPHAI values. Gingival recession could prevent proper detection of pockets. This may be a result of the LOA of gingiva; the gingival margin moves apically, and true pocket depth is not measured. There were no data on the relationship between LOA and GOAHI scores; thus, these findings were not compared with previous research. The study subjects with excluded sextants reported the least mean GOHAI-Hi scores, suggesting a poorer OHRQoL. Chewing and speaking issues are more likely encountered by the individuals with no teeth or those with very few teeth, also impacting upon OHRQoL.

Clinically, higher DMFT scores and root caries were negatively correlated with OHRQoL. As a response to thermal and chemical stimuli, root carries develop constant tooth sensitivity. Besides, root caries are more difficult to be detected and stored than coronal caries; thus, consistent with research in the United States, negative effects might be observed in this regard.59 Other studies on the DMFT value and investigation results of studies conducted in Mexico and Hong Kong were in line with the present findings, suggesting a poorer OHRQoL.

Higher teeth numbers are considered as a protective factor regarding OHRQoL. However, having more teeth in those with limited access to healthcare services enhances the odds of pain. Denture use has been determined as a protective factor for OHRQoL, even after controlling for other variables. Denture use was significantly correlated with better OHRQoL on the six other dimensions of the OHIP-14 (except for functional limitation) in this population, with fewer effects on pain, eating, psychological discomfort and social interactions. Difficulty eating was correlated most strongly in prior investigations of tooth loss and denture use.61,62

4.2 | Social determinants and OHRQoL

Ageing (≥75-year-olds reported lower OHRQoL than 65 to 75-year-olds) and belonging to lower social classes are known to be associated with reduced OHRQoL. Contrary to the data obtained from investigations conducted in Germany and Israel, older people with low socio-economic classes reported significantly higher effects on OHRQoL.63 However, this finding was consistent with those of studies on younger populations.64 Such findings highlight the necessity of planning and evaluating oral health care services. Denture use was a strong independent predictor of poor OHRQoL. Prior research also documented the same results in this respect.65,66 Numerous factors might be correlated with denture use and poor OHRQoL, for example prostheses quality (adaptation and retention).67 To avoid oral health-related impediments to well-being, it is crucial to properly implement prostheses.68 A strong correlation was also detected between OHRQoL and self-reported general health. In other words, lower self-reported general health values were strongly associated with poor OHRQoL.69 The individual aspects of OHRQoL were not significantly correlated with a history of oral disease. However, some variables were found to be significant in >3 analyses. Biopsychological discomfort and functional limitations had a relationship with wearing a denture. Experiencing tooth-induced pain was associated with social disability and handicap and biopsychological discomfort. Such data support the literature findings on introducing this variable as the influential primary determinant of quality of life.70 Obtaining a significant national dataset facilitates the understanding
of the effect of disease independent of treatment-seeking behaviour. The majority of studies investigating the effect of oral conditions on OHRQoL were restricted to participants selected from residential care settings; and as such cannot be generalized to populations with the same experiences but who do not receive dental care services. The perception of impact and intervention necessity perception might be correlated; impaired daily living activities may attract individuals’ attention in this regard. The conditions of dental fistulae, abscesses,
ulcers or active caries will likely also affect OHRQoL. However, taking preventive measures could help to reduce such complications during the time.\textsuperscript{73} In addition, considering the cohort impacts, it is vital to providing monitoring and intervention plans for the elderly to deduct the oral health diseases burden in them.

In line with previous research our data found that oral health is significantly affected by age and the level of education.\textsuperscript{58,60,75,76} Better oral health prevention practices and increased access to healthcare services has also been found among individuals with higher levels of education.\textsuperscript{74}

A critical characteristic of socio-economic status is educational attainment with a strong association found between the level of income and education. However, the educational level of participants independently predicted health status and dental visits.\textsuperscript{57,74,75} Our study also suggests that biosyngnousocial status is impacted negatively by tooth loss including untreated caries or periodontal conditions. Negative attitudes to dental care, limited access to dental care or a low economic status are also likely to be implicated.\textsuperscript{76}

To the best of our knowledge, this was the first systematic review and meta-analysis study exploring the relationship between oral health determinants and OHRQoL among people aged over 75 years. The individual-level data in the meta-analyses are illustrated in Figures 2–4 and Table 1. Negative participant attitudes towards tooth loss suggest increased dental health care-seeking to replace the missing teeth with dentures which is likely to have a substantial financial burden on individuals (or governments). This also has important implications for oral healthcare policymakers as such expenditure is considerable. A strategy for the provision of a sub-optimal, yet functional level has been defined under the concept of the shortened dental arch.\textsuperscript{77} Oral healthcare expenditure could be decreased by restricting the expected treatment outcomes by providing a shortened dental arch; hence, implementing the shortened dental arch approach to treatment, especially in the elderly, could be considered. Petersen and Yamamoto,\textsuperscript{13} suggest that the identification of common risk factors across national health plans may enable disease prevention and health promotion to also include better understanding oral health. Considering the growing burden of chronic health conditions, policymakers are advised to urgently address preventing an treating chronic disease in ageing populations, likely improving OHRQoL.\textsuperscript{78} A significant limitation of the present study was the absence of a specific assessment instrument for oral health QoL. In other words, the applied inventory measured oral health impact; however, it failed to determine the differences between oral health-related problems impact and other essential life-related characterizes.

Furthermore, it is unknown whether generic QoL screening tool used was sensitive to both self-reported periodontal health and clinically evaluated periodontal health among the elderly. Therefore, further research is required to assess the validity and sensitivity of the scales. Furthermore, most studies that have been included in this review were observational studies which limits describing any causal relationship between oral health determinants and OHRQoL.\textsuperscript{79}

5 | CONCLUSION

Our meta-analysis revealed a positive association between low educational level (≤8th grade), marital status, depression, smoking status, denture wearing, poor general health, tooth-induced pain, periodontal diseases and poor OHRQoL among the elderly. We also observed negative associations between DMFT and being 75 years of age or above with poor OHRQoL. Policymakers should consider the need for improved oral health preventive measures for the ageing population globally as demand for oral healthcare services will continue to grow.

6 | CLINICAL RELEVANCE

6.1 | Scientific rationale for the study

Ageing is a risk factor for periodontitis, and there is some epidemiological evidence that falling from a higher to lower level in quality of life is entirely responsible for oral diseases, musculoskeletal disorders, and physical and mental health issues that affect elderly persons.

6.2 | Principal findings

Our findings indicated that a positive association between low educational level (≤8th grade), marital status, depression, smoking status, denture wearing, poor general health, teeth-induced pain, periodontal diseases and poor OHRQoL among the elderly.

6.3 | Practical implications

The efficacy of preventive measures and the economic aspects of tooth replacement with dentures should be further explored. Developing oral healthcare plans and policies with the specific aim of improving this group's OHRQoL is essential.

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CONFLICT OF INTEREST

The authors declare that they have no competing interests.

AUTHORS CONTRIBUTIONS

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Not Applicable.

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DATA AVAILABILITY STATEMENT
The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID
Bahram Armoon https://orcid.org/0000-0001-5467-9889
Peter Higgs https://orcid.org/0000-0002-5587-5379

REFERENCES


44. Locker D Dental status, xerostomia and the oral health-related quality of life of an elderly institutionalized population. Spec Care Dent. 2003;23(3):86-93.


SUPPORTING INFORMATION
Additional supporting information may be found online in the Supporting Information section.