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## Review

# A systematic review and meta-analysis of clinical, microbiological, and behavioural aspects of oral health among patients with stroke



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## ABSTRACT

**Objective:** The objective of this study was to review clinical, microbiological, and immunological aspects of oral health, as well as oral health related behaviours among patients following stroke.

**Data sources:** A structured search strategy was applied to three electronic databases to identify relevant papers.

**Study selection:** The initial search yielded 19,927 papers, 60 potentially relevant studies (Kappa: 0.974) and 23 relevant papers (Kappa: 0.965) in accordance with the inclusion criteria. Outcomes regarding tooth condition, periodontal condition, oral hygiene status, and dental attendance were pooled for seven meta-analyses. Narrative summaries were provided for those outcomes which could not be pooled for meta-analysis.

**Results:** The standardized differences in mean values of the parameters (fixed effect, random effect model) for patients with stroke compared to control groups were: number of teeth (−0.325, −0.271), DMFT (0.246, 0.246), oral hygiene status – plaque index (0.305, 0.356) and gingival index (0.716, 0.653), periodontal health status – clinical attachment loss (0.437, 0.490) and probing depth (0.470, 0.579). In addition, a lower chance of dental attendance was observed among patients with stroke (odds ratio: 0.493, 0.480). For those outcomes which could not be pooled for meta-analysis, it was not possible to draw any qualitative conclusion due to the equivocal results of these studies.

**Conclusions:** There is an increasing interest in oral health of patients with stroke. Patients with stroke had a poorer clinical oral health status across a range of parameters (tooth loss, dental caries experience, and periodontal status). Coupled with this, their dental attendance was less frequent. Further studies employing standardized assessments of oral health/oral health behaviour can confirm these oral health disparities.

**Clinical significance:** With comprehensive literature search, this systematic review and meta-analysis indicated a poorer oral health status and less frequent dental attendance behaviour among patients with stroke.

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## 1. Introduction

The incidence of stroke remains a challenge globally, and the absolute numbers of stroke is likely to increase in the coming decades owing to ageing populations.<sup>1-3</sup> Stroke not only results in high mortality rates but also in considerable mobility in terms of disability-adjusted life years (DALY).<sup>4</sup> Due to its sequela and prevalence, stroke is still a major source of disability among the elderly. A combination of motor, sensory, perceptual, and cognitive deficits often occurs after stroke and having their own particular deficit and impact on activities of daily living (ADL).<sup>5-7</sup> Stroke-associated orofacial motor deficits include weak lip force, decreased tongue pressure, and low chewing efficiency, which in turn affects the ability to clear food debris out of the oral cavity and exacerbates poor oral hygiene.<sup>8-10</sup> Function, education and training, and compliance are the three dimensions of oral self-care as defined by Bauer.<sup>11</sup> Due to compromised motor and cognitive abilities after stroke, an individual may have impairments in any one of the three dimensions of oral self-care, and thus limited or unable to perform oral self-care to a satisfactory level. Consequently increased dental plaque levels and oral pathogen loads results in the oral cavity acting as a reservoir for not only oral infections (e.g. gingivitis, periodontitis and dental caries), but also serious systemic health problems such as bacteremia.<sup>12,13</sup> Aspiration pneumonia is one the most common and serious post-stroke infection accounting for an estimated one third of post-stroke mortalities and leading to the need for prolonged stroke rehabilitation.<sup>14-16</sup> Preliminary evidence among institutionalized elders suggests the link between aspiration pneumonia and oral health conditions: caries, periodontal disease, and poor hygiene.<sup>17,18</sup> Acknowledging the growing importance of the relationship between stroke and oral health, this study aimed to review clinical oral health status and oral self-care behaviours of patients with stroke.

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## 2. Materials and methods

### 2.1. Focus of the review

The focus of this review was observational studies relating to oral health outcomes (clinical, microbiological and immunological attributes) and oral health-related behaviours of patients with a previous diagnosis of stroke. Functional aspects, such as oral stereognosis, mastication and swallowing were outside the scope of this review. Potentially eligible studies were limited to those published in the English language.

### 2.2. Search strategy

The search methodology used in this review was developed and based on the search terms of "oral health" and "stroke" used previously by two systematic reviews.<sup>19,20</sup> The search strategy was then modified accordingly to meet specific requirements in the three databases: Pubmed (including Medline 1950 to November 2013), Embase (1947 to November

2013), and Web of Science (1956 to November 2013) (Appendix I, Supplementary material).

### 2.3. Selection of studies

Papers were excluded if they did not address both oral health and stroke based on their titles and abstracts. The remaining papers were further excluded if they were reviews, letters, editorials, conference proceedings, animal studies, or clinical trials. Full texts of potentially relevant papers were obtained to confirm whether information regarding oral health status was collected after stroke. In order to broaden our research results, the reference lists of selected papers were also screened to further identify potentially relevant papers through reference linkage.

### 2.4. Data collection and analysis

Two reviewers independently screened the titles and abstracts obtained from the search and full texts of potentially relevant papers were further screened for inclusion. Agreement between the two reviewers in screening abstracts and relevant papers was compared using Kappa statistics. Where disagreements occurred, consensus for inclusion was reached through discussion with a third independent reviewer. Details of the relevant papers were extracted, including study design, sample size, outcomes, follow-up period and key findings. Comprehensive Meta Analysis 2.0 software was used to pool those studies which were suitable for meta-analysis. Cochran's Q and  $I^2$  test were used to test heterogeneity among studies. Summary effects were calculated by both random and fixed effect models. Those studies which were not amenable to quantitative analysis were presented with a narrative description of key findings. The methodological quality concerning external and internal validity of the included studies was evaluated according to the criteria specified by the Methodological Evaluation of Observational Research (MORE).<sup>21</sup> The checklist contains six items to assess the external validity: (1) sampling of subjects; (2) assessment of sampling bias; (3) respondent rate; (4) exclusion rate; (5) addressing of sampling bias in the analysis; and (6) subject flow. Appraisal of internal validity encompasses the evaluation of five items: (1) source to measure outcomes; (2) definition of outcomes; (3) measurements of outcomes (validity and reliability); (4) outcomes in subpopulations; (5) reporting of outcomes. Minor and major flaws as well as poor reporting were identified for each item in the checklist.

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## 3. Results

### 3.1. Results of the search

The search generated a total of 19,927 references from three databases: 5460 papers were identified from Pubmed, 13,411 papers from Embase, and 1056 papers from the ISI Web of Science database. The initial screening process was shown in Fig. 1 and full texts of 60 potentially relevant papers were further reviewed. Thirty-seven papers were further excluded and listed in Appendix II

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