Original Paper

# Effectiveness of Community-based Interventions in Improving the Oral & Dental Health of the Elderly People: A Systematic Review and Meta-analysis

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**Running Title** Community-based Interventions for Oral & Dental Health

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## ABSTRACT

**Introduction:** Considering the rapid growth in the number of aged people and their oral & dental health problems, there is a need for effective community-based interventions to improve their oral health.

**Objective:** This study aims to investigate the effectiveness of community-based interventions in improving the oral & dental health of elderly people.

**Materials and Methods:** This is a systematic review and meta-analysis. The related studies published from January 2000 to March 2023 were searched in PubMed, Scopus, Cochrane Oral Health's Trials Register, and Web of Science databases. The risk of bias in the included studies was assessed using the Cochrane tool.

**Results:** Nineteen articles were included in the review. Interventions were divided into four groups: educational interventions, oral & dental health care interventions, chewing gum, and combined interventions. A total of 95 indicators were examined in the studies, 53 of which were not statistically significant. Regarding the overall effectiveness of the interventions, 10 studies reported them as completely effective, 5 studies as relatively effective, and 4 as ineffective. Chewing gum had the highest effectiveness. The results of the meta-analysis showed that the mean difference in the dental plaque index between the intervention and control groups was -0.65 (95% CI; -2.03%, 0.74%, Q=59.6, df=5, P=0.001, $I^2$=97.8%) the mean difference in the denture plaque index was -0.20 (95% CI; -0.38%, -0.02%, Q=3.22, df=3, P=0.36, $I^2$=21.3%), and the mean difference in the gingival index was -0.36 (95% CI; -0.99%, 0.27%; Q=5.2, df=1, P=0.02, $I^2$=80.9%).

**Conclusion:** There are no clear advantages or evidence about the effectiveness of community-based interventions in improving the oral & dental health of elderly people.

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## Highlights

• Community-based interventions that have been used to improve the oral & dental health of the elderly include educational interventions, oral health care interventions, chewing gum, and combined interventions.

• Chewing sugar free gums and effective and long-term educational courses are recommended to the elderly for their oral & dental health.

• The effectiveness of community-based interventions is not supported by sufficient and clear evidences.

## Plain Language Summary

Elderly people are vulnerable groups of the society due to being prone to chronic illnesses. Poor health conditions and the oral health problems in the elderly can affect their nutritional needs, eating patterns, and eventually, their physical conditions. There is an increasing need for more effective interventions and planning in this field. Community-based interventions are one of the important programs and include educational interventions, oral health care interventions, chewing gum, and combined interventions. Studies showed that chewing gum had the highest effectiveness and others had relative effectiveness.

## Introduction

The evidence has shown the increase in the aged population that may result in the elderly population explosion in the upcoming years [1]. Currently, more than 600 million people in the world are over the age of 60. This number is estimated to reach more than one billion by 2020, and nearly 2 billion by 2050 [2, 3]. Elderly people are considered as vulnerable groups of the society due to being prone to chronic illnesses [4, 5]. One of the most important problems and concerns in the elderly is oral & dental health problems [6, 7]. Despite the increasing advances in the fight against diseases worldwide, the need to observe oral & dental health is felt more than ever [8-10]. One of the main criteria for community health is the assessment of oral & dental health [11, 12]. Dental caries and periodontal diseases are the most prevalent dental diseases [13-16]. More than 99% of the people suffer from these diseases and more than 50 hours are wasted due to problems caused by them [17].

Reduction in the number of teeth in the elderly negatively affects their ability to chew and choose the type of food they want, and can consequently cause nutritional deficiencies in them [18, 19]. In addition, it can affect their physical appearance, body image, self-confidence, and consequently the psychosocial function and the quality of life [20, 21]. Oral & dental health management is difficult for the elderly due to their illness and medication use [22]. In recent years, many community-based interventions have been designed and carried out based on different social and economic conditions to improve the oral & dental health of the elderly [23, 24]. Given that these interventions were designed and implemented in different ways and reported different results, their systematic review can be useful in designing and implementing more effective interventions. In this regard, this study aims to systematically review the community-based interventions for improving the oral & dental health of the elderly (>60 years).

## Materials and Methods

This is a systematic review, conducted in 2023 based on the preferred reporting items for systematic reviews and meta-analyses (PRISMA) approach [25]. The required information was collected by searching in PubMed, Scopus, Cochrane Oral Health's Trials Register, and Web of Science databases using the related keywords based on the medical subject headlines (MeSh) terms. The search strategy was designed by a highly experienced medical librarian. The selected time period for the articles was from January 2000 to March 2023. To identify and cover more published articles, a search in a number of reputable journals found from the Scientific Journal Rankings-SCImago System [26] was also conducted manually. After excluding irrelevant articles, the related articles were selected and their references were examined manually to find more related articles. To examine the grey literature, a search in the databases such as the European Association for Grey Literature Exploitation (EAGLE) and the Healthcare Management In-

**Table 1.** Inclusion and exclusion criteria of the study based on the population intervention, control, outcome (PICO) approach

| PICO Components | Exclusion Criteria | Inclusion Criteria |
|---|---|---|
| Population | Studies on people with chronic diseases such as diabetes, heart diseases, etc. | Studies on the elderly people over 60 |
| Intervention | Studies used clinical or laboratory interventions (not Community-based interventions), Studies used interventions for improving other problems (nutritional, respiratory, etc.) in the elderly. | Studies used community-based interventions to improve oral & dental health |
| Control | Studies on people with chronic diseases such as diabetes, heart diseases, etc. | Studies on the elderly people over 60 |
| Outcome | Studies with outcomes unrelated to the oral & dental health such as nutritional status, quality of life, etc. | Studies with outcomes related to the oral & dental health of the elderly people (denture plaque, gingival plaque, etc.). |
| Other cases | Observational or non-interventional studies, econometric studies, feasibility studies, Pilot studies | Studies published in English |

formation Consortium (HMIC) was also conducted. Table 1 presents the inclusion and exclusion criteria based on the population, intervention, control, and outcomes (PICO) approach.

The risk of bias in the included studies was assessed by two authors using the Cochrane checklist [27]. This tool covers six dimensions of bias: Selection bias, performance bias, detection bias, attrition bias, reporting bias, and other bias. Based on the results, the risk of bias is categorized as: Low risk of bias, high risk of bias, and unclear or unknown bias. The disagreement between the two authors were resolved by referring to the third author.

To extract data, two forms (one for the general characteristics of the articles and the other for the information and the results of the interventions) were designed in the Microsoft Word 2016 software. As a trial, these forms were used to collect the data of three papers and, thus, the existing deficiencies in the initial forms were found and resolved. Then, the data was extracted by two authors separately from the selected articles. The data included items as author's surname, publication year, study country, study area, study design, participants, and sample size.

To calculate the mean difference among the indices such as denture plaque and gingival plaque, between the interventions, and between the study groups, a meta-analysis was conducted in StataCorp software, version 16. To report the results, funnel plots were used where the size of each square represents the sample size and the lines represent the confidence interval (95% CI) for each study. To evaluate heterogeneity of the results, Q statistic and $I^2$ index were used. In this study, $I^2$ higher than 50% was determined to be the criterion of heterogeneity. Funnel plot and Egger's regression test were used at a significance level of 0.01 to measure publication bias. Other collected data were analyzed and reported manually using descriptive statistics (percentage, frequency, mean).

## Results

Of 7924 articles found, 2130 were excluded due to being irrelevant. After reading the titles and abstracts, 5794 items were excluded due to not meeting inclusion criteria. After reading the full texts, 614 articles were also excluded. Finally, 19 articles papers were selected for the review (Figure 1). Their information is presented in Table 2. In these studies, there were 1851 samples in the intervention groups and 2255 in the control group.

In 19 studies, a total of 95 indicators were measured and reported, of which 53 were reported to be statistically non-significant. Regarding overall effectiveness of the interventions, 10 studies reported them as completely effective (all indicators were statistically significant), 5 studies reported as relatively effective (some indicators were statistically significant) and 4 reported as ineffective (None of the indicators was statistically significant). Regarding the effectiveness based on the type of intervention, the studies showed that chewing gum interventions had the highest effectiveness (90%) and the combined interventions had the lowest effectiveness (34.7%). Furthermore, educational interventions were effective by about 68.0% and the interventions for oral & health care provision were 42.8% effective (Figure 2).

Among the indices reported in the studies, the dental plaque index, denture plaque index, and gingival

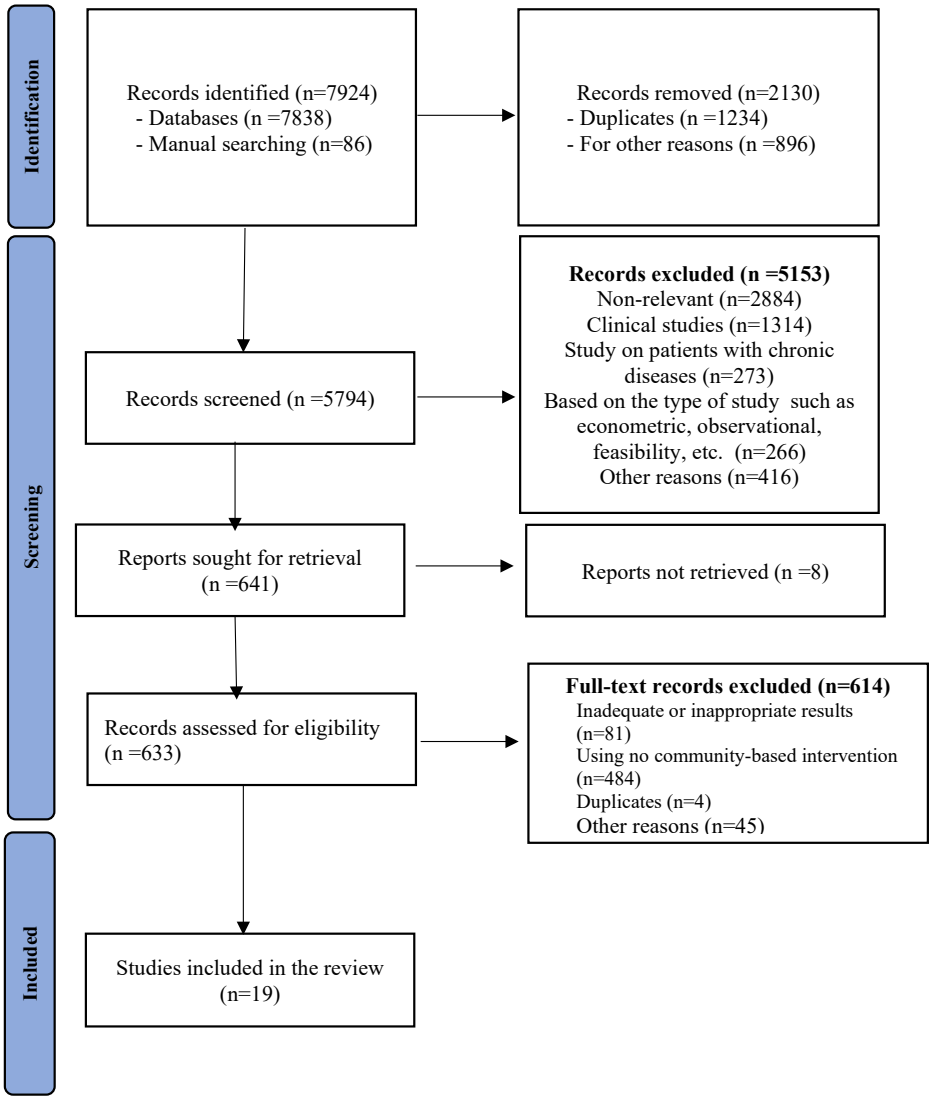


Figure 1. The flowchart of searching and screening process

index were reported in different studies. The results of the meta-analysis (Figure 3) showed that the mean difference in the dental plaque index between the intervention and control groups was -0.65 (95% CI; -2.03%, 0.74%; Q=59.6, df=5, P=0.001, $I^2$=97.8%); the mean difference in the denture plaque index was -0.20 (95% CI; -0.38%, -0.02%; Q=3.22, df=3, P=0.36, $I^2$=21.3%) and the mean difference in the gingival index was -0.36 (95% CI; -0.99%, 0.27%; Q=5.2, df=1, P=0.02, $I^2$=80.9%). Based on the mean differences, the difference in the mean scores of denture plaque index and gingival index between the two groups was moderately significant. The results of measuring the risk of publication bias (Figure 4) showed a high risk of bias (z=-2.79, Prob > |z|=0.0053). In assessing the risk of bias in 19 studies, 7 articles had a high risk of bias, 6 articles had a low risk of bias, and 6 has unknown bias (Table 3).

## Discussion

The majority of the reviewed studies reported the interventions as completely effective, where chewing gum had the highest effectiveness and the combined interventions had the lowest efficacy. In the studies, the mean difference in the denture plaque index and gingival index was mildly significant between the intervention and control groups. In general, the results of our study indicate that the community-based interventions that have been used to improve the oral & dental health of the elderly do not have a good effectiveness. One of the important reasons can be related to the study areas. As most studies were conducted in nursing homes and long-term care centers, the poor quality of care, psychological problems, and attitudes of the elderly living in these centers can affect the final results [45-47]. There-

**Table 2.** Characteristics of interventions and results of the included studies

| Author, Year, Country | Setting | Study Design | Participants | Oral & Dental Health Intervention | | | | | Results | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Intervention Group (n)/ Control Group (n) | Protocol | Type | Use of Technology | Follow up Duration (W) | Frequency | Outcomes | Sig. (P<0.05) | Overall results (Effective) |
| Adachi et al. 2002, Japan [23] | Nursing homes | RCT | Elderly people, 77/64 | Professional oral health care (POHC) given by dental hygienists | Oral & dental health care provision | No | 96 | Weekly | Fevers of 37.8 degrees C or more | Yes | Partially effective |
| | | | | | | | | | Mortality rate of aspiration pneumonia | Yes | |
| | | | | | | | | | Numbers of *C. albicans* species | Yes | |
| | | | | | | | | | Reduction of the presence of *Staphylococcus* | No | |
| | | | | | | | | | Amounts of methylmercaptan | Yes | |
| Al-Haboubi et al. 2012, UK [28] | Community | RCT | Older people aged 60 years, 95/91 | Chewing xylitol-containing gum twice a day for 15 min | Chewing gum | No | 24 | Daily | Saliva flow rate | No | Partially effective |
| | | | | | | | | | Improvement in plaque index | Yes | |
| | | | | | | | | | Improvement in gingival index | Yes | |
| | | | | | | | | | Self-perceived change in oral health | Yes | |
| Bellomo F, et al. 2005, Switzerland [29] | LTC | RCT | Institutionalized elderly adults, 29/30 | Initial occupational therapy instructions on tooth and denture brushing | Educational | No | 12 | Weekly | Denture plaque | Yes | Completely effective |
| | | | | | | | | | Dental plaque | Yes | |
| | | | | | | | | | Frequency of tooth brushing | Yes | |
| De Visschere et al. 2011, Belgium [30] | Nursing homes | RCT | Elderly residents of nursing home, 211/671 | An oral hygiene protocol in nursing homes | Educational | No | 240 | - | Denture plaque | No | Not effective |
| | | | | | | | | | Dental plaque | No | |
| De Visschere et al. 2012, Belgium [31] | Nursing homes | RCT | Elderly residents of nursing home, 187/186 | Supervised implementation of the guideline and the daily oral health care protocol derived from the guideline | Oral & dental health care provision | No | 24 | Daily | Tongue plaque | No | Partially effective |
| | | | | | | | | | Denture plaque | Yes | |
| | | | | | | | | | Dental plaque | No | |
| Frenkel, et al. 2001, UK [32] | Nursing homes | RCT | Institutionalized elderly people, 201/211 | Oral health care educational session for caregivers in nursing homes | Educational | No | 24 | - | Denture plaque | Yes | Completely effective |
| | | | | | | | | | Dental plaque | Yes | |
| | | | | | | | | | Gingivitis | Yes | |
| | | | | | | | | | Denture-induced stomatitis | Yes | |

| Author, Year, Country | Setting | Study Design | Participants | Oral & Dental Health Intervention | | | | | Results | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Intervention Group (n)/ Control Group (n) | Protocol | Type | Use of Technology | Follow up Duration (W) | Frequency | Outcomes | Sig. (P<0.05) | Overall results (Effective) |
| Hakuta et al. 2009, Japan [33] | Community | NA | Independent elderly women 79/62 | Oral function promotion programme, which included facial muscle and tongue exercises and salivary gland massages | Combined intervention | No | 12 | Two Weeks | Tongue coating area | Yes | Completely effective |
| | | | | | | | | | Tongue thickness | Yes | |
| | | | | | | | | | Food debris, tongue dryness | Yes | |
| | | | | | | | | | Salivary flow | Yes | |
| | | | | | | | | | Time for maintaining the tongue in the forward position | Yes | |
| | | | | | | | | | Frquency of moving the tip of the tongue | Yes | |
| | | | | | | | | | Frquency of moveming the lips | Yes | |
| | | | | | | | | | Pronunciation of words | Yes | |
| Komulainen et al. 2015, Finland [34] | Community | RCT | People aged 75 years or older 145/134 | Individually tailored instructions for oral and/or denture hygiene, relief of dry mouth symptoms, decrease of sugar-use frequency, use of fluoride, xylitol or antimicrobial products, and professional tooth cleaning | Multi intervention | No | 96 | - | Tooth brushing ≥2 times a day | No | Not effective |
| | | | | | | | | | Toothpaste use ≥2 times a day | No | |
| | | | | | | | | | Toothpick daily | No | |
| | | | | | | | | | Interdental flossing or brushing daily | No | |
| | | | | | | | | | Denture cleaning ≥2 times a day | No | |
| | | | | | | | | | Denture cleaning daily | No | |
| | | | | | | | | | Good oral hygiene | No | |
| | | | | | | | | | No gingivitis | No | |
| | | | | | | | | | No calculus | No | |
| | | | | | | | | | No deepened periodontal | No | |
| | | | | | | | | | No dental caries | No | |
| | | | | | | | | | Good denture hygiene | No | |
| | | | | | | | | | No denture stomatitis | No | |
| | | | | | | | | | No oral pain or discomfort | No | |
| | | | | | | | | | Mucosal lesions | No | |

| Author, Year, Country | Setting | Study Design | Participants | Oral & Dental Health Intervention | | | | | Results | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Intervention Group (n)/ Control Group (n) | Protocol | Type | Use of Technology | Follow up Duration (W) | Frequency | Outcomes | Sig. (P<0.05) | Overall results (Effective) |
| Lowe et al. 2007, UK [35] | Community | RCT | People aged 75 years or older 172/322 | General medical practice for preventive health check | Oral & dental health care provision | No | 24 | - | Reported dental visiting | Yes | Completely effective |
| MacEntee et al. 2007, Canada [36] | LTC | RCT | Institutionalized elderly adults, 51/62 | A pyramidal education for improving the oral health and nutritional status | Educational | NO | 12 | - | Body mass index <23 | No | Not effective |
| | | | | | | | | | Geriatric simplified debris index <1.9 | No | |
| | | | | | | | | | 0 or 1 occlusal contact zones in the Eichner index (without dentures) | No | |
| | | | | | | | | | 0 or 1 occlusal contact zones in the Eichner index (with dentures) | No | |
| | | | | | | | | | Self-reported chewing difficulties | No | |
| | | | | | | | | | Malnutrition | No | |
| | | | | | | | | | Gingival bleeding | No | |
| | | | | | | | | | Number of teeth | No | |
| | | | | | | | | | Fractured teeth or roots | No | |
| Meurman et al. 2001, Finland [37] | Nursing homes | Quasi-experimental | Institutionalized elderly adults 44/0 | Useing both mouthwash and toothpaste containing 0.025% combination of amine fluoride and stannous fluoride (Meridol, GABA Therwil, Switzerland) for 12 months, twice daily | Oral & dental health care provision | No | 48 | Weekly | *Actinobacillus ocfinomycetemcomitons* | No | Partiallyeffective |
| | | | | | | | | | *Porphyromonas gingivalis* | Yes | |
| | | | | | | | | | *Prevotella intermedia* | No | |
| | | | | | | | | | *Prevotella nigrescens* | No | |
| | | | | | | | | | *Bacteroides forsythus* | No | |
| | | | | | | | | | Yeast counts (≥$10^5$ Cfu/mL) | Yes | |
| | | | | | | | | | *Mutans Streptococci* (≥05 Cfu/mL) | No | |

| Author, Year, Country | Setting | Study Design | Participants | Oral & Dental Health Intervention | | | | | Results | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Intervention Group (n)/ Control Group (n) | Protocol | Type | Use of Technology | Follow up Duration (W) | Frequency | Outcomes | Sig. (P<0.05) | Overall results (Effective) |
| Morino et al. 2014 Japan [38] | Nursing homes | RCT | Elderly people over 74 years, 14/16 | Short-term profetional oral health care (POHC) after breakfast once per week for one month by two dental hygienists | Oral & dental health care provision | No | 20 | Weekly | Oral moisture | No | Partially effective |
| | | | | | | | | | Dental plaque Index | Yes | |
| | | | | | | | | | Number of bacteria | No | |
| | | | | | | | | | Percentage of Streptococcus species | Yes | |
| | | | | | | | | | Percentage of *Fusobacterium* species | No | |
| | | | | | | | | | Percentage of *Prevotella* species | No | |
| | | | | | | | | | Presence of opportunistic pathogen | No | |
| Nicol et al. 2005, UK [24] | Nursing homes | CT | Elderly residents of nursing homes, 39/39 | A staff training programme on mouth care | Educational | Yes | 72 | - | Denture hygiene | Yes | Completely effective |
| | | | | | | | | | Number of residents wearing dentures | Yes | |
| | | | | | | | | | Mucosal disease | Yes | |
| | | | | | | | | | Angular cheilitis | Yes | |
| | | | | | | | | | Denture stomatitis | Yes | |
| Peltola et al. 2007, Finland [39] | LTC | RCT | Long-term hospitalized elderly, 41/39 | Hands-on instructions for nursing staff after which they assumed responsibility for the subjects' daily oral hygiene | Oral & dental health care provision | No | 44 | Daily | Denture hygiene | Yes | Completely effective |
| | | | | | | | | | Dental hygiene | Yes | |
| Simons et al. 2002, UK [40] | Nursing homes | RCT | Frail older people, 80/31 | A medicated chewing gum | Chewing gum | No | 48 | Daily | Saliva flow rate | Yes | Completely effective |
| | | | | | | | | | *Mutans streptococci* | Yes | |
| | | | | | | | | | *Lactobacilli*, | Yes | |
| | | | | | | | | | Yeasts | Yes | |
| | | | | | | | | | Denture debris status | Yes | |
| | | | | | | | | | Denture stomatitis | Yes | |
| | | | | | | | | | Angular cheilitis | Yes | |

| Author, Year, Country | Setting | Study Design | Participants | Oral & Dental Health Intervention | | | | | Results | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Intervention Group (n)/ Control Group (n) | Protocol | Type | Use of Technology | Follow up Duration (W) | Frequency | Outcomes | Sig. (P<0.05) | Overall results (Effective) |
| Zenthofer et al. 2013, Germany [41] | LTC | RCT | Institutionalized elderly, 79/23 | Professional cleaning of teeth and dentures with individual instruction | Oral & dental health care provision | No | 144 | - | Denture hygiene index | No | Not effective |
| | | | | | | | | | Dental plaque index | No | |
| | | | | | | | | | Gingival bleeding | No | |
| Nihtilä et al. 2017, Finland [42] | Nursing homes | Non-RCT | Home-care clients aged 75 years or over, 151/118 | Oral and written instructions ( dental hygiene instructions, denture hygiene instructions and cleaning of the oral mucosa instructions) given to the participant, to the caregiver, or nurse. | Educational | No | 24 | - | Number of teeth with plaque | Yes | Completely effective |
| | | | | | | | | | Cleanliness of dentures | Yes | |
| Shokry et al. 2018, Egypt [43] | Community | Quasi-experimental | Elderly people, 75/0 | Educational program | Educational | No | - | - | Oral health knowledge | Yes | Completely effective |
| | | | | | | | | | Oral self-care practice | Yes | |
| | | | | | | | | | Oral health assessment | Yes | |
| | | | | | | | | | OHRQoL score | Yes | |
| Keyong et al. 2019, Thailand [44] | Community | RCT | Elderly people aged 60-74 years who had at least 6 natural teeth, 81/81 | Oral health education based on the Health Belief Model and tooth brushing practice in a small group of 4–5 persons, and then they were remotivated to support behavior change at 1 and 3 months | Educational | No | 24 | - | Oral health perception | Yes | Completely effective |
| | | | | | | | | | Plaque scores | Yes | |
| | | | | | | | | | Gingival inflammation | Yes | |
| | | | | | | | | | Clinical attachment loss | Yes | |

LTC: Long-term care home; RCT: Randomized clinical trial.

fore, along with interventions related to oral & dental health in the elderly, it is recommended to pay attention to other concerns of the elderly in these centers. Due to the strong correlation between oral & dental health and other problems in the elderly, it is recommended to conduct multidisciplinary interventions. Also, comprehensive and integrated services with high quality should be provided for the elderly in nursing homes and long-term care centers.

The results of the review showed that chewing gum was the most effective intervention. Various studies in other age groups which examined the effect of chewing gum on the oral & dental hygiene have also shown the high effectiveness of these interventions and have recommended to chew sugar free gums [48-52]. According to these studies, the most important mechanisms of chewing gum can be reduced dental plaque, reduced streptococcus mutans of saliva, reduced production of salivary acid, and increased salivary and mechanical cleansing properties of the chewing gum [53-55].

The results also showed the educational interventions had a moderate effectiveness. Albrecht also did not show the effectiveness of educational interventions [56]. However, most of the educational interventions for lower ages, especially school-based interventions, have been reported to have a relatively good efficacy [57-60]. One of the probable reasons for lower effectiveness of educational interventions for the elderly can be the aging and physiological issues that reduce the learning ability. Educational practices used in the studies can be effective, since most of the educational interventions are usually short-term and traditional, using inefficient methods. One of the educational models that can be recommended in this field is the Health Belief Model. The effectiveness of this educational model in improving oral & dental health has been reported [61-63].

Most of the reviewed studies were conducted in developed countries. It does not mean that no community-based interventions for the oral health of the elderly have been conducted in middle-income and low-income countries; however, it can indicate that, due to their poor performance and reporting, they could not be published. It should be noted that, due to the existing socioeconomic and cultural differences and the different quality of the interventions, their implementation, regardless of the local conditions of each country, will not be effective and will be a waste of resources [64, 65]. Another reason that may explain the high number of studies on the oral health of the elderly in developed countries can be the higher importance of aging in these countries or paying more attention to the health of elderly people [66]. Due to the fact that the aged population in middle-income and lower-income countries is growing, their low attention will increase the burden on health systems of these countries in the near future [67]. Hence, more attention is now being paid to the health of the elderly, especially their oral health [68-70].

A variety of electronical/technological methods (e-mail, internet, designed programs, software) had been used for the oral health of the elderly. The studies using a variety of such technologies have reported a higher efficacy [71, 72]. Recently, the use of technological methods to improve the health of people in other areas has been increased [73-76]. These advancements can be used to design and implement the interventions for

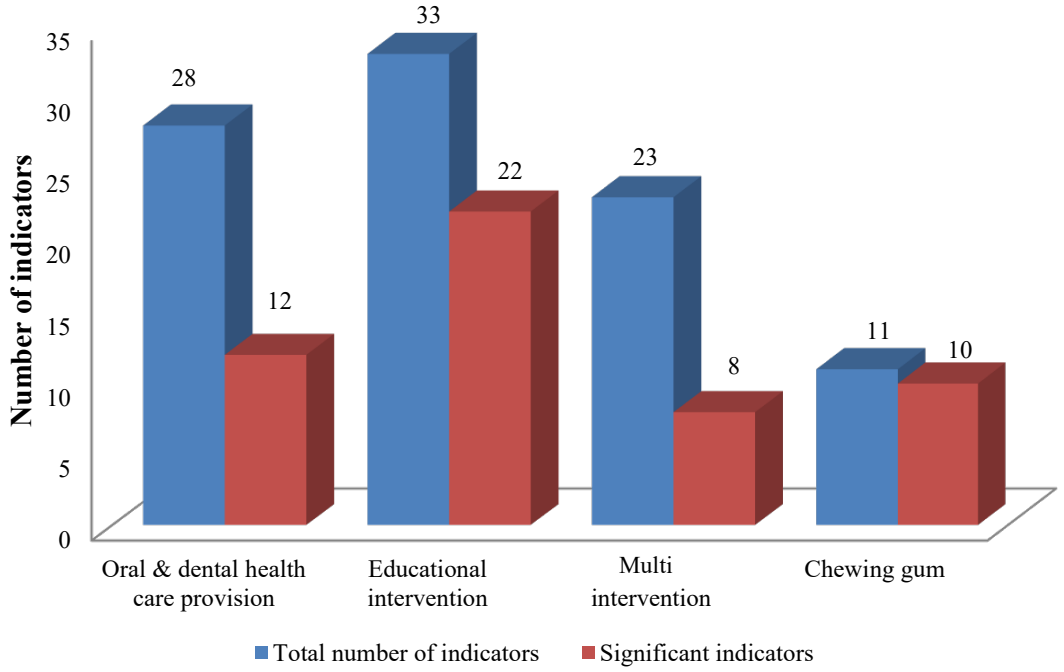


**Figure 2.** Effectiveness of interventions in improving the oral and dental health of the elderly based on the type of intervention

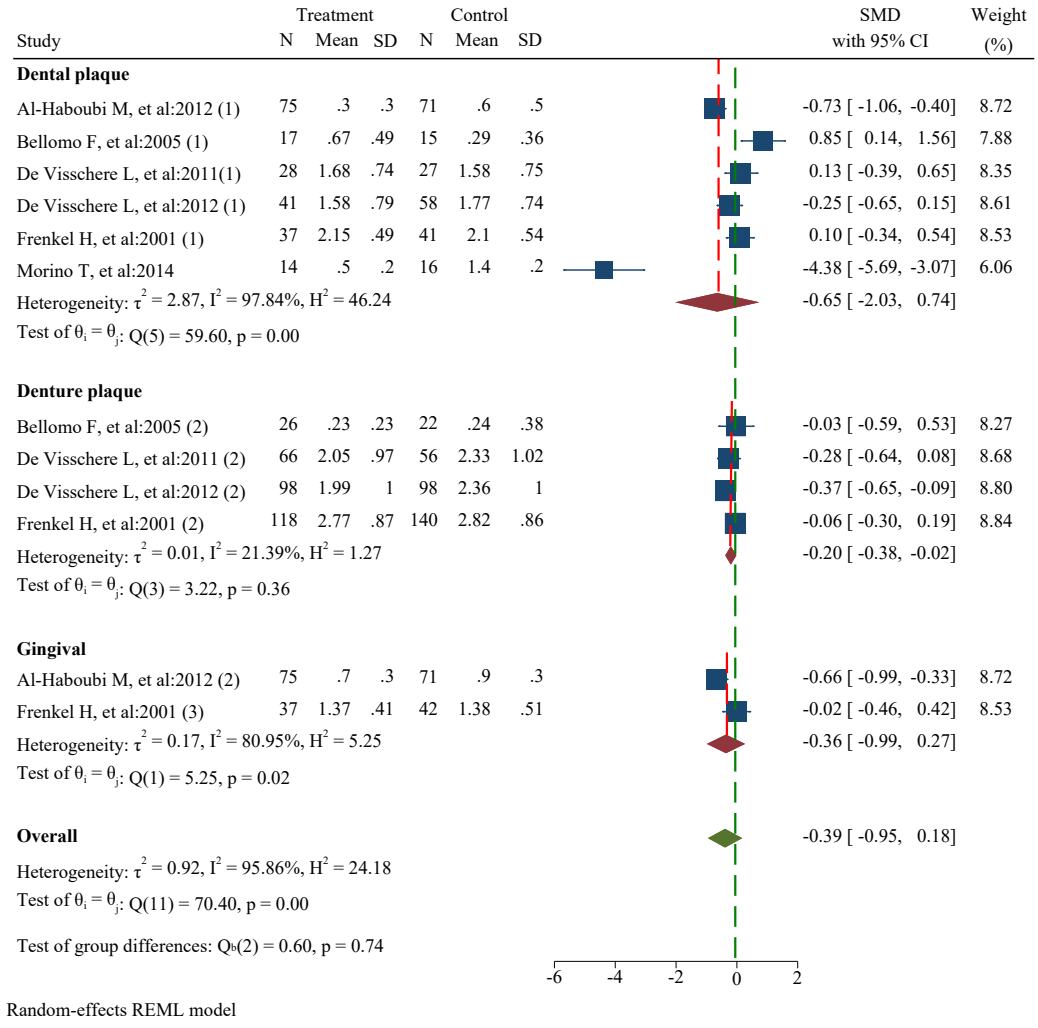


**Figure 3.** The statistics for dental plaque index, denture plaque index, and gingival index in the reviewed studie

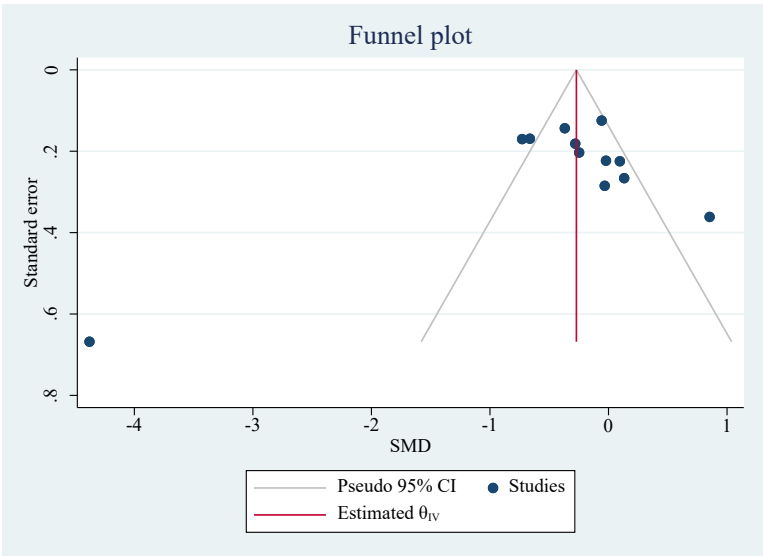


**Figure 4.** Funnel plot for assessing the risk of publication bias in the effect of community-based interventions on dental plaque index, denture plaque index and gingival index in the elderly

**Table 3.** Results of the risk of bias assessment

| Sequence Generation | Allocation Concealment | Blinding | Incomplete Outcome Data | Bias of Selective Outcome Reporting | Selective Outcome Reporting | Other Bias |
|---|---|---|---|---|---|---|
| Adachi et al. 2002 [23] | − | − | − | + | + | ? |
| Al-Haboubi et al. 2012 [28] | + | + | + | + | + | + |
| Bellomo et al. 2005 [29] | ? | − | − | + | ? | + |
| De Visschere et al. 2011 [30] | ? | − | + | + | ? | + |
| De Visschere et al. 2012 [31] | − | − | − | + | + | ? |
| Frenkel et al. 2001 [32] | + | + | + | + | ? | + |
| Hakuta et al. 2009 [33] | − | − | − | + | + | + |
| Komulainen et al. 2015 [34] | + | − | − | + | + | + |
| Lowe et al. 2007 [35] | + | + | − | + | + | ? |
| MacEntee et al. 2007 [36] | + | + | ? | ? | + | ? |
| Meurman et al. 2001 [37] | NA | NA | NA | ? | + | ? |
| Morino et al. 2014 [38] | + | ? | + | + | + | ? |
| Nicol et al. 2005 [24] | ? | ? | + | + | + | + |
| Peltola et al. 2007 [39] | ? | ? | − | + | + | ? |
| Simons et al. 2002 [40] | ? | + | + | + | + | ? |
| Zenthofer et al. 2013 [41] | + | + | + | ? | + | ? |
| Nihtilä et al. 2017 [42] | − | − | − | ? | ? | ? |
| Shokry et al. 2018 [43] | NA | NA | NA | ? | ? | ? |
| Keyong et al. 2019 [44] | ? | + | ? | + | + | + |

Abbreviations: L: Low risk of bias; H: High risk of bias; UN: Unknown bias; NA: Not applicable.

the oral health of the elderly. The articles did not have a good status in the risk of bias assessment. The most important problem was related to blinding and allocating individuals to intervention and control groups. Given that most studies had been conducted in nursing homes and long-term care centers, and since the elderly are in contact with each another in these centers, it is likely that the interventions will also have an impact on the control groups, and this can alter the results of the interventions. Therefore, it is recommended that researchers perform interventions in the future studies with more blinding. In this regard, the use of guidelines for conducting interventional studies and reporting their results [77-80] can be effective.

One of the main limitations of the present study was the low generalizability of the results. The main reason is that the reviewed studies were conducted in several high-income countries which limits the generalizability of the results to middle-income and lower-income countries. In addition, due to the high number of oral health indicators and their different method of outcome reporting, meta-analysis was not possible to be done for the most of indicators. Regarding the high costs of

dental care and lack of resources in the health system of middle-income and lower-income countries, their health system and people prefer cost-effectiveness interventions. Most of the reviewed studies focused on surrogate endpoints indicators such as saliva flow, bacterial counts, etc. Although these indicators are important, it is recommended that future studies focus more on clinical indicators or clinically significant endpoints such as tooth loss, pain, quality of life, and dentine caries. Also, according to the literature review and to our best knowledge, economic cost-effective studies in the field of oral health of the elderly are limited.

Based on the results of the study, it can be concluded that the community-based interventions for improving the oral & dental health of the elderly do not have a good efficacy. Given the rapid increase in the number of elderly people in the world and their wide oral hygiene problems, there is an increasing need for more effective interventions and planning. Chewing sugar free gums and holding effective and long-term training courses aimed at changing the behavior of the elderly are recommended. In addition, due to the weaknesses in the methodology and outcome reporting in the reviewed studies, it is recommended to use the available guidelines for carrying out the interventions and reporting their outcomes.

## Ethical Considerations

### Compliance with ethical guidelines

This study was approved by the Ethics Committee of Tabriz University of Medical Sciences (Code: IR.TBZMED.REC.1398.674).

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### Authors' contributions

Investigation and drafting the manuscript: Mir Hossein Aghaei, Fatemeh Pournaghi-Azar, and Saber Azami-Aghdash; Data acquisition and data analysis: Fatemeh Pournaghi-Azar, Mohammad Mohseni and Mahdi Nouri; Final approval: All authors.

### Conflict of interest

The authors declared no conflict of interest.

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