A scoping review of the relation between toothbrushing, and diabetes knowledge, glycemic control and oral health outcomes in people with type 2 diabetes

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Abstract

There is a bidirectional relationship between periodontal disease and type 2 diabetes (T2DM). While there is a discussion about the possible benefit of periodic periodontal care for people with T2DM, there has been less focus on whether improving home oral care has the potential to improve glycemic control (GC). This study summarized the available data on the relationship between home oral hygiene, specifically tooth brushing, and oral health and GC among people with T2DM studies that met our inclusion criteria. Self-report of more frequent toothbrushing was associated with self-report of better GC in the survey research identified. Self-report of more frequent toothbrushing was nearly always associated with better oral health outcomes measured by clinicians. In most of the interventional studies, health coaching interventions were associated with improvement in measures of GC; health coaching was associated with enhanced improvement in measures of both GC and self-reported tooth brushing compared to the provision of health ed.

Introduction

Periodontal disease was proposed as the "6th complication" of diabetes 30 years ago. There is a bidirectional relationship between diabetes, periodontal disease, and dental caries, including underlying pathophysiology and the importance of ongoing engagement in self-care management behaviors.

The American Dental Association recommends toothbrushing 2x daily with fluoride-containing toothpaste for 2 minutes; daily cleaning between teeth; consumption of healthy foods that limit sugary beverages and snacks; and regular dental visits for the prevention of oral disease.

It is not much of a stretch to see an overlap between these recommendations and the reducing risks and healthy eating elements found in the 2022 National Standards for Diabetes Self-management, Education, and Support (DSMES).

Self-report of daily interdental cleaning is associated with self-report of excellent oral health, yet interdental cleaning behaviors are engaged in by less than 1/3rd of adults. However, more fundamental than interdental cleaning is toothbrushing. A systematic review and meta-analysis found that infrequent toothbrushing, i.e., less than daily, was associated with an increased risk of periodontal disease.

Objective

To conduct a systematic scoping review to summarize the available data informing the relationship between glycemic control in adults with type 2 diabetes and the foundational oral health care behavior of regular toothbrushing.

Methods

A systematic scoping review of the literature (MEDLINE via PubMed and CINHAL Complete) using controlled vocabulary and keyword terms with no database-supplied limits.

Inclusion criteria: Adults with type 2 diabetes;
   Assessment of home toothbrushing activities, a measure of glycemia and oral health,
   Observational or interventional studies published ≤ 20yrs
   Publication within the past 20 years

Exclusion criteria
   Other forms of diabetes
   Professional dental treatment

Results

1. Eleven studies (7 observational and 4 interventional) were included from among 148 citations identified. The findings are summarized on Table 1.

2. Self-report of more frequent toothbrushing was associated with self-report of better glycemic control in all the survey research identified and was nearly always associated with better oral health outcomes measured by clinicians.

3. In most of the interventional studies, health coaching interventions (e.g., motivational interviewing) were associated with improvement in measures of glycemic control and with enhanced improvement in measures of both glycemic control and self-reported tooth brushing.
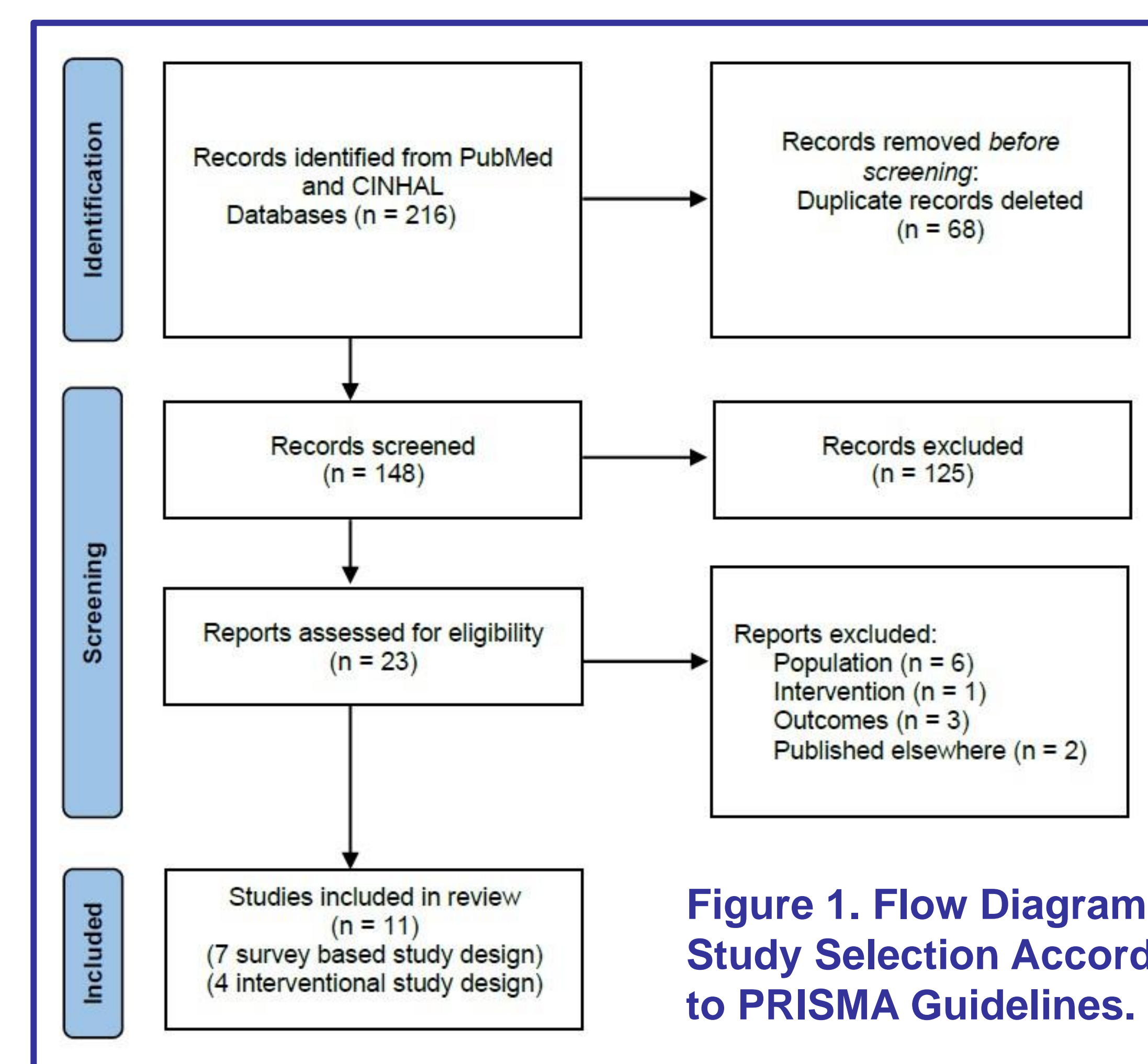
Figures & Tables

Figure 1. Flow Diagram of Study Selection According to PRISMA Guidelines.

4. Association between brushing frequency and prevalence of type 2 diabetes was mixed.

5. More frequent brushing was associated with better glycemic control (A1C, 2hr post-prandial plasma glucose, fasting glucose).

6. Less frequent brushing was associated with poorer outcomes for periodontal disease (bleeding on probing, clinical attachment level, periodontal pocket

7. Oral hygiene coaching can improve markers of glycemic control, periodontal disease, and in one study – engagement in other self-care behaviors.

Table 1. Findings of the Scoping Review.

Author, year, country, study type, demographics, primary intervention, measures (oral health and glycemic outcomes), the direction of association(s) observed and/or change(s) observed.

1st author (year) country ISO abbrev.	Study type # participants	Age range or mean (%female)	Primary intervention	Measures	(Association(s) observed) or change(s) with intervention *p<0.05 **p<0.001
Almas (2003) SA	Interventional N=60	24-64 (0%)	Oral hygiene instruction, brush 3X/day	Mean gingival crevicular fluid (GCF), community periodontal index of treatment needs (CPITN), mean plaque index (PlI); Mean Fasting Blood Glucose (FBG)	With the intervention, there were: ↓GCF *; ↓PlI *; Δ CPITN not statistically significant ↓FBG*
Cinar (2012) TR	Observational N=60	40-70 (43%)	N/A	Toothbrushing self-efficacy (TBSE), Brushing frequency Knowledge of their hemoglobin A1c level (HbA1c)	(Positive correlation (0.82) between TBSE and brushing frequency*; and TBSE and knowledge of HbA1c level*)
Cinar (2014) TR	Interventional N=186	30-65 (88-98%)	Oral health coaching versus education	Toothbrushing self-efficacy (TBSE), clinical attachment level (CAL), hemoglobin A1c (HbA1c)	With the intervention, ↓CAL** was observed at all levels of TBSE; with the intervention the ↓in HbA1c for low*, moderate** and high** TBSE level
Furuta (2020) JP	Observational N=4537	35-64 (20%)	N/A	Brushing frequency, clinical attachment level (CAL), bleeding on probing (BOP), dental plaque debris index, calculus, # of teeth	(More frequent brushing was associated with lower CAL*, less BOP*, less dental plaque**, less calculus** but no difference in # of teeth; more frequent brushing was associated with lower prevalence of obesity and hyperglycemia)
Hong (2016) KP	Observational N=4477	30-75 (50%)	N/A	Brushing frequency; pocket depth; hemoglobin A1c level (HbA1c)	(Brushing frequency was not associated with pocket depth in people with diabetes; HbA1c did not significantly differ in those with or without periodontitis)
Kanjirath (2016) US	Observational N=448	18-72 (48%)	N/A	Brushing frequency; flossing frequency; probing depth < 4 mm or 4-6 mm; bleeding on probing (BOP)	(Regular brushing was reported by a higher proportion of people with probing depth of < 4*; but there was no significant difference in BOP or frequency of probing depths greater than 4)
Kuwabara (2016) JP	Observational N=85,866	30-84 (49.1%)	N/A	Brushing frequency; BMI, abdominal circumfrence (AC), systolic/diastolic pressure (SBP, DBP), pulse rate (PR	(More frequent brushing was associated with healthier lifestyle habits** and lower BMI**, AC**, SBP**, DBP**, and PR**)
Nishirhara (2016) JP	Interventional N=40	65.1(I) 66.1(C) 38%(I) 59%(C)	Educational session with goal setting vs. control	Bleeding on probing (BOP), probing pocket depth (PPD), self-efficacy scale of self-care for people with PD (SESS), Hiroshima University Dental Behavior Inventory (HU-DBI), hemoglobin A1c (HbA1c), tumor necrosis factor-α (TNF)	For the intervention, group x time interactions were observed with dental hygiene education: ↓BOP*; Δ PPD not statistically significant; ↓SESS*; ↑HU-DBI**; no significant change in HbA1c or TNF
Saengpiborn (2015) TH	Interventional N=132	63.8(I) 64.1(C) (66% (I)) (63%(C))	Educational sessions with goal setting vs. usual care	Oral health knowledge, oral health attitude, diabetes knowledge, diabetes health attitude, engagement in oral and diabetes self care, e.g. exercise	With the intervention, group by time interaction were observed; ↑ oral health knowledge**; ↑ oral health attitude**; ↑ diabetes knowledge**; ↑ diabetes health attitude**; ↑exercise/week**
Su (2016) CN	Observational N=2,105	59.5 (64%)	N/A	Brushing frequency, BMI, fasting blood glucose (FBG), 2-hr plasma glucose (PG), hemoglobin A1c(HbA1c)	(66.7% report brushing 1X/day or less; 53.6% report never having visited a dentist; more frequent brushing was associated with better glycemic parameters. Less frequent brushing was associated with ↑ HbA1c*, PG*, FBG* but not BMI)
Zhuang (2012) CN	Observational N=487,198	30-79 (59%)	N/A	Brushing frequency Gum bleeding frequency Risk of major vascular events (MVE), all-cause mortality, cancer, diabetes	(Less frequent brushing was associated with increased risk of MVE**, all-cause mortality**, cancer** but not diabetes.)

Limitations

1. Lack of consistent outcomes measured study to study
2. Sample sizes were small
3. Geographic variability of study settings was broad
4. Reliance on self-report of oral hygiene engagement

Conclusions

1. **The data suggest that improved engagement in toothbrushing behavior may be associated with improved oral health and better glycemic control in people with type 2 diabetes.**
2. **Several studies suggested that the change in toothbrushing behavior preceded improvements in other self-care behaviors.**
3. **Additional studies are needed to explore the potential for health coaching on the self-care management behavior of toothbrushing to enhance the well-being of people with type 2 diabetes**
4. **There needs to be an assessment and update of DSME curriculum to reflect a greater focus on the specifics of oral health.**

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