

# Examining Oral Hygiene and Dental Visits' Association on Adult Oral Health Over 11 Years in England

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# Overview


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**Oral diseases affect nearly 3.5 billion people**







**They cause:**

-  **pain**
-  **discomfort**
-  **disfigurement**
-  **and even death**


 World Health Organization

**#OralHealth**

**Almost half of the world's population suffer from oral diseases**

-  **Untreated tooth decay affects 2.5 billion people**
-  **Severe gum disease affects 1 billion people**
-  **Complete tooth loss affects 350 million people**
-  **Oral cancer affects 380,000 people**

Oral diseases can be prevented and treated in their early stages.

 World Health Organization

# Background

## TOOTHBRUSHING

- Disrupt bacteria & plaque adhesion

(Mandal et al, 2017)

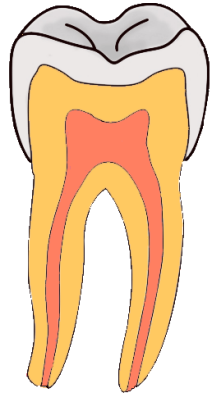
- Infrequent toothbrushing =

↑ caries incidence

(Kumar et al, 2016)

↑ periodontal disease prevalence

(Zimmerman et al, 2014)



## DENTAL ATTENDANCE

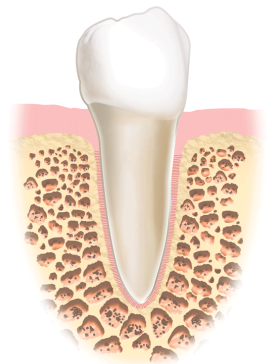
- Arrest disease progression, detect early signs, facilitate timely preventive & curative treatment

(WHO, 2017)

(Chan et al, 2022)

- Poor dental attendance = ↑ dental caries & Decay, Missing, Filled Teeth (DMFT)

(Aldossary et al, 2015)



# United Kingdom Profile

- 30.6% untreated adult caries
- 10.6% severe periodontal disease ( $\geq 15$  years old)
- 12.0% edentulous ( $\geq 20$  years old) (WHO 2022b)
- 48.8% untreated caries = poor service user (Public Health England, 2020)
- £3.6 billion financial burden  $\rightarrow$  NHS (Public Health England, 2022)

Oral health inequality = socially patterned behaviours

- Lower social class  $\rightarrow$  greater barriers  $\rightarrow$   health risks &  QoL

(Singh et al, 2019; Guarnizo-Herreño et al, 2021)



# Young to middle-aged adults

- Advancing in education & economically active
- Valuable insights of SES, behaviours, clinical impact

1. Previous research focus = broad adult populations / only older adults

Treasure et al, (2001); Heidari et al, (2009);  
Aldossary et al, (2014); Watt et al, (2013)

2. Unexplored association toothbrushing and dental attendance & clinical outcomes in UK

- Toothbrushing & periodontal health = Korea (Lee et al, 2018)
- Dental service & caries = Norway (Hadler-Olsen & Jonsson, 2021)
- Toothbrushing and dental attendance & caries = China (Petersen et al, 1997)
- Subjective measure of QoL (Brennan et al, 2009; Hong et al, 2023), impacts on daily performance (Astrom et al, 2011)
- Other risk factors : obesity (Al-Zahrani et al, 2003), dental anxiety (Wennstrom et al, 2012), knowledge (Brennan et al, 2010) and beliefs (Broadbent et al, 2006)

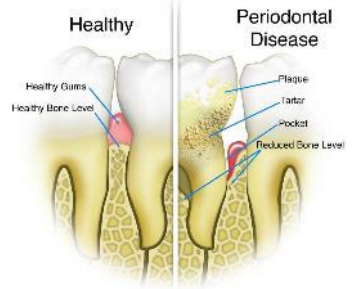
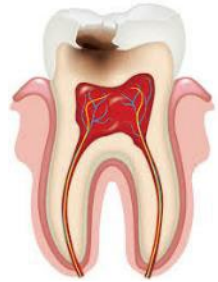




# Aim & Objectives

To explore the association between behaviours;  
**toothbrushing frequency and dental attendance**  
 with clinical outcomes;  
**dental caries, Decay Missing Filled Teeth (DMFT)**  
**index, and periodontal disease**

To observe the association for the UK  
**young to middle aged adult** as the population age  
 over an **11-year period** and if association varies after  
**adjusting for demographic and socioeconomic factors**



# Method

## *The Adult Dental Health Survey (ADHS)*

- National survey every 10 years
- Representative samples of adults  $\geq 16$  years
- Interviews, questionnaires, clinical examination
- Latest in 2021, no clinical data
- Scotland did not participate in 2009
- Data from UK Data Service 1998 and 2009

SN 4226 | [Adult Dental Health Survey, 1998](#)

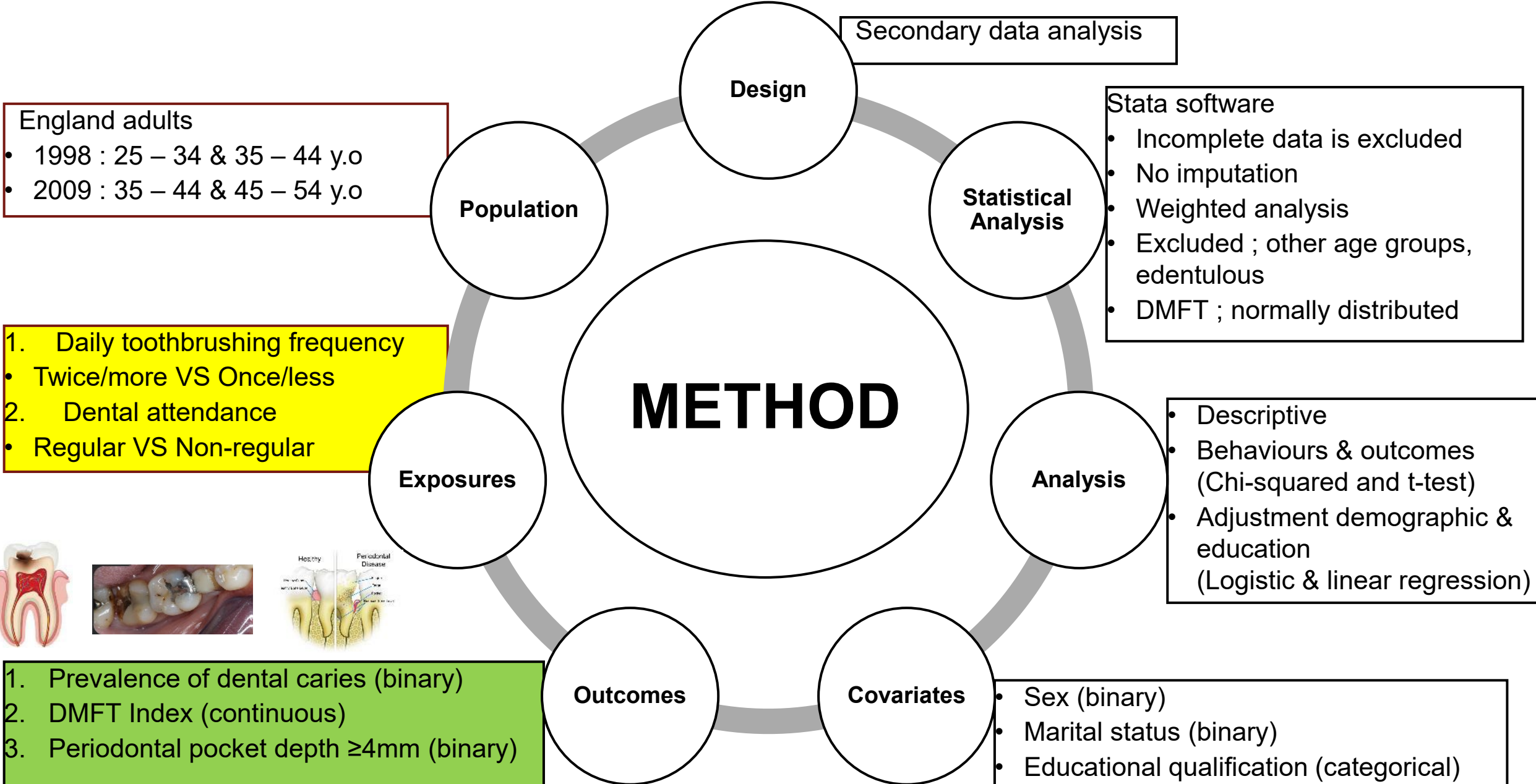
Office for National Statistics

SN 6884 | [Adult Dental Health Survey, 2009](#)

Office for National Statistics | Information Centre for Health and Social Care



**ENGLAND**





# Results



**1. Response rate & Complete case sample**

- 1998 : 74% - 1,275 adults
- 2009 : 60% - 2,421 adults

**2. Majority :**

- Female
- Married
- Educational qualification below degree level

**3. Behaviours & Oral Outcomes (1998 VS 2009)**

-  toothbrushing frequency & regular attendees
-  dental caries & PPD≥4mm
- Slight increase of mean DMFT

ADHS		1998	2009
Variable	Category	n=1,275	n=2,421
Sex – n (%)	Male	552 (49.7)	1,060 (47.7)
	Female	723 (50.3)	1,361 (52.4)
Marital status – n (%)	Married	755 (57.1)	1,579 (64.5)
	Others	520 (42.9)	842 (35.5)
Educational qualification – n (%)	Degree or above	263 (12.9)	725 (30.9)
	Below degree	844 (67.5)	1,470 (59.6)
	No qualifications	168 (12.9)	226 (9.6)
Daily toothbrushing frequency – n (%)	Twice/more	983 (75.7)	1,886 (77.4)
	Once/less	292 (24.3)	535 (22.7)
Dental attendance – n (%)	Regular	775 (57.3)	1,686 (65.5)
	Non-regular	500 (42.7)	735 (34.5)
Prevalence of dental caries – n (%)		596 (48.3)	948 (38.6)
Total DMFT index – mean (95%CI)		13.8 (13.5, 14.2)	14.3 (14.0, 14.6)
Presence of PPD ≥4mm – n (%)		651 (53.3)	1,129 (47.3)

Table 1 Descriptive characteristics of all participants in 1998 (n=1,275) and 2009 (n=2,421)

# Results

## 4. Age group 1 comparison

- TB : by 3%
- DA : by 11%
- Dental caries : by 18%
- DMFT index : No change
- PPD $\geq$ 4mm : by 5%

## 5. Age group 2 comparison

- TB : Remained consistent
- DA : by 6%
- Dental caries : Almost no change
- DMFT index : Almost no change
- PPD $\geq$ 4mm : by 7%

		Age group 1		Age group 2	
Variable	Category	1998 (25-34 years)	2009 (35-44 years)	1998 (35-44 years)	2009 (45-54 years)
<b>Daily toothbrushing frequency (%)</b>	Twice/more	<b>76.9</b>	<b>79.8</b>	<b>74.3</b>	<b>74.5</b>
	Once/less	23.1	20.2	25.7	25.5
<b>Dental attendance (%)</b>	Regular	<b>51.9</b>	<b>62.5</b>	<b>63.4</b>	<b>69.1</b>
	Non-regular	48.1	37.5	33.6	30.9
Clinical outcomes					
<b>Prevalence of dental caries (%)</b>		<b>55.3</b>	<b>37.7</b>	<b>40.4</b>	<b>39.6</b>
<b>DMFT index – mean (95%CI)</b>		<b>12.4</b> (11.9, 12.3)	<b>12.0</b> (11.6, 12.4)	<b>15.5</b> (15.0, 16.0)	<b>16.9</b> (16.5, 17.3)
<b>Presence of PPD <math>\geq</math>4mm (%)</b>		<b>47.9</b>	<b>43.0</b>	<b>59.5</b>	<b>52.4</b>

Table 2 Descriptive characteristics of variables according to age groups in 1998 (n=1,275) and 2009 (n=2,421)

# Results

## 6. Bivariate association of behaviours and outcomes

- Young to middle-aged adults who **brush their teeth twice or more daily** exhibited **better oral health**
- **Regular** dental attendees also have **improved oral health outcomes**
- DMFT appears to be significantly associated, but the actual magnitude of difference is small

ADHS Survey	1998			2009		
Exposure	Toothbrushing frequency			Toothbrushing frequency		
Outcome	Once/ Less	Twice/ more	p	Once/ less	Twice/ more	p
Prevalence of caries (%)	56.6	45.7	0.002	45.2	36.6	<0.001
DMFT index (mean)	14.5	13.6	0.021	15.5	13.9	<0.001
Presence of PPD ≥4mm (%)	58.0	51.8	0.017	55.2	45.0	<0.001
Exposure	Dental attendance			Dental attendance		
Outcome	Non-regular	Regular	p	Non-regular	Regular	p
Prevalence of caries (%)	58.9	40.5	<0.001	52.9	31.0	<0.001
DMFT index (mean)	13.5	14.1	0.553	13.3	14.8	0.002
Presence of PPD ≥4mm (%)	57.8	50.0	0.009	54.4	43.6	<0.001

Table 3 Association of oral hygiene behavior and dental attendance with outcomes in 1998 (n=1,275) and 2009 (n=2,421)

# Results

Outcome	Behaviours	ADHS 1998 – OR (95%CI)			ADHS 2009 – OR (95%CI)		
		Model 1 (Unadjusted)	Model 2 (Sex + Marital status)	Model 3 (Model 2 + Education)	Model 1 (Unadjusted)	Model 2 (Sex + Marital status)	Model 3 (Model 2 + Education)
<b>Dental caries</b>  <b>Odds ratio</b> <b>(95%CI)</b>	<b>Toothbrushing frequency</b> Once/less Twice/more	1 0.65 (0.48, 0.87) *	1 0.69 (0.51, 0.93) *	1 0.73 (0.54, 1.00) *	1 0.70 (0.56, 0.87) *	1 0.74 (0.59, 0.92) *	1 0.80 (0.64, 1.00)
	<b>Dental attendance</b> Non-regular Regular	1 0.47 (0.37, 0.62) **	1 0.54 (0.41, 0.70) **	1 0.55 (0.42, 0.73) **	1 0.40 (0.33, 0.49) **	1 0.41 (0.34, 0.51) **	1 0.42 (0.34, 0.52) **

## 7. Dental caries

### TB

- 1998 : Individuals who brushed their teeth twice or more daily had lower odds of having a carious tooth. The association remained marginally significant after all adjustments
- 2009 : The estimate became marginally non-significant after further adjustments

### DA

- 1998 & 2009 : Regular attendees showed lower odds of having dental caries in both unadjusted models
- This association remained significant after adjustments, with slight estimates reductions

# Results

Outcome	Behaviours	ADHS 1998 – OR (95%CI)			ADHS 2009 – OR (95%CI)		
		Model 1 (Unadjusted)	Model 2 (Sex + Marital status)	Model 3 (Model 2 + Education)	Model 1 (Unadjusted)	Model 2 (Sex + Marital status)	Model 3 (Model 2 + Education)
<b>DMFT</b>  Regression coefficient (95%CI)	<b>Toothbrushing frequency</b> Once/less Twice/more	ref. -0.83 (-1.74, 0.09)	ref. -0.93 (-1.85, -0.02) *	ref. -0.73 (-1.67, 0.21)	ref. -1.58 (-2.34, -0.81) **	ref. -1.70 (-2.47, -0.93) **	ref. -1.47 (-2.23, -0.70) **
	<b>Dental attendance</b> Non-regular Regular	ref. 0.53 (-0.23, 1.30)	ref. 0.42 (-0.39, 1.23)	ref. 0.53 (-0.26, 1.33)	ref. 1.43 (0.75, 2.11) **	ref. 1.50 (0.83, 2.18) **	ref. 1.56 (0.88, 2.23) **

## 8. DMFT index

### TB

- 1998 : Negative non-significant association remained after adjusting for sex, marital status, and education
- 2009 : Individuals who brushed twice or more daily had significantly lower DMFT. These associations remained significant even after adjustments

### DA

- 1998 : Non-significant association remained after adjusting for sex, marital status, and education
- 2009 : Regular attendees had a significantly higher DMFT than non-regular attendees. This estimate remained significant after adjustments



# Results

Outcome	Behaviours	ADHS 1998 – OR (95%CI)			ADHS 2009 – OR (95%CI)		
		Model 1 (Unadjusted)	Model 2 (Sex + Marital status)	Model 3 (Model 2 + Education)	Model 1 (Unadjusted)	Model 2 (Sex + Marital status)	Model 3 (Model 2 + Education)
<b>PPD <math>\geq</math>4mm</b>	<b>Toothbrushing frequency</b>						
	Once/less Twice/more	1 0.78 (0.58, 1.05)	1 0.79 (0.58, 1.07)	1 0.85 (0.63, 1.15)	1 0.67 (0.53, 0.83) **	1 0.69 (0.55, 0.86) **	1 0.75 (0.59, 0.93) **
<b>Odds ratio (95%CI)</b>	<b>Dental attendance</b>						
	Non-regular Regular	1 0.73 (0.57, 0.94) *	1 0.75 (0.58, 0.98) *	1 0.78 (0.60, 1.02)	1 0.65 (0.53, 0.79) **	1 0.66 (0.54, 0.81) **	1 0.69 (0.56, 0.85) **

## 9. *Periodontal pocket depth $\geq$ 4mm*

### TB

- 1998 : Non-significant association, and persisted after adjusting for sex, marital status, and education
- 2009 : Those who brushed their teeth twice or more daily had significantly lower odds of PPD $\geq$ 4mm. The magnitude of association remained significant with a modest attenuation

### DA :

- 1998 : Regular dental attendees exhibited lower odds of PPD $\geq$ 4mm in compared to non-regular attendees, which later became non-significant after sex, marital status, and education adjustment
- 2009 : Regular attendees had lower odds of having PPD $\geq$ 4mm in the unadjusted model and the associations remained significant with a slight attenuation

# Discussion

## Findings highlight

- The important role of **twice-daily toothbrushing** and **regular dental attendance** in achieving **better oral health outcomes** among *young to middle-aged adults*
- Protective measures, preventive strategies, essential components of continuous oral care
- Better knowledge of oral health<sup>1</sup>, improved overall oral health<sup>2</sup>, lower Oral Health Impact Profile<sup>3</sup>, and better oral health related quality of life<sup>4</sup>.

Zimmerman et al, (2014); Kumar et al, (2016); Mandal et al, (2017)

Varela-Centelles et al, (2019)<sup>1</sup>; Hadler-Olsen et al, (2021)<sup>2</sup>; Almoznino et al, (2015)<sup>3</sup>; Crocombe et al, (2011)<sup>4</sup>

## Stronger relationship between dental attendance and oral health outcomes

- The pivotal role in reducing the risk of major tooth loss<sup>5</sup>, tooth loss due to caries<sup>6</sup>, and promoting better periodontal health in the long term<sup>7</sup>.

Zimmerman et al, (2014)<sup>5</sup>; Thomson et al, (2010)<sup>6</sup>; Joshi et al, (2017)<sup>7</sup>

- 9 out of 10 British adults expressing satisfaction with the quality of dental care service they receive, affirming the role of regular dental check-ups in preserving oral health

Bedi et al, (2005)

# Discussion

Demographic and education had relatively *modest impact*, if any.

This finding is not aligned with previous literature

Donaldson et al, (2008); Arrica et al, (2017); Leary et al, (2019)

Several explanations :

- The primary behaviours have *a strong and direct* association
- Protective behaviours are *universally adopted* among majority of the study population
- *Unmeasured* confounding factors

Future research should consider exploring sugary intake, water fluoridation, financial barriers to dental care

# Discussion

## *Strength*

- Focused assessment of impacts on among young to middle-aged adults.
- Valuable insights, informing tailored public health strategies
- Methodology : pragmatic approach by utilising available data
- Enabling the identification & comparison of changing patterns of behaviours and oral condition

## *Limitations*

- Cross-sectional design, only association inferences can be tested
- Potential for recall bias & social desirability bias
- A more thorough analysis of other socioeconomic factors, such as income and employment status are beneficial
- Data up to 2009, oral health trends may evolve since then

# Recommendation

- Policymakers → support, promote, and highlight the benefits of preventive behavioural measures for better dental health
- Healthcare professionals → support maintenance of protective behaviours and empower compliance

Michie et al, (2011)

- Clinicians' knowledge of behavioural science : allow automation of good behaviours instead of dictating patients' choice

Asimakopoulou & Daly (2009); Holloway (2021)

# Conclusion

- Positive impact of toothbrushing behaviours and dental attendance in young to middle-aged adults in England
- Dental attendance : stronger associations with better oral health outcomes
- Demographic & SES have modest attenuation and influence on outcomes
- Policymakers, healthcare professionals, and educators → emphasise the importance of oral health promotion & regular attendance
- Further research : barriers to access to care, patient's compliance



# References

- Mandal A, Singh D, Siddiqui H, Das D, Dey A. New dimensions in mechanical plaque control: An overview. *Indian Journal of Dental Sciences*. 2017; 9(2):133.
- Kumar S, Tadakamadla J, Johnson N. Effect of toothbrushing frequency on incidence and increment of dental caries: a systematic review and metaanalysis. *Journal of dental research*. SAGE Publications Sage CA: Los Angeles, CA; 2016; 95(11):1230–6.
- Zimmermann H, Zimmermann N, Hagenfeld D, Veile A, Kim T-S, Becher H. Is frequency of tooth brushing a risk factor for periodontitis? A systematic review and meta-analysis. *Community Dentistry and Oral Epidemiology*. 2014; 43(2):116–27.
- World Health Organisation. Sugars and dental caries. In: World Health Organization [Internet]. 2017 [cited 2024 May 10]. Available from: <https://www.who.int/news-room/factsheets/detail/sugars-and-dental-caries>.
- Chan AKY, Tamrakar M, Jiang CM, Tsang YC, Leung KCM, Chu CH. Clinical evidence for professionally applied fluoride therapy to prevent and arrest dental caries in older adults: A systematic review. *Journal of Dentistry*. 2022; 125:104273.
- Aldossary A, Harrison VE, Bernabé E. Long-term patterns of dental attendance and caries experience among British adults: a retrospective analysis. *European Journal of Oral Sciences*. 2014; 123(1):39–45.
- Public Health England. Adult oral health: applying All Our Health. In: GOV.UK [Internet]. 2022 [cited 2024 May 10]. Available from: <https://www.gov.uk/government/publications/adult-oral-health-applying-all-our-health/adult-oral-health-applying-all-our-health>.
- Singh A, Peres MA, Watt RG. The Relationship between Income and Oral Health: A Critical Review. *Journal of Dental Research*. 2019; 98(8):853–60.
- Guarnizo-Herreño CC, Scholes S, Heilmann A, O’Connor R, Fuller E, Shen J, et al. Dental attendance and behavioural pathways to adult oral health inequalities. *Journal of Epidemiology and Community Health*. 2021; 75(11):1063–9.
- Treasure E, Kelly M, Nuttall N, Nunn J, Bradnock G, White D. Factors associated with oral health: a multivariate analysis of results from the 1998 Adult Dental Health survey. *British Dental Journal*. 2001; 190(2):60–8.
- Aldossary A, Harrison VE, Bernabé E. Long-term patterns of dental attendance and caries experience among British adults: a retrospective analysis. *European Journal of Oral Sciences*. 2014; 123(1):39–45.
- Watt RG, Steele JG, Treasure ET, White DA, Pitts NB, Murray JJ. Adult Dental Health Survey 2009: implications of findings for clinical practice and oral health policy. *British Dental Journal*. 2013; 214(2):71–5.
- Heidari E, Andiappan M, Banerjee A, Newton JT. The oral health of individuals with dental phobia: a multivariate analysis of the Adult Dental Health Survey, 2009. *British Dental Journal*. 2017; 222(8):595–604.
- Lee J-H, Shin Y-J, Lee J-H, Kim H-D. Association of toothbrushing and proximal cleaning with periodontal health among Korean adults: Results from Korea National Health and Nutrition Examination Survey in year 2010 and 2012. *Journal of Clinical Periodontology*. 2018; 45(3):322–35.
- Hadler-Olsen E, Jönsson B. Oral health and use of dental services in different stages of adulthood in Norway: a cross-sectional study. *BMC Oral Health*. 2021; 21(1).

# References

- Petersen PE, Peng B, Tai BJ. Oral health status and oral health behaviour of middle-aged and elderly people in PR China. *International Dental Journal*. 1997; 47(6):305–12.
- Brennan DS, Spencer AJ. Life events and oral-health-related quality of life among young adults. *Quality of Life Research*. 2009; 18(5):557–65.
- Hong CL, Thomson WM, Broadbent JM. Oral Health-Related Quality of Life from Young Adulthood to Mid-Life. *Healthcare*. 2023; 11(4):515.
- Åstrøm AN, Wold B. Socio-behavioural predictors of young adults' self-reported oral health: 15 years of follow-up in the The Norwegian Longitudinal Health Behaviour study. *Community Dentistry and Oral Epidemiology*. 2011; 40(3):210–20.
- Al-Zahrani MS, Bissada NF, Borawski EA. Obesity and Periodontal Disease in Young, Middle-Aged, and Older Adults. *Journal of Periodontology*. 2003; 74(5):610–5.
- Wennström A, Wide Boman U, Stenman U, Ahlqwist M, Hakeberg M. Oral health, sense of coherence and dental anxiety among middle-aged women. *Acta Odontologica Scandinavica*. 2012; 71(1):256–62.
- Brennan D, Spencer J, Roberts-Thomson K. Dental knowledge and oral health among middle-aged adults. *Australian and New Zealand Journal of Public Health*. 2010; 34(5):472–5.
- Broadbent JM, Thomson WM, Poulton R. Oral Health Beliefs in Adolescence and Oral Health in Young Adulthood. *Journal of Dental Research [Internet]*. 2006; 85(4):339–43.
- Varela-Centelles P, Diz-Iglesias P, Estany-Gestal A, Blanco-Hortas A, Bugarín-González R, Seoane-Romero JM. Regular dental attendance and periodontal health knowledge: A cross-sectional survey. *Oral Diseases*. 2019; 26(2):419–28
- Almoznino G, Aframian D, Sharav Y, Sheftel Y, Mirzabaev A, Zini A. Lifestyle and dental attendance as predictors of oral health-related quality of life. *Oral Diseases*. 2015; 21(5):659–66
- Crocombe LA, Brennan DS, Slade GD. The influence of dental attendance on change in oral health-related quality of life. *Community Dentistry and Oral Epidemiology*. 2011; 40(1):53–61.
- Thomson WM, Williams SM, Broadbent JM, Poulton R, Locker D. Long-term Dental Visiting Patterns and Adult Oral Health. *Journal of Dental Research*. 2010; 89(3):307–11
- Joshi S, Suominen AL, Knuuttila M, Bernabé E. Toothbrushing behaviour and periodontal pocketing: An 11-year longitudinal study. *Journal of Clinical Periodontology*. 2017; 45(2):196–203
- Bedi R, Gulati N, McGrath C. A study of satisfaction with dental services among adults in the United Kingdom. *British Dental Journal*. 2005; 198(7):433–7.
- Donaldson AN, Everitt B, Newton T, Steele J, Sherriff M, Bower E. The Effects of Social Class and Dental Attendance on Oral Health. *Journal of Dental Research*. 2008; 87(1):60–4.
- Arrica M, Carta G, Cocco F, Grazia Cagetti M, Sale S, Ierardo G, et al. Does a social/behavioural gradient in dental health exist among adults? A cross-sectional study. *Journal of International Medical Research*. 2017; 45(2):451–61.
- Leary SD, Do LG. Changes in oral health behaviours between childhood and adolescence: Findings from a UK cohort study. *Community Dentistry and Oral Epidemiology*. 2019; 47(5):367–73.
- Michie S, Stralen MM van, West R. The Behaviour Change wheel: a New Method for Characterising and Designing Behaviour Change Interventions. *Implementation Science*. 2011; 6(42).
- Asimakopoulou K, Daly B. Adherence in Dental Settings. *Dental Update*. 2009; 36(10):626–30.
- Holloway J. Understanding behaviour change to promote regular dental attendance. *Primary Dental Journal*. 2021; 10(3):55–61.

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## Q&A

