

# Impact of socioeconomic status on children and adolescent's orthodontic treatment; A Systematic Review

Natasha M. Lemasney<sup>1</sup> and Manu R. Mathur<sup>2</sup>

<sup>1</sup>Paediatric Dentistry, Cork University Dental School and Hospital, Ireland; <sup>2</sup>Public Dental Health, Queen Mary University London, UK

**Background:** Good evidence is available that socioeconomic status (SES) positively correlates with access to orthodontic treatment. There is much less literature, however, on whether socioeconomic inequities affect patients once they are in treatment. SES predicts of treatment outcomes across many health disciplines. **Objectives:** To determine whether a similar relationship exists with orthodontic treatment and identify, evaluate and summarise the available evidence. **Methods:** Systematic review with searches of multiple databases to identify studies of children and adolescents who underwent orthodontic treatment, in which parental SES was the variable of interest, and treatment duration, treatment outcome or adherence of patients to the treatment plan were the measured outcomes of interest. Quality appraisal used CASP checklists. Data were synthesised narratively and in tables and graphs. **Results:** Seventeen studies were included in the final review. The high level of heterogeneity between studies made it hard to draw conclusions from the data as a whole. Many studies also had several quality issues. Some evidence suggested an association between low SES and discontinuation of orthodontic treatment, and between the receipt of state subsidised care and poor appointment attendance. **Conclusion:** No strong associations can be concluded. There is a need for more high-quality studies, perhaps incorporating access and uptake variables, to capture how different socioeconomic groups interact with orthodontic care.

**Keywords:** Socioeconomic, Orthodontics, Inequalities

## Introduction

In England, the National Health Service spends approximately £250 million annually on primary care orthodontic services (NHS, 2016). From this, an estimated £11.4 million is wasted on failed orthodontic treatments (Shaw, 2003). Thus, predicting the outcome of orthodontic treatment is of paramount importance. Apart from the clinically measurable treatment outcome, the level of adherence to the treatment plan and the duration of treatment are also important considerations. Poor adherence may predispose patients to treatment discontinuation (Trenouth, 2003), while treatment duration is an important factor in both patient satisfaction and cost (Pachêco-Pereira *et al.*, 2015).

Most of the literature investigating predictors of the course and outcome of orthodontic treatment focuses on clinical factors such as malocclusion severity, appliance types and clinician qualification (Mavreas and Athanasiou, 2008; Rooney *et al.*, 2016; Stefanovic *et al.*, 2021). Socio-economic status (SES) is also a predictor across many health disciplines. Cohort studies of children with leukaemia from Greece (Sergentanis *et al.*, 2013) and the USA (Kent *et al.*, 2009) found that children from lower SES groups face worse survival rates than their peers from higher SES groups. Similarly, low SES predicts poorer quality of life for children with chronic diseases, such as asthma, diabetes and epilepsy (Didsbury *et al.*, 2016). The association between SES and oral health is also well documented, with higher SES associated with better oral health and greater access to dental care (Bernabé *et al.*, 2009).

There is extensive literature examining the association between SES and access to orthodontic care. These variables are positively correlated, with Ulhaq *et al.* (2012), finding that patients from the least deprived areas are nearly twice as likely to receive orthodontic treatment as those from the most deprived areas. Less literature, however, looks at how socioeconomic inequities affect patients once they are in treatment, whether intra-treatment or posttreatment variables. Patients of lower SES face additional barriers to care; provider biases, poorer health literacy and reduced family support, which may amalgamate to impact the course and outcome of orthodontic treatment (Arpey *et al.*, 2017).

This systematic review aims to determine whether there is a relationship between parental SES and children and adolescents' orthodontic treatment, focusing on the duration and outcome of treatment and adherence to treatment plans.

## Methods

A protocol was developed utilising the PRISMA-P checklist (Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols) (Shamseer *et al.*, 2015).

The search strategy was developed with the assistance of a librarian. Relevant databases were identified; Cochrane Library, MEDLINE Ovid, Embase Ovid, Scopus, Evidence Search and Web of Science. A focused search strategy was developed for each database (Appendix 1.). The U.S. Institutes of Health Ongoing Trials Register and World Health Organization International Clinical Trials Registry

were also searched. Grey literature was identified through a Google search, along with a search of the International Association for Dental Research's conference abstract archive and a search of a dissertation database, Open Access Theses and Dissertations. The search took place between 27/11/2021 and 03/01/2022. Titles of all retrieved sources were screened to identify those potentially eligible. Abstracts of all remaining sources were read, and the full texts of any potentially relevant were read and screened against the eligibility criteria. In cases where there was difficulty obtaining the complete text, authors were contacted. A reason for exclusion was noted for all excluded studies. A snowball search included potentially relevant literature identified in the bibliographies of the sources. Citation searching was also carried out on any included studies. Any duplicates were then removed.

The inclusion criteria are outlined in Table 1. Randomised controlled trials were not considered as they would not answer the research questions. Only literature published from 1972 onwards was included in the review. This is based on the year of invention of the indirectly bonded edgewise orthodontic brackets, the modern fixed orthodontic appliance (Peck, 2009).

Data extraction was guided by Centre for Reviews and Dissemination's (2008) Guidance for Undertaking Reviews

in Healthcare. The following data were gathered: Publication Year, Country of Origin, Type of Publication, Source of Funding, Aim/Objective of Study, Study Design, Inclusion/Exclusion Criteria, Recruitment Procedures, Length of Study, Number of Participants Enrolled, Number of Participants Lost to Follow-Up, Number of Participants Included in Analysis, Age, Gender and Ethnicity of Population, Type of Malocclusion, Co-Morbidities, Type of Orthodontic Treatment, Setting of Orthodontic Treatment, Treatment Provider Type, Measure of Parental SES and Indices Used, Other Exposures Measured, Target Outcome/Outcomes Measured, Measurement Tool and Indices Used, Statistical Techniques Used, Point in Treatment that Outcome is Measured, Summary of Results, Quality. Data extraction was managed via Microsoft Excel.

Risk of bias was assessed using the ROBINS – I tool, while the methodological quality of all included studies was assessed utilising the Critical Appraisal Skills Program checklist for the relevant study type (CASP, 2018 and Stern *et al.*, 2016).

Data were synthesised narratively and in tables and graphs. Statistical assessment of heterogeneity and quantitative synthesis were not appropriate due to the heterogeneity of the sources. The impact of heterogeneity was assessed narratively.

**Table 1.** Selection Criteria.

<i>Criteria</i>	<i>Included</i>	<i>Excluded</i>
<b>Study Profile</b>		
Publication status	Published and unpublished literature	
Study Type	Case-control studies, cohort studies, cross-sectional surveys and systematic reviews	Randomised control trials, case reports, case series and expert opinions.
Country of Origin	All	
Language	English	Non-English language studies
Publication Date	1972 onwards	Pre 1972
<b>Population Profile</b>		
Age	Children and adolescents (<20 years)	Adults
<b>Intervention Profile</b>		
Treatment type	Orthodontic treatment for the treatment of malocclusion	Treatment involving orthognathic surgery, Treatment involved in the management of cleft lip and palate
Treatment Setting	Hospital and community settings	
<b>Profile of Prognostic Factors</b>		
Type of Prognostic Factors	Parental SES. May be represented by; income, education, occupation, home location, practice location, school location, type of school attended, receipt of welfare and self-reported SES.	Studies where parental SES is not a variable
<b>Profile of Outcomes</b>		
Type of Outcomes	Treatment Outcome; Measures of malocclusion severity; Index of Orthodontic Treatment Need (IOTN), Peer Assessment Rating (PAR) and Index of Complexity, Outcome and Need (ICON) scores, patient or parental post-treatment satisfaction and treatment completion Treatment Duration; Patient Adherence to the Treatment Plan; (number of appointments needed, relapse, number of missed appointments, number of lost or broken appliances, adherence to appliance wear and oral hygiene)	Pre-treatment factors, e.g. Access.

## Results

As seen in Figure 1, 1,042 unique studies were screened, of which 204 were read in full. Twenty were not available in English, with a further four not available in full. The remaining excluded studies did not meet the inclusion criteria.

Of seventeen included studies, seven came from the USA and seven from the U.K, with Canada, Denmark and Croatia responsible for one study each. Publication dates ranged from 1982 to 2020. Two studies were cross-sectional and fifteen were cohort studies. There were seven prospective cohort studies, with follow-up periods ranging from five to eighty months. Samples ranged from 41 to

24,501 participants. Nine studies considered treatment outcomes, three considered treatment adherence, one treatment duration, three studied both treatment outcome and adherence and one considered both treatment duration and adherence (Table 2).

Three studies found that patients receiving state-subsidised treatment were more likely to have missed appointments than privately paying patients. For example, Maribelli et al. (2005) found that state-subsidised patients missed nearly twice as many appointments as privately paying patients. Similar results were found by Bukhari et al. (2016) and Wilson and Harris. (2015). However, Dickens et al. (2008) found that attendance histories were similar in state-subsidised and privately paying

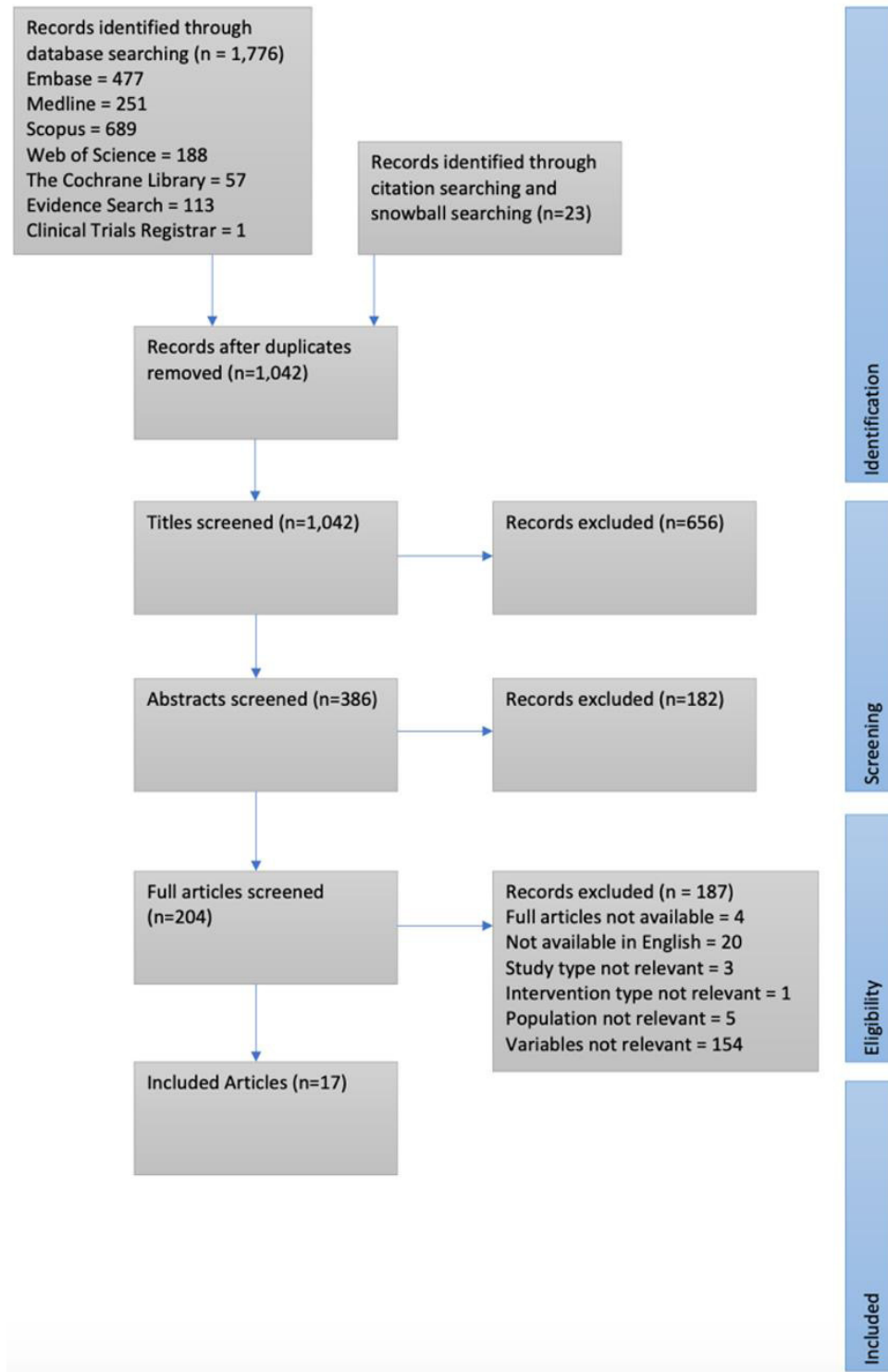


Figure 1. PRISMA diagram.

**Table 2.** Summary of Included Studies.

<i>Reference</i>	<i>Country</i>	<i>Outcome Studied</i>	<i>Measure of SES</i>	<i>Measure of Target Outcome</i>	<i>Summary of Results</i>
Al-Jewair et al. (2011)	Canada	Treatment Plan Adherence	Annual household income, parental education level	Oral hygiene	Adherence predicted by having married parents and good school performance in multiple regression
Bukhari et al. (2016)	USA	Treatment Plan Adherence	Medicaid eligibility	Attendance history	Being female and good oral hygiene predicted good attendance. Poorer attendance predicted by longer treatment, being African American and Medicaid eligibility
Dickens et al. (2008)	USA	Treatment Outcome Treatment Plan Adherence	Medicaid eligibility	Change in malocclusion severity (PAR Index) Attendance history, appliance wear, oral hygiene	Similar reductions in PAR and similar numbers of broken appointments, broken appliances or poor oral hygiene comments across groups.
Dobbs et al. (2014)	USA	Treatment Plan Adherence	Medicaid eligibility	Attendance history, appliance wear, oral hygiene	No differences in attendance or adherence related to Medicaid eligibility.
Joury et al. (2011)	UK	Treatment Outcome	Parental class (Standard Occupations Classification), parental education, parental employment status	Change in malocclusion severity (ICON score)	Greater improvement in occlusion in adolescents with high maternal or household social class. Ethnicity, adherence, malocclusion severity/ treatment complexity, type of anterior malocclusion, and clinician skills also predicted improvement.
King et al. (2011)	USA	Treatment Outcome	Medicaid eligibility	Change in malocclusion severity (PAR Index, ICON score)	Similar malocclusion severity after treatment across groups. More privately paying than Medicaid patients completed treatments in 2 years.
Mandall et al. (2008)	UK	Treatment Outcome Treatment Plan Adherence	Postcode of patient's home (Townsend's deprivation score)	Completion vs. failure to complete treatment Attendance history, appliance wear	SES not associated with completion of orthodontic treatment, number of appliance breakages or number of failed/ cancelled appointments.
Maribelli et al. (2005)	USA	Treatment Outcome Treatment Plan Adherence	Medicaid eligibility	Change in malocclusion severity (PAR Index, ICON score) Attendance history, appliance wear, oral hygiene	Medicaid not associated with pretreatment or post treatment PAR or ICON scores. More missed appointments and oral hygiene poorer in the Medicaid group. Adherence with attendance or wearing appliances, and hygiene not associated with PAR improvement.
Martin et al. (2017)	USA	Treatment Outcome	Medicaid and/or CHIP eligibility	Completion vs. failure to complete treatment	Self-pay patients had treatment completion rates that were twice that of Medicaid, CHIP and privately insured patients. Age, gender and distance travelled to the dental clinic did not affect completion rates.
McDougall et al. (2017)	UK	Treatment Outcome	Patients home address (Index of Multiple Deprivation)	Completion vs. failure to complete treatment	Higher failure rates were recorded for IMD 4 and 5. The most successful treatment group was the middle ranking IMD 3.
Nakhleh et al. (2020)	UK	Treatment Duration	Parental class (Standard Occupations Classification), parental education, parental employment status	Days wearing fixed appliance	Parental occupation, education or employment status not related to treatment duration.

**Table 2.** Continued overleaf.

**Table 2.** Summary of Included Studies continued.

Price et al. (2017)	UK	Treatment Outcome	Patient address (Index of Multiple Deprivation)	Completion vs. failure to complete treatment Residual need rates	Discontinuation more likely with lower SES after adjusting for confounding. Residual need among patients among lower SES patients who completed treatment. No association between SES and residual need in those who completed treatment.
Rölling (1982)	Denmark	Treatment Outcome	Parental occupation/ education	Completion vs. failure to complete treatment	Children from low and lower middle social groups were more likely to discontinue treatment
Turbill et al. (1999)	UK	Treatment Outcome	Postcode patient home and practice (percentage manual workers)	Change in malocclusion severity (PAR Index)	Practices in more “manual class areas” had higher finishing PAR scores. Differences in post-treatment were small and of limited clinical relevance.
Turbill et al. (2003)	UK	Treatment Outcome	Patient and practice address, parental occupation (Registrar General’s social class groupings, Carstairs Index score of area, Jarman Underprivileged Area Index Score, Townsend Material Deprivation Index Score)	Completion vs. failure to complete treatment	Discontinuation associated with lower SES background, but with low predictive power.
Unpublished	Croatia	Treatment Outcome	Unclear	Change in malocclusion severity	Unknown
Wilson et al. (2015)	USA	Treatment Duration Treatment Plan Adherence	Medicaid eligibility	Months wearing fixed appliance, Completion of treatment, numbers of appointments, appointments missed, lost brackets and broken appliances	Medicaid eligibility predicted longer treatment, poor attendance, discontinuation of treatment and extraction of teeth.

patients. The small sample for this study and case selection by treatment providers may have reduced power and introduced sampling bias. However, these findings are in keeping with a high-quality U.K. study (Mandall *et al.*, 2008), which used Townsend’s Deprivation Score to indicate SES when looking at predictors of appointment attendance and found no association.

Maribelli *et al.* (2005) was the only study to associate attending state-subsidised schools with poor oral hygiene. Conversely, neither Dobbs *et al.* (2015) nor Dickens *et al.* (2008) found differences in oral hygiene between state-subsidised and privately paying cohorts. Furthermore, Al-Jewair *et al.* (2011) failed to find an association between household income and oral hygiene.

Nakleh *et al.* (2020) found no association between SES and treatment duration. SES was measured via parental occupation, education and employment status and dichotomised into high and low SES groups. This might have masked differences if treatment duration increased on both ends of the class spectrum, as was seen with treatment outcome in McDougall *et al.* (2017). Conversely, Wilson and Harris (2015) found that state-subsidised patients experienced longer treatment than privately paying patients (mean of 29 vs 25 months), even when controlling for malocclusion severity. This study met fewer of the criteria on the CASP checklist than the previous study, including a poor outline of the recruitment process.

Five studies examined treatment completion rates, four of which found low SES predicted treatment discontinuation. Price *et al.*’s (2017) large retrospective study, found that those in the most deprived Index of Multiple Deprivation (IMD) quintile were more likely to have treatment discontinued and to finish treatment with residual treatment needs than those in the least deprived quintile. These results are in keeping with Turbill *et al.* (2003), Rölling (1982) and McDougall *et al.* (2017). Mandall *et al.* (2008) also found that patients living in more deprived areas were less likely to complete treatment than those in affluent areas; however, this difference was not statistically significant. These studies used patient postcodes to indicate SES. IMD can lead to misclassification in diverse areas, which may have masked differences.

Treatment outcome was also determined using measures of the change in malocclusion severity using PAR and ICON scores. No association was demonstrated between PAR scores and SES. King *et al.* (2011), Maribelli *et al.* (2005) and Dickens *et al.* (2007) used eligibility for state-subsidised treatment as a measure of parental SES, while Turbill *et al.* (1999) used patient and practice postcodes. Two of the studies involving state-subsidised patients were carried out in a teaching clinic with reduced fees for private patients. This may have led to misclassification of SES, as low SES patients may have opted to pay for private treatment.

King et al. (2011) and Maribelli et al. (2005) also found similar ICON scores in high and low SES cohorts. One further study, Joury et al. (2011) used parental occupation, education and employment status to measure SES, of which only high SES maternal and household occupation were associated with improved ICON scores.

Only four studies; Joury et al. (2011), Mandall et al. (2008), Maribelli et al. (2005) and Turbill et al. (1999) had low risk of bias (Table 3). The quality of many of the included studies was in question (Table 4.). Recurring themes include; failure to take confounding variables into account, providers assessing treatment outcomes, small samples and poor accounts of methods making it difficult to assess quality.

### Discussion

The heterogeneity between studies prevented data synthesis. Differences stemmed from the metrics used for SES and the study outcomes, the country's health system and the role of state-subsidy. Thus, clear links between parental SES and children's orthodontic treatment were not established.

The quality of many included studies was questionable. The failure to consider confounding variables, particularly malocclusion severity is relevant, as prioritising in countries with state-subsidised treatment means lower SES patients will often have more severe malocclusions than private, higher SES patients. Overall, the quality of the cohort studies was better than the cross-sectional surveys. Geographical differences were also found, with one European country producing most of high-quality studies and no studies being produced from low- or middle-income countries. As the research questions of this review remain unanswered future studies could be conducted in these countries.

There was some evidence of association between eligibility for state-subsidised treatment and poorer appointment attendance. This may be due to inequities in treatment access or may be confounded by treatment complexity, as noted above. With only a minority of orthodontists accepting state subsidised treatment, such patients may face longer distances to appointments (Mandall *et al.*, 2008; Maribelli *et al.*, 2005). There may also be cognitive dissonance (Cameron, 2009) if subsidised patients and their parents are not investing their own money in treatment,

**Table 3.** Risk of Bias Assessment – ROBINS – I Tool.

	<i>Confounding</i>	<i>Selection</i>	<i>Measurement of Intervention</i>	<i>Missing Data</i>	<i>Measurement of Outcomes</i>	<i>Reported Result</i>	<i>Overall</i>
Al-Jewair et al. (2011)	Low	Serious	Serious	Low	Serious	Moderate	Serious
Bukhari et al. (2016)	Moderate	Can't Tell	Can't Tell	Low	Can't Tell	Low	Can't Tell
Dickens et al. (2008)	Moderate	Critical	Low	Moderate	Low	Moderate	Critical
Dobbs et al. (2014)	Moderate	Low	Moderate	Low	Moderate	Low	Moderate
Joury et al. (2011)	Low	Low	Low	Low	Low	Low	Low
King et al. (2011)	Low	Serious	Low	Low	Moderate	Low	Serious
Mandall et al. (2008)	Low	Low	Low	Low	Low	Low	Low
Maribelli et al. (2005)	Moderate	Low	Low	Low	Low	Low	Low
Martin et al. (2017)	Moderate	Serious	Moderate	Low	Serious	Moderate	Serious
McDougall et al. (2017)	Moderate	Can't Tell	Can't Tell	Low	Can't Tell	Low	Can't Tell
Nakhleh et al. (2020)	Serious	Low	Low	Low	Low	Low	Serious
Price et al. (2017)	Low	Low	Low	Moderate	Low	Low	Moderate
Röling (1982)	Moderate	Serious	Serious	Low	Critical	Serious	Critical
Turbill et al. (1999)	Low	Low	Low	Low	Low	Low	Low
Turbill et al. (2003)	Low	Low	Low	Moderate	Low	Low	Moderate
Wilson et al. (2015)	Low	Can't Tell	Can't Tell	Low	Can't Tell	Low	Can't Tell

**Table 4.** Critical Appraisal – Summary of CASP Checklists.

Cohort and Case Control Studies											
Title	Clearly focused issue?	Cohort recruited acceptably?	Exposure accurately measured?	Outcome accurately measured?	Identified all important cofounders?	Taken account of cofounders?	Was follow up complete enough?	Was follow up long enough?	Do you believe the results?	Applied to local population?	Results fit with other evidence?
Al-Jewair et al. (2011)	Yes	Can't Tell	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes
Dickens et al. (2008)	Yes	No	Yes	No	No	No	Yes	Yes	No	Can't Tell	Yes
Dobbs et al. (2014)	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes
Joury et al. (2011)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes
King et al. (2011)	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
Mandall et al. (2008)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maribelli et al. (2005)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Martin et al. (2017)	Yes	No	Yes	Yes	No.	Yes	Yes	Yes	No	No	Yes
McDougall et al. (2017)	Yes	Can't Tell.	Yes	Can't Tell	No	Yes	Yes	Yes	Yes	Yes	Yes
Nakhleh et al. (2020)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Price et al. (2017)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Turbill et al. (1999)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Turbill et al. (2003)	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Wilson et al. (2015)	Yes	Can't Tell	Yes	Yes	Can't Tell	Can't Tell	Yes	Yes	Yes	Can't Tell	Yes

Qualitative Studies

Title	Clear statement of aims?	Method appropriate?	Design appropriate?	Recruitment appropriate?	Data collection addressed issue?	Researcher-participant relationship considered?	Ethical issues considered?	Analysis sufficiently rigorous?	Clear statement of findings?
Bukhari et al. (2016)	Yes	Yes	Can't Tell	Yes	Yes	Can't Tell	Can't Tell	No	Yes
Rölling (1982)	Yes	Yes	Can't tell	Yes	Can't tell	No	Can't Tell	No	No

value it less and are less motivated to attend appointments. This could explain why SES disparities were not found when Mandall et al. (2008) studied NHS treatment, as both SES cohorts received state-funded care.

Eligibility for state-subsidised treatment may also predict longer treatment duration (Wilson and Harris, 2015). The role of malocclusion severity and attendance history in treatment duration would need to be considered however, before drawing conclusions. Conversely, the observation that poor attendance and prolonged treatment are solely linked to the receipt of state-subsidized treatment,

rather than other indices of socioeconomic status, may be due to using employing eligibility for state-subsidized treatment as a proxy for SES. This proxy often lacks a direct correlation with family income (Schechter *et al.*, 2001). Specifically, in the Medicaid system in the United States, medical expenses are subtracted from income to determine eligibility, thereby rendering both sicker and poorer patients eligible (United States Government, 2022). This could be manifested in attendance history if patients with a complicated medical history are burdened with multiple healthcare obligations to balance.

As discussed, there is evidence that lower SES is associated with higher rates of treatment discontinuation. Only Mandall et al. (2008) recorded reasons for discontinuation, where poor attendance (43%), followed by poor oral hygiene (31%), were the most common reasons. A link between low SES and poor appointment attendance has already been demonstrated. Stormacq et al. (2019) found that SES is also the most important determinant of health literacy, which could impact both a patient's attendance and oral hygiene.

Discontinued cases may not represent a complete failure in treatment, as some improvement in malocclusion may still have occurred. Excluding discontinued cases may bias data if more cases from lower SES groups fail to complete treatment. Of the five studies looking at treatment outcome, three were retrospective, which only sampled completed cases. In a prospective study, King et al. (2011) did not outline whether any data was lost to follow-up and, if so, how this was dealt with. Joury et al. (2011), another prospective cohort study, excluded discontinued cases from the data.

Another reason for failure to find associations may lie in the selection of patients for orthodontic treatment, with patients selected based on lower disease risk and the likelihood of adherence to treatment. This restriction of patients might mask any differences in the study outcomes between socio-economic groups.

As with all research, this study had some limitations. The grey literature and clinical trial database searches may have missed sources. All the records were from high-income countries, overwhelmingly from the U.K. and US. While this may result from the limitation of the search strategy to English language studies, it may also highlight differences in the provision of orthodontic treatment or gaps in the evidence, where more research is needed.

In conclusion, we found no strong evidence that parental SES can be used to predict the course of a child's orthodontic treatment. There is a need for more studies, perhaps incorporating access variables, to provide a comprehensive account of how different socioeconomic groups interact with orthodontic care. High-quality prospective cohort studies could yield stronger evidence of causality. Furthermore, research is needed from low- and middle-income countries. Studies involving a broader range of public, private, and semi-private healthcare services are also needed.

### Declarations of Interest

There was no financial support provided for this research, nor do the authors have any conflicts of interest to declare. The authors confirm that the data supporting the findings of this review are available within the article and its supplementary material.

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## Appendix 1. Search Syntax

### *Medline*

1. (child\* OR adolescent\* OR teen\* OR youth\*). ti,ab
2. Child. MeSH
3. Adolescent. MeSH
4. (orthodontic\* OR "fixed appliance\*" OR fixed-appliance\* OR "removable appliance\*" OR removable-appliance\*).ti,ab.
5. Orthodontics. MeSH
6. (socio-economic OR socioeconomic OR income\* OR education OR occupation\* OR "social status" OR "SES" OR inequalit\* OR equity OR Medicaid OR "state subsidised" OR "free school meal\*" OR deprivation). ti,ab.
7. Social Class. MeSH

(outcome\* OR duration OR "IOTN" OR "index of orthodontic treatment need" OR "PAR" OR "peer assessment rating" OR "satisfaction" OR "treatment time" OR "number of appointments" OR relapse OR "residual need" OR "cessation of treatment" OR compliance OR "missed appointments" OR "appliance use" OR "appliance breakage" OR "oral hygiene")

8. Treatment Outcome. Mesh
9. Duration of Therapy. MeSH
10. Treatment Adherence and Compliance. MeSH
11. 1 OR 2 OR 3
12. 4 OR 5
13. 6 OR 7
14. 8 OR 9 OR 10 OR 11
15. 12 AND 13 AND 14 AND 15

### *SCOPUS*

( TITLE-ABS-KEY ( child\* OR adolescent\* OR teen\* OR youth\* ) AND TITLE ABS-KEY ( orthodontic\* OR "fixed appliance\*" OR fixed-appliance\* OR "removable appliance\*" OR removable-appliance\* ) AND TITLE-ABS-KEY ( socio-economic OR socioeconomic OR income\* OR education OR occupation\* OR "social status" OR "SES" OR inequalit\* OR equity OR medicaid OR "state subsidised" OR "free school meal\*" OR deprivation ) AND TITLE-ABS-KEY ( outcome\* OR duration OR "IOTN" OR "index of orthodontic treatment need" OR "PAR" OR "peer assessment rating" OR "satisfaction" OR "treatment time" OR "number of appointments" OR relapse OR "residual need" OR "cessation of treatment" OR compliance OR "missed appointments" OR "appliance use" OR "appliance breakage" OR "oral hygiene" ) )

### *Web of Science*

1. TS=(child\* OR adolescent\* OR teen\* OR youth\*)
2. TS=(orthodontic\* OR appliance\*)
3. TS=((socio-economic OR socioeconomic OR income\* OR education OR occupation\* OR "social status" OR "SES" OR inequalit\* OR equity OR Medicaid OR "state subsidised" OR "free school meal\*" OR deprivation))
4. TS=((outcome\* OR duration OR "IOTN" OR "index of orthodontic treatment need" OR "PAR" OR "peer assessment rating" OR "satisfaction" OR "treatment time" OR "number of appointments" OR relapse OR "residual need" OR "cessation of treatment" OR compliance OR "missed appointments" OR "appliance use" OR "appliance breakage" OR "oral hygiene"))
5. (((#1) AND #2) AND #3) AND #4

### *Embase*

1. child\*:ab,ti OR adolescent\*:ab,ti OR teen\*:ab,ti OR youth\*:ab,ti OR 'child'/exp OR 'adolescent'/exp
2. orthodontic\*:ab,ti OR appliance\*:ab,ti OR 'orthodontics'/exp
3. 'socio economic':ab,ti OR socioeconomic:ab,ti OR income\*:ab,ti OR education:ab,ti OR occupation\*:ab,ti OR 'social status':ab,ti OR ses:ab,ti OR inequalit\*:ab,ti OR equity:ab,ti OR medicaid:ab,ti OR 'state subsidised':ab,ti OR 'free school meal\*':ab,ti OR deprivation:ab,ti OR 'social status'/exp
4. outcome\*:ab,ti OR duration:ab,ti OR iotn:ab,ti OR 'index of orthodontic treatment need':ab,ti OR par:ab,ti OR 'peer assessment rating':ab,ti OR satisfaction:ab,ti OR 'treatment time':ab,ti OR 'number of appointments':ab,ti OR relapse:ab,ti OR 'residual need':ab,ti OR 'cessation of treatment':ab,ti OR compliance:ab,ti OR 'missed appointments':ab,ti OR 'appliance use':ab,ti OR 'appliance breakage':ab,ti OR 'oral hygiene':ab,ti OR 'treatment outcome'/exp OR 'treatment duration'/exp OR 'patient attitude'/exp
5. #1 AND #2 AND #3 AND #4

### *Cochrane Library*

(child\* OR adolescent\* OR teen\* OR youth\*):ti,ab,kw AND (orthodontic\* OR "fixed appliance\*" OR fixed-appliance\* OR "removable appliance\*" OR removable-appliance\*):ti,ab,kw AND (socio-economic OR socioeconomic OR income\* OR education OR occupation\* OR "social status" OR "SES" OR inequalit\* OR equity OR Medicaid OR "state subsidised" OR "free school meal\*" OR deprivation):ti,ab,kw AND (outcome\* OR duration OR "IOTN" OR "index of orthodontic treatment need" OR "PAR" OR "peer assessment rating" OR "satisfaction" OR "treatment time" OR "number of appointments" OR relapse OR "residual need" OR "cessation of treatment" OR compliance OR "missed appointments" OR "appliance use" OR "appliance breakage" OR "oral hygiene"):ti,ab,kw

### *Evidence Search*

(child\* OR adolescent\* OR teen\* OR youth\*) AND (orthodontic\* OR appliance\* OR fixed-appliance\* OR removable appliance\*" OR removable-appliance\*) AND (socio-economic OR socioeconomic OR income\* OR education OR occupation\* OR "social status" OR "SES" OR inequalit\* OR equity OR Medicaid OR "state subsidised" OR "free school meal\*" OR deprivation) AND (outcome\* OR duration OR "IOTN" OR "index of orthodontic treatment need" OR "PAR" OR "peer assessment rating" OR "satisfaction" OR "treatment time" OR "number of appointments" OR relapse OR "residual need" OR "cessation of treatment" OR compliance OR "missed appointments" OR "appliance use" OR "appliance breakage" OR "oral hygiene")