



Socioeconomic burden of orthodontic treatment: a systematic review

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Abstract

Objective. The relationship between Socio-Economic Status (SES) and the factors that may play a role in orthodontic treatment demand and uptake have not been explored. Such information is needed for better planning of orthodontic services and to ensure that health care is provided equally among all social classes. The objective of this systematic review was to find out whether socioeconomic status affects the treatment needs of orthodontic patients.

Methods. Literature search was done using Medical Subject Heading terms (MeSH) in PubMed, LIVIVO, Google Scholar, and EbscoHost from 1 January 1965 to 1 August 2021. All cross-sectional studies were included. Both male and female participants were included in the review. The quality of assessment for the included studies was evaluated independently by two reviewers using “The Jonna Briggs Institute” tool (JBI) for cross-section studies. The Cochrane Collaboration’s tool was modified and used for assessing the risk of bias and risk of summary.

Results. A total of 704 articles were found. The relevant database searches were PubMed 259 articles, followed by EbscoHost 280, LIVIVO 145, and Google Scholar 20 articles. A final of 10 cross-sectional studies were included in the review.

Conclusion. The reviewers found evidence that parents ultimately decide whether the child will undergo treatment, possibly depending on their financial situation.

Keywords: orthodontic treatment, social burden, economic burden, treatment needs

Introduction

According to The Office of Disease Prevention and Health (ODPHP) [1], “A range of personal, social, economic, and environmental factors that influence health status are known as determinants of health” [1]. Each of these health determinants is known to play a crucial and individual role in influencing health. For example, social determinants of health involve economic, cultural, ethnic, psychological, and behavioral aspects of health. These broad terms are further subcategories into income, work, education, transport, leisure, and housing [2]. These factors may lead to injustice in health and are known as one of the primary social inequality markers in the distribution and occurrence of

diseases [3].

Determinants of health extend beyond the boundaries and control of traditional medicinal healthcare and the public health system. Whether people are healthy is mostly determined by their circumstances and environment. To a large extent, other factors such as where we live, the state of our environment, genetics, and our relationships with friends and family all also have considerable impacts on health. Whereas, the more commonly considered factors such as access and use of health care services often have an insignificant impact [4]. However, improving the inter- and intra-relationship between determinants and their subcategories can help improve individual and population health [1].

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Dental diseases, despite being largely preventable, remain a major roadblock in public health problems across the world. Dental caries, periodontal diseases, and oral cancers are the main oral diseases that are highly prevalent chronic conditions that have a significant negative impact on life. Despite significant improvements in the average oral health status in many countries [5], the burden of oral health diseases is not equally shared within societies. These problems with oral health disproportionately affect poor and other disadvantaged populations. In recent decades, owing to advancements in dentistry a significant overall improvement in dental conditions has occurred in both high- and middle-income countries. However, oral diseases are expensive to treat and the costs of dental treatment are considerably high to both the individuals affected and the sponsored healthcare system bearing it. In many low-income countries, dental disparities levels appear to be increasingly linked to educational, economic development, and socioeconomic burdens of the society, leading to the emergence of oral health inequalities in various strata of the population.

During the past decade, the field of orthodontics has greatly evolved regarding the use of esthetic treatments and use of esthetic materials. Nowadays, orthodontic brackets are becoming smaller and more discrete; esthetical appliances represent an alternative for patients who are reluctant to use metallic appliances. Orthodontic appliances have evolved according to public demand and available technology, especially with the underlying goal of reducing the appliances' visibility [6]. Despite this, rates of untreated malocclusion remain high among children and adults who are socially disadvantaged, resulting in a substantial oral health burden [7]. Owing to social and economic disparities, these individuals have limited access to orthodontic services not only because of their families' competing needs for limited resources but also because of the limited availability of orthodontists in their communities. Moreover, orthodontic procedures are not included in dental insurance plans, resulting in people with low financial status failing to avail such facilities.

The main reason for which people pursue orthodontic management is to enhance their dental esthetics. Self-perception of dental esthetics has been found to vary between subjects from rural and urban areas; those from rural areas, for instance, are more tolerant to the presence of malocclusion [8]. Although a correlation between subjective and objective assessment of esthetics has been reported, laypeople tend to underestimate their own esthetic needs [9]. It is not clear whether dissatisfaction with dental appearance is influenced by SES. The relationship between SES and the factors that may play a role in treatment demand and uptake has not been explored. Such information is needed for better planning of orthodontic services and to ensure that health care is provided equally among all social classes. Thus, we planned this review intending to find out

whether socioeconomic status affects the treatment needs of orthodontic patients.

Methods

Protocol and registration

The present systematic review was registered at the National Institute for Health Research PROSPERO International Prospective Register of Systematic Reviews as a Non-Cochrane review.

Registration number: CRD42021277171

The search protocol is designed based on the PRISMA (Preferred Reporting Items for Systematic Reviews and meta-analysis) guidelines 2009.

Formulating the review question

The research question was set following the PICO format (Population/ Sample characters, Intervention, Comparison, and Outcome) and is described in detail in table I.

Table I. Selection criteria applied for this review - PICO-S format.

PICO Model

Population/ Sample Characters	Patients undergoing orthodontic treatment
Intervention	Orthodontic treatment
Comparison	N.A
Outcome	Social and Economic factors

Research question

Does the socioeconomic status of a person affect the utilization of orthodontic treatment?

INCLUSION CRITERIA

1. Peer-reviewed scientific journals from 1965 to 2021
2. Full articles in English were included
3. Descriptive cross-sectional studies
4. Studies including both genders. Age groups from 8-15 years were included
5. Knowledge attitude and practice (KAP) studies including any information on SES of the mentioned group.
6. Articles relieving information on patients attending with at least one parent were included in the study.
7. All articles stating patients and parents willingness to disclose all the information were included

EXCLUSION CRITERIA

1. Articles with incomplete data were excluded
2. Case reports, case series, randomized control trials, reviews and abstracts
3. Articles in other language than English.
4. Articles on quality of life
5. Studies containing information other than socioeconomic status or economic burden
6. Patients whose parents had received orthodontic treatment were also excluded.

Criteria for considering studies for this review

Type of studies, participants/sample characters

All cross-sectional studies were included. Male and female participants were included in the review. The age group was set from 8 to 15 years. All the studies that were in accordance with the set inclusion and exclusion criteria were included.

A strict criterion was followed only to include studies with direct or indirect mention of SES or which studied the burden of orthodontic treatment. Articles comparing or including Quality of life or Quality-adjusted life-years were excluded.

Types of outcome measures

Primary outcomes

To evaluate the financial burden on patients undergoing orthodontic treatment.

Search methods for identification of studies

Electronic databases like EbscoHost, Cochrane Library, LIVIVO, PubMed, and Google Scholar were searched. Based on the inclusion and exclusion criteria, 2 reviewers were independently assigned to demarcate relevant articles. Any disagreement was discussed until a consensus was reached amongst them.

Using the PICO-formatted question, methodological Medical Subject Heading (MeSH) terms were generated to make the search strategy more sensitive in the identification of studies.

In addition, various keywords were identified and were used in combination with MeSH terms to avoid missing out on articles. These strategies were revised appropriately for each database. The search strategy was used in a combination of controlled vocabulary and free text terms and was linked with the Cochrane Highly Sensitive Search Strategy (CHSSS) for identifying studies.

The following Concepts were used to identify the MeSH terms:

- Concept 1: Financial Burden
- Concept 2: Socioeconomic burden
- Concept 3: Education
- Concept 4: Orthodontic treatment

The following bibliographic databases and trials registers were searched:

1. Livivo database search strategy (1 January 1965 to 1 August 2021)
 - #1 Socioeconomic
 - #2 “Income”[Mesh]
 - #3 “Educational Status”[Mesh]
 - #4 “orthodontic treatment”
 - #5 #1 AND #2 AND #3
2. PubMed search strategy (1 January 1965 to 1 August 2021)
 - #1 Socioeconomic

- #2 “Income”[Mesh]
- #3 “Educational Status”[Mesh]
- #4 “Orthodontic treatment”
- #5 #1 AND #2 AND #3

3. EbscoHost(1 January 1965 to 1 August 2021)
 - #1 Socioeconomic
 - #2 “Income”[Mesh]
 - #3 “Educational Status”[Mesh]
 - #4 “Orthodontic treatment”
 - #5 #1 AND #2 AND #3
4. Google Scholar (1 January 1965 to 1 August 2021)
 - (((Socioeconomic) OR (“Income”[Mesh])) OR (“Educational Status”[Mesh])) AND (“orthodontic treatment”)

Hand searching

Hand-searching was also done at the Institution level to avoid missing out on articles.

Data collection and analysis

Selection of studies

Two review authors (SG and SS) assessed titles and abstracts for inclusion in the review. Selection criteria were used for selecting papers suitable for inclusion. Downloaded sets of records from each database were imported to the bibliographic software package Zotero and merged into one core database to remove duplicate records and to facilitate retrieval of relevant articles.

Data extraction and management

Data extraction was carried out on a specially designed form, independently by two review authors, who were blinded to each other’s data. Results were compared to check for inconsistencies, and disagreements were resolved by discussion.

The following details for each study were recorded on the data extraction form:

Author and year of study, Study setting, Sample Size, Participants/Sample Characteristics, Outcome measured. Described in detail in table II.

Assessment of risk of bias in Clinical trial included studies

We planned to assess the risk of bias using the JBI tool for cross-sectional studies outlined by JBI Systematic Reviews described in table III. The goal of this critical appraisal (assessment of the risk of bias) was to assess the methodological quality of studies and to determine the extent to which the included studies had been diminishing the possibility of bias in its design, conduct, and analysis. Details regarding the publication and the study, the participants, settings, the interventions, the comparators, the outcome measures, study design, statistical analysis and results, and all other relevant data (funding; conflict of interest, etc.) has to be carefully and accurately extracted from all included studies.

Table II. Details of the studies analyzed in the Review.

Sr No	Author/ Year/ Country	Participants Details	Outcome measured
1	Dogan A 2010 Turkey	107 boys 101 girls Total 208 children Age 9 and 18 years mean 12.8 ± 2.5)	Socio-demographic features and self-perception of parents concerning the malocclusion of their children
2	Germa A 2010 France	3089 Boys 2899 Girls 5988 children Children and teenagers aged 8–18 years	The specific role of social and economic characteristics on the use of orthodontic treatment among French children
3	Krey KF 2012 Germany	Total sample 1538 11 to 14 years	Influence of age, gender, and socio-economic status on orthodontic treatment
4	Tumurkhuu T 2016 Mongolia	557 Schoolchildren 11-16 years	Relationship between malocclusion and socioeconomic status
5	Deli R 2012 Italy	2284 children 6 to 16 years	Relationship between the attitude towards orthodontic treatment and the objective level of orthodontic need, and variables like gender, socioeconomic status, and geographical context
6	Kavaliauskiene A 2010 Lithuania	5632 school children 11 to 15 years	Frequency of orthodontic anomalies in terms of self-reported complaints about malposed teeth and malocclusion across different sociodemographic strata.
7	Tickle M 1999 UK	5918 Children 14 years old	Relationship between socioeconomic status and both normatively assessed and self-perceived need for orthodontic treatment
8	Turbill ET UK	1272 Children Meage 12.77	Effects of social inequality on the likelihood of patients discontinuing orthodontic treatment
9	Dimberg L 2015 Sweden	257 Children Mean age 11.5	Impact of malocclusions or orthodontic treatment needs with age, gender, socio-economic markers, dental fear, and aspects of oral health taken into consideration
10	Joury E 2011 Syria	145 Children 12-16 Years	Socio-Economic Position can predict orthodontic treatment outcome at the end of 1 year of active treatment

Table III. JBI tool for critical appraisal.

Citation	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8
Dogan A	Y	Y	Y	Y	N	N	Y	Y
Germa A	Y	Y	Y	Y	N	N	Y	Y
Krey F	Y	Y	Y	Y	N	N	Y	Y
Tumurkhuu T	Y	Y	Y	Y	N	N	Y	Y
Deli R	Y	Y	Y	Y	Y	Y	Y	Y
Kavaliauskiene A	Y	Y	Y	Y	N	N	Y	Y
Tickle M	Y	Y	Y	Y	N	N	Y	Y
Turnbill E	Y	N	Y	Y	U	N	Y	Y
Dimberg L	Y	Y	Y	Y	Y	Y	Y	Y
Joury E	Y	Y	Y	Y	N	N	Y	Y
Percentage %	100.0	90.0	100.0	100.0	20.0	20.0	100.0	100.0

JBI critical appraisal checklist for cross-sectional studies

1. Were the criteria for inclusion in the sample clearly defined?

2. Were the study subjects and the setting described in detail?

3. Was the exposure measured in a valid and reliable way?

4. Were objective, standard criteria used for measurement of the condition?

5. Were confounding factors identified?

6. Were strategies to deal with confounding factors stated?
7. Were the outcomes measured in a valid and reliable way?
8. Was appropriate statistical analysis used?

Results

Study selection

We searched 4 databases PubMed, EbscoHost, LIVIVO, and Google Scholar, and found a total of 704 articles. The relevant database searchers were Pubmed 259 articles followed by Ebscohost 280, LIVIVO 145, and Google scholar 20 articles.

Later, in the literature search, we identified 75 articles that were potentially relevant to our topic and were non-duplicate. Of these, 45 were excluded based on the assessment of the titles, and the abstracts; 30

articles of these were retrieved and considered for further assessment (Figure 1 flow chart). Next, both the primary (SG) and secondary (SS) reviewers assessed the full text of the 30 studies, resulting in the exclusion of 20 articles. As a final result, the reviewers were left with 10 articles that were included in the review.

Description of studies

The methodological quality of the included 10 articles was assessed by critically appraised using the JBI tool for cross-sectional studies. Any disagreements between the reviewers were resolved by discussion. All the reviewers agreed by consensus that 10 articles be included in the systematic review. These articles were all original research papers and included 10 cross-sectional studies. The included studies were published between 1965 and 2021.

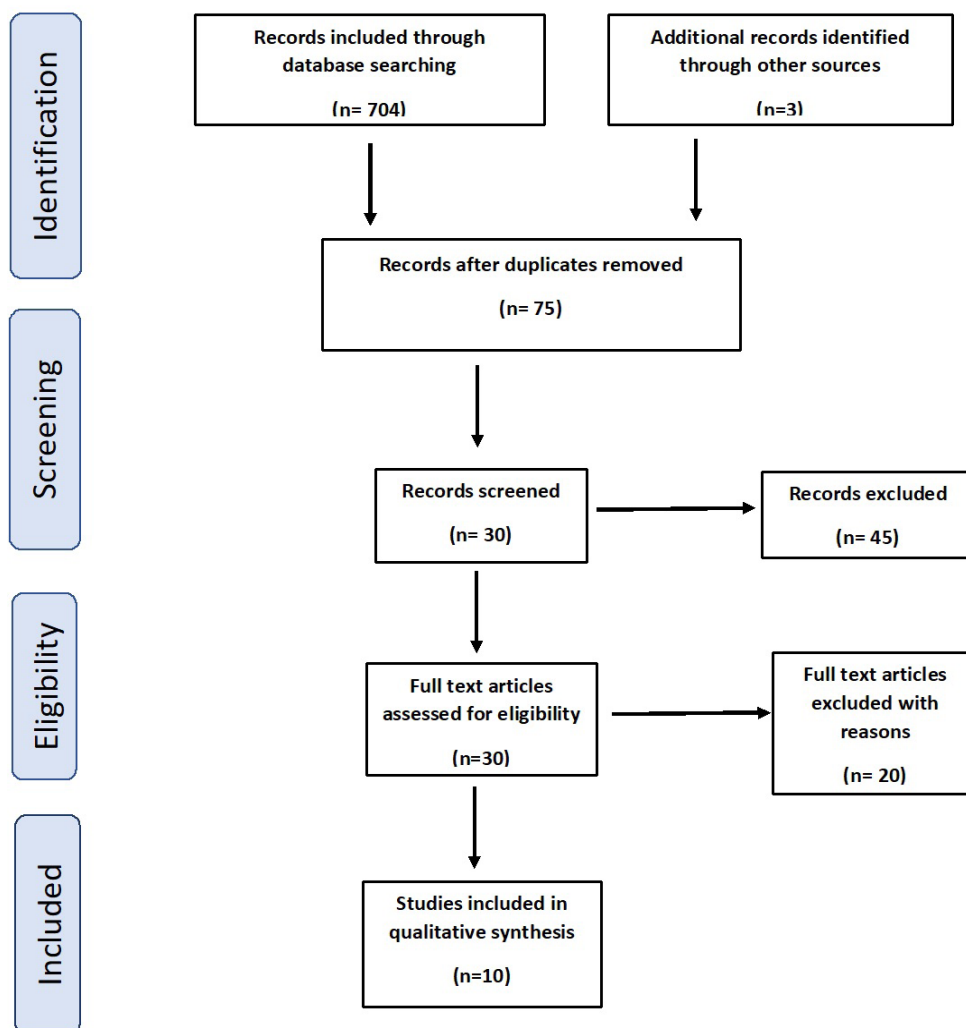


Figure 1. PRISMA flow diagram.

This review included various study settings like Brazil, Turkey, France, Mongolia, US, Italy, UK, Lithuania, Syria, and Sweden. Out of these, 3 studies were conducted in the UK by Tickle et al, Turbill et al. Janice et al conducted 2 studies in Brazil in 2012 and 2013.

Description of study participants

The ten included studies recruited a total of 24,226 patients in the age group of 6-18 years. The included studies used various parameters to assess socioeconomic and financial burdens laid by orthodontic treatment. 7 studies measured the burden by standardized indices like Index of orthodontic treatment need (IOTN) [10-14] and Index of treatment complexity, outcome and need (ICON) [14] and other Indices [15,16]. While the other 3 remaining studies used non-standardized self-prepared [17,18] or an anonymous questionnaire [4]. However, the authors also made a note of caution to not include those studies which did not use any parameters to denote SES. For example, the reviewers excluded an article by Christopherson et al. [19] because the assessment of SES was not performed by identifying each child's family income. Instead, the authors had used the percentage of children in school that received free school lunches and used this as a global estimate and approximation of the children's SES.

Results of individual studies based on parental education

Three studies analyzed the burden of education status on orthodontic treatment needs. According to Joury E [14] when the father's and mothers' education and employment status was compared the difference was small and not statistically significant. On contrary, according to Doga A [10] as the education of the father increased, the Dental Health Component and Esthetic Component grades decreased for all cases ($P < 0.05$). Similarly, as the mother's education increased, the Esthetic Component grades remained unaffected ($P < 0.01$). In contrast to the above-mentioned studies, Tumurkhuu T [11] found that adolescents whose mothers had intermediate or advanced education had a higher malocclusion, needing orthodontic treatment than those mothers with lower levels of education. Germa A [17] showed that children whose mother had the least education were less likely to undergo an orthodontic treatment compared to children whose mother had obtained a university diploma.

Results of individual studies based on social-economic class

The original objective stated for this systematic review was how does a person's socioeconomic status affect the orthodontic treatment needs. There were no suitable studies to include in the systematic review that

only addressed this outcome measure, as a result, reviewers identified the relevant studies with this parameter and excluded the non-relevant objectives from those studies.

According to Joury et al. [14] adolescents whose mothers were from a low social class were less likely to achieve improvement in occlusion compared with their counterparts whose mothers were from a high social class. The authors also found that the mother's social class was more relevant and important to improvement in occlusion than the father's social class. Similarly, Germa et al. [17] found that there was an association between annual income and orthodontic treatment. When the annual income of the family was low, children were less likely to have orthodontic treatment than children of families with high income. Tickle et al. [12] found that there was a trend for normatively assessed need to be more frequently present among the deprived children and for lack of need to be more prevalent amongst affluent children. Similarly, Turbill et al. [16] found that the participants from 'lower' social stratum areas had a greater tendency to discontinue treatment than compared to 'upper' social strata. However, in contrast to all other studies included in the review, according to Dimberg et al. [20] there were no significant effects of age, gender, or socioeconomic markers on orthodontic treatment needs.

Results of individual studies based on geographic location to social-economic class

Krey et al. [18] found that the number of subjects undergoing orthodontic treatment from the western part of Germany was slightly higher, but not statistically significantly than those from the east. According to the authors, the higher proportion of subjects receiving orthodontic treatment in West Germany was due to the ability of their parents to finance the treatment as compared to East Germany [18]. This financial ability is directly related to the SES of the parents, which in turn is related to the place of residence [18]. Deli et al. [15] found statistically significant differences in SES and region of residence: subjects with a higher SES presented a better orthodontic status. Children with a very high SES were more often from central (65.9%) and northern Italy (20.8%), while only 13.3% lived in southern Italy. They also found out that 53.2% of subjects undertreatment presented a very high or high SES providing a statistically significant association between SES and being undertreatment. Kavaliauskiene et al. [13] reported that the use of orthodontic appliances differed depending on the place of residence. The proportion of children wearing removable appliances or braces in the cities was twice as high as that of country areas. However, children from high-affluence families reported wearing orthodontic appliances twice as often as their counterparts

from low-income families. Additionally, schoolchildren from average- and low-affluence families as compared to their counterparts from high-affluence families were 1.32 and 2.33 times, respectively, less likely of wearing orthodontic appliances.

Results of individual studies based on the job profile

Germa et al. [17] found that orthodontic treatment needs were low when the parents were in service, sales workers, manual workers or when the child had no supplementary insurance, as well when the family lived in a rural area. The rate of orthodontic treatment was higher when parents were professionals, managers and had a high income, or when the child lived in an area with a high density of orthodontists. This indicated that the tendency of undergoing orthodontic treatment increased with high job qualifications.

Level of evidence

The data for each included article were extracted and tabulated using the standardized data extraction tools kit by JBI. Because all included articles were cross-sectional studies, a separate JBI Data Extraction Form was utilized following the study design. Data extracted from cross-sectional studies included specific details about inclusion in the sample, measurement about the exposure, standardized criteria used for measurement, confounding factors, reliability of the outcomes measured, and appropriateness of the statistical tests used. All results were subject to double data entry to minimize the risk for errors. Data extracted from the 8 domains were categorized into Yes, No and Unknown. The methodological quality of the studies was derived for the graphical purpose from Cochrane’s risk of bias tool which is depicted in figure 2 and figure 3.

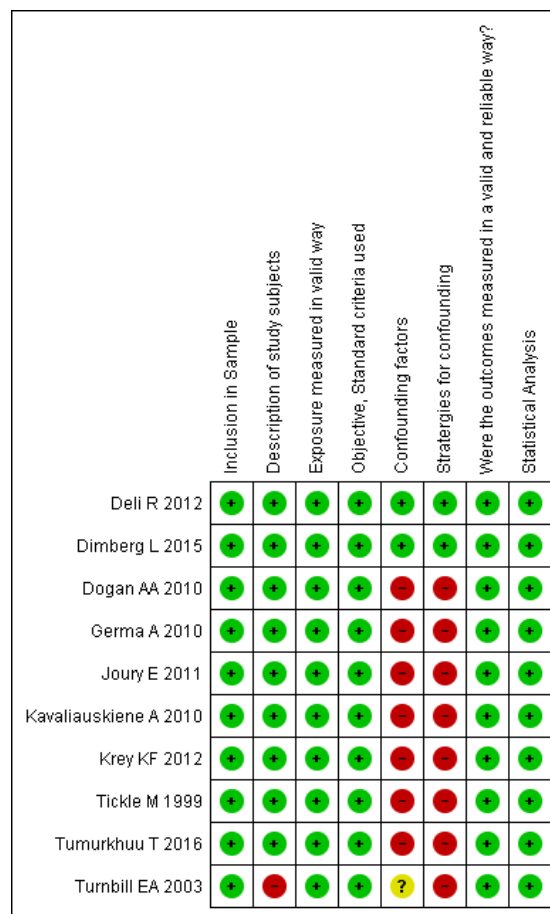


Figure 3. Risk of bias Summary: review authors’ judgments about each risk of bias item presented as percentages across all included studies.

Discussion

Socioeconomic status is assessed by variables such as income, educational level, occupation, and location, which fundamentally structure the conditions or circumstances [21]. In the current review most of the studies pointed out that as the education status, social class, geographic location of the parents improved the need for orthodontic treatment decreased in the population. This was summarized by large evidence gathered from various studies.

Family resources and standards of living play a major role in adolescent health, development, and treatment outcome [22]. For instance, when parental education from different social classes was compared to orthodontic treatment needs by Joury et al. [14], a large difference was found between different social classes. Mothers from the low social class were less likely to achieve improvement in occlusion when compared to mothers from the high social class. This signifies that household class was less important than individual parents’ social class. This finding highlights that parental social class played a significant role

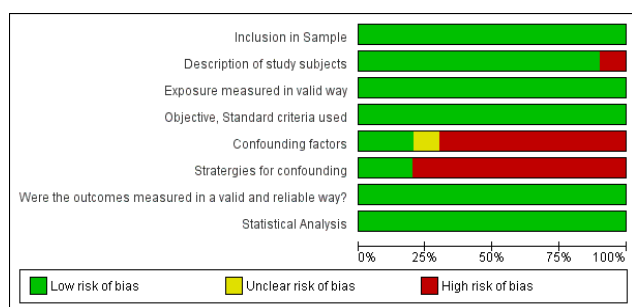


Figure 2. Risk of bias: review authors’ judgments about each risk of bias item for each included study.

and was a major contributing factor in determining the role of orthodontic treatment in children.

Vally et al. [23] in 1997 found that an orthodontist tends to recommend 10-12% more treatment than a layperson. A similarity in scoring amongst the orthodontist and parents with high education highly indicates, that as education status increases the parents become more aware of the prevalent orthodontic treatment needs. Dogan et al. [10] in their study found that as the education status of the parents increased their scoring became more similar to that of the orthodontist. This significantly reduced the number of children undergoing orthodontic treatment who had parents from a high educational background.

However, Tumurkhuu et al. [11] showed a negative correlation between maternal education and malocclusion. The authors interpreted that in developing countries or regions with clear socioeconomic disparity, women with higher levels of education or socioeconomic status change their lifestyle faster, resulting in poorer oral health [24-27]. The authors also pointed out that mothers with low education backgrounds provided more traditional food like meat [1], which maintains an environment that optimizes craniofacial growth in children. While, mothers with high education prepare softer or more processed foods and less traditional diet, which decreases masticatory jaw function in their offspring [28].

With regards to socioeconomic class and orthodontic treatment needs, the reviewed research indicated that social class was an important factor when considering orthodontic treatment needs. With an increase in social class, orthodontic treatment needs are reduced significantly. Joury et al. [14] reported a significant difference in the improvement of occlusion between adolescents whose mothers were from a high social class 60% than those who were from a low social class 14%. The authors also pointed out that the mother's social class was more relevant to improvement in occlusion rather than the father's social class. Bregani et al. [29] noted that the mother's social class was more significant than the father's social class. Mothers took more responsibility for adolescent treatment, it seemed that the characteristics of the mother's employment played a major role in determining the extent to which they were able to provide support in their child's treatment. Mothers from a low social class, who were expected to have less job control and more stressful working conditions, were less able to take time off work and accompany their child on his/her orthodontic treatment visits. The authors noted that mothers with a lower occupational level did not lower the social class of the father but a mother with a higher occupational level raised the family's social class.

Similar evidence, about socioeconomic status and orthodontic treatment, need was also given by Germa et al. [17] and Tickle et al [12]. According to Tickle et al. [12], socio-economic status affects the normative orthodontic treatment needs. It is also known to affect perceptions of

the need for orthodontic treatment. According to some authors, the high social status of parents is associated with higher education as well as increased demand for orthodontic treatment for their children [30,31]. Moreover, the likelihood of discontinuation of orthodontic treatment in families with low SES is also assumed to be higher [16]. The lower proportion of orthodontic treatment of subjects with a lower SES might be due to financial constraints [32] and a possible higher tolerance for dental deviations in these social groups.

The prevalence of malocclusion has been found to vary with the different populations, races, and origins. Differences in care-seeking behavior among urban and rural dwellers may arise from different priorities the family has. Low-income families in rural communities may have learned to adjust and prioritize their routine to activities such as work, school, and general healthcare services. These adjustments must have neglected the ability to utilize orthodontic treatments. The other reason for the high degree of variability in the uptake of orthodontic treatment in the rural area across the globe could be the distance needed to travel from the rural area to the urban area. In other words, financial ability is directly related to the SES of the parents, which in turn is related to the place of residence [18]. Studies have reported that children from high-income families were more satisfied with the way their teeth looked and oral health than their peers from poorer families [33,34]. However it is important to note that the relationship between rural residency and decreased utilization may not apply to other types of dental care services as orthodontic care is regularly spaced and needs frequent visits.

According to Turbill et al. [16] orthodontically qualified practitioners appear to be more readily available in 'more middle class' areas than rural areas. There are several reasons why orthodontists may prefer not to work in deprived areas, such as those areas simply being more unattractive, the expected poorer compliance of the patients, and probably the lack of scope for private practice. This reason may account for to lower acceptance rate of orthodontic treatment in rural areas. However, in contrast, Kavaliauskiene et al. [13] showed that there was no association between the prevalence of malocclusion and place of residence or family affluence. However, European and American studies have found that immigrant background [2], lower-income [35], and lower socioeconomic group [36] are associated with higher orthodontic treatment needs.

On the other hand, Germa et al. [17] observed that children whose mother or stepmother was born in Africa had orthodontic treatment at a lower rate than those born in France. These findings were consistent with a German study that reported that immigrant status of either parent or child was associated with a lower prevalence of orthodontic treatment in a population with low socioeconomic status [37]. Women born in Africa may have been less exposed

to orthodontic treatment than their French counterparts and thus may be less aware of its potential benefits. The other reason sighted by the authors was that orthodontic treatment was less frequent in rural areas, possibly because longer distances to reach an orthodontist may have been an obstacle to orthodontic treatment, which requires regular visits.

Conclusion

Analysis of this systematic review showed that it is important to consider that children and adolescents may want to undergo orthodontic treatment or would like to have the orthodontic situation improved, but parents ultimately decide whether the child will undergo treatment or not, possibly depending on their financial situation.

References

- Office of Disease prevention and Health. Determinants of health. Available from: <https://www.healthypeople.gov/2020/about/foundation-health-measures/Determinants-of-Health>.
- Arcaya MC, Arcaya AL, Subramanian SV. Inequalities in health: definitions, concepts, and theories. *Glob Health Action*. 2015;8:27106.
- Frenk J, Moon S. Governance challenges in global health. *N Engl J Med*. 2013;368:936-942.
- Determinants of Health. WHO. 3 February 2017. Available from: <https://www.who.int/news-room/q-a-detail/determinants-of-health>.
- Elani HW, Harper S, Allison PJ, Bedos C, Kaufman JS. Socio-economic inequalities and oral health in Canada and the United States. *J Dent Res*. 2012;91:865–870.
- Russell JS. Aesthetic orthodontic brackets. *J Orthod*. 2005;32:146-163.
- Bresnahan BW, Kiyak HA, Masters SH, McGorray SP, Lincoln A, King G. Quality of life and economic burdens of malocclusion in U.S. patients enrolled in Medicaid. *J Am Dent Assoc*. 2010;141:1202-1212.
- Bergström K, Halling A, Huggare J. orthodontic treatment demand--differences between urban and rural areas. *Community Dent Health*. 1998;15:272–276.
- Badran SA. The effect of malocclusion and self-perceived aesthetics on the self-esteem of a sample of Jordanian adolescents. *Eur J Orthod*. 2010;32:638–644.
- Doğan AA, Sari E, Uskun E, Sağlam AM. Comparison of orthodontic treatment need by professionals and parents with different socio-demographic characteristics. *Eur J Orthod*. 2010;32:672-676.
- Tumurkhuu T, Fujiwara T, Komazaki Y, Kawaguchi Y, Tanaka T, Inazawa J, et al. Association between maternal education and malocclusion in Mongolian adolescents: a cross-sectional study. *BMJ Open*. 2016;6:e012283.
- Tickle M, Kay EJ, Bearn D. Socio-economic status and orthodontic treatment need. *Community Dent Oral Epidemiol*. 1999;27:413-418.
- Kavaliauskienė A, Sidlauskas A, Zaborskis A. Demographic and social inequalities in need for orthodontic treatment among schoolchildren in Lithuania. *Medicina (Kaunas)*. 2010;46:767-773.
- Joury E, Johal A, Marcenes W. The role of socio-economic position in predicting orthodontic treatment outcome at the end of 1 year of active treatment. *Eur J Orthod*. 2011;33:263-269.
- Deli R, Macri LA, Radico P, Pantanali F, Grieco DL, Gualano MR, et al. orthodontic treatment attitude versus orthodontic treatment need: differences by gender, age, socioeconomic status and geographical context. *Community Dent Oral Epidemiol*. 2012;40 Suppl 1:71-76.
- Turbill EA, Richmond S, Wright JL. Social inequality and discontinuation of orthodontic treatment: is there a link? *Eur J Orthod*. 2003;25:175-183.
- Germa A, Kaminski M, Nabet C. Impact of social and economic characteristics on orthodontic treatment among children and teenagers in France. *Community Dent Oral Epidemiol*. 2010;38:171-179.
- Krey KF, Hirsch C. Frequency of orthodontic treatment in German children and adolescents: influence of age, gender, and socio-economic status. *Eur J Orthod*. 2012;34:152-157.
- Christopherson EA, Briskie D, Inglehart MR. Objective, subjective, and self-assessment of preadolescent orthodontic treatment need--a function of age, gender, and ethnic/racial background? *J Public Health Dent*. 2009;69:9-17.
- Dimberg L, Lennartsson B, Bondemark L, Arnrup K. Oral health-related quality-of-life among children in Swedish dental care: The impact from malocclusions or orthodontic treatment need. *Acta Odontol Scand*. 2016;74:127-133.
- ICOHIRP. Social inequalities in oral health: from evidence to action. Secondary social inequalities in oral health: from evidence to action. 2015. Available from: <http://www.icohirp.com/monograph.html>.
- Krieger N, Williams DR, Moss NE. Measuring social class in US public health research: concepts, methodologies, and guidelines. *Annu Rev Public Health*. 1997;18:341–378.
- Vally I. A comparison of lay and professional opinion on treatment need and treatment outcome. MScD Thesis, University of Wales College of Medicine. 1997
- Jigid B, Ueno M, Shinada K, Kawaguchi Y. Early childhood caries and related risk factors in Mongolian children. *Community Dent Health*. 2009;26:121–128.
- Thomaz EB, Cangussu MC, Assis AM. Malocclusion and deleterious oral habits among adolescents in a developing area in northeastern Brazil. *Braz Oral Res*. 2013;27:62–69.
- Normando TS, Barroso RF, Normando D. Influence of the socioeconomic status on the prevalence of malocclusion in the primary dentition. *Dental Press J Orthod*. 2015;20:74–78.
- Manaseki S. Mongolia: a health system in transition. *BMJ*. 1993;307:1609–1611.
- Varrela J. Masticatory Function and Malocclusion: A Clinical Perspective. *Seminars in orthodontic*. 2006;12:102–109.
- Bregani P, Della Porta V, Carbone A, Ongari B, di Natale B. Attitudes of juvenile diabetics and their families towards

- dietetic regimen. In: Laron Z (Ed.). Nutrition and the diabetic child. Basel: Karger; 1979. p. 159–163.
30. Shaw WC, O'Brien KD, Richmond S. Quality control in orthodontics: factors influencing the receipt of orthodontic treatment. *Br Dent J.* 1991; 170:66–68.
 31. Reichmuth M, Greene KA, Orsini MG, Cisneros GJ, King GJ, Kiyak HA. 2005 Occlusal perceptions of children seeking orthodontic treatment: impact of ethnicity and socioeconomic status. *Am J Orthod Dentofacial Orthop.* 2005;128:575-582.
 32. Foster Page LA, Thomson WM. Malocclusion and uptake of orthodontic treatment in Taranaki 12-13-year-olds. *N Z Dent J.* 2005;101: 98–105; quiz 111.
 33. Chen MS, Hunter P. Oral health and quality of life in New Zealand: a social perspective. *Soc Sci Med.* 1996;43:1213-1222.
 34. Chen MS. Social, psychological, and economic impacts of oral conditions and treatments. In: Cohen LK, Gift HC, editors. *Disease Prevention and Oral Health Promotion, Socio-Dental Sciences in Action.* Copenhagen: Munksgaard; 1995. p. 33-72.
 35. Proffit WR, Fields HW Jr, Moray LJ. Prevalence of malocclusion and orthodontic treatment need in the United States: estimates from the NHANES III survey. *Int J Adult Orthodon Orthognath Surg.* 1998;13:97–106.
 36. Morris E, Landes D. The equity of access to orthodontic dental care for children in the North East of England. *Public Health.* 2006;120:359–363.
 37. Bissar AR, Oikonomou C, Koch MJ, Schulte AG. Dental health, received care, and treatment needs in 11- to 13-year-old children with immigrant background in Heidelberg, Germany. *Int J Paediatr Dent.* 2007;17:364–370.