Systematic Review
Social/Community Dentistry

Prevalence of dental caries, periodontal disease, malocclusion, and tooth wear in indigenous populations in Brazil: a systematic review and meta-analysis

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Abstract: The aim of this review was to evaluate the prevalence of dental caries, periodontal disease, malocclusion, and tooth wear in indigenous in Brazil. A systematic review of observational studies was performed according to the PRISMA guidelines (CRD42020218704). The search strategy involved the electronic databases of Embase, LILACS, PubMed, Web of Science, Scopus, and the CAPES Theses and Dissertations for gray literature. The eligibility criteria consisted of publications that assessed the prevalence of oral conditions in indigenous populations in Brazil. Studies with indigenous people living in urban area were excluded. The risk of bias was evaluated by using JBI Critical Appraisal for prevalence studies. Thirty studies were included in the review, and the majority showed a low risk of bias. A meta-analysis of 20 studies was conducted using the random-effects model and a 95% confidence interval. Several ethnicities were studied in isolation or in groups (n = 7,627 for dental caries; n = 2,774 for periodontal disease; n = 1,067 for malocclusion; n = 150 for tooth wear). The prevalence of caries ranged from 50% among indigenous people aged 18-36 months to 100% among those aged 65–74 years. The prevalence of periodontal disease ranged from 58% to 83%. The prevalence of malocclusion was 43%. Tooth wear was assessed in only one ethnic group and showed a prevalence of 100% in indigenous people aged >18 years. The certainty of evidence assessed by the GRADE system ranged from very low to moderate. This systematic review showed significant differences in the prevalence of dental caries, periodontal disease and malocclusion between indigenous population groups and territories in which indigenous people live.

Keywords: Dental Caries, Periodontal Disease; Malocclusion; Tooth Wear; Indigenous Peoples.

Introduction

Over half of all indigenous groups in Latin America and the Caribbean live in Brazil. These groups consist of 305 different ethnicities and speak 274 native languages,[1] which makes the Brazilian indigenous population the most ethnically diverse in the world. According to the Brazilian Health

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Information System for Indigenous Peoples (SIASI - *Sistema de Informação da Atenção à Saúde Indígena*) of the Special Secretariat for Indigenous Health (SESAI - *Secretaria Especial de Saúde Indígena*), there are a total of 738,624 indigenous people in 5,361 villages throughout the national territory.

Recognition of and respect for indigenous socio-diversity in Brazil was guaranteed by the Federal Constitution in 1988. This allowed the development of specific healthcare policies to meet the sociocultural and geographical peculiarities of each ethnicity and led to the approval of the Arouca Bill in 1999 (Law No. 9,836)[2] and the establishment of the Indigenous Healthcare Subsystem as part of the National Healthcare System (SUS – *Sistema Único de Saúde*). The healthcare model was organized by creating 34 Special Indigenous Health Districts (DSEI – *Distrito Sanitário Especial Indígena*) throughout the national territory. The DSEI is a dynamic ethnocultural space, and well-defined area in terms of geographic, population and administrative levels.[3]

The National Oral Health Policy (PNSB – *Política Nacional de Saúde Bucal*) emphasized the importance of knowing the epidemiological profile and oral health problems of different indigenous groups, not only in terms of the most prevalent diseases, but also their socioeconomic conditions, habits, lifestyles and health needs, for better planning of public policies.[4] The contact of non-indigenous population with the indigenous people has brought about changes in their subsistence, resulting in a negative impact on the oral health of these individuals.[5,6]

Recent studies on this topic only report general data from South America. In a systematic review on dental caries in indigenous people, the authors showed that caries was a public health problem for these people and prevention and treatment strategies must consider cultural specificities.[7] Based on this review, the levels of dental caries among indigenous people are high when compared with those of the general population of Brazil, Chile, Uruguay, and Venezuela in all age groups.[8]

Furthermore, it has recently been shown that irrespective of age, sex or country, the worldwide prevalence and severity of dental caries are higher among indigenous groups when compared with non-indigenous groups and this is particularly noticeable in untreated dental caries and tooth loss.[9] Reducing these inequalities in indigenous oral health at a global level initially involves a solid understanding of the magnitude of inequalities that indigenous populations continue to experience.[10]

Dental caries followed by periodontal disease has been the most frequently oral disease addressed in these populations due to its relevance from the public health point of view, with recognized impacts on the quality of life of affected individuals.[11] Whereas despite some important local studies that have been conducted with indigenous groups, other problems such as malocclusion[5,12-15] and tooth wear[16] have not yet been extensively studied.

The sociocultural diversity of Brazilian indigenous people, their living and health conditions reinforce the need to disseminate knowledge of different epidemiological profiles and health surveillance actions that address the specificities of different indigenous ethnicities. Systematic reviews offer a high level of evidence, and the results can help guide and assess public health policies. Thus, the objective of this review was to summarize the available data on the prevalence of oral diseases and conditions, such as dental caries, periodontal disease, malocclusion, and tooth wear in indigenous people in Brazil and thus contribute to understanding the burden of these conditions on these populations.

Methodology

Protocol and registration

This systematic review was performed following the JBI Manual for Evidence Synthesis[17] and reported in accordance with the Preferred Reporting Items Checklist for Systematic Reviews and Meta-Analyses (PRISMA Statement).[18] A protocol was registered at the International Prospective Registry of Systematic Reviews (PROSPERO) database under number CRD42020218704.

Eligibility criteria

The inclusion criteria were defined according to the CoCoPop strategy (Condition, Context,

Population).[17] Observational studies with data on the prevalence of dental caries, periodontal disease, malocclusion, and tooth wear in different indigenous populations in Brazil were included if they contained the following information: Co - Condition: tooth decay, periodontal disease, malocclusion, and erosion; Co - Context: Brazil; Population: indigenous people of both sexes, in all age groups, irrespective of socioeconomic status, living in indigenous lands. The review excluded: a) abstracts, opinions, book chapters; b) studies that did not meet inclusion criteria; c) duplicate samples.

Information sources and search strategy

The search strategy included studies published until June 18, 2021, with search alerts as a self-updating tool and revised in March 2022 in the following databases: Embase, LILACS, PubMed, Scopus, Web of Science, and Cochrane library. Gray literature was explored using the Brazilian Theses and Dissertations database system (CAPES). Additionally, a manual search of the reference lists of studies included was performed. A software reference manager (EndNote X9 ™ Thomson Reuters, Toronto, Canada) was used to collect references and remove duplicate articles. The full search strategy is shown in Table 1.

Selection process

Firstly, two groups of three authors (JMRV, ACCC; TSS; MABR, ABSS, LNQ) independently analyzed the titles, abstracts and studies selected that met the eligibility criteria. The Rayyan software (Qatar Computing Research Institute, Doha, Qatar) was used during this selection phase.[19] The full texts were then evaluated according to the eligibility criteria by the same group of authors. Any cases of disagreement during these two phases were resolved by another author (JVP).

Data collection

Data extraction involved the following information: a) author and year of publication; b) Sampling method; c) age of participants; d) ethnicity; e) sample size; f) collection instrument / index; g) prevalence of oral conditions; h) confidence interval. This phase was carried out independently by two authors (JMRV and JVP) and disagreements were resolved by a third researcher from the team (MABR).

Risk of bias assessment

The Joanna Briggs Institute (JBI) Critical Appraisal Tool for Prevalence Studies[20] was used to assess the risk of bias of the studies included. The analysis was performed independently by two authors (JMRV and JVP) and disagreements were assessed by a third author (MABR). The reviewers scored each item with "yes", "no", "unclear" and "not applicable". Studies were categorized as: a) low risk of bias, if studies attained over 70% of "yes" scores; b) moderate risk of bias, if "yes" scores were between 50% and 69%; and c) high risk of bias, if "yes" scores were below 49%[21].

Effect measures

The primary outcome was the prevalence of oral conditions including dental caries, periodontal disease, malocclusion, and tooth wear. The measure of effect used was the event rate and confidence interval for each of the conditions studied.

Synthesis of results and statistical analysis

Individual studies were combined in the meta-analysis using the random-effects model,[22] Freeman–Tukey double arcsine transformation, and the inverse variation method. The variance between studies was analyzed using the tau-squared statistic (τ^2) and the magnitude of heterogeneity was estimated by the I-squared statistic (I^2). For each analysis, when possible, data were grouped according to the following age groups: 18-36 months, 5 years, 12 years, 15–19 years, 35–44 years, and 65–74 years. These age groups were selected according to the ages recommended by the World Health Organization (WHO) for epidemiological studies[23]. Furthermore, the only important variable described in the eligible studies was the Brazilian geographic regions, so a sub-group analysis was planned; however, we judged that there were not sufficient studies to do this meaningfully.[24] Therefore, for analyses with high heterogeneity, we use the function *find.outliers* in the *dmetar* package,[25] and a sensitivity test was

Table 1. Search strategies designed specific for each electronic database.

Data base	Query	Records retrieved
		#1 AND #2
PubMed	#1 "oral health"[MeSH Terms] OR "Dental Clinics"[All Fields] OR "Dental Health Surveys"[All Fields] OR "diagnosis oral"[All Fields] OR "Mouth Diseases"[All Fields] OR "Mouth Rehabilitation"[All Fields] OR "dental care"[MeSH Terms] OR "care dental"[All Fields] OR "Dental Caries"[MeSH Terms] OR "Dental Decay"[All Fields] OR "caries dental"[All Fields] OR "decay dental"[All Fields] OR "Carious Dentin"[All Fields] OR ("Dental Caries"[MeSH Terms] OR ("dental"[All Fields] AND "caries"[All Fields]) OR "Dental Caries"[All Fields] OR ("carious"[All Fields] AND "dentins"[All Fields])) OR "dentin carious"[All Fields] OR ("Dental Caries"[MeSH Terms] OR ("dental"[All Fields] AND "caries"[All Fields]) OR "Dental Caries"[All Fields] OR ("dentins"[All Fields] AND "carious"[All Fields])) OR "Dental White Spot"[All Fields] OR ("Dental Caries"[MeSH Terms] OR ("dental"[All Fields] AND "caries"[All Fields]) OR "Dental Caries"[All Fields] OR ("white"[All Fields] AND "spots"[All Fields] AND "dental"[All Fields])) OR "White Spots"[All Fields] OR "spot white"[All Fields] OR "spots white"[All Fields] OR "White Spot"[All Fields] OR "Dental White Spots"[All Fields] OR "white spot dental"[All Fields] OR "DMFT"[All Fields] OR "dental pain"[All Fields] OR "oral problems"[All Fields] OR "dental needs"[All Fields] OR "dental treatment"[All Fields] OR "disease periodontal"[All Fields] OR "diseases periodontal"[All Fields] OR "Periodontal Disease"[All Fields] OR "Parodontosis"[All Fields] OR "Parodontoses"[All Fields] OR "Pyorrhea Alveolaris"[All Fields] OR "malocclusion"[MeSH Terms] OR "Malocclusions"[All Fields] OR "Tooth Crowding"[All Fields] OR "crowding tooth"[All Fields] OR ("malocclusion"[MeSH Terms] OR "malocclusion"[All Fields] OR ("crowdings"[All Fields] AND "tooth"[All Fields])) OR "Crossbite"[All Fields] OR "Crossbites"[All Fields] OR "Cross Bite"[All Fields] OR "bite cross"[All Fields] OR ("malocclusion"[MeSH Terms] OR "malocclusion"[All Fields] OR ("bites"[All Fields] AND "cross"[All Fields])) OR "Cross Bites"[All Fields] OR "Angle's Classification"[All Fields] OR "Angle Classification"[All Fields] OR "Angles Classification"[All Fields] OR ("malocclusion"[MeSH Terms] OR "malocclusion"[All Fields] OR ("classification"[All Fields] AND "angle s"[All Fields])) OR "tooth erosion"[MeSH Terms] OR "erosion tooth"[All Fields] OR ("tooth erosion"[MeSH Terms] OR ("tooth"[All Fields] AND "erosion"[All Fields]) OR "tooth erosion"[All Fields] OR ("erosions"[All Fields] AND "tooth"[All Fields])) OR "Tooth Erosions"[All Fields]	564
	#2 "indians, south american"[MeSH Terms] OR ("indians, south american"[MeSH Terms] OR ("indians"[All Fields] AND "south"[All Fields] AND "american"[All Fields]) OR "South American Indians"[All Fields] OR ("american"[All Fields] AND "indian"[All Fields] AND "south"[All Fields])) OR ("indians, south american"[MeSH Terms] OR ("indians"[All Fields] AND "south"[All Fields] AND "american"[All Fields]) OR "South American Indians"[All Fields] OR ("american"[All Fields] AND "indians"[All Fields] AND "south"[All Fields])) OR "indian south american"[All Fields] OR "South American Indian"[All Fields] OR "South American Indians"[All Fields] OR ("indians, south american"[MeSH Terms] OR ("indians"[All Fields] AND "south"[All Fields] AND "american"[All Fields]) OR "South American Indians"[All Fields] OR ("amerinds"[All Fields] AND "south"[All Fields] AND "american"[All Fields])) OR ("indians, south american"[MeSH Terms] OR ("indians"[All Fields] AND "south"[All Fields] AND "american"[All Fields]) OR "South American Indians"[All Fields] OR ("american"[All Fields] AND "amerind"[All Fields] AND "south"[All Fields])) OR ("indians, south american"[MeSH Terms] OR ("indians"[All Fields] AND "south"[All Fields] AND "american"[All Fields]) OR "South American Indians"[All Fields] OR ("american"[All Fields] AND "amerinds"[All Fields] AND "south"[All Fields])) OR ("indians, south american"[MeSH Terms] OR ("indians"[All Fields] AND "south"[All Fields] AND "american"[All Fields]) OR "South American Indians"[All Fields] OR ("amerind"[All Fields] AND "south"[All Fields] AND "american"[All Fields])) OR "South American Amerind"[All Fields] OR "South American Amerinds"[All Fields] OR "indigenous"[All Fields]	
Embase	#1 ('dental health' OR 'dental clinic' OR 'dental disease assessment' OR 'mouth disease' OR 'full mouth rehabilitation' OR 'dental procedure' OR 'care, dental' OR 'dental caries' OR 'caries, dental' OR 'decay, dental' OR 'carious dentin' OR 'carious dentins' OR 'dentin, carious' OR 'dentins, carious' OR 'dental white spot' OR 'white spots, dental' OR 'white spots' OR 'spot, white' OR 'spots, white' OR 'white spot' OR 'dental white spots' OR 'white spot, dental' OR 'dmft index' OR 'tooth pain' OR 'oral problems' OR 'dental needs' OR 'dental treatment' OR 'disease, periodontal' OR 'diseases, periodontal' OR 'periodontal disease' OR 'periodontosis' OR 'pyorrhea alveolaris' OR 'malocclusion' OR 'malocclusions' OR 'crowding (tooth)' OR 'crowding, tooth' OR 'crowdings, tooth' OR 'crossbite' OR 'crossbites' OR 'cross bite' OR 'bite, cross' OR 'bites, cross' OR 'cross bites' OR 'angle classification' OR 'angles classification' OR 'tooth disease' OR 'erosion, tooth' OR 'erosions, tooth' OR 'tooth erosions') AND [embase]/lim	498
	#2 ('american indian' OR 'american indian, south' OR 'american indians, south' OR 'indian, south american' OR 'south american indian' OR 'south american indians' OR 'amerinds, south american' OR 'american amerind, south' OR 'american amerinds, south' OR 'amerind, south american' OR 'south american amerind' OR 'south american amerinds' OR 'indigenous' OR 'indigenous people') AND [embase]/lim	

Continue

Continuation

LILACS	#1 ("saúde bucal" OR "oral health*" OR "salud bucal" OR "assistência odontológica" OR "dental care*" OR "atención odontológica" OR "cárie dentária" OR "dental caries" OR "caries dental" OR "má oclusão" OR "malocclusion*" OR "maloclusión" OR "erosão dentária" OR "tooth erosion*" OR "erosión de los dientes") #2 ("saúde bucal" OR "oral health*" OR "salud bucal" OR "assistência odontológica" OR "dental care*" OR "atención odontológica" or "cárie dentária" OR "dental caries" OR "caries dental" OR "má oclusão" OR "malocclusion*" OR "maloclusión" OR "erosão dentária" OR "tooth erosion*" OR "erosión de los dientes") AND (db:("LILACS" OR "BBO" OR "BINACIS" OR "IBECS")	21
Cochrane	#1 "oral health" OR "Dental Clinics" OR "Dental Health Surveys" OR "Diagnosis, Oral" OR "Mouth Diseases" OR "Mouth Rehabilitation" OR "dental care" OR "Care, Dental" OR "Dental Caries" OR "Dental Decay" OR "Caries, Dental" OR "Decay, Dental" OR "Carious Dentin" OR "Carious Dentins" OR "Dentin, Carious" OR "Dentins, Carious" OR "Dental White Spot" OR "White Spots, Dental" OR "White Spots" OR "Spot, White" OR "Spots, White" OR "White Spot" OR "Dental White Spots" OR "White Spot, Dental" OR DMFT OR "dental pain" OR "oral problems" OR "dental needs" OR "dental treatment" OR "periodontal disease" OR "Disease, Periodontal" OR "Diseases, Periodontal" OR "Periodontal Disease" OR "Parodontosis" OR "Parodontoses" OR "Pyorrhea Alveolaris" OR "malocclusion" OR "Malocclusions" OR "Tooth Crowding" OR "Crowding, Tooth" OR "Crowdings, Tooth" OR "Crossbite" OR "Crossbites" OR "Cross Bite" OR "Bite, Cross" OR "Bites, Cross" OR "Cross Bites" OR "Angle's Classification" OR "Angle Classification" OR "Angles Classification" OR "Classification, Angle's" OR "tooth erosion" OR "Erosion, Tooth" OR "Erosions, Tooth" OR "Tooth Erosions" #2 "Indians, South American" OR "American Indian, South" OR "American Indians, South" OR "Indian, South American" OR "South American Indian" OR "South American Indians" OR "Amerinds, South American" OR "American Amerind, South" OR "American Amerinds, South" OR "Amerind, South American" OR "South American Amerind" OR "South American Amerinds" OR "indigenous"	41
Web of Science	#1 ("Indians, South American" OR "American Indian, South" OR "American Indians, South" OR "Indian, South American" OR "South American Indian" OR "South American Indians" OR "Amerinds, South American" OR "American Amerind, South" OR "American Amerinds, South" OR "Amerind, South American" OR "South American Amerind" OR "South American Amerinds" OR "indigenous") #2 ("oral health" OR "Dental Clinics" OR "Dental Health Surveys" OR "Diagnosis, Oral" OR "Mouth Diseases" OR "Mouth Rehabilitation" OR "dental care" OR "Care, Dental" OR "Dental Caries" OR "Dental Decay" OR "Caries, Dental" OR "Decay, Dental" OR "Carious Dentin" OR "Carious Dentins" OR "Dentin, Carious" OR "Dentins, Carious" OR "Dental White Spot" OR "White Spots, Dental" OR "White Spots" OR "Spot, White" OR "Spots, White" OR "White Spot" OR "Dental White Spots" OR "White Spot, Dental" OR DMFT OR "dental pain" OR "oral problems" OR "dental needs" OR "dental treatment" OR "periodontal disease" OR "Disease, Periodontal" OR "Diseases, Periodontal" OR "Periodontal Disease" OR "Parodontosis" OR "Parodontoses" OR "Pyorhea Alveolaris" OR "malocclusion" OR "Malocclusions" OR "Tooth Crowding" OR "Crowding, Tooth" OR "Crowdings, Tooth" OR "Crossbite" OR "Crossbites" OR "Cross Bite" OR "Bite, Cross" OR "Bites, Cross" OR "Cross Bites" OR "Angle's Classification" OR "Angle Classification" OR "Angles Classification" OR "Classification, Angle's" OR "tooth erosion" OR "Erosion, Tooth" OR "Erosions, Tooth" OR "Tooth Erosions")	442
CAPES - Brazilian Catalog of Theses and Dissertations	("Indians, South American" OR "American Indian, South" OR "American Indians, South" OR "Indian, South American" OR "South American Indian" OR "South American Indians" OR "Amerinds, South American" OR "American Amerind, South" OR "American Amerinds, South" OR "Amerind, South American" OR "South American Amerind" OR "South American Amerinds" OR "indigenous") AND ("oral health" OR "Dental Clinics" OR "Dental Health Surveys" OR "Diagnosis, Oral" OR "Mouth Diseases" OR "Mouth Rehabilitation" OR "dental care" OR "Care, Dental" OR "Dental Caries" OR "Dental Decay" OR "Caries, Dental" OR "Decay, Dental" OR "Carious Dentin" OR "Carious Dentins" OR "Dentin, Carious" OR "Dentins, Carious" OR "Dental White Spot" OR "White Spots, Dental" OR "White Spots" OR "Spot, White" OR "Spots, White" OR "White Spot" OR "Dental White Spots" OR "White Spot, Dental" OR DMFT OR "dental pain" OR "oral problems" OR "dental needs" OR "dental treatment" OR "periodontal disease" OR "Disease, Periodontal" OR "Diseases, Periodontal" OR "Periodontal Disease" OR "Parodontosis" OR "Parodontoses" OR "Pyorhea Alveolaris" OR "malocclusion" OR "Malocclusions" OR "Tooth Crowding" OR "Crowding, Tooth" OR "Crowdings, Tooth" OR "Crossbite" OR "Crossbites" OR "Cross Bite" OR "Bite, Cross" OR "Bites, Cross" OR "Cross Bites" OR "Angle's Classification" OR "Angle Classification" OR "Angles Classification" OR "Classification, Angle's" OR "tooth erosion" OR "Erosion, Tooth" OR "Erosions, Tooth" OR "Tooth Erosions")	256

performed with the removal of outliers. All analyses were performed in the R program (version 4.2 for Windows, using the *meta* and *dmetar* packages)[26] and reported a 95% confidence interval (CI).

Certainty assessment

Certainty of the evidence identified was assessed by the Grading of Recommendation, Assessment, Development, and Evaluation (GRADE) tool.[27] In the absence of a formal procedure for the assessment of certainty in prevalence estimates, we applied the framework developed for the incidence estimates in the context of prognostic studies.[28] For the meta-analysis of prevalence, the best evidence is obtained through cross-sectional studies or baseline examination from cohort studies. Thus, the assessment of evidence from these types of studies begins with a "high certainty of evidence", and is downgraded depending on the risk of bias, inconsistency, indirectness, imprecision, and publication bias. Finally, the level of certainty among the items of evidence identified can be characterized as high, moderate, low, or very low.

Results

Study selection

The search in the databases resulted in 1,566 articles. After removing duplicates, 1,066 studies were read for titles and abstracts, and 47 were selected for a full reading. At this stage, 17 articles were included.[5,12,14-16,29-40] The gray literature records and those from the reference lists resulted in 13 accessory studies.[13,41-52] Some of these studies addressed more than one clinical condition. The studies excluded and the reasons for exclusion are shown in Table 2.

Among the 30 studies included in the qualitative analysis[5, 12-16, 29-52], 20 were added in the quantitative analysis.[5,12-16,29,33,35-37,39,41-44,47-50] The studies identified, screened, and selected are shown in Figure 1.

Study characteristics

Dental caries

The prevalence of dental caries was reported in eighteen studies (Table 3). Twelve publications were carried out between 2010 and 2021,[29,33,34,36,37,4,41,44,45,48,51,52] and the others between 2001 and 2008.[5,13,30,35,49,50]

Several ethnicities were studied in isolation or in groups: Guarani,[29] Kaiowá,[29] Terena,[29] Kadiwéu,[29] Xavante,[5,51] Baniwa,[30] Kotiria,[41] Enawenê-Nawê,[13] Xukuru,[34,40] Kaiabi,[33,44,45] Yudjá,[33,44,45] Ikpeng,[33,44,45] Trumai,[33,44,45] Kamaiurá,[33,44,45] Waurá,[33,44,45] Kisedjê,[44,45] Panará,[33,44,45] e Tapayuna, ,[33,44,45] Mehinako,[35,45] Parakanã,[48] Kaiowá-Guarani,[49] Yanomami,[50] Yawalapiti,[35] Aweti,[35] Potiguara,[36] Korubo[52] and Kaingang.[37]

The prevalence of dental caries was assessed by the decayed, missing, filled teeth index (DMFT/dmft) in 7,627 indigenous people living in villages in Brazilian territory, without distinction of sex, in the majority of cases. The studies were carried out in the states of Mato Grosso do Sul, Mato Grosso, Amazonas, Pernambuco, Pará, Paraíba, and Rio Grande do Sul.

Periodontal disease

Ten studies reported the prevalence of periodontal disease in the indigenous population of Brazil (Table 4). Of these studies, eight were published between 2007 and 2021 [13, 29, 31, 32, 39, 43, 46, 47] and two in the 1970[16] and 1960[38].

The ethnicities studied were Guarani,[29,39] Yanomami,[16,43,46] Kaiowá, Kadiwéu,[29] Terena,[29,32] Enawenê-Nawê,[13] Kiriri,[31] Macuxi,[46] Kayabi,[32,47] Umutina, Paresí, Bororo, Bakairi, Irantxe, Nambikwara,[32] Kuikuro, Kalapalo, Matipu, Nahukuá, Mehinako, Wavre, Aweti, Kamaiurá, Trumai, Yawalapiti, Suiá, Ikpeng and Yudjá.[47] One study did not report the ethnicity.[23]

In total, 2,774 indigenous people were assessed, however sex was not distinguished in most cases. All studies were carried out in Brazil in the states of Rio de Janeiro,[29] Mato Grosso do Sul,[29] Mato Grosso,[13,32,38,47] Bahia,[31] and Roraima,[16,43,46]

The majority of studies used the CPI index (Community Periodontal Index) to assess periodontal diseases.[13,29,39,43,47] The periodontal attachment loss index was used in one study[43]. Clinical attachment loss (CAL), Probing Depth (PD) and the distance between the cement-enamel junction and the free gingival margin (CEJ-GM) were also used.[31] The Russell index was reported in

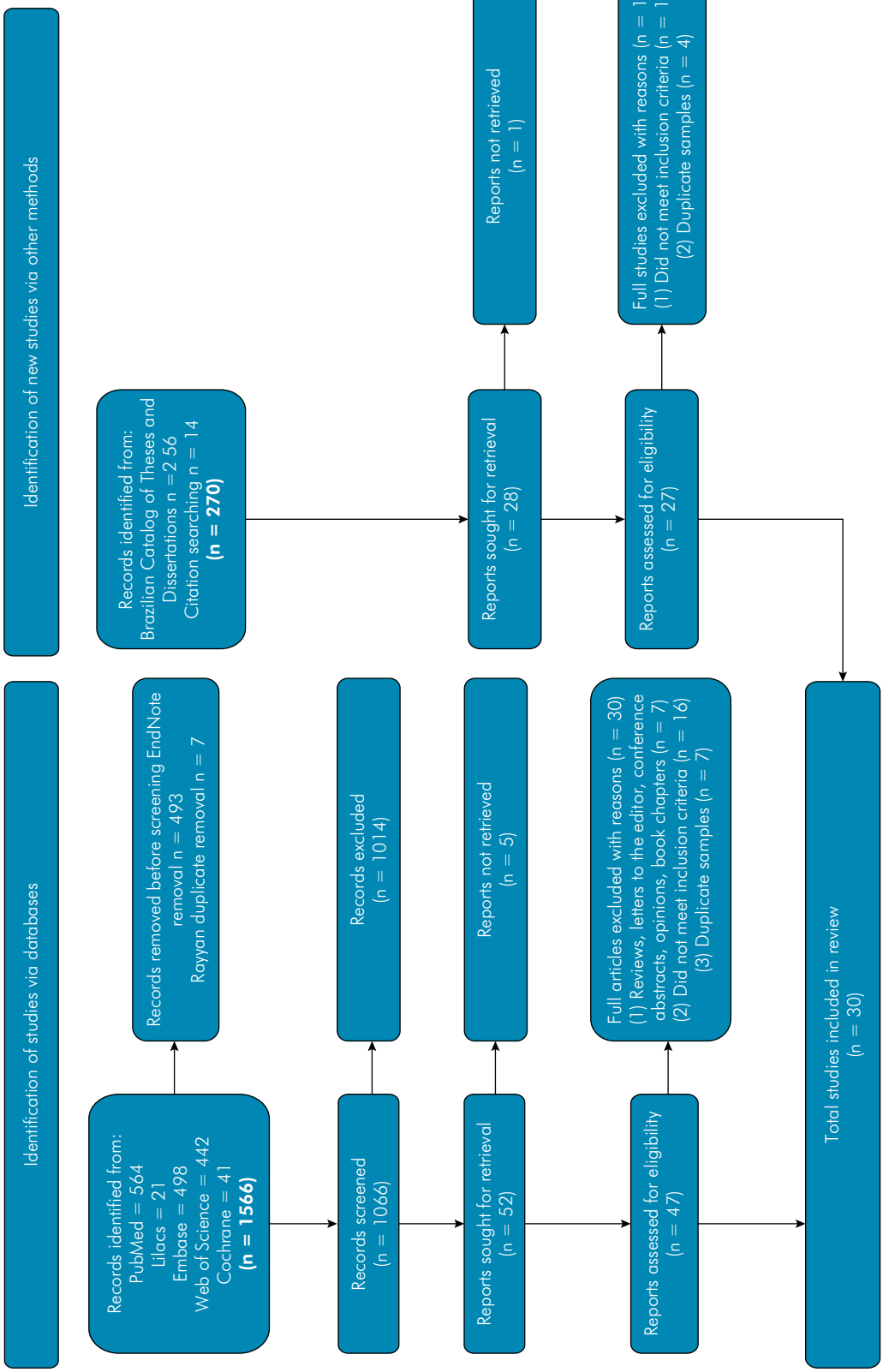


Figure 1. Flow diagram of literature search and selection criteria.

Table 2. Excluded studies and reasons for exclusion (n = 44)

Author, year	DOI / Link / PMID / ISBN	Reasons for exclusion
Alves Filho, 2007	https://www.arca.fiocruz.br/handle/icict/5075	1
Alves Filho, 2012	https://www.arca.fiocruz.br/handle/icict/14449	2
Arantes, 1998	https://pesquisa.bvsalud.org/portal/resource/pt/lil-225418	3
Arantes, 2005	https://www.arca.fiocruz.br/handle/icict/4454	2
Arantes et al., 2009	doi: 10.1080/03014460802672844.	2
Arantes, Frazão, 2016	doi: 10.1353/hpu.2016.0043.	2
Arantes, Frazão, 2018	doi: 10.1111/cdoe.12375.	3
Arantes et al., 2010	PMID: 20718309	3
Arantes et al., 2018	doi: 10.1371/journal.pone.0208312.	2
Boaventura, 2017	http://hdl.handle.net/123456789/238	2
Brega et al., 2021	doi: 10.3390/ijerph18115633.	2
Caires, 2018	http://hdl.handle.net/1843/ODON-BADK43	2
Caires et al., 2018	doi: 10.1590/1807-3107bor-2018.vol32.0019.	2
Carneiro, 2005	https://amazonasindigenasite.ufam.edu.br/7-neai/15164-.html	2
de Lima, 2010	https://www.arca.fiocruz.br/handle/icict/18624	2
de Lima et al., 2013	ISBN 978-88-7587-663-0	2
Dumont et al., 2008	doi: 10.1590/s1413-81232008000300024.	2
Drummond, 2016	http://hdl.handle.net/1843/ODON-ANZPZV	2
Fonseca et al., 2020	https://pesquisa.bvsalud.org/portal/resource/pt/biblio-1055776	2
Goldfeld; Kilpatrick, 2007	doi: 10.1111/j.1440-1754.2007.01024.x.	1
Gomes, 2016	https://ppgsas.propesp.ufpa.br/ARQUIVOS/dissertacoes/TURMA%202014/BARBARA%20GUERREIRO_2014.pdf	2
Guimarães, 2000	https://pesquisa.bvsalud.org/portal/resource/pt/biblio-861823	3
Guimaraes, Rodrigues, 2002	PMID: WOS:000180217901456.	1
Lemos et al., 2010	doi: 10.1590/s1413-81232010000700056.	2
Lemos et al., 2018	doi: 10.1590/0102-311x00079317.	2
Maurício et al., 2013	https://www.researchgate.net/publication/268102928_Oral_Health_of_Indigenous_People_Xukuru_Do_Ororub_At_Age_10_to_14_Years_Pernambuco_-_Brazil	3
Mauricio; Moreira, 2020	doi: 10.1590/1413-812320202510.26492018.	3
Mejia et al., 2010	PMID: 20718305.	1
Miranda, 2016	http://repositorio.unb.br/handle/10482/22466	2
Moreira, Lima, 2015	PMID: WOS:000376659900173.	1
Normando, 2014	doi: 10.1590/2176-9451.19.3.015-016.edt.	1
Normando et al., 2013	doi: 10.2319/020112-91.1.	2
Normando et al., 2016	doi: 10.1016/j.ajodo.2016.03.033.	2
Pinto-Filho et al., 2018	doi: 10.1007/s11356-018-2807-3.	3
Ribeiro et al., 2015	doi: 10.1111/idj.12187.	3
Ribeiro et al., 2016	doi: 10.1016/j.jash.2016.02.012.	2
Ronderos et al., 2001	doi: 10.1034/j.1600-051x.2001.281102.x.	2
Santos et al., 2020	PMID: WOS:000605268700068.	1
Schroth et al., 2009	doi: 10.1016/j.pcl.2009.09.010.	2
Slack-Smith, 2019	doi: 10.1016/j.pcl.2009.09.010.	1
Soares, 2017	http://ds.saudeindigena.icict.fiocruz.br/handle/bvs/4956	3
Soares et al., 2021	doi: 10.1590/1413-81232021264.06472019.	3
Vieira et al., 2009	doi: 10.1590/s1678-77572009000500017.	2
Vieira et al., 2015	PMID: rayyan-111766923.	2

Reasons for exclusion: 1 - Reviews, letters, conference abstracts, personal opinions, book chapters; 2 - Did not meet inclusion criteria; 3 - Duplicate samples.

Table 3. Description of included studies for dental caries.

Author, year, location	Sampling method	Age	Ethnicity	Sample size (male/female)	Instrument and index	Prevalence	CI95% Lower	CI95% Higher
Arantes et al., 2021,[29] Mato Grosso do Sul	Stratified	5 y	Total	606	dmft	67.82	64.00	71.42
			Guarani	183		67.21	60.12	70.60
			Kaiowá	228		53.95	47.47	60.30
			Terena	167		85.63	79.51	90.15
			Kadiwéu	28		78.57	60.46	89.79
		12 y	Total	543	DMFT	56.35	52.15	60.47
			Guarani	141		56.74	48.49	64.63
			Kaiowá	195		45.64	38.80	52.65
			Terena	173		69.36	62.14	75.75
			Kadiwéu	34		50.00	34.07	65.93
		15–19 y	Total	415	DMFT	78.31	74.10	82.01
			Guarani	120		79.17	71.05	85.47
			Kaiowá	112		70.54	61.53	78.18
			Terena	120		80.83	72.88	86.87
			Kadiwéu	63		85.71	75.03	92.30
		35–44 y	Total	266	DMFT	98.50	96.20	99.41
			Guarani	72		97.22	90.43	99.23
			Kaiowá	76		98.68	92.92	99.77
			Terena	75		98.67	92.83	99.76
			Kadiwéu	43		100.0	91.80	100.0
Arantes et al., 2001,[5] Mato Grosso	Census	5 –12 y	Xavante	74	DMFT	32.43	22.86	43.73
Carneiro et al., 2008,[30] Amazonas	Census	2 > 50 y	Baniwa	590	DMFT/dmft	78.14	74.62	81.28
Cortês, 2013,[41] Amazonas	Census	1–5 y	Kotiria	54	dmft	68.52	55.26	79.32
		12 y		11	DMFT	90.91	62.26	98.38
		15–19 y		22		95.50	78.20	99.19
Detogni, 2007[13] Mato Grosso	Census	5 y	Enawene-Nawe	21	DMFT	90.48	71.09	97.35
		12–13 y		21		95.24	77.33	99.15
Gonçalves et al., 2015,[40] Pernambuco	Census	5–15 y	Xukuru	224	dmft	75.45	69.41	80.62
				342	DMFT	62.87	57.63	67.82
Guisilini, 2016,[44] Mato Grosso	Census	6–71 m	Kaiabi, Yudjá, Ikpeng, Trumai, Kamaiurá, Waurá, Kisedjê, Panará e Tapaiuna.	402	dmft	51.00	46.12	55.85
		6 –17 m		73		5.48	2.15	13.26
		18–36 m		128		36.72	28.87	45.34
		37–47 m		77		59.74	48.58	69.98
		48–59 m		66		87.88	77.86	93.73
		60–71 m		58		86.21	75.07	92.84

Continue

Continuation

Hirooka et al., 2014,[45] Mato Grosso	Census	Total	Kisêdje, Tapayuna, Kaiabi, Ikpeng, Yudjá, Mehinaku, Waurá, Panará, Kaiamurá and Trumai (medium and low Xingu)	246	dmft	86.59	81.76	90.29
		36–71 m						
		36-47 m		92		72.83	62.96	80.86
		48-59 m		63		95.24	86.91	98.37
		60–71 m		91		94.51	87.78	97.63
Lemos et al., 2018,[33] Mato Grosso	Census	5 y (2007)	Tapayuna, Kaiabi, Ikpeng, Yudjá, Mehinaku, Waurá, Panará, Kamaiurá and Trumai	100	dmft	94.00	87.52	97.22
		5 y (2013)		86		89.53	81.29	94.40
		12 y (2007)		50	DMFT	76.00	62.59	85.70
		12 y (2013)		77		77.92	67.46	85.73
		15–19 y (2007)		218		95.87	92.34	97.81
		15–19 y (2013)		260		92.31	88.42	94.97
Mauricio, Moreira, 2014,[34] Pernambuco	Randomized	10–14 y	Xukuru do Ororubá	233 (121/112)	DMFT	73.39	67.37	78.65
Oliveira et al., 2018,[48] Pará	Convenience	18–36 m	Parakanã	44	dmft	70.45	55.78	81.84
		5 y		23		95.65	79.01	99.23
		12 y		11	DMFT	100	74.12	100.00
		15–19 y		59		98.31	91.00	99.70
		35-44 y		33		100	89.57	100.00
		65–74		3		100	43.85	100.00
Parizotto, 2004,[49] Mato Grosso	Stratified	0–5 y	Kaiowá-Guarani	190	dmft	72.11	65.34	78.00
		< 1 y		12		25.00	8.89	53.23
		1 y		41		29.27	17.61	44.48
		2 y		39		71.79	56.22	83.46
		3 y		47		95.74	85.75	98.83
		4 y		26		92.31	75.86	97.86
		5 y		25		96.00	80.46	99.29
Pereira, 2007,[50] Amazonas	Census	5 y	Yanomami	12	dmft	91.67	64.61	98.51
Pontes, 2014,[51] Mato Grosso	Convenience	< 5 > 35 y	Xavante	298 (101/197)	DMFT/ dmft	99.33	97.59	99.82
Rigonatto et al., 2001,[35] Mato Grosso	Convenience	< 5 y	Yawalapiti, Aweti, Mehinaku and Kamaiura	41	dmft	78.05	63.29	88.00
		14–20 y		37	DMFT	94.59	82.30	98.50
Sampaio et al., 2010,[36] Paraiba	Stratified	18 m > 74 y	Potiguara	1461	DMFT/ dmft	89.19	87.49	90.68
		18–36 m		146	dmft	45.21	37.36	53.30
		5 y		142		87.32	80.85	91.83
		12 y		159		83.02	76.42	88.06
		15–19 y		507	DMFT	93.89	91.45	95.66
		35–44 y		394		99.49	98.17	99.86
		65–74 y		113		99.12	95.16	99.84
Santos, 2018,[52] Amazonas	Convenience	1 ≥ 40 y	Korubo- 2015	21	DMFT	0.0	-	-
			Korubo - 2016	24		4.17	0,74	20.24
Soares et al., 2019,[37] Rio Grande do Sul	Census	35–44 y	Kaingang	107 (26/81)	DMFT	91.59	84.78	95.51

DMFT/dmft; Decayed, missing, filled teeth index; y: years; m: months.

Table 4. Description of included studies for Periodontal disease.

Author year, location - BR	Sampling method	Age, years	Ethnicity	Sample size (Male/ Female)	Instrument /index	PPD*	CI95% Lower	CI95% Higher	BP **	CI95% Lower	CI95% Higher	PPC ***	CI95% Lower	CI95% Higher	PPP ****	CI95% Lower	CI95% Higher	sextant excluded	CI95% Lower	CI95% Higher	NI *****
Alves Filho et al., 2009,[39] Angra dos Reis - RJ	Census	12≥75	Guarani	Total 300	CPI / population	40.4	34.94	45.97	11.33	8.22	15.42	21.00	16.77	25.96	0.67	0.18	2.40	7.67	5.16	11.24	-
		12		40		12.5	5.46	26.11	2.50	0.44	12.88	10.00	3.96	23.05	-	-	-	-	-	-	-
		15-19		73		31.51	22.00	42.86	19.18	11.78	29.66	12.33	6.62	21.80	-	-	-	-	-	-	-
		20-24		29		13.79	5.50	30.56	6.90	1.91	21.96	-	-	-	-	-	-	-	-	-	-
		25-34		48		43.75	30.70	57.72	10.42	4.53	22.17	33.33	21.68	47.46	-	-	-	-	-	-	-
		35-44		48		37,5	25.22	51.64	6.25	2.15	16.84	27.08	16.57	41.00	2.08	0.37	10.90	2.08	0.37	10.90	-
		45-64		18		83.3	60.78	94.16	11.11	3.10	32.80	61.11	38.62	79.69	-	-	-	11.11	3.10	32.80	-
		65-74		25		76.0	56.57	88.50	20.00	8.86	39.13	24.00	11.50	43.43	4.00	0.71	19.54	28.00	14.28	47.58	-
		≥75		19		89.47	68.61	97.06	10.53	2.94	31.39	10.53	2.94	31.39	-	-	-	68.42	46.01	84.64	-
Arantes et al., 2021,[29] MS	Stratified	35-40	Total	266	CPI / sextant	-	-	-	70.3	64.5	75.5	80.1	74.8	84.5	39.5	33.8	45.5	-	-	-	-
			Guarani	72		-	-	-	72.2	60.9	81.3	81.9	71.4	89.3	22.2	14.1	33.2	-	-	-	-
			Kaiowá	76		-	-	-	61.8	50.6	72.0	73.7	62.8	82.3	36.8	26.9	48.1	-	-	-	-
			Terena	75		-	-	-	70.7	59.5	79.8	65.3	54.0	75.1	49.3	38.3	60.4	-	-	-	-
			Kadiwéu	43		-	-	-	81.4	67.1	90.5	88.4	75.1	95.9	55.8	41.1	69.6	-	-	-	-
Detogni, 2007,[13] MT	Census	17-19	Enawene-Nawe / 1999	114	CPI / Population	73.68	64.92	80.90	42.11	33.44	51.28	31.58	23.77	40.59	-	-	-	-	-	-	-
			Enawene-Nawe / 2005	150		72.0	64.33	78.57	32.0	25.06	39.83	40.0	32.50	48.00	-	-	-	-	-	-	-
		25-29	Enawene-Nawe / 1999	84		71.43	61.00	79.98	14.29	8.37	23.33	57.14	46.48	67.18	-	-	-	7.14	3.31	14.72	-
			Enawene-Nawe / 2005	132		54.55	46.04	62.79	18.18	12.53	25.63	36.36	28.65	44.85	-	-	-	9.09	5.28	15.22	-
		35-44	Enawene-Nawe / 1999	108		50.00	40.73	59.27	5.56	2.57	11.59	44.44	35.42	53.85	-	-	-	50	40.73	59.27	-
			Enawene-Nawe / 2005	102		29.41	21.45	38.87	-	-	-	29.41	21.45	38.87	-	-	-	52.94	43.32	62.34	-
		65-74	Enawene-Nawe / 1999	48		12.50	5.86	24.70	-	-	-	12.50	5.86	24.70	-	-	-	87.50	75.30	94.14	-
			Enawene-Nawe / 2005	72		-	-	-	-	-	-	-	-	-	-	-	-	100	94.93	100.0	-

Continue

Continuation

		17-19	Enawene-Nawe / 1999	114		17.54	11.65	25.55	10.53	6.12	17.50	7.02	3.60	13.24	-	-	-	41.23	32.62	50.41	-
Detogni, 2007,[13] MT	Census		Enawene-Nawe / 2005	150		24.0	17.87	31.43	17.33	12.11	24.19	6.67	3.66	11.84	-	-	-	22.67	16.70	30.0	-
		35-44	Enawene-Nawe / 1999	108	CPI / sextanat	12.04	7.17	19.51	0.93	0.16	5.06	11.11	6.47	18.42	-	-	-	87.96	80.49	92.83	-
			Enawene-Nawe / 2005	102		4.90	2.11	10.97	-	-	-	4.90	2.11	10.97	-	-	-	88.24	80.55	93.14	-
		65-74	Enawene-Nawe / 1999	48		4.17	1.15	13.98	-	-	-	4.17	1.15	13.98	-	-	-	95.83	86.02	98.85	-
			Enawene-Nawe / 2005	72		-	-	-	-	-	-	-	-	-	-	-	-	100.0	94.93	100.0	-
		19≥45		215		92.56	88.25	95.37	-	-	-	-	-	-	-	-	-	-	-	-	-
		19-34		132	Periodontal pocket (>4mm)	91.67	85.69	95.28	-	-	-	-	-	-	-		-	-	-	-	-
		35-44		38		9474	82.71	98.54	-	-	-	-	-	-	-	-	-	-	-	-	-
		≥45		45		93.33	82.14	97.71	-	-	-	-	-	-	-	-	-	-	-	-	-
Figueiredo et al., 2013,[31] BA	Randomized	19≥45	Kiriri	215		97.67	94.67	99.00	-	-	-	-	-	-	-	-	-	-	-	-	-
		19-34		132	Cal †PD + (CEJ-GM) >3mm	96.21	91.44	98.37	-	-	-	-	-	-	-	-	-	-	-	-	-
		35-44		38		100.0	90.82	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-
		≥45		45		100.0	92.13	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-
		15-19		78		93.59	85.86	97.23	61.54	50.44	71.55	30.77	21.63	41.71	1.28	0.23	6.91	-	-	-	-
		35-44		109	CPI / population	100.0	96.60	100.0	10.09	5.73	17.17	67.89	58.64	75.92	22.02	15.27	30.68	-	-	-	-
		≥60		17		100.0	81.57	100.0	-	-	-	52.94	30.96	73.83	47.06	26.17	69.04	-	-	-	-
Freitas, 2008,[43] Xitei and Ketaa Base Polo, RR	Census	15-19	Yanomami	76		97,37%: 0-3mm	90.90	99.28	-	-	-	-	-	-	-	-	-	-	-	-	-
						2,63%: 4-5mm	0.72	9.10													
					PIP / population	67.89%: 0-3mm;	58.64	75.92													
		35-44		109		27.52%: 4-5mm;	20.01	36.56	-	-	-	-	-	-	-	-	-	-	-	-	-
						4.59%: 6-8mm	1.98	10.29													

Continue

Continuation

Freitas, 2008,[43] Xitei and Ketaa Base Polo, RR	Census	≥60	Yanomami	17	PIP / population	5.88%: 0-3mm	1.05	26.98	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
						58.82%: 4-5mm;	36.01	78.39															
						23.53%: 6-8mm;	9.56	47.26															
						11.76%: 9-11mm	3.29	34.34															
Gaetti-Jardim, 2015,[32] Umutina Reservation, MT	Convenience	18-70	Umutina, Paresi, Bororo, Bakairi, Kayabi, Irantxe	100	NI	86.00	77.86	91.47															
Kussaba, 2017,[46] CASAI Boa Vista RR	Convenience	17-70	Yanomami	84 (41/43)	NI / population	-	-	-	22.62	14.99	32.65	-	-	-	-	-	-	-	-	-	-	-	-
			Macauxi	73 (36/37)					17.81	10.71	28.12	-	-	-	-	-	-	-	-	-	-	-	-
Mesquita et al., 2010,[47] Middle and Lower Xingu, MT	Convenience	15-19	Kuikuro, Kalapalo, Matipu, Nahukuá, Mehinaku, Wavre, Aweti, Kamaiurá, Trumai, Yawalapiti, Suiá, Kaiabi, Ikpeng and Yudjá	219	CPI / population	70.78	64.44	76.40	8.22	5.26	12.62	62.56	55.98	68.70	-	-	-	0.46	0.08	2.54	-		
		35-44		128		92.19	86.22	95.70	3.13	1.22	7.76	82.03	74.48	87.72	7.03	3.74	12.82	4.69	2.17	9.85			
		65-74		161		54.66	46.95	62.15	-	-	-	45.34	37.85	53.05	9.32	5.73	14.80	33.54	26.71	41.14	12.12		
		15-19		219	CPI / sextant	32.42	26.57	38.88	7.31	4.55	11.54	25.11	19.83	31.25	-	-	-	-	-	-	0.46		
		35-44		128		51.56	42.99	60.05	5.47	2.67	10.86	44.53	36.21	53.18	1.56	0.43	5.52	26.56	19.78	34.82	-		
		65-74		161		20.50	14.98	27.39	1.24	0.34	4.42	18.01	12.84	24.67	1.24	0.34	4.42	61.87	53.16	68.07	16.67		
Pereira et al., 1972,[16] RR	NI	13-18	Yanomami	56 (31/25)	Periodontal Disease Index (PDI) / population	58.93	45.88	70.83	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		19-29		38 (19/19)		97.37	86.51	99.53	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		30-49		33 (17/16)		100.0	89.57	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
		>50		23 (12/11)		100.0	85.69	100.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tumang, Piedade, 1968,[38] Xingú National Park, Leonardo Villas Boas, MT	Convenience	NI	NI	64	Russel index	98.44	91.67	99.72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

*PPD: Prevalence of periodontal disease; **BP: Bleeding prevalence; ***PDC: Prevalence dental calculus; ****PPP: Prevalence of periodontal pocket; *****NI: No information; †CAL: clinical attachment loss; PD: probing depth; CEJ-GM: distance between the cement-enamel junction and the free gingival margin; CPI index (Community Periodontal Index); PDI: periodontal disease index; PIP: Periodontal Attachment Loss Index

one study[38] and the periodontal disease index (PDI) in another study.[16] Two articles did not report the index used.[32,46]

Malocclusion

The prevalence of malocclusion in indigenous people in Brazil was reported in 7 studies (Table 5). Of these studies, two were published in the 60s and 70s,[14,16] three from 2000 to 2007[4,13,42] and two between 2011 and 2015.[12,15]

Among the various ethnic groups in the Brazilian territory, the studies included the Xavante,[5,14] Bakairi,[14] Yanomami,[16] Guarani-Mbya,[42] Enawenê-Nawê,[13] Arara-Laranjal, Arara-Iriri,[15] Asurini, Pat-Krô, Pikayaka.[12]

The ethnicities studied totaled 1,067 indigenous people. Only one study was unclear about the number of individuals being screened. Relative to the division by sex (male/female), only one study reported this number.[5] The studies were carried out in the states of Mato Grosso,[5,13,14] Pará,[12,15] Roraima,[16] and São Paulo.[42]

The malocclusion condition was assessed by the Angle Classification[5,12,14] and Dental Aesthetic Index – DAI.[42] One study[15] used the Björk method,[53] one other study used the classification of the National Institute of Dental Research – NIDR,[16] and another study did not inform the index/instrument used.[13]

Tooth wear

Tooth wear was assessed in one study.[16] The ethnic group studied was the Yanomami, who live in the state of Roraima, totaling 150 (79 male and 71 female) indigenous individuals, aged between 13 and 18 years and adults over the age of 18 years. The instrument used was the Pedersen index for cervical abrasion and the Broca index for occlusal wear (Table 6).

Risk of bias within studies

Among the studies that assessed dental caries, twelve presented a low risk of bias,[5,13,29,33,34,36,37,40,41,44,45,50] two investigations presented a moderate risk,[30,49] and four studies presented a high risk of bias.[35,48,51,52]

Table 5. Description of included studies for malocclusion.

Author, year, location	Sampling method	Age (y)	Ethnicity	Sample size (male/memale)	Instrument and index	Prevalence (%)	CI 95% Lower	CI 95% Higher	Class I (%)	Class II (%)	Class III (%)	No relation
Arantes et al., 2001,[5] MT	Census	2 > 50	Xavante	228 (108/120)	Angle classification	15.35	11.25	20.60	51,7	1,8	7,9	38,6
Souza et al., 2015,[12] PA	Census	2–22	Assurini	87	Angle classification	60.92	50.41	70.50	39.08	12.64	9.20	-
			Pat-krô	57		66.67	53.72	77.51	19.30	43.86	3.51	-
			Pikayaka'	31		48.39	31.97	65.16	29.03	16.13	3.23	-
Detogni, 2007,[13] MT	Census	12–13	Enawene-Nawe / 1999	9	Not specified	33.33	12.06	64.58	-	-	-	-
			Enawene-Nawe / 2005	34		76.47	60.00	87.56	-	-	-	-
		18–19	Enawene-Nawe / 1999	72		91.67	82.99	96.12	-	-	-	-
Frattucci, 2000,[42] SP	Convenience	12	Guarani Mbyá	21	DAI*	14.29	4.98	34.64	-	-	-	-
		18		5		0	-	-	-	-	-	-
Niswander, 1967,[14] MT	Convenience	10–16	Xavante	155	Angle classification	5.16	2.64	9.85	5.0	0	0	-
		18–-65	Bakairi	42		45.24	31.22	60.05	30.95	7.14	7.14	-
Normando et al.,[15] 2011, PA	Census	2–22	Arara-Laranjal	130	Bjork et al. (1964)	33.85	26.28	42.34	17.7	10.8	5.4	-
			Arara-Iriri	46		63.04	48.60	75.48	8.7	21.7	32.6	-
Pereira et al., 1972,[16] RR	Uninformed	13 > 50	Yanomami	150	N.I.D.R.**	70.67	62.94	77.36	77.7	22.3	0	-

*DAI: Dental Aesthetic Index **NIDR: National Institute of Dental Research.

Table 6. Description of included studies for tooth wear condition.

Author, year, location	Sampling method	Age (years)	Ethnicity	Sample size (male/ memale)	Instrument and index	Prevalence	CI95%	CI95%
						%	Lower	Higher
Pereira et al., 1972,[16] RR	Uninformed	13–18	Yanomami	56 (31/25)	Pedersen and Broca Index	64.29	51.19	75.54
		19–29		38 (19/19)		100.0	90.82	100.0
		30–49		33 (17/16)		100.0	89.57	100.0
		> 50		23 (12/11)		100.0	85.69	100.0

In most cases, the studies presented descriptive statistical analysis only[5,30,33,35,4,45,48-52] or were affected by not demonstrating a response rate.[48,49,51,52]

For periodontal disease, the majority of studies presented a low risk of bias[13,29,31,39,43,47] and four studies presented a high risk of bias.[16,32,38,46] The quality of the studies was mainly affected by the use of descriptive statistics[13,16,32,38,43,46,47] and the lack of information on the response rate.[16,32,38,46,47]

Relative to the studies that investigated malocclusion, four presented a low risk of bias[5,12,13,15] and three studies presented a high risk.[14,16,42] In most cases, the analysis was affected by a descriptive statistical analysis.

The only study that assessed tooth wear presented a high risk of bias due to sampling, lack of standardization for measurement conditions and data analysis. In addition, the study did not clearly state all the conditions assessed.[16] The risk of bias assessment is shown in Table 7.

Results of individual studies and syntheses

The results of the individual studies are presented in Tables 3–6. Synthesis of the results is presented by oral health condition assessed.

Dental caries

The meta-analysis of the prevalence of dental caries in the indigenous population aged 18-36 months included three studies[36,44,48] and presented an effect estimate of 50% (95%CI: 31–69, I^2 = 87%). Sensitivity testing for this analysis was not performed as no outliers were detected (Figure 2A).

For the 5-year-old population, the meta-analysis consisted of seven studies[13, 29, 33, 36, 48-50] and showed a prevalence of 88% (95%CI: 79–95, I^2 = 90%) (Figure 2B). One outlier study was excluded after the sensitivity analysis[29] and the effect estimate was 91% (95%CI: 87–94, I^2 = 0%) (Figure 2C).

The prevalence of dental caries in the 12-year-old indigenous population was 84% (95%CI: 69–95, I^2 = 93%) (Figure 2D). One outlier study was excluded after the sensitivity analysis[29] and the effect estimate was 88% (95%CI: 79–94, I^2 = 47%) (Figure 2E).

The prevalence of dental caries in the indigenous population aged 15 to 19 years was 92% (95%CI: 86–97, I^2 = 92%) (Figure 3A). One outlier study was excluded after the sensitivity analysis[29] and the effect estimate was 94% (95%CI: 93–96, I^2 = 0%) (Figure 3B).

The prevalence of dental caries in the indigenous population aged 35 to 44 years and 65 to 74 years was 98% (95%CI: 94–100, I^2 = 82%) (Figure 3C) and 100% (95%CI: 100–100, I^2 = 0%), respectively (Figure 3D). Sensitivity tests for these analyses were not performed since no outliers were detected.

Periodontal disease, gingival bleeding, dental calculus, and periodontal pocket

The prevalence of periodontal disease was 68% (95%CI: 29–96, I^2 = 97%), 72% (95%CI: 28–99, I^2 = 99%) and 58% (95% CI: 6–100%, I^2 = 99%) for the age groups 15–19 years (Figure 4A), 35–44 years (Figure 4B) and 65–74 years (Figure 4C), respectively. The sensitivity test, after excluding outliers, was possible only for the prevalence of periodontal disease in the 65–74 age group, indicating a prevalence of 83% (95%CI: 44–100, I^2 = 98%) (Figure 4D).

The prevalence of gingival bleeding was 27% (95%CI: 3–62, I^2 = 98%), 4% (95%CI: 0–10, I^2 = 83%) and 4% (95% CI: 0–16, I^2 = 77%) for the age groups 15-19 years (Figure 5A), 35–44 years (Figure 5B), and 65–74

Table 7. Risk of Bias assessed by the Joanna Briggs Institute Critical Appraisal checklist for prevalence studies for use in JBI Systematic Reviews. Risk of bias was categorized as High when the study reaches up to 49% score "yes", Moderate when the study reached 50% to 69% score "yes", and Low when the study reached more than 70% score "yes".

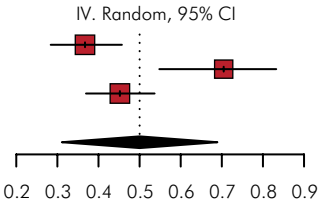
Condition	Authors, year	Q.1	Q.2	Q.3	Q.4	Q.5	Q.6	Q.7	Q.8	Q.9	% Yes	risk
Dental caries	Arantes et al., 2021,[29]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Arantes et al., 2001,[5]	Y	Y	Y	Y	Y	Y	N	N	Y	77.8%	L
	Carneiro et al., 2008,[30]	Y	N	N	Y	Y	Y	Y	N	Y	66.7%	M
	Cortês, 2013,[41]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Detogni, 2007,[13]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Gonçalves et al., 2015,[40]	Y	Y	Y	Y	Y	Y	Y	N	Y	88.9%	L
	Guisilini, 2016,[44]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Hirooka et al., 2014[45]	Y	Y	Y	Y	Y	Y	Y	N	Y	88.9%	L
	Lemos et al., 2018,[33]	Y	Y	Y	Y	Y	Y	Y	N	Y	88.9%	L
	Mauricio, Moreira, 2014,[34]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Oliveira et al., 2018,[48]	Y	N	N	Y	U	Y	N	N	U	33.3%	H
	Parizotto, 2004,[49]	Y	Y	N	Y	N	Y	Y	N	N	55.5%	M
	Pereira, 2007,[50]	Y	Y	Y	Y	U	Y	Y	N	Y	77.8%	L
	Pontes, 2014,[51]	Y	N	N	Y	U	Y	N	N	N	33.3%	H
	Rigonatto et al., 2001,[35]	Y	N	N	Y	N	Y	N	N	Y	44.4%	H
	Sampaio et al., 2010,[36]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Santos, 2018,[52]	Y	N	U	Y	U	Y	N	N	U	33.3%	H
	Soares et al., 2019,[37]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
Periodontal disease	Alves Filho et al., 2009,[39]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Arantes et al., 2021,[29]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Detogni, 2007,[13]	Y	Y	Y	Y	Y	Y	Y	N	Y	88.9%	L
	Figueiredo et al., 2013,[31]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Freitas, 2008,[43]	Y	Y	Y	Y	Y	Y	Y	N	Y	88.9%	L
	Gaetti-Jardim Jr et al., 2015,[32]	Y	N	N	Y	N	U	U	N	U	22.2%	H
	Kussaba, 2017,[46]	N	N	N	Y	N	Y	Y	N	U	33.3%	H
	Mesquita et al., 2010,[47]	Y	Y	Y	Y	Y	Y	Y	N	U	77.8%	L
	Pereira et al., 1972,[16]	Y	N	U	Y	U	N	N	N	U	22.2%	H
	Tumang, Piedade, 1968,[38]	Y	N	N	N	U	Y	N	N	N	22.2%	H
Maloclusion	Arantes et al., 2001,[5]	Y	Y	Y	Y	Y	Y	N	N	Y	77.8%	L
	Souza et al., 2015,[12]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Detogni, 2007, [13]	Y	Y	Y	Y	Y	Y	Y	N	Y	88.9%	L
	Frattucci, 2000,[42]	Y	N	N	Y	U	Y	Y	N	N	44.4%	H
	Niswander, 1967,[14]	Y	N	N	Y	N	Y	N	N	N	33.3%	H
	Normando et al., 2011,[15]	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	L
	Pereira et al., 1972,[16]	Y	N	U	Y	U	Y	N	N	U	33.3%	H
Tooth wear	Pereira et al., 1972,[16]	Y	N	U	Y	U	Y	N	N	U	33.3%	H

Q1. Was the sample frame appropriate to address the target population? Q2. Were study participants sampled in an appropriate way? Q3. Was the sample size adequate? Q4. Were the study subjects and the setting described in detail? Q5. Was the data analysis conducted with sufficient coverage of the identified sample? Q6 Were valid methods used for the identification of the condition? Q7. Was the condition measured in a standard, reliable way for all participants? Q8. Was there appropriate statistical analysis? Q9. Was the response rate adequate, and if not, was the low response rate managed appropriately?
Y:- Yes; N: No; U: Unclear, NA: Not applicable; H: High, M: Moderate; L:– Low.

A – 18 to 36 months

Study	Events	Total	Weight	IV. Random, 95% CI	Risk of Bias
Guisilini et al., 2016	47	128	34.6%	0.37 [0.28; 0.46]	LOW
Oliveira et al., 2018	31	44	30.5%	0.70 [0.55; 0.83]	HIGH
Sampaio et al., 2010	66	146	34.9%	0.45 [0.37; 0.54]	LOW
Total (95% CI)		318	100.0%	0.50 [0.31; 0.69]	

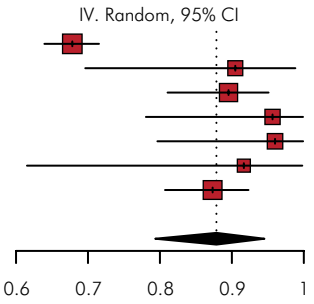
Heterogeneity: $Tau^2 = 0.0257$; $Chi^2 = 15.21$, df = 2 ($P < 0.01$); $I^2 = 87\%$



B – 5 years

Study	Events	Total	Weight	IV. Random, 95% CI	Risk of Bias
Arantes et al., 2021	411	606	19.8%	0.68 [0.64; 0.72]	LOW
Detogni, 2007	19	21	11.6%	0.90 [0.70; 0.99]	LOW
Lemos et al., 2018	77	86	17.1%	0.90 [0.81; 0.95]	LOW
Oliveira et al., 2018	22	23	12.0%	0.96 [0.78; 1.00]	HIGH
Parizzoto et al., 2004	24	25	12.4%	0.96 [0.80; 1.00]	MODERATE
Pereira et al., 2007	11	12	8.8%	0.92 [0.62; 1.00]	LOW
Sampaio et al., 2010	124	142	18.3%	0.87 [0.81; 0.92]	LOW
Total (95% CI)		915	100.0%	0.88 [0.79; 0.95]	

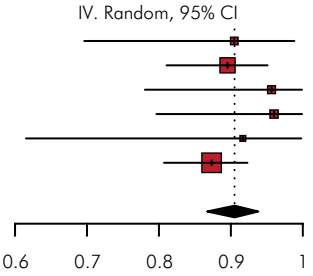
Heterogeneity: $Tau^2 = 0.0153$; $Chi^2 = 60.78$, df = 6 ($P < 0.01$); $I^2 = 90\%$



C – 5 years – without outlier

Study	Events	Total	Weight	IV. Random, 95% CI	Risk of Bias
Detogni, 2007	19	21	6.9%	0.90 [0.70; 0.99]	LOW
Lemos et al., 2018	77	86	27.7%	0.90 [0.81; 0.95]	LOW
Oliveira et al., 2018	22	23	7.5%	0.96 [0.78; 1.00]	HIGH
Parizzoto et al., 2004	24	25	8.2%	0.96 [0.80; 1.00]	MODERATE
Pereira et al., 2007	11	12	4.0%	0.92 [0.62; 1.00]	LOW
Sampaio et al., 2010	124	142	45.7%	0.87 [0.81; 0.92]	LOW
Total (95% CI)		309	100.0%	0.91 [0.87; 0.94]	

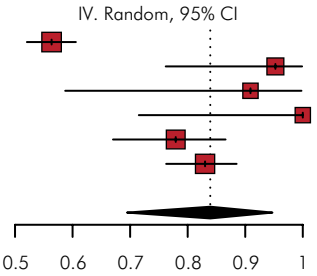
Heterogeneity: $Tau^2 = 0.0$; $Chi^2 = 2.25$, df = 5 ($P = 0.81$); $I^2 = 0\%$



D – 12 years

Study	Events	Total	Weight	IV. Random, 95% CI	Risk of Bias
Arantes et al., 2021	306	543	20.5%	0.56 [0.52; 0.61]	LOW
Detogni, 2007	20	21	15.4%	0.95 [0.76; 1.00]	LOW
Cortes, 2013	10	1	12.6%	0.91 [0.59; 1.00]	LOW
Oliveira et al., 2018	1	1	12.6%	1.00 [0.72; 1.00]	HIGH
Lemos et al., 2016	60	77	19.0%	0.78 [0.67; 0.87]	LOW
Sampaio et al., 2010	132	159	19.9%	0.83 [0.76; 0.89]	LOW
Total (95% CI)		822	100.0%	0.84 [0.69; 0.95]	

Heterogeneity: $Tau^2 = 0.0336$; $Chi^2 = 75.76$, df = 5 ($P < 0.01$); $I^2 = 93\%$



E – 12 years – without outlier

Study	Events	Total	Weight	IV. Random, 95% CI	Risk of Bias
Detogni, 2007	20	21	15.9%	0.95 [0.76; 1.00]	LOW
Cortes, 2013	10	11	10.3%	0.91 [0.59; 1.00]	LOW
Oliveira et al., 2018	11	11	10.3%	1.00 [0.72; 1.00]	HIGH
Lemos et al., 2016	60	77	28.9%	0.78 [0.67; 0.87]	LOW
Sampaio et al., 2010	132	159	34.5%	0.83 [0.76; 0.89]	LOW
Total (95% CI)		279	100.0%	0.88 [0.79; 0.94]	

Heterogeneity: $Tau^2 = 0.0070$; $Chi^2 = 75.52$, df = 4 ($P = 0.11$); $I^2 = 47\%$

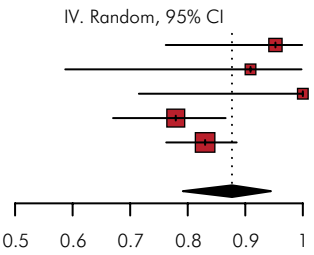


Figure 2. Forest plot of dental caries: A: Prevalence in the indigenous population aged 18–36 months; B: Prevalence of dental caries in the 5-year-old indigenous population; C: Sensitivity analysis after removal of outlier values of dental caries prevalence in the 5-year-old indigenous population; D: Prevalence of dental caries in the 12-year-old indigenous population; E: Sensitivity analysis after removal of outlier values of dental caries prevalence in a 12-year-old indigenous population.

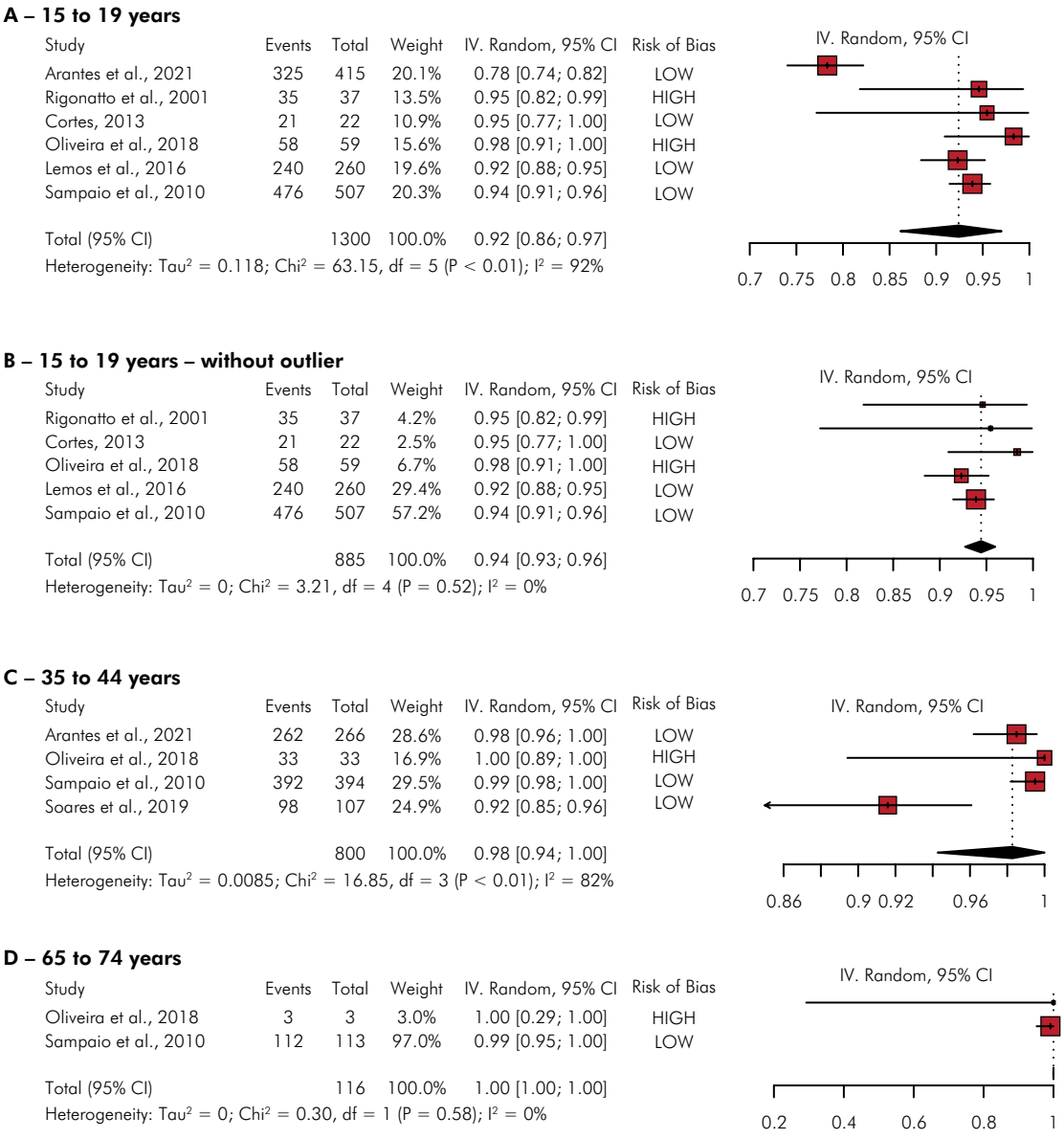


Figure 3. Forest plot of dental caries: A: Prevalence of dental caries in the indigenous population aged 15–19 years; B: Sensitivity analysis after removal of outlier values of dental caries prevalence in the indigenous population aged 15–19 years; C: Prevalence of dental caries in the indigenous population aged 35–44 years; D: Prevalence of dental caries in the indigenous population aged 65-74 years.

years (Figure 5C), respectively. Sensitivity tests for these analyses were not performed since no outliers were detected.

The prevalence of dental calculus was 34% (95%CI: 9% - 65%, I^2 = 97%), 52% (95%CI: 11–91, I^2 = 97%) and 29% (95%CI: 3–67, I^2 = 98%) for the age groups 15–19 years (Figure 6A), 35–44 years (Figure 6B) and 65–74 years (Figure 6C), respectively. Sensitivity tests with outlier exclusion was possible only for the prevalence in the 65–74 age group, indicating a prevalence of 47% (95%CI: 23–71, I^2 = 91%) (Figure 6D).

The prevalence of periodontal pockets was 6% (95%CI: 0–17%, I^2 = 93%), 7% (95%CI: 0–19, I^2 = 91%) for the age groups from 35–44 years (Figure 7A) and 65–74 years (Figure 7B), respectively. Sensitivity tests for these analyses were not performed since no outliers were detected.

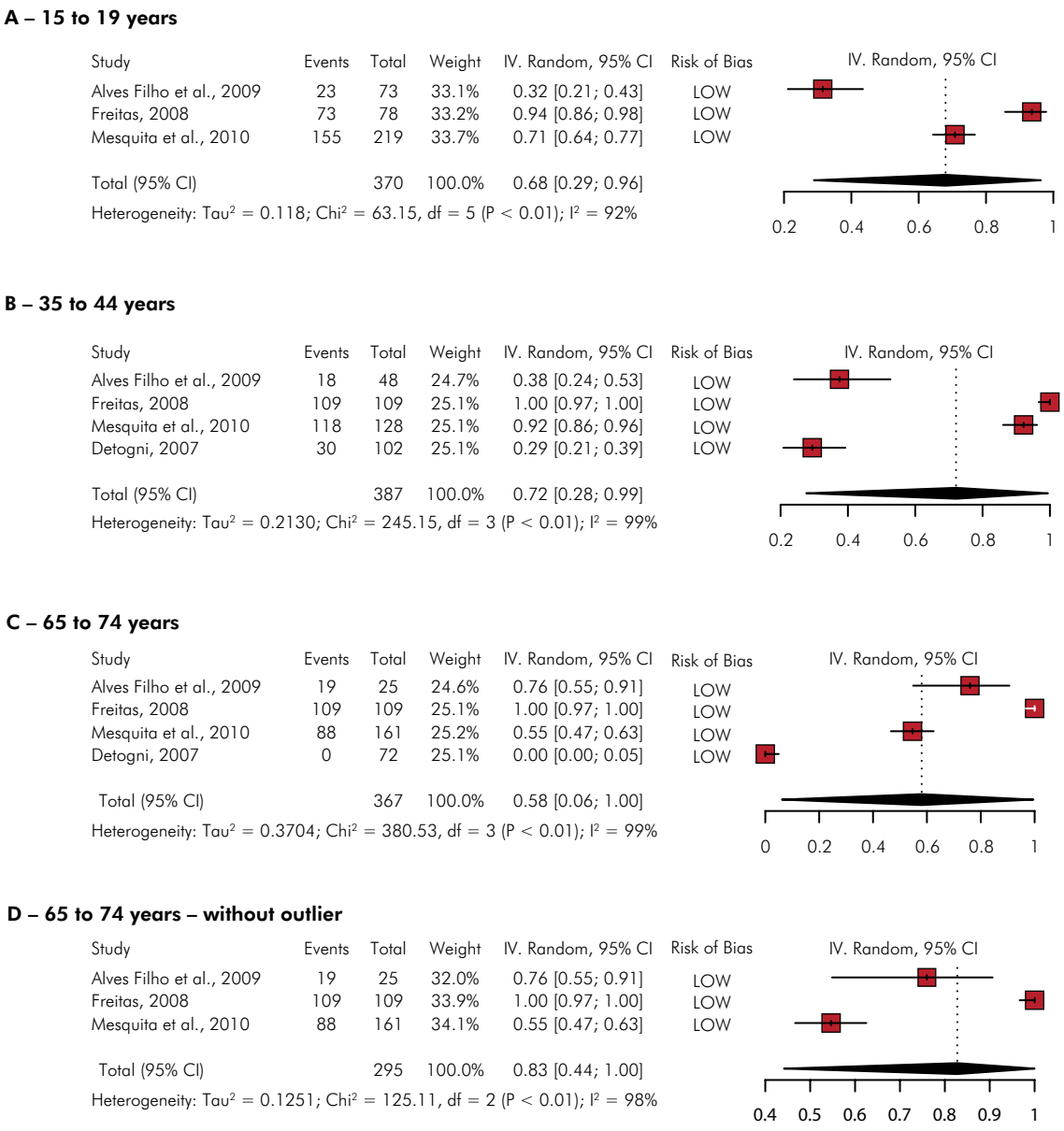


Figure 4. Forest plot of periodontal disease: A: Prevalence of periodontal disease in the indigenous population aged 15–19 years; B: Prevalence of periodontal disease in the indigenous population aged 35–44 years; C: Prevalence of periodontal disease in the indigenous population aged 65–74 years; D: Sensitivity analysis after removal of outlier values of the prevalence of periodontal disease in the indigenous population aged 65–74 years.

Malocclusion

Seven studies were included in the meta-analysis on this outcome.[5,12-16,42] No studies reported results separated by age group and, for this reason, all data were summarized in a single analysis. The pooled results showed a prevalence of 43% (95%CI: 20–67, I^2 = 98%) (Figure 8A). The sensitivity test, after excluding outliers,[5,13,14] showed a prevalence of 48% (95%CI: 25–71), but the heterogeneity remained high (I^2 = 94%) (Figure 8B).

Certainty of evidence

The GRADE approach was used to assess eighteen outcomes. Two analyses of caries prevalence (age group 5 years and 15 to 19 years) were classified as moderate level of certainty. All other analyses were

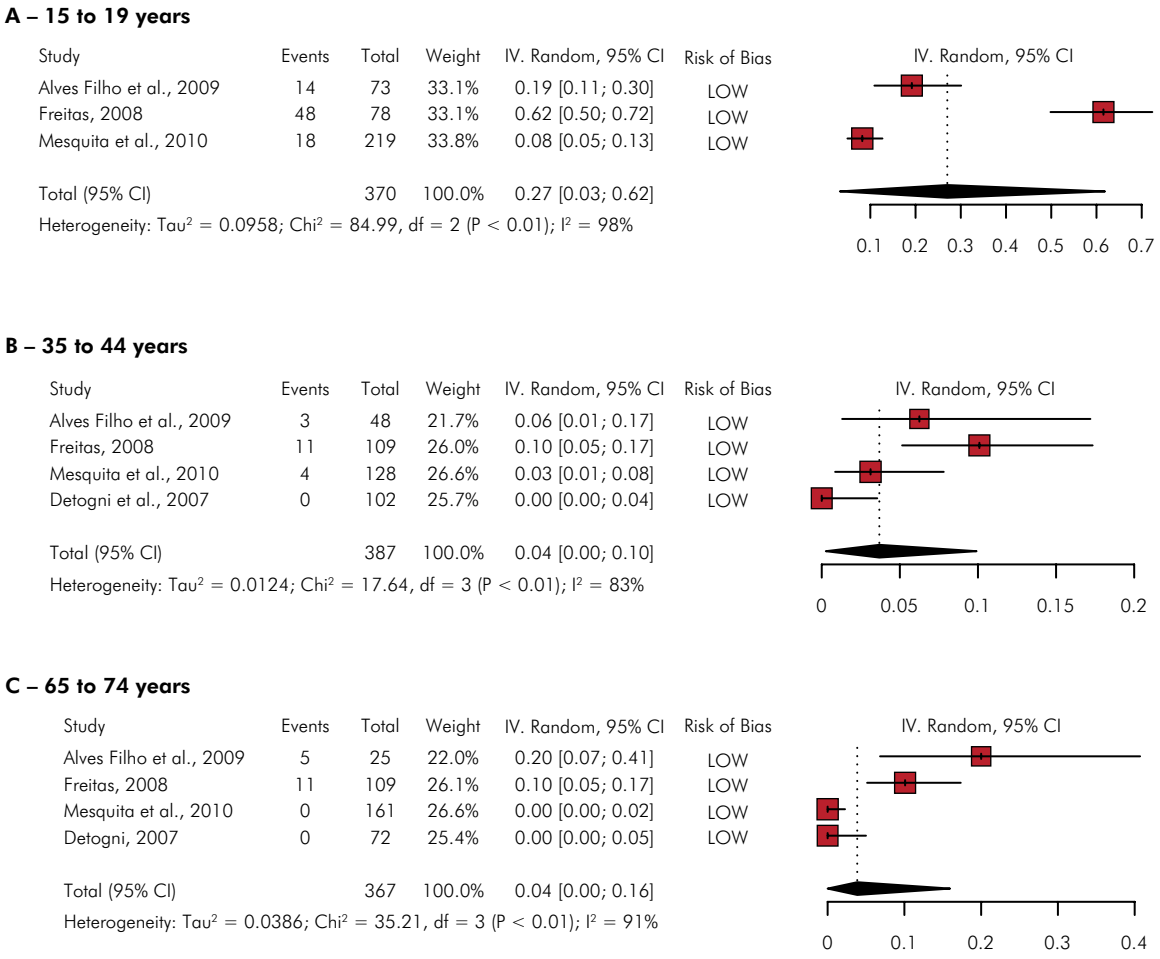


Figure 5. Forest plot of gingival bleeding: A: Prevalence of gingival bleeding in the indigenous population aged 15–19 years; B: Prevalence of gingival bleeding in the indigenous population aged 35–44 years; C: Prevalence of gingival bleeding in the indigenous population aged 65–74 years.

categorized as low or very low level of certainty, which means the true effect may be substantially different from the estimate of the effect. Table 8 shows more details for each outcome assessed.

Discussion

The present review analyzed the prevalence of dental caries, periodontal disease, malocclusion, and tooth wear in indigenous people of Brazil living in indigenous lands. The study differs from other published reviews in that it assessed all age groups and addressed the above-mentioned conditions together. Thus it revealed an important variation in the prevalence of these conditions among different indigenous people. It is worth mentioning that these differences were also found within the same geographic region, and in the same ethnic group inhabiting different regions.

The prevalence of dental caries in the population aged 18-36 months was 37% in the Kaiabi, Yudjá, Ikpeng, Trumai, Kamaiurá, Waurá, Kisedjê, Panará and Tapaiuna ethnic groups in the Xingú Indigenous Park-MT and 70% in the Parakanã ethnic group in the state of Pará. The high heterogeneity observed in the meta-analysis can be explained by geographic differences (North, Northeast, and Midwest regions) and by the sociocultural diversity of the different ethnicities studied. The summary prevalence of dental caries (50%) in the indigenous population

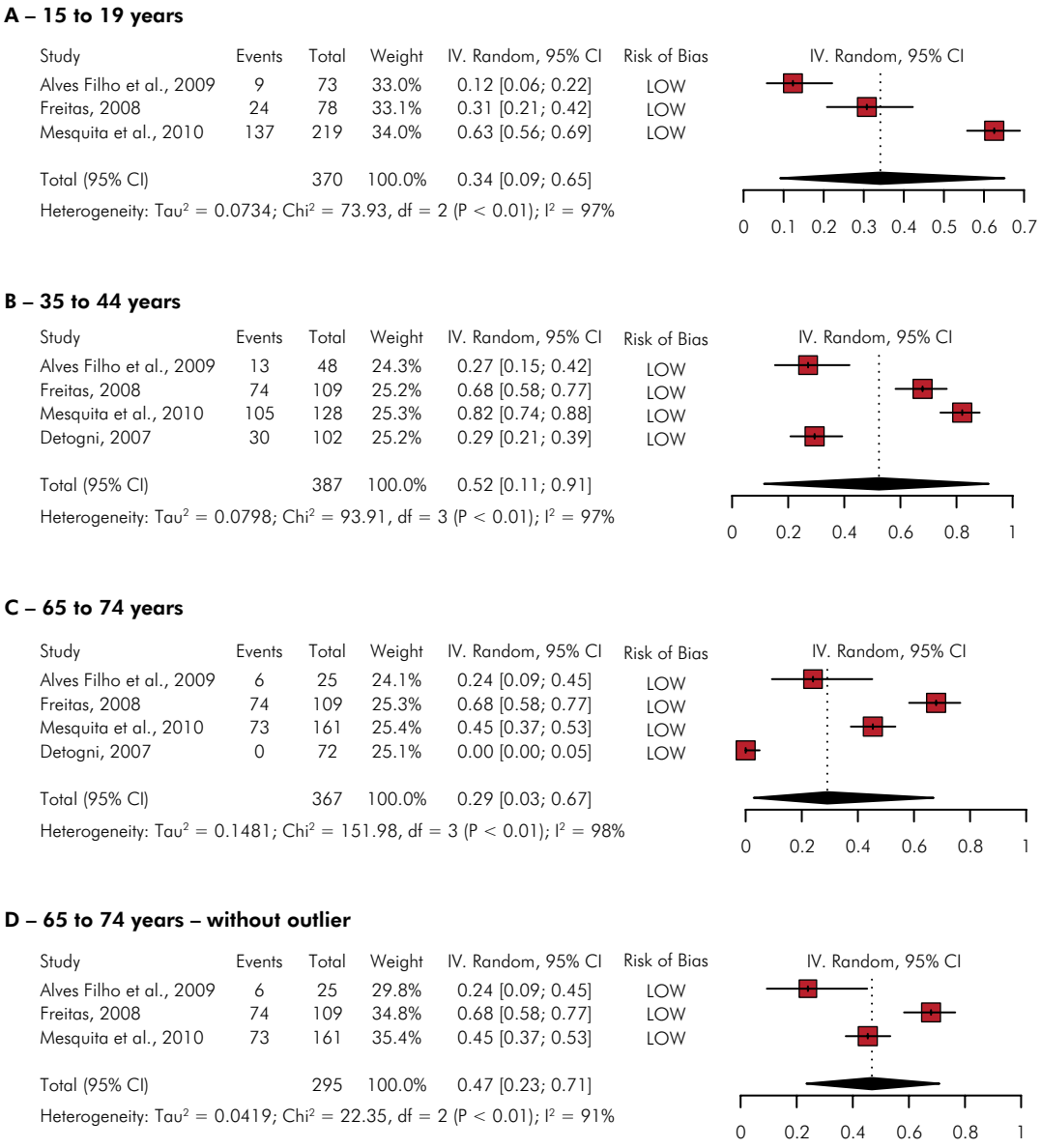


Figure 6. Forest plot of dental calculus: A: Prevalence of dental calculus in the indigenous population aged 15–19 years; B: Prevalence of dental calculus in the indigenous population aged 35–44 years; C: Prevalence of dental calculus in the indigenous population aged 65–74 years; D: Sensitivity analysis after outlier removal of dental calculus prevalence in the indigenous population aged 65–74 years.

was higher than the average found in the Brazilian urban population (26.85%) and the North (31.83%), Northeast (26.91%) and Central-West (20.71%) regions of the country.[54]

The highest prevalence found (70%) was for the Parakanã ethnic group, which can be attributed to the history of contact with urban population and important milestones such as the construction of the Tocantins railroad in the 1920s, the Transamazon highway in the 70s, and the Tucuruí hydroelectric power station in the 1980s that began operating in 1984.[48] These changes impacted the dynamics of the health-disease process of this population. Health care was focused on assisting the individuals affected by the diseases that plagued these indigenous people, but no health promotion and disease prevention

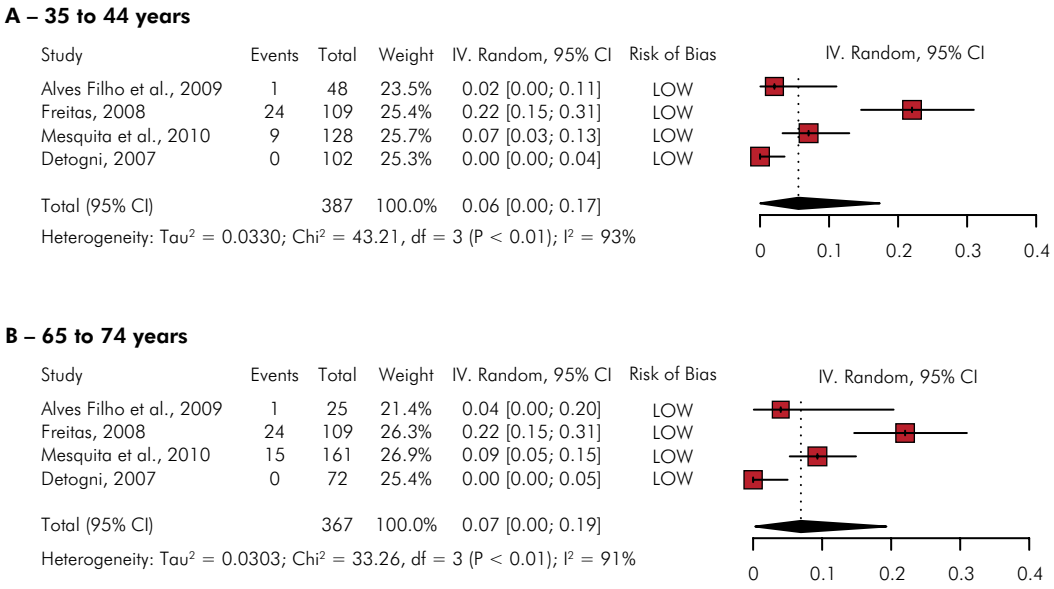


Figure 7. Forest plot of periodontal pocket: A: Prevalence of periodontal pockets in the indigenous population aged 35–44 years; B: Prevalence of periodontal pockets in the indigenous population aged 65–74 years.

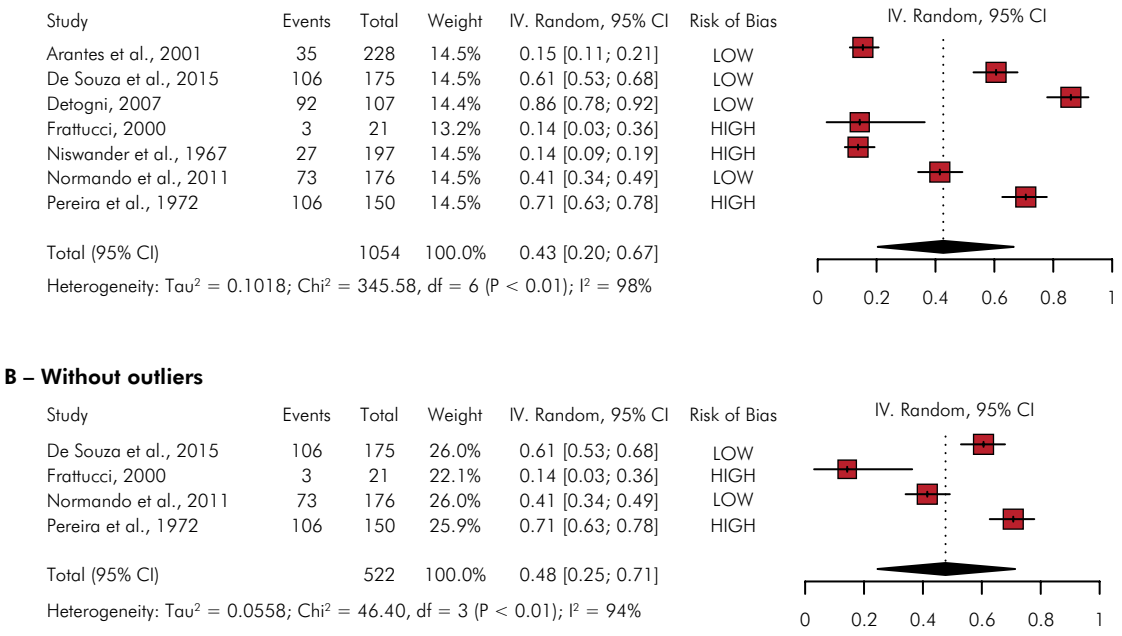


Figure 8. A: Forest plot of prevalence of malocclusion in the indigenous population; B: Sensitivity analysis after removal of outlier values of malocclusion prevalence in the indigenous population.

actions were developed. Relative to oral health, the same reasoning was followed, and care was focused on tooth extractions that were sporadically performed, and oral health care actions lacked a systematization.[48,55]

Table 8. Grading of Recommendations Assessment, Development, and Evaluation (GRADE) Summary of Findings Table for the Outcomes of the Systematic Review and Meta-Analysis.

Variable	Quality Assessment							Summary of Results		
									Effect	General
	Number of studies	Study Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Others considerations	Number of participants	Pooled prevalence (95% CI)	Certainty
Prevalence of dental caries										
(18–36 months)	3	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	318	50% (31%–69%)	⊕ Very low
(5 years)	6	Cross sectional studies	Not serious	Not serious	Serious[b]	Not serious	none[d]	309	91% (87%–94%)	⊕⊕⊕ Moderate
(12 years)	5	Cross sectional studies	Not serious	Not serious	Serious[b]	Serious[e]	none[d]	822	88% (79%–94%)	⊕⊕ Low
(15–19 years)	5	Cross sectional studies	Not serious	Not serious	Serious[b]	Not serious	none[d]	885	94% (93%–96%)	⊕⊕⊕ Moderate
(35–44 years)	4	Cross sectional studies	Not serious	Serious[f]	Serious[b]	Not serious	none[d]	800	98% (94%–100%)	⊕⊕ Low
(65–74 years)	2	Cross sectional studies	Serious[g]	Not serious	Serious[b]	Not serious	none[d]	116	100% (100%–100%)	⊕⊕ Low
Prevalence of malocclusion	7	Cross sectional studies	Serious[g]	Very serious[a]	Serious[b]	Very serious[c]	none[d]	1054	43% (20%–67%)	⊕ Very low
Prevalence of periodontal disease										
(15–19 years)	3	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	370	68% (29%–96%)	⊕ Very low
(35–44 years)	4	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	387	72% (28%–99%)	⊕
(65–74 years)	4	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	367	58% (6%–100%)	⊕ Very low
Prevalence of bleeding										
(15–19 years)	3	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	370	27% (3%–62%)	⊕ Very low
(35–44 years)	4	Cross sectional studies	Not serious	Serious[f]	Serious[b]	Serious[c]	none[d]	387	4% (0%–10%)	⊕ Very low
(65–74 years)	4	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	367	4% (0%–16%)	⊕ Very low
Prevalence of dental calculus										
(15–19 years)	3	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	370	34% (9%–65%)	⊕ Very low
(35–44 years)	4	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	387	52% (11%–91%)	⊕ Very low
(65–74 years)	4	Cross sectional studies	Not serious	Very serious[a]	Serious[b]	Very serious[c]	none[d]	367	29% (3%–67%)	⊕ Very low
Prevalence of periodontal pocket										
(35–44 years)	4	Cross sectional studies	Not serious	Serious[f]	Serious[b]	Very serious[c]	none[d]	387	6% (0%–17%)	⊕ Very low
(65–74 years)	4	Cross sectional studies	Not serious	Serious[f]	Serious[b]	Very serious[c]	none[d]	367	7% (0%–19%)	⊕ Very low

[a] Very serious inconsistency. Substantial heterogeneity ($I^2 > 50\%$) and point estimates and confidence intervals vary considerably; [b]The sample of the studies included were from specific populations; [c]Very serious imprecision. The confidence interval of the effect estimate varied by over 10%; [d] Publication bias not assessed due to low number of studies (< 10); [e]Serious imprecision. The confidence interval of the effect estimate varied by over 5%, but less than 10%; [f]Serious inconsistency. Substantial heterogeneity ($I^2 > 50\%$), but there was overlap of the confidence intervals; [g]Half of the eligible studies were at high risk of bias.

The lowest percentage of dental caries among ethnic groups in the Xingu Indigenous Park (lower, middle, and east Xingu region) can be explained by the actions of the DSEI Xingu Oral Healthcare Program[56], primary care services, collective actions and trained indigenous teachers and Indigenous Oral Health Agents that were provided.[45]

The prevalence of dental caries in the Potiguara indigenous people can be attributed to the direct contact they have with urban populations in neighboring cities, which contributed to the changes in their traditional eating habits and exposure to cariogenic industrialized foods.[36]

The prevalence of caries ranged from 68% to 96% in the age groups of 5 years, but the prevalence was higher than 90% in the majority of the studies included. The lowest prevalence was observed in the four largest indigenous groups in the state of Mato Grosso do Sul, which are Guarani (about 4,770 people), Kaiowá (37,650), Terena (about 27,350) and Kadiwéu (1,550). Together they represented 98% of the state's indigenous population[1]. This difference in prevalence with other studies from other locations resulted in high heterogeneity (I^2 = 90%) in the meta-analysis and a sensitivity analysis was performed (I^2 = 0%). The meta-analysis revealed a mean prevalence of caries of 88% in the ethnic groups Enawenê-Nawê (northwest of the state of Mato Grosso), Tapayuna, Kaiabi, Ikpeng, Yudjá, Mehinako, Waurá, Panará, Kamaiurá and Trumai (Xingú Indigenous Park (lower, east and middle-MT); Parakanã (Tucuruí-PA), Kaiowá-Guarani (Caarapó-MTS Reserve), Yanomami (Maiá-Santa Isabel do Rio Negro-AM) and Potiguara (Indian Reservation Potiguara-PB), which is higher than the national average for non-indigenous children (53.4%).[57] The high prevalence of dental caries among indigenous children caused concern as it suggested that they were more exposed to risk factors such as the intake of free sugar, a common risk factor for other chronic non-communicable diseases.[58] Moreover, the overall mean score for deciduous dentition was significantly higher (SMD = 0.67; 95%CI 0.47–0.87) among indigenous than nonindigenous children[9].

The mean prevalence of dental caries at the age of 12 years was high (84%) ranging from 56% to 100%. A prevalence higher than 90% was observed for the Kotiria and Enawenê-Nawê ethnicities. The Enawêne-Nawê ethnicity, who inhabit the northwest region of Mato Grosso, have been particularity important because they have had less interaction with society, and despite contact in the 1970s, they remained relatively isolated even after threats to their social life (hydroelectric plant projects, agricultural and mining activities, and soy plantations surrounding their territory).[13,55] The high DMFT of this population has been related to their traditional pasty, sweet and starch-rich diet, which caused the critical oral health condition in this group even before contact with society.[59] Whereas the Kotiria ethnicity, despite the great difficulties with reaching the indigenous communities, the increased traffic flow of vessels on the Alto Rio Uaupés, and circulation of products and people in the region over the past decades has potentiated and catalyzed changes in their way of life.[41]

In the population aged 15–19 years, the mean prevalence was 92%, higher than the one found in the Brazilian urban population, which was 76.1%.[57] In the adult (35–44 years) and elderly (65–74) population, a high prevalence of caries was observed, similar to that found in the Brazilian urban population (above 99%).[57] This similarity allowed us to conclude that dental caries in the elderly and adulthood was a public health problem for indigenous and non-indigenous people. However, in a recent systematic review the DMFT scores of permanent dentition showed that the indigenous population had worse caries experience than the nonindigenous population with a standardized mean difference of 0.26 (95%CI 0.13–0.39).[9]

Periodontal disease is one of the two most significant oral diseases that contribute to the global burden of chronic disease, thus qualifying it as a global public health problem. In addition to social determinants, periodontal health status is related to several proximal factors.[60] Periodontal disease normally begins with gingivitis, and if untreated, it can progress to periodontitis,[61] especially in immune-compromised individuals and in the presence of risk factors such as smoking and diabetes[62]. Periodontitis, in turn, can lead to tooth loss, difficulties with

eating and speaking, affect social interaction, and impact the quality of life.[63-65] Periodontal disease in indigenous people has hardly been studied and the studies included in the qualitative analysis were heterogeneous in terms of method, instruments used, analysis by sextants or total arches, and the conditions of gingival bleeding, dental calculus, and periodontal pockets were reported globally or individually.

The prevalence of periodontal disease observed in the present study showed a significant difference between studies, considering ethnic groupings or a particular ethnicity. This result suggested that in addition to the accumulation of biofilm, periodontal diseases are influenced by sociocultural and environmental factors. In this context, socioeconomic status and plaque index > 40% was associated with the indication of tooth extraction in the Kiriri ethnic group[66]. In the population aged 15–19 years and 35–44 years, the lowest prevalence (32% and 38%, respectively) was observed in the Guarani who live in villages on the coast of São Paulo and Rio de Janeiro.[39] Access to the villages occurs by land and sea, which has favored the development of health promotion activities and oral health care since 1993. In the Yanomami of the Xitei-Ketaa-RR Pole,[43] the prevalence observed was above 90% in all age groups studied. This could be attributed to the predominantly pasty, less abrasive diet, favoring the biofilm accumulation and consequent gingival inflammation. In the lower and middle Xingu ethnic groups, the prevalence ranged from 55% in the elderly population to 92% in the 35–44 age group, higher than that found in the non-indigenous population.[54] It is worth mentioning that the adult and elderly had a considerable number of sextants excluded due to edentulism,[47] as observed in the Enawenê-Nawê ethnic group.[13] A recent systematic review showed that the prevalence of periodontitis was 35% (95%CI: 0.18–0.52) higher among the indigenous population than the non-indigenous population.[67]

The prevalence of gingival bleeding in adolescents (27%) was lower than the national average for the urban population (33.8%).[57] However, it would be important to highlight that the prevalence found in the Yanomami inhabitants of the Polo Base Xitei-Ketaa-RR was the highest, 62%, and this was also observed in the urban population of the northern region (51.0%).[57] Dental calculus was more prevalent (52%) in the population aged 35–44 years, but with indices lower than those found in the urban population (64.1%).[57]

Malocclusion in indigenous people has not been widely studied and the studies included in the qualitative analysis, which assessed malocclusion, were heterogeneous in terms of the age groups and methodology. The prevalence found in the present study ranged from 14% to 86% with a mean of 43% in the quantitative analysis, considering all age groups analyzed. The data found were lower than those found for the world average (56%) and the Americas (53%)[68] and higher than the national average in urban population (37.6% and 36.0% in the age group 12 and 15-19 years, respectively).[57] Malocclusion in indigenous Brazilians has been associated with genetic factors that substantially contribute to the morphology of occlusal and facial features in the indigenous groups studied, as observed in the Arara-laranjal, Arara-iriri[15] and Asurini, Pat-krô and Pikayaká[12] ethnicities. The study carried out in the 1970s, which assessed malocclusion in the Yanomami population, concluded that the influence of mastication on the evolution of human dentition did not appear to be preponderant; physiological occlusal wear eliminated dental cusps, but this did not decrease masticatory efficiency; occlusal interferences caused attrition asymmetry; and physiological proximal wear had little influence on anterior crowding.[16] Therefore, the prevalence of malocclusion in indigenous populations must be assessed in other ethnic groups, and so must the changes that have occurred in sociocultural aspects.

In relation to tooth wear, the only study included showed a high prevalence in the Yanomami ethnicity (64.3% at 13–18 years old and 100% in those over 18 years old).[16] In turn, the results of a recent study on the Macuxi ethnic group (Roraima, Brazil) showed a prevalence of tooth wear of 38.1% and that indigenous adults have a greater chance of tooth wear (8.09 CI 3.70–17.98) than adolescents.[69] The prevalence of tooth wear in population-based studies in permanent teeth of children and adolescents was reported by

a systematic review and indicated a prevalence of 30.4%, however, with high heterogeneity between studies. According to the authors, the correct choice of a clinical index for detecting dental erosion and the geographic location play an important role in the great variability of erosive tooth wear in permanent teeth of children and adolescents.[70]

The strength of the present review was that the study did not include self-declared indigenous individuals living in urban areas, but only included individuals living in indigenous territory. This approach was in line with the aspects pointed out in the literature, which considered it a challenge to have consistent data on the indigenous population due to the way people self-identify.[71]

On the other hand, the results should be interpreted with attention considering that the quality of the studies included may have affected the results of this systematic review. The main limitation of this systematic review and meta-analysis was the low certainty of the body of evidence, which was justified by the high heterogeneity of estimates; indirect evidence, as the samples of the studies included in the analysis were from specific indigenous ethnicities and not representative of the entire indigenous population in Brazil. A further limitation was the imprecision of the data due to the great variation in the confidence intervals of the analyses. Furthermore, it was not possible to analyze and compare ethnicities in isolation, as many studies analyzed several ethnicities, and presented a single result in a grouped form.

New approaches with representative samples of ethnicities and with standardized dental disease outcomes[71] in alignment with population-based studies need to be carried out, as well as analysis within the context of the life of these populations. Based on our results, a nationwide survey on the oral health conditions of the different indigenous people in Brazil must be conducted as it would substantially contribute to the development of strategies for action and organization of health services in accordance with the different realities of each Special Indigenous Health District (DSEI).

Conclusion

Based on limited evidence, this study reported significant differences in prevalence of dental caries, periodontal disease, and malocclusion in the Brazilian indigenous population. These variations resulted from the great diversity among Brazilian indigenous people; that is, different socioeconomic, environmental, and cultural conditions. Furthermore, the instruments used, and the results reported need to be standardized and improved in future research involving indigenous people.

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