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Review article

Prevalence of noncarious cervical lesions among adults: A systematic review

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ABSTRACT

Objectives: This study aims to systematically review the literature on noncarious cervical lesions (NCCLs) and calculate an overall prevalence estimate.
Methods: The protocol of this systematic review was prepared according to PRISMA and MOOSE guidelines. The MEDLINE-PubMed and Cochrane-CENTRAL databases were searched. Relevant published papers that provided information regarding the prevalence or number of NCCLs among general or specific populations were included.
Results: The initial search identified 569 titles and abstracts, 24 of which met the eligibility criteria involving 14,628 participants. The weighted mean prevalence of NCCLs among the whole studied population was 46.7 % (95 % CI: 38.2; 55.3 %), ranging from 9.1%–93%. Based on sub-analyses, studies with populations older than 30 years revealed higher weighted prevalence (53 %) than those with populations younger than 30 years (43 %). Regarding the diagnostic method, when visual or tactile clinical examination was used, the prevalence was lower than when the Smith and Knight tooth wear index was used. When different definitions were used, the weighted mean prevalence varied from 28 % to 62 %. As to the terms used to address the lesions, the prevalence was higher when "noncarious cervical lesion" was used and lower when "root defects," "abrasion," or "abfraction" were used. When geographical regions were compared, South America had the highest reported prevalence of NCCLs, while the United States had the lowest. Moreover, general populations presented the highest prevalence, slightly higher than dental populations, whose members frequented dental practices.
Conclusion: The overall prevalence of NCCLs was 46.7 % and higher in older populations. Visual and tactile clinical examination underestimate this prevalence compared to the established index. The terms and definitions used also influenced the prevalence data. Distinct geographical differences were observed, and general populations were more inclined to present NCCLs.

1. Introduction

A noncarious cervical lesion (NCCL) is defined as a defect resulting from the loss of tooth structure at the cementoenamel junction (CEJ) that is not related to bacteria [1]. Noncarious cervical lesions are also commonly referred to as "abfraction lesions" [2–7], "cervical wear" [8–11], "cervical abrasions" (or "noncarious cervical tooth surface loss" [12], "abfraction-like cervical lesions" [13] and "vestibular cervical dental abfractions" [14]. The etiology of NCCLs is considered multifactorial, with combinations of friction (attrition and abrasion), biocorrosion, and occlusal stress [7]. The term "erosion" is also used to refer to the role of acids in tooth wear [15–17].

Debate regarding all these etiological factors, including which process is dominant, persists [11,18,19]. Tooth substrate loss due to attrition, abrasion, and erosion is not found only in the cervical region, which complicates the diagnosis of NCCLs. In 1984, Lee and Eakle

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[20]—in an attempt to create a clearer definition—thus began to discuss and segregate the different etiological factors of noncarious loss of tooth structure. In 1992 [21], the term "noncarious cervical lesion" was being used, and in 1994, Levitch [18] accurately discussed each etiological factor that was somehow related to the development of NCCLs to clarify their cause, diagnosis, treatment, and prevention.

Despite all past discussion on the subject, different approaches are still being used to classify and diagnose NCCLs. Some studies identify any loss of tissue at the CEJ as an NCCL [22–25]; others consider only wedge-shaped lesions [26–28] or 1-mm-deep lesions [1,9,29] to be NCCLs. A large variation in the reported prevalence rates of NCCLs is present in epidemiological studies, ranging from 5 % to 85 %. This variation might result from using different nomenclature for the same alteration; diversity in the definition, diagnosis, and assessment method used; and variance in the geographical location, time period, and type of population studied [1,11,13,18,27,30–34].

The reported prevalence of NCCLs in different geographical locations seems to vary considerably, yet no previous studies have estimated the worldwide prevalence. This study therefore aims to systematically review the literature to estimate the worldwide prevalence of NCCLs in the adult population, while a sub-analysis intends to clarify the large variation in rates.

2. Methods

More details of this systematic review as included and excluded studies, sub-analysis, quality assessment and guidelines can be seen in the Online Appendix Supplement (Tables S1–S7). The protocol of this systematic review was prepared according to PRISMA and MOOSE guidelines (see Online Appendix S6 and S7). The focused research question was also prepared as follows: What is the worldwide prevalence of noncarious cervical lesions (NCCLs) among adults? For details regarding the search terms used, see Table 1.

2.1. Search strategy

Two online sources were used to find research papers that satisfied the purpose of this study: the National Library of Medicine, Washington, DC (MEDLINE-PubMed), and the Cochrane Central Register of Controlled Trials (CENTRAL). Databases were searched for eligible studies conducted in or earlier than November 2018 according to the following criteria: studies in the English language; human subjects ≥16 years old; diagnosed with NCCLs as assessed by dental care professionals; and cross-sectional study design reporting the prevalence of NCCLs in an adult population.

2.2. Screening and selection

Two independent reviewers (DNRT and RZT) screened the titles and abstracts to find eligible papers. If eligible aspects were present in the title, the paper was selected for further reading; if not, the abstract and key words were screened for suitability. The two reviewers then read all selected full-text papers in detail. Any disagreement between the two was resolved with additional discussion, and if disagreement persisted, the judgment of a third reviewer (DES) was decisive. The papers that fulfilled all the selection criteria were processed for data extraction. For those papers that provided insufficient data to be included in the analysis, the first or corresponding author was contacted in an attempt to obtain additional data.

Table 1
Search strategy and terms.

Search terms used for PubMed-MEDLINE and Cochrane Library. The search strategy was customized appropriately according to the database being searched considering differences in controlled vocabulary and syntax rules.
The following strategy was used:
((Non caries cervical lesions) OR (Non caries cervical lesion*) OR (Non caries cervical lesion) OR (Non carious cervical lesions) OR (Non carious cervical lesion*) OR (Non carious cervical lesion) OR (Abfraction AND dental))

The asterisk (*) was used as a truncation symbol.

2.3. Data extraction and methodological quality assessment

The same two independent reviewers processed data from the papers that met the selection criteria for further analysis. The focus was the prevalence of NCCLs among adult populations. Percentages concerning the prevalence of NCCLs were thus extracted. However, if the selected paper did not provide the prevalence of NCCLs but did report on the number of subjects with the alteration, the prevalence was calculated by dividing the number of patients who presented NCCLs during the time period specified by the size of the population under investigation. The heterogeneity across studies was detailed according to the following factors: subjects' characteristics, the geographical region of the investigated population; NCCL definition; diagnostic criteria for NCCLs; and the prevalence of NCCLs (see online appendix S1).

2.4. Risk of bias

The methodological qualities of the included studies were subsequently assessed according to the quality criteria on the Joanna Briggs Institute's "Checklist for Analytical Cross Sectional Studies" [35]. When the sources of data and details on the methods of assessment, description or consideration of potential sources of bias, calibration or training of examiners, definition of noncarious cervical lesions, and whether the investigated group was a representative population were provided, the study was considered to have a low risk of bias.

2.5. Data analysis

The overall weighted mean prevalence percentage was calculated using SPSS Statistics 21.0. To assign more weight to the studies that carry more information for this analysis, each included study was assigned a weight according to its sample size. Due to the heterogeneity of the data, it was determined a priori to perform a quantitative subanalysis for age group, type of population, geographical location per continent where the study was conducted, the definition of "NCCL" used, the diagnosis of NCCLs, and the terms used to address NCCLs. For a detailed overview of which studies were used per analysis, see Online Appendix S4.

2.6. Grading

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group's GRADE method was used to appraise the evidence that emerged from this review. The three aforementioned reviewers rated the body of evidence, and any disagreement was resolved with additional discussion.

3. Results

3.1. Search results

The comprehensive search identified 569 unique papers. The screening of titles and abstracts resulted in 69 full-text papers, of which 36 were excluded for not meeting the eligibility criteria (see Fig. 1, online appendix S2), resulting in 11 included studies. All reference lists of the selected studies were then hand-searched for additional publications that could possibly meet the eligibility criteria of the study. Thirteen additional studies were thus included (see online appendix S3), totalizing 24 articles to be analyzed (see Table 2).

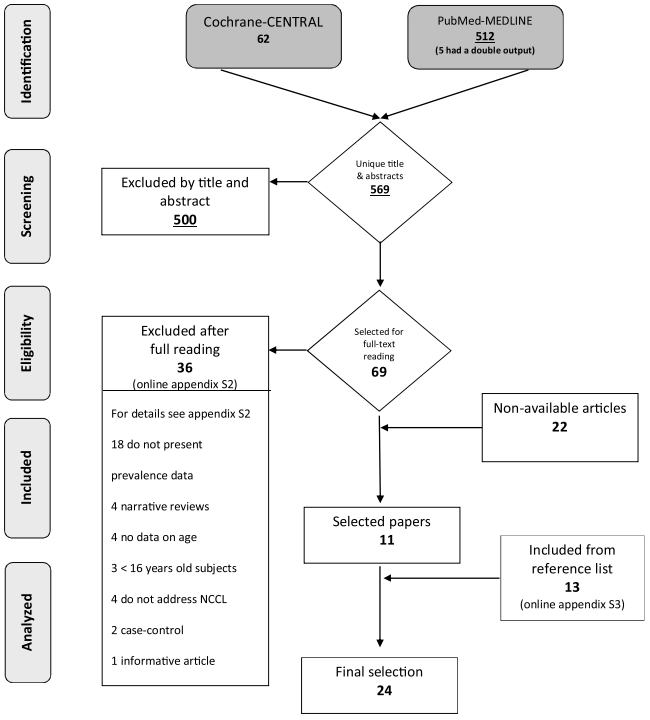

Fig. 1. Search and selection results.

3.2. Characteristics of selected studies

The extracted data regarding study design, the characteristics of the studied population, the definition of "noncarious cervical lesion" (NCCL), criteria and diagnostic methods for NCCLs, and the geographical location of the studies are presented in the online appendix.

An evaluation of the selected papers revealed considerable heterogeneity. The range of the included number of participants within studies was 40–2,707, with a mean of 609.5. Gender was equally distributed in Studies II, VI, and XIX. Conversely, in Studies I, IV, VIII, IX, X, XI, XX, and XXIV, subject groups consisted of more females than males, while Studies III, V, VII, XII, XIII, XIV, XV, XVIII, and XXI consisted of more males than females. Furthermore, the population of Study XXIII was 100 % male. Gender distribution was not stated in Studies XVI, XVII, and XXII.

As to the age range of the studied population, subjects were aged between 16 and 75 years old. Studies IV, VI, VII, X, XII, XVI, and XXIV included only those older than 30. Similarly, Studies X, XV, XVIII, XIX, XX, and XXIV used restricted age groups, which can represent inclusion criteria bias.

Subjects who frequented dental practices were included in Studies I, VII, VIII, IX, XI, XIII, XVIII, and XIX. While general representative populations were assessed in Studies II, IV, V, VI, X, XIV, XV, XVI, XVII, XXI, XXII, XXIII, and XXIV, specific populations were assessed in Studies III (Worker's Health Center Reference population), XII (population with increased risk of oral disease), and XX (military personnel population). Moreover, Europe, Asia, and South America were the most assessed regions, discussed in 37.5 %, 25 %, and 21 % of the studies, respectively.

Regarding diagnostic methods, most of the studies used visual or tactile clinical examination to detect NCCLs. The Smith and Knight tooth wear index was used for assessment in Studies II, IV, and XXIII, while Study VI favored a modified index based on Smith and Knight's. Only Study VII assessed clinical signs on accurate diagnostic casts and was thus excluded from the sub-analysis.

Finally, "noncarious cervical lesions" was the term used to refer to the lesions in Studies I, II, III, IV, V, VI, VIII, IX, XIV, XV, XVI, XVIII,

Table 2
Overall characteristics of the included studies, for further details see Table S1 (online supplement).

Author/year Study location Study design Risk of bias	Participants' age	Method of NCCL assessment	Cases of NCCL Total sample	Prevalence
(I) Yoshizaki, 2017 [1] Brazil Cross-sectional Low	Older than 18 years old	Visual and tactile analysis	80 cases out of 118 subjects	67.8 %
(II) Yang, 2016 [2] China Cross-sectional Moderate	20–69 years old	Smith and Knight tooth wear index (3)	831 cases out of 1320 subjects	63 %
(III) Bomfim, 2015 [4] Brazil Cross-sectional Moderate	20–68 years old	Visual analysis	78 cases out of 100 subjects	76.8 %
(IV) Lai, 2015 [5] China Cross-sectional Moderate	35–44 and 65–74 years old	Smith and Knight tooth wear index (3)	1394 cases out of 1759 subjects	79 %◊
(V) Que, 2013 [6] China Cross-sectional Low	20–69 years old	Visual and tactile analysis	633 cases out of 1023 subjects	61.7 %
(VI) Jiang, 2011 [7] China Cross-sectional Moderate	35–44 and 65–74 years old	Smith and Knight tooth wear index (3)	1029 cases out of 2160 subjects	47.6 %◊
(VII) Tsiggos, 2008 [8] Greece Cross-sectional Moderate	30–55 years old	Clinical signs assessed on accurate diagnostic casts	25 cases out of 102 subjects	24.5 %
(VIII) Smith, 2008 [9] Trinidad and Tobago Cross-sectional High	16–3 years old	Visual examination	97 cases out of 156 subjects	62.2 %
(IX) Kolak, 2018 [10] Servia Cross-sectional Substantial	19–55 + years old	Visual examination	270 cases out of 394 subjects	68.5 %
(X) Hahn, 1999 [11] Germany Cross-sectional Moderate	50–60 years old	Visual and tactile examination	277 cases out of 298 subjects	93 %◊
(XI) Reyes, 2009 [12] USA Cross-sectional Low	23–82 years old	Visual and tactile examination	23 cases out of 46 subjects	50 %◊
(XII) Ringelberg et al., 1996 [13] USA Cross-sectional Substantial	45–75 + years old	Visual and tactile examination	87 cases out of 873 subjects	10 %
(XIII) Akgul et al., 2003 [14] Turkey Cross-sectional High	Older than 20 years old	Visual examination	39 cases out of 428 subjects	9.1 %
(XIV) Bernardt et al., 2006 [15]	20–59 years old	Visual and tactile examination	855 cases out of	31.6 %◊

(continued on next page)

Table 2 (*continued*)

Author/year Study location Study design Risk of bias	Participants' age	Method of NCCL assessment	Cases of NCCL Total sample	Prevalence
Germany Cross-sectional Low			2707 subjects	
(XV) Brandini et al., 2011 [16] Brazil Cross-sectional High	19–31 years old	Visual and tactile examination	31 cases out of 58 subjects	53.5 %
(XVI) Estafan et al., 2005 [17] USA Cross-sectional High	Mean of 28.9 years old	Visual examination of casts	99 cases out of 299 subjects	33.1 %
(XVII) Lussi et al., 1991 [18] Switzerland Cross-sectional Substantial	26–30 and 46–50 years old	Visual and tactile examination	84 cases out of 391 subjects	21.5 %◊
(XVIII) Ommerborn et al., 2007 [19] Germany Cross-sectional Substantial	20–39 years old	Visual examination	27 cases out of 91 subjects	30 %◊
(XIX) Pegoraro et al., 2005 [20] Brazil Cross-sectional Substantial	25–45 years old	Visual and tactile examination	62 cases out of 70 subjects	88 %◊
(XX) Radentz et al., 1976 [21] USA Cross-sectional High	17–45 years old	Visual and tactile examination	40 cases out of 80 subjects	50 %◊
(XXI) Bergstrom & Lavstedt., 1979 [22] Sweden Cross-sectional Moderate	18–65 years old	Visual examination	441 cases out of 1423 subjects	31 %
(XXII) Sangnes & Gjermo, 1976 [23] Norway Cross-sectional High	18–50+ years old	Visual and tactile examination	240 cases out of 533 subjects	45 %
(XXIII) Takehara et al., 2008 [24] Japan Cross-sectional Moderate	20–50+ years old	Smith and Knight tooth wear index (3)	78 cases out of 159 subjects	49.1 %
(XXIV) Telles et al., 2006 [25] Brazil Cross-sectional High	16–22 years old	Visual and tactile examination	29 cases out of 40 subjects	72.5 %◊

◊ - calculated by the authors of this review based on the presented data in the selected paper.

XIX, XXIII, and XXIV. "Root defects" was used in Studies X and XII; "abfractions" in Studies VII and XI; "abrasion" in Studies XII, XX, XXI, and XXII; and "erosion" in Study XVII. Additionally, Studies II, III, V, IX, XVIII, and XXIII referred to the definition Aw et al. established in 2002, while Studies VIII, XIII, XV, and XVI referred to the definition Levitch et al. established in 1994.

3.3. Risk of bias assessment

The quality assessment values, including methodology and statistical validity, are presented in the online appendix S5. Based on a summary of these criteria, the estimated potential risk of bias was low for four studies, moderate for eight, substantial for five, and high for seven.

3.4. Data analysis

The meta-analysis could not be conducted due to the heterogeneity of the data; the weighted mean prevalence of NCCLs among the whole studied population was therefore 46.7 % (see Table 2). Data concerning the presence of NCCLs in the population were extracted or calculated from 24 papers that involved 6,844 NCCL cases altogether. The prevalence ranged from 9.1%–93% (see Table 1). A weighted mean prevalence was calculated including four (I, V, XI, and XIV) that had a low estimated risk of bias, which resulted in an overall weighted mean prevalence of NCCLs among subjects of 40.7 %.

The sub-analysis is presented in Table 3. Concerning age, studies with older populations indicated a higher weighted prevalence (54 %), while studies whose populations also included younger subjects indicated a lower weighted prevalence (43 %). Regarding diagnostic methods, when visual or tactile clinical examination was used, the prevalence was 38 % (n = 9,128); when the Smith and Knight tooth wear index was used, the prevalence was about 62 % (n = 5,398. Furthermore, when different definitions were used, the weighted mean prevalence varied from 28 % [18] to 62 % [1]. As to the terms used to address lesions, the prevalence was higher when "noncarious cervical lesion" was used (53 %) and lower when "root defects," "abrasion," or "abfraction" were used (30 %). The prevalence in South America was the highest of all geographical regions (69 %, n = 542), and North America (i.e., the United States) had the lowest prevalence (19 %, n = 1,298. Both regions used visual and tactile clinical examination as diagnostic methods, which prevents bias in the comparison. In between, Europe had a prevalence of 35 % (n = 6,367, while Asia had a prevalence of 62 % (n = 6,421). General populations presented the highest prevalence 54 %, n = 9,463. Moreover, when the population frequented dental practices, the prevalence was about 44 % (n = 1,405).

3.5. Grading

Table 4 reviews the factors used to establish the body of evidence according to GRADE [36] and the risk of magnitude. Considering that a high heterogeneity was found between the included studies, as well as on the basis of sub-analysis, the magnitude of this observation depends on the method of assessment used to diagnose NCCLs, the age range of the studied subjects, the type of population, the geographical location studied, and the definition and terms used to address NCCLs. This paper thus proposes that the groups of subjects, diagnostic criteria, definitions, and terms used for NCCLs should be standardized in future studies.

4. Discussion

This systematic review addresses the available body of dental literature concerning an important issue that is prevalent among diverse populations: noncarious cervical lesions (NCCLs). The weighted mean prevalence of NCCLs was 47 % among the studied populations—confirming its importance and clinical relevance—varying from 9 % in a Turkish study [37] to 93 % in a German one [32] (see Table 2). This range is slightly higher than the findings of current literature, which report a prevalence of 5 %–85 % [18]. This variation may be due to inclusion bias in Hahn et al.'s study [32], which included only subjects of a restricted age group (50–60 years old). As demonstrated in past studies [1,31,38,39] and this review, age can be a determining factor

Table 3
Overall analysis and sub analysis on the weighted mean prevalence of included studies. (See online appendix S4 showing which studies were used per analyses).

	N. of Studies	N. of lesions – N. of participants	WM (SD)	95 %CI*
(A) Overall analysis				
Total	**24**	**6844–14628**	**46.75 (21.44)**	**[38.18;55.32]**
(B)Sub analysis on age				
Only 30 + subjects	5	2765–5192	54.06 (25.66)	[53.36;54.76]
16-30 +	19	4037–9436	42.76 (17.40)	[42.41;43.11]
(C)sub analysis on population				
General population	13	6016–12170	49.39 (18.29)	[44.2;64.88]
Dental population	8	623–1405	44.32 (27.6)	[25.20;63.44]
Specific population	3	205–1053	19.39 (12.53)	[15.75;40.30]
(D)Sub analysis on geographical location				
South America	6	377–542	69.27 (09.90)	[61.36;77.19]
North America	4	249–1298	19.20 (16.10)	[3.42;34.97]
Europe	9	2253–6367	35.39 (17.39)	[24.03;46.75]
Asia	5	3965–6421	61.68 (12.37)	[50.84;72.52]
(E)Sub analysis on diagnosis				
Visual and/or tactile examination	19	3487–9128	38.19 (20.41)	[29.01;47.36]
Smith and Knight index	4	3332–5398	61.64 (13.49)	[48.43;74.85]
(F)Sub analysis on definition				
Aw (2002)	6	1917–3087	62.09 (7.18)	[59.52;64.66]
Levitch (1994)	4	266–941	28.26 (20.12)	[8.55;47.97]
(G)Sub analysis on terms				
NCCL	15	5588–10454	53.39 (17.46)	[44.56;62.22]
Root defect	2	364–1171	31.12 (36.16)	[29.05;33.19]
Abrasion	4	760–2464	30.84 (11.72)	[19.36;42.32]
Abfraction	2	48–148	32.42 (11.84)	[16.02;48.82]

*As a measure of precision, the standard error of the weighted mean (which reflects the variation among studies) was used relative to the number of experiments available to calculate the lower and upper limits of the 95 % confidence interval of the weighted mean difference.
WM = weighted mean.
SD = standard deviation.
95 %CI = 95 %confidence interval.

Table 4
GRADE evidence profile.

Study design	Cross-sectional
Risk of bias	Low to high
Consistency	Rather inconsistent
Precision	Rather precise
Directness	Rather generalizable
Publication bias	Possible
Body of evidence	Low to moderate
Magnitude of the finding	Moderate

for the prevalence of NCCLs, since older populations have probably been exposed to the etiological factors longer than younger ones. Hahn et al. [32] also used the term “root defect” to refer to NCCLs, whether from erosive, abrasive, or even abfraction processes, which may have led them to include more lesions per patient. These considerations, among others, demonstrate potential bias in the estimation of NCCL prevalence for the whole studied population from 24 papers.

The definition and diagnosis of NCCLs have long been discussed. As NCCLs come in a large variety of forms, some studies have demonstrated that different lesion shapes are often related to the prevalence of specific etiological factors [40,41], and different terms have been used to define these lesions, including “root defects” [32,42], “abrasion” [37,43–45], “abfraction” [26,27], and “erosion” [46]. As per a recent morphological classification [47], proposed in an attempt to reduce the confusion and misunderstanding regarding the appearance of these lesions, NCCLs can be classified according to their appearance as shallow, concave, wedge-shaped, notched, and irregular. In the past, terms such as “dished-out,” “saucer-shaped,” “cupped,” “c-shaped,” “v-shaped,” “shallow grooves,” “grooved,” “gingival notching,” and “deep notches” [1,48–52] were used. Additionally, the most commonly used method of NCCL diagnostic assessment found in the included studies was visual or tactile clinical examination [22,26,28,32,33,37,38,42–46,53–59], followed by the Smith and Knight tooth wear index [24,29,60–62]. As clinical examination does not present specific grading, the lower weighted prevalence found when comparing the use of this method to that of Smith and Knight’s tooth wear index may result from the difficulty of establishing a given pattern. Moreover, the studies that used Smith and Knight’s index were conducted in Asia, a populous region, which supports the higher prevalence. The recognition and knowledge of the appearance of NCCLs remains unclear, as the studies included in this review reveal a high heterogeneity.

The different definitions used to describe NCCLs may also contribute to the high variance of reported prevalence rates [1,11,18,43,45,63,64]. Aw et al.’s is used most often and states that an NCCL is “a loss of tooth structure at the cementoenamel junctional level unrelated to dental caries” [1]. However, CEJ location can be confused with the coronal border of the cervical lesion, which means that the recognition and definitive diagnosis of NCCLs remains difficult from a clinical perspective [65]. In turn, the difficulty of differentiating early shallow NCCLs and gingival recession persists, compromising the diagnosis and resulting in a higher or lower prevalence. This lack of standardized definitions therefore strengthens the bias across studies.

The large number of included studies allowed for sub-analysis by geographical region as summarized in Table 2, with the corresponding weighted mean values. The highest prevalence of NCCLs among adults was observed in studies conducted in South America (69 %, $n = 542$), especially in Brazil. All the studies used visual or tactile clinical examination to assess the NCCLs; however, only two included subjects from the general population [22,56], which may have raised the

estimated prevalence. The prevalence in Asia was estimated to be 61 % (n = 6,421), and four of the five studies conducted in this location used the Smith and Knight tooth wear index to assess the NCCLs, which, according to the data, also had a prevalence of 61 % (n = 5,398. Conversely, four American studies reported a prevalence of only 19 % (n = 1,053, possibly since one study [26] included only abfraction NCCLs, which are sharp and wedge-shaped. The second study [42] considered only defects with more than 2 mm of axial depth, disregarding the other types of lesions; the third was assessed through cast evaluation [57]; and the fourth presented a specific population, not being representative enough [43]. All these aspects together tended to lower the prevalence.

Table 2 also indicates that the type of population influences the prevalence data, as this aspect varied from 19 % for specific populations (n = 1,053) to 49 % for general populations (n = 12,170). In fact, general populations are more heterogeneous and thus present wider variation and different etiological factors, which raises the prevalence of the variance in question, precisely because it is considered multifactorial [7,11,18,19]. It is therefore evident that the studied subjects' characteristics are indeed relevant to the estimation of the prevalence of NCCLs, since they concern the risk factors of NCCLs.

5. Limitations and future recommendation

As the data presented in this systematic review are heterogenous due to a lack of standardization, a meta-analysis could not be conducted. Nevertheless, the guidelines for future studies should consider creating or standardizing an index that could be used to diagnose early and advanced NCCLs, thus allowing researchers to compare results from different studies or even conduct multivariate analyses in large-scale studies. Future generations must be alerted to the early diagnosis and treatment of NCCLs, which are increasingly common in dental care practice. These clinical manifestations can affect a patient's quality of life and understanding them can help to prevent potential future problems, such as dentin hypersensitivity and gingival recession, among others. Ethics approval: Not applicable/not required.

6. Conclusion

The worldwide prevalence of NCCLs among adults is 46.7 % and higher in older populations than younger ones. The established index also supports the rise in prevalence when compared to visual and tactile clinical examination. South America has the highest prevalence of NCCLs among different geographical regions, and general populations are more inclined to present these lesions than specific ones.

Author contributions

Daniela Navarro Ribeiro Teixeira: contributed to conception, design, acquisition, analysis, interpretation of data and drafted the manuscript.

Renske Z. Thomas: contributed to conception, design, acquisition, analysis, interpretation of data and critically revised the manuscript for important intellectual content.

Paulo Vinicius Soares:contributed to interpretation of data and critically revised the manuscript for important intellectual content.

Marco. S. Cune: contributed to interpretation of data and critically revised the manuscript for important intellectual content.

Marco M. M. Gresnigt:contributed to conception, interpretation of data and critically revised the manuscript for important intellectual content.

Dagmar Else Slot: contributed to conception, design, analysis, interpretation of data and critically revised the manuscript for important intellectual content. All authors gave final approval and agree to be accountable for all aspects of the work in ensuring that questions relating to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Declaration of Competing Interest

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jdent.2020.103285.

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