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REVIEW

ORAL HEALTH SITUATION OF CHILEAN PRESCHOOL CHILDREN IN THE YEARS 2007-2015: SYSTEMATIC REVIEW AND ANALYSIS AT INDIVIDUAL LEVEL.

Situación de salud oral en preescolares chilenos entre los años 2007-2015: Revisión sistemática y análisis a nivel individual.

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ABSTRACT:

Introduction: Oral diseases are a worldwide public health problem in need of constant evaluation and follow-up.

Aim: To analyze Chilean preschoolers' oral health indicators by age, sex, socioeconomic status and urban/rural location of their school.

Material and Methods: Systematic review conducted in *PubMed, EMBASE, Scielo* and gray literature to identify oral health epidemiological studies in Chile. We included studies with regional representativeness, published until May 2021. We requested the studies' datasets (individual data) and conducted a reanalysis for six oral health indicators: prevalence of untreated caries, caries experience, gingivitis, malocclusions and dmft/DMFT. Sex, age, urban/rural location of their school and socioeconomic status (SES) were considered as exposure variables. We assessed the risk of bias in each study and synthesized the oral health results for each of them. Differences between each indicator and explanatory variables were analyzed through Fisher's exact test. Adjusted prevalence ratios were estimated through Poisson regression.

Results: We selected nine studies and had access to five individual-level study datasets. Differences were observed in caries and gingivitis according to age, SES and rurality in most of the studies, observing highest differences for low SES in 2009 (PR caries experience = 2.68; PR untreated caries = 2.90). No differences were observed for SES nor rurality for malocclusions.

Conclusion: A reduction of indicators was not observed over the years. SES has remained as a social determinant of oral health in preschoolers in Chile.

KEYWORDS:

Oral health; Pediatric dentistry; Child, Preschool; Dental Caries; Gingivitis; Social Determinants of Health.

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RESUMEN:

Introducción: Las enfermedades bucales son un problema de salud pública a nivel mundial que requiere constante evaluación y seguimiento.

Objetivo: Analizar indicadores de salud bucal en preescolares chilenos según edad, sexo, nivel socioeconómico y ruralidad.

Material y Métodos: Revisión sistemática en Pubmed, EMBASE, Scielo y literatura gris, para identificar estudios epidemiológicos en Chile de salud bucal disponibles a mayo 2021. Se solicitaron las bases a nivel individual y se realizó un análisis secundario para seis indicadores de salud bucal: prevalencia de caries no tratada, experiencia de caries, prevalencia de gingivitis, de maloclusiones y ceod/COPD. Como variables de exposición se consideró el sexo y edad del niño, ruralidad y nivel socioeconómico (NSE). Se realizó el análisis de sesgo y resumieron los resultados de salud oral por estudio. Se analizaron las diferencias entre cada indicador y las variables explicativas mediante prueba exacta de Fisher y se estimaron las razones de prevalencia ajustadas mediante regresión de Poisson.

Resultados: Se accedió a cinco bases de datos a nivel individual de nueve estudios seleccionados. Se observaron diferencias en los indicadores de caries y gingivitis según edad, NSE y ruralidad en la mayoría de los estudios, observando las diferencias más altas para NSE bajo en el norte el año 2009 (RP experiencia de caries= 2,68; RP caries no tratada= 2,90). No se observaron diferencias por NSE, ni ruralidad para maloclusiones.

Conclusión: No se observó una reducción de los indicadores a través de los años. NSE se ha mantenido como un determinante social de la salud bucal de los preescolares chilenos.

PALABRAS CLAVE:

Salud bucal; Odontología pediátrica; Preescolar; Caries dental; Gingivitis; Determinantes sociales de la salud.

INTRODUCTION.

Oral diseases are a major worldwide public health problem due to their high prevalence, consequences on people's health and quality of life, and high treatment costs.[1,2] The distribution of these diseases has a marked social gradient, as they mostly affect the most vulnerable populations.[1,3-5]

In Chile, the oral health situation does not differ from the one described above. The most prevalent oral diseases are dental caries, periodontal diseases, and malocclusions.[6-9]

These diseases begin at an early age and share risk factors with other chronic conditions,[2] and social inequities in childhood and adolescence are a predictor of the oral and general health status of adults.[10,11] Therefore, it is essential to act as early as possible, even from pregnancy, implementing primary prevention strategies (health promotion, specific protection, diagnosis and early treatment of the disease). Emphasis on the most vulnerable population, leads to a healthier adulthood with better oral health and quality of life. But at the same time, reduces inequalities in access to oral health.

For this reason, the 2011-2020 (Chilean) National Health Strategy has focused its action on children, specifically in periods of tooth eruption, prioritizing comprehensive dental care for children aged 2, 4, 6, and 12, and pregnant women, with an emphasis on the most disadvantaged members of society.[12]

The World Health Organization (WHO) recommends that all countries carry out standardized epidemiological diagnoses of oral health on a regular basis to plan and evaluate oral health programs.[13] In Chile, there are nationally representative surveys that provide data on oral health status, access to dental care, and quality of life in the adult po-

pulation.[9,14,15] In addition, since 2000, multiple oral health studies have been carried out with children. Oral health diagnoses in the Chilean adult population are summarized in the study conducted by Morales *et al.*[16] However, to date, a synthesis for the children's outcomes has not been carried out.

Our study aims to analyze the main oral health indicators in Chilean preschool children according to socioeconomic status and rurality. For this, we conducted a secondary analysis using individual-level data from the oral health studies with national or regional representativeness detected from our review. We attempt to identify the oral health challenges for the coming years.

MATERIALS AND METHODS.

Design

The study follows the PRISMA individual patient data (PRISMA-IPD) guidelines for systematic reviews with secondary analyses of individual-level dataset with the aim of collecting, check, and re-analyzing the data.[17]

Search and eligibility criteria

One reviewer (MJM) designed and conducted the search strategy in Pubmed, EMBASE, and Scielo. We identified studies available until May 2021 with national or regional representativeness in the Chilean children. The search terms used in Pubmed and EMBASE were: (oral health OR caries OR gingivitis OR dentomaxillary anomalies OR malocclusion OR dmft) AND (Child* OR infant* OR preschool*). For Scielo: (*salud oral* OR caries OR gingivitis OR anomalías dentomaxilares OR ceod/COPD) AND (niño* OR preescolar OR niñez). Additional relevant references were identified from the selected studies. Subsequently, a review of the gray literature was carried out on the Ministry of Health official website, Chile's national research grants agency (Agencia Nacional de Investigacion y Desarrollo –ANID) and Google Scholar. We included cross-sectional studies in English and Spanish; in the Chilean infant population (children under 7 years of age) with national or regional representation, whose outcome variable was an indicator of oral health (caries, malocclusion, or gingivitis). We excluded case reports and studies without the predefined territorial representativeness, studies focused on specific populations or those with aggregated data.

Data collection processes and database integrity at the individual level

The datasets were requested through the Transparency Portal of the Ministry of Health of Chile. A secondary analysis was performed for each dataset of the oral health diagnostic studies selected. Two of the authors (AC and LM) reviewed all the exposure variables and oral health outcomes in each dataset. We extracted age, sex, rurality (urban/rural), commune/district or region, and type of school. The latter was used as a proxy for socioeconomic status (SES), considering municipal schools as low SES, subsidized private as medium SES, and paid private as high SES. The outcome variables (oral health indicators) were created from the components of the dmft or DMFT index when available. Otherwise, they were estimated based on each children's per tooth status (Supplementary Table 1). Similarly, the prevalence of gingivitis was estimated from the individual's gingival health information, when not available in the original study. The discrepancies and final review of the variables were resolved by a third author (JA).

Assessment of risk of bias in individual studies

One reviewer (MJM) performed the 'Risk of bias' assessment for all included studies, according to the 'Quality assessment tool for quantitative studies' criteria. Three authors (LM, JA, and AC) reviewed the results obtained. The risk of bias could be strong, moderate, or weak for five domains: selection bias, study design, confounders, blinding of assessors/analysts, and data collection methods.

The results are summarized by domain and by study in Supplementary Figure 1.

Analysis of data

Outcomes and effect measures

We created six oral health indicators on each dataset:

A) Prevalence of untreated caries, corresponding to the presence of cavitated caries in each child

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(at 6 years of age carious component of dmft and DMFT>0).

B) Caries experience prevalence, estimated through the presence of decayed teeth, with indication of extraction and filling in primary dentition (dmft) and carious, missing, and filled in permanent dentition (DMFT) (at 6 years dmft and DMFT≠0).

C) Caries experience count, estimated through the sum of decayed teeth, with indication of extraction and filling in primary dentition (dmft) and carious, missing, and filled in permanent dentition (DMFT).

D) Gingivitis prevalence. For the study by Soto *et al*.,[20] the presence of gingivitis was calculated considering only the teeth they assessed.

E) Malocclusion prevalence.

F) Significant Caries Index (SiC), estimated as the mean of the dmft of the third with the highest caries values.

In cases where the original data did not allow to create the outcome variables, we recorded the results as non-reported variable (NR). Then, crude, and adjusted prevalence ratios (PR) of untreated caries, caries experience prevalence and count, gingivitis, and malocclusions were estimated. We adjusted for the individual level variables age, sex, socioeconomic status, and the regional level urban/rural location with a multilevel Poisson regressions in each study.

Because the prevalence rates are greater than 30%, prevalence ratios were preferred over odds ratio.[18,19] Multilevel Poisson models were compared with linear Poisson models using likelihood ratio test (LRTs). The residual variance of the multilevel models is also reported.

Synthesis methods

We described each oral health indicator, according to children's age. The dmft, DMFT, and SiC variables were described using their mean and standard deviation. Prevalence of caries, gingivitis, and malocclusions are described with percentages and 95% confidence intervals. Additionally, we explored the associations of five oral health outcomes with our explanatory variables using Fisher's exact test, Student's t-test; or ANOVA.

We present the adjusted prevalence ratios, the residual variance, and the LRTs obtained in the regression models.

RESULTS.

The results are summarized in Figure 2. We identified six epidemiological studies on oral health in Chilean children. One of the studies had national representativeness, while all others had regional representativeness. The studies were conducted from 2007 to 2015.

It was possible to access only five datasets. Although four datasets were provided through the official transparency reques[20–23] one was accessed directly through the study's research team (Grant FONIS SA13I0130).[24] The studies assessed different age-groups and varied in their regional scope, with one of them assessing north, center and south, and others only assessing center (Metropolitan Region). The overview of the primary studies is summarized in Supplementary Table 2.

The highest prevalence of untreated caries, prevalence of caries experience, caries experience count (dmft) and SiC were observed at two years of age in the Metropolitan Region (MR) in 2015 (22.43%, 22.79%, 0.81, and 2.44, respectively).[24]

In the north/center study of 2009[23] the highest prevalence of untreated caries (49.28%), prevalence of caries experience (51.60%) and dmft index (2.24) were observed in four years old. The 2010 south study[21] showed the same pattern (47.44%, 50.31%, 2.26 respectively). In contrast, the SiC index for the same age group was higher in the studies conducted in the MR in 2007 (6.28)[22] and 2015 (5.69).[24] In the six year-old group, we observed the highest values for all outcomes in the national study of 2007.[20] There, untreated caries was 52.12%, prevalence of caries experience was 70.36%, dmft was 3.72, DMFT was 0.16, and SiC was 8.2 (Table 1).

Regarding the prevalence of gingivitis, values ranged from 2.6% to 32.6% at two years,[17-20] 6.13% to 45.02% at four years,[17-20] and 21.08% to 55.09% at six years[20,24] (Table 2).

Four of the five studies analyzed evaluated malocclusions,[20-23] being the 2007 Metropolitan

Figure 1. PRISMA IPD Flow Diagram of studies selection.

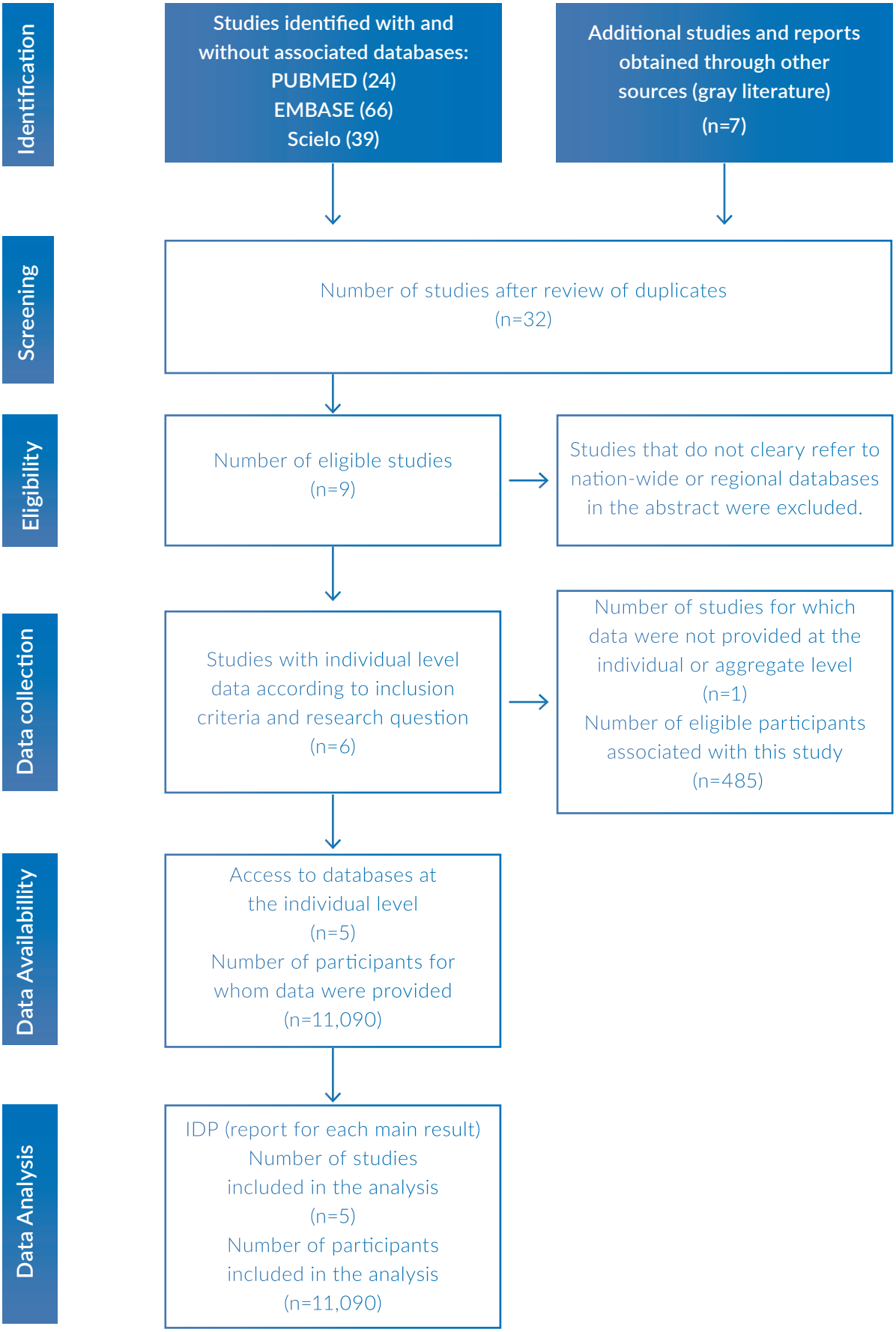

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Table 1. Caries prevalence, caries experience and Significant Caries index (SiC) in oral health diagnostic studies in preschool children.

Author Year/Scope	Age	Prevalence of untreated caries		Caries history prevalence		dmft/DMFT	Significant Caries Index (SiC)
		% (n)	(CI 95%)	% (n)	(CI 95%)	Mean (SD)	Mean (SD)
Ceballos *et al.*[22]	2 years	17.0 (85)	(13.70 - 20.3)	17.00 (85)	(13.70 - 20.30)	0.54 (1.54)	1.65 (2.33)
2007/Metropolitan region	4 years	45.06 (228)	(40.71 - 49.41)	48.02 (243)	(43.66 - 52.39)	2.32 (3.27)	6.28 (2.72)
Soto *et al.*[20]	6 years	52.12 (1157)	(50.04 - 54.20)	70.36 (1562)	(68.46 - 72.26)	3.72 (3.69) /0.16 (0.57)	8.2 (2.22)
2007/ National							
Soto *et al.*[23]	2 years	16.84 (229)	(14.85 - 18.83)	16.99 (231)	(14.99 - 18.98)	0.46 (1.37)	1.39 (2.08)
2009/Macro-zonal (North & Center)	4 years	49.28 (615)	(46.50 - 52.06)	51.60 (644)	(48.83 - 54.38)	2.24 (3.17)	5.93 (2.97)
Hoffmeister *et al.*[21]	2 years	18.02 (250)	(16.00 - 20.05)	18.67 (259)	(16.62 - 20.73)	0.57 (1.54)	2.02 (2.34)
2010/ Macro-zonal (South)	4 years	47.44 (759)	(44.99 - 49.89)	50.31 (805)	(47.86 - 52.77)	2.26 (3.27)	5.56 (3.22)
Monsalves *et al.*[24]	1 year	4.58 (7)	(1.23 - 7.92)	4.58 (7)	(1.23 - 7.92)	0.08 (0.44)	0.25 (0.74)
2015/Metropolitan region	2 years	22.43 (61)	(17.44 - 27.41)	22.79 (62)	(17.78 - 27.81)	0.81 (1.99)	2.44 (2.83)
	3 years	37.96 (156)	(33.25 - 42.67)	37.96 (156)	(33.24 - 42.67)	1.56 (2.79)	4.52 (3.18)
	4 years	41.59 (240)	(37.56 - 45.63)	42.11 (243)	(38.07 - 46.16)	2.08 (3.12)	5.69 (3.01)
	5 years	39.01 (197)	(34.74 - 43.28)	39.41 (199)	(35.13 - 43.68)	2.34 (3.31)	6.31 (2.88)
	6 years	40.17 (151)	(35.02 - 45.32)	57.83 (203)	(52.64 - 63.03)	2.90 (3.56) /0.05 (0.28)	7.26 (2.64)

SiC: Significant Caries index. **SD:** Standard Deviation.

Table 2. Prevalence of gingivitis and malocclusions in oral health diagnostic studies in preschool children.

Author/ Scope	Year	Age	Gingivitis prevalence % (n)	Gingivitis prevalence (CI 95%)	Malocclusions prevalence % (n)	Malocclusions prevalence (CI 95%)
Ceballos *et al.*[22] Metropolitan Region	2007	2 years 4 years	2.6 (13) 6.13 (31)	(1.20 - 3.99) (4.03 - 8.22)	48.8 (244) 49.21 (249)	(44.40 - 53.20) (44.84 - 53.58)
Soto *et al.*[20] National	2007	6 years	55.09 (1099)*	(52.90 - 57.27)	38.29 (850)	(36.26 - 40.31)
Soto *et al.*[23] Macro-zonal (North & Center)	2009	2 years 4 years	32.60 (443) 45.02 (561)	(30.10 - 35.09) (42.26 - 47.79)	Not available 33.36 (414) **	Not available (30.73 - 35.99)
Hoffmeister *et al.*[21] Macro-zonal (South)	2010	2 years 4 years	3.75 (52) 6.25 (100)	(2.75 - 4.75) (5.06 - 7.47)	Not available 29.44 (471)	Not available (27.20 - 31.67)
Monsalves *et al.*[24***] Metropolitan Region	2015	1 year 2 years 3 years 4 years 5 years 6 years	8.50 (13) 18.75 (51) 17.27 (71) 17.74 (102) 15.34 (77) 21.08 (74)	(4.03 - 12.97) (14.08 - 23.42) (13.60 - 20.94) (14.61 - 20.87) (12.18 - 18.50) (16.79 - 25.37)	Not available Not available Not available Not available Not available Not available	Not available Not available Not available Not available Not available Not available

***:** 225 children who did not present any of the permanent teeth to be examined (1.6, 1.1, 2.6, 3.6, 4.1, 4.6) were excluded.
****:** 3 missing and 4 not registered were excluded.
*****:** 2 missing at 4 years and 3 missing at 5 years were excluded.
CI: Confidence interval.

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Table 3. Bivariate analysis of caries prevalence and experience in oral health diagnostic studies in preschool children.

Author Year/Scope	Age	Prevalence of untreated caries (%)			Caries history prevalence (%)			deft/DMFT		
		Sex (n) (*p*-value)	SES (n) (*p*-value)	Rurality (n) (*p*-value)	Sex (n) (*p*-value)	SES (n) (*p*-value)	Rurality (n) (*p*-value)	Sex (n) (*p*-value)	SES (n) (*p*-value)	Rurality (n) (*p*-value)
Ceballos *et al.*[22] 2007/ Metropolitan Region	2 years	Female: 15.23 (39) Male: 18.85 (46) (*p*=0.287)	High: 9.46 (7) Medium: 6.25 (1) Low: 18.78 (77) (*p*=0.078)	Urban: 16.01 (77) Rural: 42.11 (8) (*p*=0.008)	Female: 15.23 (39) Male: 18.85 (46) (*p*=0.287)	High: 9.46 (7) Medium: 6.25 (1) Low: 18.78 (77) (*p*=0.078)	Urban: 16.01 (77) Rural: 42.11 (8) (*p*=0.008)	Female: 0.46 Male: 0.62 (*p*=0.240)	High: 0.34 Medium: 0.25 Low: 0.59 (*p*=0.328)	Urban: 0.48 Rural: 2.05 (*p*<0.001)
	4 years	Female: 42.06 (90) Male: 47.26 (138) (*p*=0.278)	High: 27.27 (27) Medium: 17.65 (3) Low: 50.77 (198) (*p*<0.001)	Urban: 44.44 (216) Rural: 60.00 (12) (*p*=0.178)	Female: 46.26 (99) Male: 49.32 (144) (*p*=0.529)	High: 29.29 (29) Medium: 23.53 (4) Low: 53.85 (210) (*p*<0.001)	Urban: 47.33 (230) Rural: 65.00 (13) (*p*=0.170)	Female: 2.16 Male: 2.45 (*p*=0.331)	High: 1.31 Medium: 0.76 Low: 2.65 (*p*<0.001)	Urban: 2.27 Rural: 3.65 (*p*=0.065)
Soto *et al.*[20] 2007/ National	6 years	Female: 50.49 (565) Male: 53.77 (592) (*p*=0.126)	High: 23.81 (75) Medium: 52.82 (393) Low: 59.35 (689) (*p*<0.001)	Urban: 49.28 (923) Rural: 67.44 (234) (*p*<0.001)	Female: 69.26 (775) Male: 71.48 (787) (*p*=0.27)	High: 40.32 (127) Medium: 71.24 (530) Low: 77.95 (905) (*p*<0.001)	Urban: 67.70 (1268) Rural: 84.73 (294) (*p*<0.001)	Female: 3.47/0.17 Male: 3.97/0.14 (*p*=0.001) (*p*=0.13)	High: 1.37/0.03 Medium: 3.60/0.11 Low: 4.43/0.22 (*p*<0.001) (p<0.001)	Urban: 3.47/0.15 Rural: 5.06/0.22 (*p*<0.001) (*p*=0.03)
Soto *et al.*[23] 2009/ Macro-zonal (North & Center)	2 years	Female: 15.26 (101) Male: 18.34 (128) (*p*=0.147)	High: 5.59 (20) Low: 20.86 (209) (*p*<0.001)	Urban: 13.93 (150) Rural: 27.92 (79) (*p*<0.001)	Female: 15.56 (103) Male: 18.34 (128) (*p*=0.193)	High: 5.87 (21) Low: 20.96 (210) (*p*<0.001)	Urban: 14.02 (151) Rural: 28.27 (80) (*p*<0.001)	Female: 0.42 Male: 0.51 (*p*=0.248)	High: 0.13 Low: 0.58 (p<0.001)	Urban: 0.40 Rural: 0.72 (*p*<0.001)
	4 years	Female: 47.89 (295) Male: 50.63 (320) (*p*=0.336)	High: 22.37 (34) Medium: 50.25 (201) Low: 54.60 (380) (*p*<0.001)	Urban: 46.72 (441) Rural: 57.24 (174) (*p*=0.002)	Female: 50.16 (309) Male: 53.01 (335) (*p*=0.336)	High: 25.66 (39) Medium: 51.75 (207) Low: 57.18 (398) (*p*<0.001)	Urban: 48.83 (461) Rural: 60.20 (183) (*p*=0.001)	Female: 2.10 Male: 2.38 (p=0.107)	High: 0.78 Medium: 2.25 Low: 2.56 (*p*<0.001)	Urban: 2.09 Rural: 2.70 (*p*=0.004)
Hoffmeister *et al.*[21] 2010/ Macro-zonal (South)	2 years	Female: 18.06 (132) Male: 17.99 (118) (*p*=1.000)	High: 7.33 (11) Medium: 28.57 (6) Low: 19.16 (233) (*p*<0.001)	Urban: 16.85 (201) Rural: 25.26 (49) (*p*=0.006)	Female: 18.60 (136) Male: 18.75 (123) (*p*=0.95)	High: 7.33 (11) Medium: 33.33 (7) Low: 19.82 (241) (*p*<0.001)	Urban: 17.4 (208) Rural: 26.29 (51) (*p*=0.005)	Female: 0.54 Male: 0.60 (*p*=0.47)	High: 0.19 Medium: 1.14 Low: 0.60 (*p*=0.002)	Urban: 0.50 Rural: 0.98 (*p*<0.001)

***Continued on the next page

*** Table Continued

	4 years	Female: 44.93 (337) Male: 49.65 (422) (p=0.063)	High: 18.24 (29) Medium: 44.06 (126) Low: 52.29 (604) (p<0.001)	Urban: 46.22 (654) Rural: 56.76 (105) (p=0.008)	Female: 48.53 (364) Male: 51.88 (441) (p=0.19)	High: 20.75 (33) Medium: 48.25 (138) Low: 54.89 (634) (p<0.001)	Urban: 49.26 (697) Rural: 58.38 (108) (p=0.02)	Female: 2.12 Male: 2.38 (p=0.11)	High: 0.77 Medium: 2.05 Low: 2.52 (p<0.001)	Urban: 2.19 Rural: 2.85 (p=0.009)
Monsalves *et al.*[24] 2015/ Metropolitan Region	1 year	Female: 6.33 (5) Male: 2.70 (2) (p=0.44)	High: 1.69 (1) Low: 6.38 (6) (p=0.25)	Urban: 3.82 (5) Rural: 9.09 (2) (p=0.265)	Female: 6.33 (5) Male: 2.70 (2) (p=0.44)	High: 1.69 (1) Low: 6.38 (6) (p=0.25)	Urban: 3.82 (5) Rural: 9.09 (2) (p=0.27)	Female: 0.09 Male: 0.08 (p=0.92)	High: 0.02 Low: 0.13 (p=0.133)	Urban: 0.08 Rural: 0.09 (p=0.95)
	2 years	Female: 24.00 (30) Male: 21.09 (31) (p=0.662)	High: 8.96 (6) Medium: 22.22 (2) Low: 27.04 (53) (p=0.005)	Urban: 22.78 (54) Rural: 20.00 (7) (p=0.830)	Female: 24.00 (30) Male: 21.77 (32) (p=0.67)	High: 8.96 (6) Medium: 33.33 (3) Low: 27.04 (53) (p=0.003)	Urban: 23.21 (55) Rural: 20.00 (7) (p=0.83)	Female: 0.71 Male: 0.89 (p=0.46)	High: 0.22 Medium: 3.00 Low: 0.91 (p<0.001)	Urban: 0.80 Rural: 0.86 (p=0.88)
	3 years	Female: 36.65 (81) Male: 39.47 (75) (p=0.61)	High: 22.86 (24) Medium: 32.79 (20) Low: 45.71 (112) (p<0.001)	Urban: 35.31 (119) Rural: 50.00 (37) (p=0.024)	Female: 36.65 (81) Male: 39.47 (75) (p=0.61)	High: 22.86 (24) Medium: 32.79 (20) Low: 45.71 (112) (p<0.001)	Urban: 35.31 (119) Rural: 50.00 (37) (p=0.02)	Female: 1.50 Male: 1.63 (p=0.63)	High: 0.78 Medium: 1.25 Low: 1.97 (p<0.001)	Urban: 1.48 Rural: 1.93 (p=0.20)
	4 years	Female: 37.62 (106) Male: 45.27 (134) (p=0.076)	High: 21.25 (17) Medium: 41.01 (73) Low: 47.02 (150) (p<0.001)	Urban: 38.01 (157) Rural: 50.61 (83) (p=0.007)	Female: 38.43 (108) Male: 45.61 (135) (p=0.09)	High: 22.50 (18) Medium: 42.13 (75) Low: 47.02 (150) (p<0.001)	Urban: 38.74 (160) Rural: 50.61 (83) (p<0.01)	Female: 1.72 Male: 2.43 (p<0.01)	High: 0.85 Medium: 2.13 Low: 2.36 (p<0.001)	Urban: 1.83 Rural: 2.73 (p=0.002)
	5 years	Female: 36.64 (85) Male: 41.03 (112) (p=0.360)	High: 36.84 (14) Medium: 43.59 (85) Low: 36.03 (98) (p=0.254)	Urban: 31.10 (107) Rural: 55.90 (90) (p<0.001)	Female: 37.07 (86) Male: 41.39 (113) (p=0.36)	High: 36.84 (14) Medium: 44.62 (87) Low: 36.03 (98) (p=0.16)	Urban: 31.10 (107) Rural: 57.14 (92) (p<0.001)	Female: 2.04 Male: 2.60 (p=0.06)	High: 1.5 Medium: 2.64 Low: 2.25 (p=0.19)	Urban: 1.79 Rural: 3.52 (p<0.001)
	6 years	Female: 35.52 (65) Male: 45.51 (76) (p=0.064)	High: 14.29 (3) Medium: 46.24 (80) Low: 36.94 (58) (p=0.009)	Urban: 32.51 (66) Rural: 50.68 (75) (p=0.001)	Female: 54.64 (66) Male: 61.68 (81) (p=0.20)	High: 23.81 (5) Medium: 58.38 (101) Low: 61.78 (97) (p=0.004)	Urban: 53.20 (108) Rural: 64.19 (95) (p=0.049)	Female: 2.29 / 0.05 Male: 3.57 / 0.05 (p=0.001) (p=0.98)	High: 1.00 / 0.00 Medium: 3.16 / 0.04 Low: 2.84 / 0.07 (p=0.03) (p<0.001)	Urban: 2.31 / 0.04 Rural: 3.69 / 0.07 (p<0.001) (p=0.02)

SES: Socioeconomic status.

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Table 4. Cross-variable analysis of the prevalence of gingivitis and prevalence of malocclusions in studies of oral health in preschool children.

Author Year/Scope	Age	Gingivitis prevalence (%) Sex (n) (*p*-value)	Gingivitis prevalence (%) SES (n) (*p*-value)	Gingivitis prevalence (%) Rurality (n) (*p*-value)	Prevalence of malocclusions (%) Sex (n) (*p*-value)	Prevalence of malocclusions (%) SES (n) (p-value)	Prevalence of malocclusions (%) Rurality (n) (*p*-value)
Ceballos *et al.*[22] 2007 Metropolitan Region	2 years	Female: 2.34 (6) Male: 2.87 (7) (p=0.784)	High: 2.70 (2) Low: 2.68 (11) (p=1.000)	Urban: 2.7 (13) Rural: 0 (0)	Female: 47.27 (121) Male: 50.41 (123) (p=0.531)	High: 55.41 (41) Medium: 56.25 (9) Low: 47.32 (194) (p=0.371)	Urban: 48.86 (235) Rural: 47.37 (9) (p=1.000)
	4 years	Female: 5.61 (12) Male: 6.51 (19) (p=0.712)	High: 7.07 (7) Low: 6.15 (24) (p=0.739)	Urban: 5.95 (29) Rural: 10.00 (2) (p=0.350)	Female: 47.20 (101) Male: 50.68 (148) (p=0.472)	High: 54.55 (54) Medium: 47.06 (8) Low: 47.95 (187) (p=0.497)	Urban: 49.59 (241) Rural: 40.00 (8) (p=0.496)
Soto *et al.*[20] 2007 National	6 years	Female: 57.07 (589) Male: 52.96 (510) (p=0.036)	High: 34.53 (96) Medium: 53.71 (369) Low: 61.55 (634) (p<0.001)	Urban: 52.93 (894) Rural: 66.99 (205) (p<0.001)	Female: 39.59 (443) Male: 36.97 (407) (p=0.206)	High: 33.02 (104) Medium: 36.83 (274) Low: 40.65 (472) (p=0.028)	Urban: 36.84 (690) Rural: 46.11 (160) (p=0.001)
Soto *et al.*[23] 2009/ Macrozonal (North & Center)	2 years	Female: 30.11 (199)* Male: 34.96 (244) (p=0.064)	High: 20.95 (75) Low: 36.76 (368) (p<0.001)	Urban: 29.46 (317) Rural: 44.52 (126) (p<0.001)	Not Available	Not Available	Not Available
	4 years	Female: 45.11 (277) ** Male: 44.94 (284) (p=0.955)	High: 21.85 (33) Medium: 44.75 (179) Low: 50.22 (349) (p<0.001)	Urban: 42.78 (403) Rural: 51.97 (158) (p=0.003)	Female: 32.90 (202) Male: 33.81 (212) (p=0.763)	High: 42.00 (63) Medium: 34.50 (138) Low: 30.82 (213) (p=0.027)	Urban: 33.09 (311) Rural: 34.22 (103) (p=0.726)
Hoffmeister *et al.*[21] 2010/ Macrozonal (South)	2 years	Female: 3.69 (27) Male: 3.81 (25) (p=1.000)	High: 4.00 (6) Medium: 4.76 (1) Low: 3.70 (45) (p=0.711)	Urban: 3.44 (41) Rural: 5.67 (11) (p=0.150)	Not Available	Not Available	Not Available

***Continued on the next page

*** Table Continued

	4 years	Female: 5.20 (39) Male: 7.18 (61) (p=0.120)	High: 1.89 (3) Medium: 10.14 (29) Low: 5.89 (68) (p=0.002)	Urban: 5.87 (83) Rural: 9.19 (17) (p=0.104)	Female: 30.13 (226) Male: 28.82 (245) (p=0.583)	High: 29.56 (47) Medium: 36.71 (105) Low: 27.62 (319) (p=0.011)	Urban: 29.89 (423) Rural: 25.95 (48) (p=0.303)
Monsalves *et al.*[24] 2015 Metropolitan Region	1 año	Female: 7.59 (6) Male: 9.46 (7) (p=0.776)	High: 10.17 (6) Low: 7.45 (7) (p=0.565)	Urban: 8.40 (11) Rural: 9.09 (2) (p=1.000)	Not Available	Not Available	Not Available
	2 years	Female: 20.80 (26) Male: 17.01 (25) (p=0.440)	High: 13.43 (9) Medium: 11.11 (1) Low: 20.92 (41) (p=0.379)	Urban: 18.99 (45) Rural: 17.14 (6) (p=1.000)	Not Available	Not Available	Not Available
	3 years	Female: 19.00 (42) Male: 15.26 (29) (p=0.360)	High: 9.52 (10) Medium: 11.48 (7) Low: 22.04 (54) (p=0.007)	Urban: 18.10 (61) Rural: 13.51 (10) (p=0.399)	Not Available	Not Available	Not Available
	4 years	Female: 14.64 (41) Male: 20.68 (61) (p=0.064)	High: 17.50 (14) Medium: 16.95 (30) Low: 18.24 (58) (p=0.952)	Urban: 20.15 (83) Rural: 11.66 (19) (p=0.016)	Not Available	Not Available	Not Available
	5 years	Female: 15.58 (36) Male: 15.13 (41) (p=0.902)	High: 21.05 (8) Medium: 15.90 (31) Low: 14.13 (38) (p=0.479)	Urban: 14.58 (50) Rural: 16.98 (27) (p=0.507)	Not Available	Not Available	Not Available
	6 years	Female: 21.31 (39) Male: 20.96 (35) (p=1.000)	High: 28.57 (6) Medium: 12.72 (22) Low: 29.30 (46) (p=0.001)	Urban: 24.63 (50) Rural: 16.22 (24) (p=0.064)	Not Available	Not Available	Not Available

*: 1 missing was excluded. **: 2 missing were excluded. RM: Metropolitan Region.

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Table 5. Prevalence ratios adjusted for the relationship of oral health indicators.

PREVALENCE		SOCIOECONOMIC STATUS Ref= Private (high SES)				RURALITY		SEX		AGE		RESIDUAL variance		LR test *versus* Poisson model
		Charter (medium SES)		Public (low SES)		Ref= Urban		Ref= Female		Ref= Lowest year in each study				
		PR	CI 95%	PR	CI 95%	PR	CI 95%	PR	CI 95%	PR	CI 95%	E	CI 95%	
Study 2 and 4 years. Metropolitan Region/2007	Untreated caries	0.65	0.23 - 1.83	1.84	1.29 - 2.63	1.54	0.98 - 2.42	1.11	0.89 - 1.40	1.64	1.45 - 1.86	N/A	N/A	**
	Caries history	0.77	0.30 - 1.97	1.83	1.29 - 2.59	1.55	1.00 - 2.41	1.07	0.86 - 1.33	1.70	1.50 - 1.92	N/A	N/A	**
	Gingivitis	N/A	N/A	0.92	0.37 - 2.24	1.08	0.18 - 6.58	1.19	0.65 - 2.18	1.47	1.05 - 2.06	N/A	N/A	**
	Malocclusions	0.93	0.56 - 1.56	0.87	0.69 - 1.09	0.90	0.55 - 1.46	1.08	0.90 - 1.29	1.00	0.91 - 1.09	N/A	N/A	**
Study 6 years. National/2007	Untreated caries	2.19	1.71 - 2.81	2.36	1.86 - 3.01	1.21	1.04 - 1.40	0.95	0.84 - 1.06	N/A	N/A	N/A	N/A	**
	Caries history	1.75	1.45 - 2.13	1.87	1.55 - 2.26	1.13	0.99 - 1.29	0.97	0.88 - 1.08	N/A	N/A	N/A	N/A	**
	Gingivitis	1.54	1.23 - 1.93	1.71	1.37 - 2.13	1.07	0.91 - 1.27	1.09	0.97 - 1.23	N/A	N/A	0.01	0.00 - 0.05	0.0013
	Malocclusions	1.09	0.87 - 1.37	1.17	0.94 - 1.46	1.15	0.95 - 1.39	1.08	0.95 - 1.24	N/A	N/A	0.01	0. 00 - 0.05	0.0368
Study 2 and 4 years: North & Center/2009	Untreated caries	2.64	1.94 - 3.60	2.90	2.20 - 3.84	1.08	1.00 - 1.17	1.11	0.97 - 1.27	1.65	1.52 - 1.79	N/A	N/A	**
	Caries history	2.40	1.78 - 3.22	2.68	2.06 - 3.50	1.08	1.00 - 1.17	1.10	0.96 - 1.26	1.69	1.56 - 1.83	N/A	N/A	**
	Gingivitis	1.87	1.44 - 2.43	1.97	1.59 - 2.44	1.20	1.07 - 1.36	1.08	0.95 - 1.22	1.15	1.07 - 1.23	0.06	0.03 - 0.13	0.0000
	Malocclusions	0.82	0.61 - 1.11	0.73	0.55 - 0.97	0.97	0.86 - 1.08	1.02	0.84 - 1.24	1.41	0.52 - 3.77	N/A	N/A	**
Study 2 and 4 years. South/2010	Untreated caries	2.31	1.56 - 3.41	2.71	1.94 - 3.79	0.89	0.81 - 0.97	0.93	0.82 - 1.05	2.59	2.23 - 3.00	0.02	0.01 - 0.08	0.0009
	Caries history	2.38	1.64 - 3.44	2.61	1.90 - 3.58	0.89	0.82 - 0.97	0.95	0.84 - 1.07	2.63	2.28 - 3.05	0.02	0.00 - 0.07	0.0062
	Gingivitis	2.52	1.06 - 6.00	1.38	0.66 - 2.89	1.39	0.99 - 1.94	0.81	0.58 - 1.11	1.38E+00	0.96 - 1.97	0.29	0.08 - 1.08	0.0023
	Malocclusions	1.24	0.88 - 1.75	0.93	0.69 - 1.27	0.99	0.91 - 1.07	1.04	0.87 - 1.25	N/A	N/A	N/A	N/A	**
Study 1 and 6 years. Metropolitan Region/2015	Untreated caries	1.70	1.19 - 2.42	2.21	1.60 - 3.04	1.37	0.94 - 1.98	1.12	0.98 - 1.29	1.20	1.12 - 1.28	0.08	0.03 - 0.22	0.0000
	Caries history	1.61	1.17 - 2.21	2.18	1.63 - 2.93	1.28	0.97 - 1.68	1.11	0.98 - 1.26	1.27	1.19 - 1.34	0.03	0.01 - 0.12	0.0003
	Gingivitis	1.04	0.66 - 1.63	1.28	0.88 - 1.85	0.76	0.43 - 1.33	1.01	0.82 - 1.23	1.17	1.07 - 1.29	0.17	0.06 - 0.48	0.0000

PR: Prevalence Ratio. **LR:** Likelihood ratio. **CI:** Confidence Interval. **Blue font:** Statistically significant values. **N/A:** Variable does not apply, study with a single age group. **(**):** Linear Poisson model was used because there is no correlation at the cluster level. **E:** Estimator.

Region study the one that reported the highest prevalence with 48.8% at two years, and 49.21% at four years[22] (Table 2).

In the analysis by sex, no differences were observed in the prevalence of caries, gingivitis and malocclusions.

However, differences were observed for dmft at 4, 5, and 6 years in the Metropolitan Region in 2015,[24] and at six years at the national level in 2007.[20] The analysis by SES, showed differences for caries prevalence and experience in all studies, except for two years-old in the Metropolitan Region study of 2007.[22] The same was observed for urban/rural location with differences for all outcomes in all studies. There was an exception in the Metropolitan Region study in 2015 for two years-olds[24] and in the Metropolitan Region study in 2007[23] for four years-old (Table 3).

Table 4 shows gingivitis and malocclusions differences by SES and urban/rural location. The main differences were observed for four-year-olds in the north and central studies of 2009 and 2010 (Table 4).

Table 5 shows the prevalence ratios (PR) for untreated caries, caries experience, gingivitis, and malocclusions. In all studies, a higher prevalence was observed for untreated caries, caries experience, and gingivitis as age increased.

Additionally, a higher prevalence of caries experience and untreated caries was observed in children belonging to the low SES compared to high SES in all the studies analyzed. Also, a higher prevalence of caries experience and untreated caries was observed in children from medium SES compared to high SES in several of the studies analyzed (Table 5).

For gingivitis, these differences were only observed in the 6-year national study from 2007;[20] the study of 2 and 4 years in the Northern and Central areas in 2009, and the study of 2 and 4 years in the South in 2010.[21,23]

In terms of urban/rural location, a higher prevalence of caries experience and untreated caries was observed in rural areas compared to urban ones for the study of 2 and 4 years in the North and Center, 2009.[23]

But for untreated caries only in the 6-year national study, 2007.[20] For gingivitis, these differences were only observed in the study of 2 and 4 years in the North and Center, 2009,[23] and the study of 2 and 4 years in the South, 2010.[21]

DISCUSSION.

This review presents a synthesis of the main oral health indicators in the preschool population based on a secondary analysis of datasets from oral health diagnoses conducted in Chile between 2007 and 2015.

In all the studies analyzed, an upward trend was observed in caries and gingivitis indicators as age increased. The cumulative damage caused by chronic oral diseases, such as caries and periodontal disease, confirms that the older the person is, the worse indicators of oral health are observed.[8,9,25]

As reported by other international studies,[26–28] children already present damage from caries at two years of age, which reinforces the need to implement effective promotional and preventive measures that guarantee an optimal oral health from an early age, with the consequent decrease in the prevalence of caries in adolescence and adulthood.

In this sense, the implementation of the Population Risk-based Monitoring Program (Población en control con enfoque de riesgo odontológico; CERO, for its acronym in Spanish) has been very important for Chile as of 2017. The program monitors beneficiaries of the public health system through dental check-ups in primary care from 6 months to 6 years of age, with or without oral pathologies. In 2021, the age range of the program was extended to 9 years of age,[29] and the CERO Adolescent Program was created, covering the group of 10 to 19 years old.[30] Analyzing the impact of these programs should be a future priority for dental research in Chile.

A greater damage was systematically observed

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in the groups of children with lower SES compared to those with high SES, as reported by other authors.[26,31] In turn, urban/rural location was associated with dental caries, in accordance with previous research conducted in Chile.[32,33]

International and national evidence indicates that rurality encompasses multiple factors that generate a structural vulnerability for those who live in more rural areas.[34] It is possible that traditional clinical strategies and interventions in dentistry are not effective enough to mitigate these differences.[35–37]

This research provides a synthesis of oral health in preschool children in Chile, considering six oral health indicators based on five studies from 2007 to 2015. These consolidated data can be used for comparison and monitoring, a fundamental input for decision-making in public policies that address oral health in early childhood and that focus on improving these indicators and reducing the gaps. Among the strengths of this study, we highlight systematic literature search, and the verification and analysis of the data at the individual level directly from the original datasets.

This way, the results reflect a new and original statistical analysis, considering standardized parameters to compare the variables and indicators of oral health. It is for this reason that there may be differences with derived reports or publications that have used aggregated results for analysis.

The studies included in this review used the international recommendations of the WHO for population studies to measure the prevalence of caries and dmft,[13] which allows a comparison between them. However, for gingivitis and malocclusions, not all studies analyzed detailed the operationalization of these variables (Supplementary Table 1).

In the study carried out by Soto *et al.*,[20] the presence of gingivitis was estimated considering three categories (healthy, bleeding, and calculus), while in the others, the register was dichotomous (with or without gingivitis). A similar limitation was observed for the evaluation of malocclusions, with more than two categories in the Metropolitan Region study of 2015[24] and in the national representative study of 2007,[20] and a dichotomous assessment in the others. No study describes how malocclusions were measured. The standardization of explanatory variables in the studies also limited this research. Constructs such as SES were not assessed equally across studies, making comparison difficult (Supplementary Table 1).

Additionally, it was not possible to include in this analysis variables such as health insurance, tooth-brushing frequency, dental visits, and breastfeeding. Not all primary studies evaluated them, or they had important differences in their operationalization.

Another aspect to consider is the representativeness of the studies declared in their methodologies. The analyses obtained cannot be extrapolated to the national level in its entirety, since the representativeness of each study is diverse: national and regional (Supplementary Table 2). In addition, differences were observed in the sampling strategies, while some studies carried out cluster sampling according to the school type, others also considered geographical areas or the Human Development Index, which makes replicability difficult.

The results of this study should be analyzed with caution, understanding that they come from data that were not collected with the aim of establishing comparisons between age subgroups. Some of our cross-variable analysis had a small sample size. This is probably the reason why we did not observe significant differences by SES in caries prevalence at two years in the study by Ceballos *et al.*,[22] and at 5 years in the study by Monsalves *et al.*[24]

The lack of nationally and regionally representative periodic studies on oral health in children is explained by the absence of an epidemiological monitoring policy for oral diseases in Chile, a challenge that must be addressed in the near future. This will be fundamental for the evaluation of the impact of programs and policies that are

implemented in Chile, allowing comparability and traceability of oral health indicators. A first approach or initial strategy that could be cost-effective is to incorporate these indicators in Chilean children surveys, as has been done for the adult population in national health surveys.

A recommendation for future research is to consider the prevalence of untreated caries and the prevalence of caries experience. It is beneficial to know both indicators given that the first one involves an analysis of the needs for restorative treatment, while the second helps to know the magnitude of the problem and the accumulation of damage. Those who have a experience of caries are at greater risk of further disease, than those who have never had caries.

On the other hand, it is suggested to consider analyses that include contextual variables and socioeconomic status, such as rurality, ethnicity, differences between populations, education of caregivers, and income, since systematic differences in oral health status are observed based on these variables in some of the studies analyzed.

CONCLUSION.

The results of this study synthetized the research carried out on oral health in preschool children in Chile. The aim of our analysis was to verify, check and reanalyze the individual-level data from different studies, thus providing a useful overview for future research and decision-making in oral health.

Our study highlights the need for up-to-date oral health research in preschool children given that the last available study was conducted 6 years ago. In addition, it is reported that the indicators have not decreased and that there are important differences between age groups, SES, and urban/rural location.

The results show the importance of having an epidemiological surveillance program in oral health that is periodic, standardized, and representative, both at the national and local levels, to monitor and evaluate the impact of public policies on the indicators of oral health in children.

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Authors' contributions:

Moraga-Aros L: Contributed to the literature review, analysis and drafted and reviewed the manuscript

Aubert-Valderrama J: Contributed to the design, data interpretation, drafted and critically revised the manuscript

Correa-Ramirez A: Contributed to the literature review, analysis, drafted and reviewed the manuscript

Monsalves-Villalobos M: Contributed to the conception and design of the research and critically revised the manuscript.

All authors approved the final accepted version of the manuscript.

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Supplementary Table 1. Methodological description of population studies of oral health diagnosis in Chilean preschool children between 2005 and 2015.

Study name	Author and year	Scope	Sampling in the original study	SES and its measurement	Caries measurement	Gingivitis measurement	DMA measurement
Study of Diagnosis in Oral Health of Children aged 2 and 4 who attend Preschool Education in the Metropolitan Region of Chile. during the year 2007)	Ceballos et al.[22] 2007	Regional (MR)	Random stratified by cluster of preschool educational establishments in the MR, according to the type of financing of the educational establishment. SES was a variable measured but not used for stratification.	Using the type of financing of the establishment as a proxy. Low level corresponds to the Public Nurseries, JUNJI and Integra. The middle level is the Subsidized Private Nurseries, and the upper level corresponds to Private Nurseries.	Tooth with no signs of treated or untreated clinical caries, or with caries in early stages (white spot) was determined as healthy.	Inflammation of the gums without compromise of the insertion and support tissues of the tooth. Dichotomic.	Presence of: cross bite, inverted, open, covered, overjet and altered oververbite. Dichotomic.
(National Diagnosis of Oral Health of the 6-year-old child)	Soto et al.[20] 2007	National	Random stratified by cluster. Two-stage stratified by SES and urban-rural condition.	Using the type of financing as a proxy. The municipal school was classified as Low SES (except in the districts of Las Condes, Vitacura, and Lo Barnechea, which were medium SES). Subsidized private schools were Medium SES and paid private schools with a monthly tuition higher than CLP$70,000, were classified as High SES.	A tooth is considered healthy if there is no clinical evidence of caries either present or or treated. Non-cavitated carious lesions were excluded as evidence of caries.	Not measured. Modified CPI (Community Periodontal Index) was evaluated with 3 categories: healthy, gingival bleeding, presence of supragingival calculus. In 6 permanent teeth.	These categories were recorded: Healthy, mild anomaly (open, inverred crossed bite, maxillary compression), moderate or severe anomaly (covered bite, true progeny, permanent tooth geny, permanent tooth eruption alterations, fissures)
Diagnosis of Oral Health of Children aged 2 and 4 who attend Preschool Education in the North, Center I and Center II Zones	Soto et al.[23] 2009	Macrozonal (North and Center)	Random stratified by cluster. Strata according to type of educational establishment. In each region, it was stratified by sex, SES, urban-rural location.	SES was built using the type of financing of the establishment as a proxy. Low SES=Nurseries managed by JUNJI or Integra or municipal establishment. Average SES: subsidized private schools (for 4 years). High SES: Paid nurseries or private schools (tuition greater than CLP$70,000).	A tooth is considered healthy if there is no clinical evidence of caries either present or treated. Non-cavitated carious lesions were excluded as evidence of caries.	Inflammation of the gums without compromise of the insertion and support tissues. Inflammation was considered to be the change in color of the gum, edema and bleeding to the touch in any sextant. Dichotomic.	Evaluated only at 4 years. It was considered when it was found: crossbite, inverted, open, covered, overjet or altered overbite. Dichotomic.
Diagnosis of Oral Health of children aged 2 and 4 who attend preschool education in the southern part of the country	Hoffmeister et al.[21] 2010	Macrozonal (South)	Stratified by geographical area and by cluster (establish ment). Establishments (primary sampling unit) were selected according to dependency as a proxy for the SES.	Socioeconomic status of the household considered the income level of the household and educational level of the head of household.	Proportion of children without a caries history, corresponding to the value of dmft = 0	Inflammation of the soft tissues surrounding the tooth. Inflammation was considered to be: increase in volume, change in color, bleeding on examination. Dichotomic.	Evaluated only at 4 years. It was considered when it was found: crowding, gaps or irregularities, anterior over lapping of the maxilla or mandible, open bite, cross bite, anteroposterior molar relationship. Dichotomic.
Relative influence of the structural and intermediate social determinants in the generation of inequities in oral health in children from 1 to 6 years of age in the Metropolitan Region	Monsalves et al.[24] 2015	Regional (MR)	Probabilistic sampling stratified by Human Development Index and by clusters according to type of financing of establishments as SES proxy.	Socioeconomic status was constructed using the caregiver's educational level, household income level, health insurance and type of financing of the educational establishment.	Caries prevalence was established as the proportion of children without a caries history (dmft= 0)	Gingival bleeding was evaluated. Dichotomic.	Malocclusion, open, crossed, inverted bite or dental malposition were recorded.

SES: Socioeconomic status. **DMA:** Dento-maxillary anomalies. **RM: Metropolitan Region.**

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Supplementary Table 2. Overview of population-based oral health diagnostic studies in Chilean preschoolers between 2005 and 2015.

Study name	Author Year	Scope	Target population	Study Aims
Study of Diagnosis in Oral Health of Children aged 2 and 4 who attend Preschool Education in the Metropolitan Region of Chile during the year 2007	Ceballos et al. [22] 2007	Regional (RM)	Children aged 2 (n=500) and 4 years (n=506) of the Metropolitan Region.	Prepare a diagnosis of oral health of children aged 2 and 4 years of preschool education in the Metropolitan Region.
National Diagnosis of Oral Health of the 6-year-old child	Soto et al. [20] 2007	National	6-year-old children from Chile (n=2220)	Diagnose the oral health status of the 6-year -old child. To evaluate at a national level the oral health habit of 6-year-old children.
Diagnosis of Oral Health of Children aged 2 and 4 who attend Preschool Education in the North, Center I and Center II Zones	Soto et al. [23] 2009	Macro-zonal (North & Center)	Children aged 2 (n=1360) and 4 years old (n=1248) from the north, center I and center II zones	In children aged 2 and 4 who attend preschool education in the north and center of the country: 1. Prepare an oral health diagnosis. 2. Know the hygiene and eating habits related to their oral health. 3. Know the background regarding access to dental care for children.
Diagnosis of Oral Health of children aged 2 and 4 who attend preschool education in the southern part of the country	Hoffmeister et al. [21] 2010	Macro-zonal (South)	Children aged 2 (n=1387) and 4 years old (n=1600) from the southern zone	In children aged two and four who attend preschool education from the VIII to the XII region of the country, the following is sought: 1. Prepare a diagnosis of oral health according to geographical area and socioeconomic level 2. Know the nutritional status of children according to geographical area and socioeconomic level 3. Know the habits related to their oral health according to geographical area and socioeconomic level 4. Know the background regarding access to dental care for children according to geographic area and socioeconomic level.
Relative influence of the structural and intermediate social determinants in the generation of inequities in oral health in children from 1 to 6 years of age in the Metropolitan Region	Monsalves et al. [24] 2015	Regional (RM)	Children from 1 to 6 years of the MR (2275 children).	To determine the relative weight of the structural and intermediate social determinants in generating inequities in oral health in children from 1 to 6 years of age in the Metropolitan Region. To determine the relative weight of the structural and intermediate social determinants in generating inequities in oral health in children from 1 to 6 years of age in the Metropolitan Region.

SES: Socioeconomic status. **DMA:** Dento-maxillary anomalies. **RM: Metropolitan Region.**

Supplementary Figure 2. Bias risk analysis.

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