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Health Insurance and Education: Major Contributors to Oral Health Inequalities in Colombia

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Abstract

Background: Health inequalities, including inequalities in oral health, are problems of social injustice worldwide. Evidence on this issue from low- and middle-income countries is still needed. We aimed to examine the relationship between oral health and different dimensions of socioeconomic position (SEP) in Colombia, a very unequal society emerging from a long-lasting internal armed conflict.

Methods: Using data from the last Colombian oral health survey (2014), we analysed inequalities in severe untreated caries (≥3 teeth), edentulousness (total tooth loss), and number of missing teeth. Inequalities by education, income, area-level SEP, and health insurance scheme were estimated by the Relative and Slope Indices of Inequality (RII and SII, respectively).

Results: A general pattern of social gradients was observed and significant inequalities for all outcomes and SEP indicators were identified with RII and SII. Relative inequalities were larger for decay by health insurance scheme, with worse decay levels among the uninsured (RII:2.57; 95%CI 2.11, 3.13), and in edentulousness (RII:3.23; 95%CI 1.88, 5.55) and number of missing teeth (RII:2.08; 95%CI 1.86, 2.33) by education, with worse levels of these outcomes among the lower educated groups. Absolute inequalities followed the same pattern. Inequalities were larger in urban areas.

Conclusion: Health insurance and education appear to be the main contributors to oral health inequalities in Colombia, posing challenges for designing public health strategies and social policies. Tackling health inequalities is crucial for a fairer society in a Colombian post-conflict era and our findings highlight the importance of investing in education policies and universal health care coverage.

Key words: Oral Health; Epidemiology; Global Health; Socioeconomic Factors; Colombia

INTRODUCTION

As tackling health inequalities has increasingly become a goal of governments worldwide, it remains an academic and public policy priority to understand the nature of socioeconomic inequalities in different settings and health outcomes. Despite being entirely preventable, oral health conditions remain a major public health problem in many countries including Colombia where the last national dental survey, the 2014 ENSAB-IV, showed no significant improvements in adults' oral health during the last decade.[1] Exploring the underlying determinants of this issue, such as the role of socioeconomic factors, can make a relevant contribution to the evidence base and inform policy development. This topic has been largely under-researched in the Colombian society characterised by a complex combination of chronic and infectious diseases, health consequences of a long lasting internal armed conflict, problems of access and quality of health care, marked socioeconomic inequalities, and a major role of the informal economy.[2, 3] In this context, there is consistent evidence of inequalities in general health outcomes.[4-7] For example, among Colombian adults, lower education groups were associated with relative increases of 1.7 times in cancer mortality and 2.4 times in obesity compared to higher socioeconomic groups.[4, 5]

Studies in different countries have shown that inequalities in oral health exist not only when comparing two groups but also in the form of gradients along the social hierarchy.[8, 9] However, analyses on social gradients in adult oral health have largely focused on high-income countries and less is known about patterns of inequalities and social determinants of adult oral health in low- and middle-income settings. In the Latin-American context, these issues have been mainly analysed in Brazil, Chile, and Mexico,[10-12] but have been largely under-studied in the so-called 'Andean countries' (Ecuador, Peru, Bolivia, Colombia, and Venezuela). In Colombia, analyses conducted in adult populations have been focused on inequalities by ethnicity and socioeconomic inequalities in accessing oral health services.[13, 14] For example, a study among pregnant women revealed that access to dental care was lower for those living in poorer municipalities, rural areas, and those uninsured or in the subsidized health insurance scheme.[15] The latter refers to a scheme that subsidizes health care for the most vulnerable families, identified through a proxy means test (an assessment of families' living conditions based on the availability and quality of housing and basic public services, ownership of durable goods and human capital endowments).[16] Problems of access to dental care were also identified in the 2014 ENSAB-IV, with 23% of adults aged 20-79 years reporting that their last dental visit was more than two years ago.[1]

Health care services in Colombia (including dental services) are provided based on different health insurance schemes.[17] Each family can participate in one of these schemes based on the working status of their members and their poverty level. The subsidized scheme comprises those lacking formal employment and classified as 'poor' with their health care being mainly tax-funded; in the contributory scheme are those in formal employment or in independent jobs who are able to pay a monthly fee; the exceptional scheme includes armed forces, teachers in the public sector and petroleum industry workers. This leaves a proportion of the population (8% in the ENSAB-IV sample)[1] as uninsured, i.e. those who do not meet the criteria to be categorised as 'poor' and are not in formal employment or able to pay a monthly fee. The existence of these different schemes and additional financial barriers make access to health care an ongoing issue in Colombia.[18, 19] Understanding oral health inequalities in Colombia is a priority given the aforementioned context, together with evidence of the considerable access barriers to dental care and the potential impact of oral diseases on the daily activities and household finances, particularly for those living in vulnerable conditions.[1, 13, 15] Also, studies on inequalities in oral health and other health outcomes suggest that different socioeconomic measures could have particular influences on health, given that they capture distinct material and non-material resources of individuals that influence their position in society.[20] Therefore, this study aimed to quantify the magnitude of adult oral health inequalities in Colombia using different measures of people's socioeconomic circumstances.

METHODS

Data source and study sample

This population based cross-sectional analysis was carried out using data from the most recent oral health survey in Colombia, the 2014 ENSAB-IV, which provides information about clinical oral health, access to dental care and certain social determinants of oral health for children and adults up to 79 years of age.[1] The survey had a response rate of 88.2% and produced representative data at national and regional levels by using a multistage, stratified random sampling design. In every region, municipalities and then sampling points within municipalities were selected with probability proportional to population size. From the sampling points, households were randomly selected. Information about sociodemographic characteristics of all family members was collected and then, a

more in-depth interview and a clinical dental examination were conducted among persons selected. Further details of the survey's design can be found elsewhere.[1] Data were collected on a sample of 20,534 persons, of which 8,042 were adults aged 20-79 years. This sample was limited for this analysis to 7,877 individuals, after excluding those with incomplete data on the study variables. Since the proportion of adults with missing data was 2%, no imputation of missing data was carried out.

Study measures

Three oral health outcomes were analysed: 1) severe untreated caries, defined as having ≥3 teeth with untreated carious lesions, 2) edentulousness (no natural teeth), and 3) number of missing teeth. While the first outcome is an indicator of current oral health status, the other two are considered measures of life-time oral health. Presence of caries was assessed using ICDAS (International Caries Detection and Assessment System) criteria and teeth with ICDAS-merged moderate/extensive carious lesions (i.e., cavitated lesions) were considered for the outcome of severe untreated caries. Clinical examiners were trained and calibrated, with inter- and intra-examiner reproducibility Kappa values of 0.7 and 0.8, respectively.[1] We analysed edentulousness among participants aged 45 years and over, and only dentate adults were considered for the outcomes of severe untreated caries and number of missing teeth. Dichotomous variables were created for having severe untreated caries and edentulousness, while number of missing teeth was treated as a count variable.

We examined inequalities by four different dimensions of SEP that collectively capture different individual, household and area-level characteristics that influence people's relative position in Colombian society: education, income, area-level SEP, and health insurance scheme. Education was measured as the highest level achieved and categorized into primary or less, secondary, technical, and university. Information on household income was collected in categories based on the 2013 monthly national minimum wage (NMW), and five categories were employed: < half NMW; ≥ half and <1 NMW; ≥1 and <2 NMW; ≥2 and <3 NMW; and ≥3 NMW. Area-level SEP corresponds to a classification of groups of dwellings based on their structural characteristics and features of the area where they are located such as access to public services, transport roads and commercial value of the land.[21] This classification, which goes from 1 (lowest) to 6 (highest), is mainly used in Colombia to define the allocation of public services subsidies. Four categories were available in the ENSAB-IV and employed in this study: lowest (1), low (2), middle (3), and highest (4-6). Finally, the health insurance scheme

was categorized into exceptional, contributory, subsidised, and uninsured (described above). Further details about the Colombian health care system can be found elsewhere.[17]

Age, gender, marital status, region, place of residence (urban/rural) and ethnicity were considered as covariates. In the analyses, age was included as a continuous variable and the other variables were included using the categories showed in Table 1.

Statistical analysis

We first estimated the age-standardized prevalence/mean of each oral health measure by all SEP indicators. A direct method for age-standardization was used on the basis of the age distribution of the 2013 Colombian population.[22] Then, to explore the association between oral health and SEP, we fitted regression models with the oral health measure as dependent variable, the SEP indicator as independent variable, while adjusting for the above-mentioned covariates.

Finally, we estimated the relative index of inequality (RII) and slope index of inequality (SII) to assess relative and absolute inequalities respectively.[23] For this, each SEP indicator was transformed to a quantitative variable scaled from 0 to 1 according to its distribution in the analytical sample. This variable was calculated for each SEP category as the mean proportion of the population having a higher level of income, education, area-level SEP, or health insurance scheme. In this analysis, RII and SII were estimated using robust Poisson and linear regression models respectively. These regression models have been previously used to estimate the indices, especially in analyses of survey data where issues of convergence with log-binomial models are common.[24, 25] For the binary outcomes of severe untreated caries and edentulousness, we also derived RII and SII using log-binomial regression models. Convergence was achieved in all models for severe untreated caries but only two of eight models for edentulousness, with results being very similar to the main estimates derived from the robust Poisson and linear models (results shown in Appendix). We included all the above-mentioned covariates in the models and took into account the complex sampling design and survey weights, which considered the clustering and stratified sampling process, unequal selection probability and non-response. The RII can be interpreted as the prevalence odds ratio of the outcome between those with the worst and those with the best socioeconomic conditions.[23, 26] Values of RII>1 signify higher prevalence of decay, edentulousness, or higher number of missing teeth among those with worse

socioeconomic characteristics. The SII corresponds to the absolute difference in the outcomes between the two extremes of the SEP hierarchy. Values of SII>0 indicate inequality.

Analyses were also conducted stratifying by age groups and place of residence (urban/rural). According to the Colombian national statistics office,[27] urban areas comprise all cities and municipalities that have a central administrative office and consist of sets of buildings delimited by streets or avenues, while rural areas are characterized by more dispersed dwellings or agricultural holdings, where there are no street name systems. We stratified by place of residence due to differences between urban and rural settings in factors that could influence health inequalities such as social networks, cooperative links and experiences with the armed conflict.

RESULTS

We analysed data from 7,877 adults aged 20-79 years of which 7,313 were dentate and 564 edentate. Baseline characteristics of the analytic sample are presented in Table 1. Regarding oral health outcomes, the age-standardised prevalence of edentulousness was 15.7% (95%CI 14.3% to 17.2%) among adults aged 45 years and over. Among dentate participants, the age-standardised prevalence of severe untreated caries was 28.3% (95%CI 27.1% to 29.6%) and the mean number of missing teeth was 6.0 (95%CI 5.9 to 6.1) (Table 2). Age standardized estimates of oral health outcomes by SEP (all four measures analysed) showed a general picture of social gradients in the expected direction, namely, worse oral health outcomes at successively lower SEP levels with just few exceptions (Table 2 and Figure 1). After adjusting for demographic characteristics, ethnicity and geographical location, PRs and IRRs confirmed the existence of social gradients in all oral health outcomes. The only exceptions to this pattern were observed for edentulousness and number of missing teeth by health insurance scheme, as well as for edentulousness by area-level SEP. In these cases, the second lower health insurance scheme and area-level SEP had higher PR for edentulousness and IRR for missing teeth compared to the lowest health insurance scheme groups and area-level SEP respectively (Appendix Table 1).

Table 1 - Baseline characteristics of the study sample, participants aged 20-79 years (n=7,877) [a]

Variables	n	(weighted %) [b]
Age (years)		
20 - 29	1,987	25.54
30 - 39	1,691	21.22
40 - 49	1,444	18.68
50 - 59	1,161	14.94
60 - 69	919	11.28
70 - 79	675	8.34
Sex		
Male	2,761	35.53
Female	5,116	64.47
Marital status		
Married	1,961	25.27
Cohabiting	2,855	35.93
Divorced/Separated	1,064	13.68
Widowed	591	7.54
Single	1,406	17.58
Region		
Atlantic	1,281	16.18
East	1,341	17.16
Central	1,377	17.80
Pacific	1,401	17.91
Bogota	1,199	15.13
Amazon/Orinoquia	1,278	15.83
Place of residence		
Urban	6,075	77.48
Rural	1,802	22.52
Ethnicity		
White	1,975	25.88
Mixed (mestizo)	3,375	42.41
Indigenous	463	5.69
Afro Colombian	821	10.28
Other ethnicities	159	2.09
No sure/Don’t know	1,084	13.66
Educational level		
University	872	10.92
Technical	959	12.32
Secondary	2,836	36.56
Primary or less	3,210	40.20
Household income		
≥ 3 NMW [c]	731	9.48
≥ 2 and < 3 NMW	895	11.61

≥ 1 and < 2 NMW	2,565	32.78
≥ Half and <1 NMW	2,554	32.25
< Half NMW	1,132	13.89
Area level SEP		
Highest	360	4.85
Middle	1,297	17.11
Low	3,011	37.46
Lowest	3,209	40.59
Health insurance scheme		
Exceptional	307	3.96
Contributory	2,822	35.89
Subsidized	4,248	53.54
Not insured	500	6.61

[a] Sample of adults with complete information on relevant variables
[b] Frequencies are weighted but counts are not.
[c] 2013 Monthly National Minimum Wage (NMW): COP$589,500

Table 2 - Age-standardized prevalence/mean of oral health outcomes by SEP

	Having ≥3 teeth with untreated caries [a]	Edentulousness [b]	Number of missing teeth [a]
	Prevalence rate (95% CI)		Mean (95% CI)
Total	28.32 (27.07, 29.60)	15.67 (14.30, 17.15)	6.00 (5.86, 6.14)
Educational level			
University	15.67 (12.86, 18.96)	4.57 (2.35, 8.68)	3.94 (3.57, 4.31)
Technical	21.69 (18.12, 25.75)	6.82 (3.12, 14.25)	4.66 (4.15, 5.16)
Secondary	28.08 (25.92, 30.34)	12.12 (9.11, 15.94)	5.45 (5.17, 5.72)
Primary or less	36.39 (33.75, 39.12)	18.08 (16.34, 19.97)	7.01 (6.78, 7.24)
Household income			
≥ 3 NMW [c]	13.04 (10.22, 16.50)	7.94 (5.27, 11.80)	4.47 (4.09, 4.84)
≥ 2 and < 3 NMW	22.21 (18.97, 25.82)	10.56 (7.49, 14.68)	5.37 (4.97, 5.76)
≥ 1 and < 2 NMW	26.42 (24.33, 28.62)	15.10 (12.59, 18.01)	5.78 (5.51, 6.05)
≥ Half and <1 NMW	33.45 (31.11, 35.87)	18.44 (15.76, 21.46)	6.39 (6.14, 6.64)
< Half NMW	38.33 (34.53, 42.28)	18.82 (15.78, 22.28)	7.39 (6.99, 7.80)
Area level SEP			
Highest	15.14 (10.65, 21.08)	4.20 (2.27, 7.64)	3.67 (3.19, 4.15)
Middle	21.98 (19.30, 24.91)	12.89 (10.14, 16.25)	5.59 (5.27, 5.91)
Low	25.04 (23.10, 27.08)	19.80 (17.35, 22.50)	6.07 (5.84, 6.30)
Lowest	35.68 (33.58, 37.84)	15.05 (12.89, 17.48)	6.48 (6.25, 6.72)
Health insurance scheme			
Exceptional	16.06 (11.52, 21.95)	15.10 (9.73, 22.68)	5.27 (4.66, 5.88)
Contributory	19.48 (17.67, 21.44)	12.20 (10.28, 14.43)	5.23 (5.01, 5.46)
Subsidized	33.48 (31.69, 35.33)	18.28 (16.32, 20.42)	6.65 (6.45, 6.85)
Not insured	41.36 (35.93, 47.01)	11.34 (5.58, 21.69)	5.68 (5.01, 6.35)

[a] Among dentate adults (n=7,313)

[b] Among adults aged 45+ years (n=3,407)

[c] 2013 Monthly National Minimum Wage (NMW): COP$589,500

RII and SII estimates showed significant relative and absolute inequalities for all outcomes and SEP indicators (Table 3). There were larger relative inequalities in severe untreated caries by health insurance scheme, with the uninsured having worse decay levels (RII: 2.57; 95%CI 2.11, 3.13). For this outcome, a large RII was also observed by education with higher prevalence of severe untreated caries among adults with lower educational achievement (RII: 2.16; 95%CI 1.77, 2.63). Relative

inequalities were larger by education in edentulousness (RII: 3.23; 95%CI 1.88, 5.55 for edentate) and number of missing teeth (RII: 2.08; 95%CI 1.86, 2.33 for fewer number of teeth) with higher rates for both of these outcomes among the lower educated groups. This pattern was also observed for absolute inequalities as showed by SII estimates. When stratifying by place of residence, our findings revealed that inequalities tend to be larger in urban areas (Table 4), with the exception of inequalities by education in number of missing teeth and severe untreated caries. Again, a similar pattern was observed for absolute inequalities (Appendix Table 2). Regarding analysis by age groups, there was not a clear and consistent pattern of inequalities across groups. However, for the outcome of severe untreated caries, inequalities were larger among younger adults (aged 20-39 years) for all SEP measures (Appendix Table 3). Finally, we tested for interactions between SEP and gender, and stratified results revealed larger educational inequalities in edentulousness and number of missing teeth among women (Appendix Table 4).

Table 3 - Relative and absolute inequalities in oral health outcomes by different SEP measures

	Having ≥3 teeth with untreated caries	Edentulousness	Number of missing teeth
SEP	Relative inequalities - RII (95% CI)		
Educational level	2.16 (1.77, 2.63) ***	3.23 (1.88, 5.55) ***	2.08 (1.86, 2.33) ***
Household income	1.98 (1.66, 2.36) ***	2.00 (1.42, 2.83) ***	1.37 (1.25, 1.50) ***
Area level SEP	1.71 (1.39, 2.11) ***	1.66 (1.14, 2.42) **	1.31 (1.17, 1.46) ***
Health insurance scheme	2.57 (2.11, 3.13) ***	1.55 (1.04, 2.29) *	1.37 (1.23, 1.53) ***
	Absolute inequalities - SII (95% CI)		
Educational level	20.65 (15.43, 25.87) ***	11.79 (6.55, 17.03) ***	3.91 (3.30, 4.51) ***
Household income	18.91 (14.06, 23.75) ***	10.58 (5.20, 15.97) ***	2.26 (1.72, 2.80) ***
Area level SEP	14.28 (8.66, 19.90) ***	7.51 (1.92, 13.11) **	1.96 (1.34, 2.58) ***
Health insurance scheme	25.24 (20.11, 30.36) ***	6.53 (1.08, 11.98) *	2.02 (1.45, 2.59) ***

* p<0.05, **p<0.01, ***p<0.001
RII: Relative Index of Inequality, SII: Slope Index of Inequality
Models adjusted by age, gender, marital status, region, place of residence (urban/rural) and ethnicity

Table 4 - Relative inequalities in oral health outcomes by different SEP measures and place of residence

	Having ≥3 teeth with untreated caries	Edentulousness	Number of missing teeth
Urban areas	RII (95% CI)		
Educational level	2.11 (1.69, 2.65) ***	3.25 (1.84, 5.73) ***	1.97 (1.74, 2.22) ***
Household income	2.22 (1.82, 2.72) ***	1.94 (1.32, 2.85) **	1.36 (1.23, 1.50) ***
Area level SEP	1.81 (1.45, 2.28) ***	1.69 (1.13, 2.54) *	1.32 (1.18, 1.49) ***
Health insurance scheme	2.70 (2.18, 3.36) ***	1.67 (1.07, 2.60) *	1.38 (1.23, 1.56) ***
Rural areas			
Educational level	2.46 (1.60, 3.80) ***	2.07 (0.46, 9.26)	2.61 (1.95, 3.49) ***
Household income	1.39 (0.99, 1.95)	1.73 (0.84, 3.59)	1.34 (1.09, 1.65) **
Area level SEP	1.25 (0.71, 2.22)	0.84 (0.27, 2.64)	1.07 (0.74, 1.54)
Health insurance scheme	2.04 (1.29, 3.22) **	0.98 (0.41, 2.34)	1.30 (0.99, 1.69)

* p<0.05, **p<0.01, ***p<0.001
RII: Relative Index of Inequality
Models adjusted by age, gender, marital status, region and ethnicity

DISCUSSION

We examined the nature of socioeconomic inequalities in oral health in Colombia, a middle-income country with particular political, social, and economic features. We found significant inequalities in different oral health outcomes and SEP indicators with type of health insurance and educational level being the main contributors to the identified inequalities. There were larger inequalities in decay by health insurance scheme, with the uninsured having worse decay levels, and in edentulousness and number of missing teeth by education with higher rates for both of these outcomes among the lower educated groups. Oral health inequalities were generally larger in urban areas, and in some cases among younger adults and women.

Our findings showed that the type of health insurance and educational level were particularly relevant to adults' oral health. Some previous studies with Colombian data, highlight that the health insurance scheme does not seem to be contributing to addressing health and oral health inequalities.[13, 18, 28, 29] On the contrary, inequalities have been observed in other studies with the uninsured and those in the subsidised scheme being more likely to have lower gastric cancer survival,[28] higher neonatal mortality rates,[30] get a delayed tuberculosis diagnosis,[29] use less preventive services,[31] and have lower access to health care when needed.[32] This evidence together with our results indicates that the Colombian

health care system, which is based on managed competition, urgently needs shifting towards universal coverage and focusing on primary health care. Health care systems with these two key features have performed better in developing locally relevant strategies and interventions aimed at influencing the social determinants of health inequalities.[33, 34]

Results of this study also revealed education as a consistent marker related to oral health, as inequalities by education tended to be high across all outcomes. Education reflects early life SEP, particularly in low- and middle-income countries.[35] In the nationally representative sample analysed in this study, 40% of adults had an educational attainment of primary level or less.[1] Even among younger adults (aged 20-39 years), a fifth of them only completed primary education. This shows a dramatic lag in social opportunities with implications on work chances, characteristics of jobs, economic conditions and health status. The relatively low levels of education observed in this sample could also have an impact on health/ oral health through pathways including psychosocial factors, health-related behaviours and health literacy. There is evidence of consistent and significant educational inequalities in other health outcomes in Colombia[36, 37] giving support to the idea of an imperative call for social policies aimed at improving access to quality education up to the highest levels, which would contribute to achieve better population health and a reduction in social and health inequalities.

Policies to tackle oral health inequalities in Colombia need to also consider other dimensions of SEP, particularly those related to household material circumstances and neighbourhood socioeconomic characteristics, as inequalities by income and area-level SEP were also significant for all outcomes in our study. Moreover, the complex interplay of different social, economic and health system factors needs to be further examined, considering also that they can be partly influenced by the context and the specific characteristics of the Colombian society. For example, inequalities by area-level SEP found in this analysis could be partly explained by problems of accessibility and availability of dental providers in areas with poorer living conditions.

Differences found in this analysis by place of residence (urban/rural) are in line with studies on other health outcomes,[38] particularly a recent study on mental health that found a different pattern of inequalities in rural and urban settings in Colombia.[39] In both that paper and our analyses, rural areas exhibited lower or even inverse gradients when compared to urban settings. This could indicate that

perceptions about belonging to different SEP levels could be less marked or better tolerated in the dispersed, rural areas where also strong social networks and cooperative links are more frequently observed.[40] These psychosocial factors could potentially buffer the impact of more vulnerable socioeconomic circumstances on health.[41] In addition, the armed conflict has caused an important internal migration mostly towards urban areas where those internally displaced have to start a new life in very precarious conditions and without the family and social support from their place of origin.[42] This, combined with the fact that in urban settings access to goods and services are more linked to economic resources, could contribute to the larger inequalities observed in urban areas. Analysing these urban-rural differences in health inequalities and their relationship with features of the Colombian context should be further explored in future studies.

The majority of evidence on socioeconomic inequalities in oral health comes from high-income country populations.[43] However, in recent decades, a growing body of literature on the association between socioeconomic conditions and adult oral health in low- and middle-income countries has emerged.[44] That literature shows mostly inequalities in the expected direction, but also some studies report no or negative associations.[45] Our results agree with the former and in general with evidence from other Latin American countries showing marked socioeconomic gradients in different measures of oral health.[10-12] Importantly, we showed inequalities by health insurance scheme, as was also observed in a study from Chile,[10] a Latin American country with a health care system very similar to the Colombian one.

The strengths of our study include its nationally representative sample that allowed for findings that are generalizable to the Colombian population. We employed a range of SEP markers that collectively reflect important individual, household, and area-level socioeconomic characteristics. Our oral health outcomes cover both measures of disease but also function and represent current and historical indicators. In addition, the study employed a comprehensive and detailed analysis that also estimated both absolute and relative inequalities. However, our results should be interpreted considering some limitations. First, the accuracy of the area-level SEP indicator in reflecting current socioeconomic conditions depends on how recently it has been updated by local authorities. As neighbourhoods change and new facilities become available, including access to public services, transport, etc., their SEP classification may change over time. Unfortunately, that change is not always timely registered in official records. Another limitation concerns the income variable that was supplied as ordinal

groupings to comply with confidentiality requirements, leading to a loss of precision in measurement. Additionally, the SEP measures used in this study may not be ideal for older adults, particularly pensioners.[46] A better alternative might be wealth (i.e., accumulated assets), which better capture variations in socioeconomic position and financial security among retired adults,[47, 48] but data on wealth were not collected in the survey. We think, however, that this may have had a limited effect on our findings as the sample was predominantly consisting of people who have not reached the pension age. A limitation related to the oral health measures was the lack of data regarding causes of tooth loss. However, as the causes of tooth loss are usually linked to caries and periodontal disease, it is reasonable to consider the outcomes based on missing teeth as indicators of cumulative disease. We also acknowledge that while being relevant for interpretation the dichotomisation of the untreated caries variable may influence the findings, therefore we employed an established cut-off point for the classifications of severe untreated caries.[49-51] Finally, similar to other analyses on cross-sectional data, it was not possible to establish a temporal sequence in the hypothesised relationship SEP-oral health.

This is, to our knowledge, the first study to examine inequalities in the Colombian adult oral health using different outcomes and SEP measures, based on nationally representative data. Results of this analysis could be used by policy makers as a baseline point to assess the potential impact of future policies and interventions aimed at improving population oral health and tackling inequalities. Those interventions should include a wide range of strategies including emphasis on prevention and oral health promotion, integration of oral health into non-communicable diseases programmes, public health actions with a degree and intensity proportionate to the level of disadvantage and, more importantly, actions on the broader structural determinants of health. Our findings particularly highlight the importance of investing in education policies and universal health care coverage.[52] Focusing only on the most disadvantaged within a society is not enough to comprehensively address health inequalities. The existence of social gradients in health, including oral health, require policy responses aimed at guaranteeing to all members of society: opportunities, health care, access to safe environments, and in general, access of material and non-material resources that are important for health. These societal aims are particularly relevant at this time when building a fairer society is key in a Colombian post-conflict era.

What is already known on this subject?

- Most of the evidence on social gradients in adult oral health comes from high-income countries.
- This issue has been under-studied in the Colombian context, characterised by very high levels of socioeconomic inequality and the social and health consequences of a long-lasting internal armed conflict.
- To date, no study has analysed the relationship between different dimensions of socioeconomic position and oral health among Colombian adults.

What this study adds?

- Using the most recent nationally representative survey of oral health in Colombia, we found a general pattern of social gradients with significant relative and absolute inequalities for all oral health outcomes and socioeconomic position measures.
- When comparing the magnitude of inequalities, type of health insurance and educational level were particularly relevant.
- Evidence from this study highlights a clear need to invest in education policies and universal health care coverage in Colombia, together with other actions on the broader structural determinants of health.
- These societal aims are crucial for a fairer society in a Colombian post-conflict era.

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