Oral health studies in the 1982 Pelotas (Brazil) birth cohort: methodology and principal results at 15 and 24 years of age

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Estudo longitudinal de saúde bucal na coorte de nascidos vivos em Pelotas, Rio Grande do Sul, Brasil, 1982: aspectos metodológicos e resultados principais aos 15 e 24 anos de idade

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Abstract

The aim of this study was to describe the methodology and results of oral health studies nested in a birth cohort in Pelotas, Southern Brazil. For the oral health studies a sub-sample (n = 900) was selected from the cohort and dental examinations and interviews were performed at ages 15 (n = 888) and 24 years (n = 720; 81.1%). Data collection included dental outcomes, dental care, oral health behaviors, and use of dental services. Mean DMF-T varied from 5.1 (SD = 3.8) to 5.6 (SD = 4.1) in the study period. The proportion of individuals with at least one filled tooth increased from 51.9% to more than 70%. Individuals who had always been poor used dental services less and had fewer healthy teeth on average than those who had never been poor. Individuals with decreasing or increasing family income trajectories showed intermediate values. An increase was seen in the number of healthy teeth from age 15 to 24 only among those who had never been poor. A history of at least one experience with poverty had a negative impact on oral health in adulthood.

Dental Health Services; Oral Health; Adolescent

Introduction

Oral health diseases and disorders negatively affect activities of daily living, such as school and work, causing millions of hours of lost study and work hours around the world [1].

The most prevalent oral conditions, like dental caries, periodontal diseases, and malocclusion are chronic (developing over the course of years or even decades) and can even begin in early childhood [2]. Social deprivation in early childhood, such as low family income, has been associated with chronic diseases in general and mortality in adulthood [3]. One can thus expect the same association between unfavorable socioeconomic status in early life and chronic oral diseases.

Given that chronic oral conditions can be associated with exposures throughout life, the most adequate study design for investigating risk factors for these conditions is a prospective cohort, ideally beginning at birth. Oral health studies with such characteristics are very difficult to perform due to the high costs, difficulty in obtaining financing for this specific theme in extended studies, and the need for a large qualified team. Losses to follow-up are one of the principal sources of bias in this type of research, as in cohort studies in general. Therefore, the literature includes little methodological description of longitudinal, population-based oral health studies,

particularly in countries of the Southern Hemisphere, like Brazil.

A literature review detected only three population-based birth cohorts that are still active and that have investigated oral conditions in young adults and related exposures and risk factors. The multidisciplinary health and development study in Dunedin, New Zealand [4], included all children born in the only maternity hospital in the city from April 1, 1972, to March 31, 1973, and 1,037 children were followed periodically, including oral health studies, at 5, 9, 15, 18, 26, and 32 years of age [5]. A new follow-up at 38 years of age is being planned. The other two studies are the cohorts in Pelotas, Rio Grande do Sul State, Brazil, which have followed all the children born in 1982 (N = 5,914) [6] and 1993 (N = 5,249) [7]. In the 1982 cohort, multiple oral health outcomes and related exposures were investigated through two household surveys conducted at 15 and 24 years of age, representing respectively mid-adolescence and early adulthood [8]. In 1993, oral health studies were performed at 6 years (n = 359) [9] and 12 years of age (n = 339) [10], representing, respectively, the oral conditions related to the deciduous and permanent dentition.

The objectives of the present study were to present the methodology, describe the principal findings of oral health studies, and evaluate oral conditions according to lifetime family income trajectories in participants in the 1982 Pelotas (Brazil) birth cohort.

Methods

The study was performed in Pelotas, a city in southern Rio Grande do Sul State, Brazil, near the border with Uruguay. The urban population of Pelotas increased from 214,000 in 1982 to 340,000 in 2007 [11]. The main economic activities are agriculture, cattle-raising, and commerce, besides serving as an important college town, with three universities. The per capita GDP in Pelotas increased from US$ 2,700 in 1992 [12] to US$ 3,490 in 2003 [13]. The population descends mainly from Spanish and Portuguese colonizers, Amerindian and African slaves, and Germanic immigrants. Approximately 90% of the houses are connected to the public water supply, which has been fluoridated since 1961. Of the 45 health units managed by the municipality, 32 have dental teams, 22 of which in the urban area and 10 in the rural area. Additionally, there are eight dentist's offices installed in public schools, where primary oral health care is performed. In 2007, there were 514 dentists in the municipality registered with the National Board of Dentistry [14].

In 1982, all the children born in the three maternity hospitals then existing in Pelotas were identified. The 5,914 live born children were weighed and measured at the maternity hospital and their mothers were measured and interviewed with a structured questionnaire that contained questions on socioeconomic and demographic factors, as well as data on the pregnancy and the mother's health. The cohort was followed at various periods in life. Further details on the methodology of the overall cohort study can be found in another publication [15].

In the Oral Health Study 1997 (OHS 97), when the adolescents in the cohort reached 15 years of age, a systematic sample of 70 (27%) of the 259 census tracts in the city limits was selected, all the households in these tracts were visited, and 1,076 adolescents from the cohort were interviewed. For the OHS 97, a random sample of 900 adolescents was selected among those that were interviewed in 1997. This sample size was sufficient to estimate the prevalence rates for the outcomes considered as unknown (P = 50%), with a sample error of 5 percentage points and 95% confidence interval, besides having been adequate for testing some associations between exposures and outcomes, considering 35% prevalence of outcomes among the unexposed, relative risk of 1.4, type 1 error of 5%, and 80% statistical power [8]. All the individuals were submitted to oral examinations, in addition to a structured interview conducted in their homes.

The oral examination focused on dental caries and malocclusions, collected according to criteria proposed in the 3rd edition of the instructions manual for epidemiological surveys in oral health by the World Health Organization (WHO) [16]. The study also identified the presence and type of soft tissue lesions (Table 1). Dental caries were recorded according to the DMF-T index (number of decayed, missing, and filled teeth). To assess malocclusions, the WHO [16] recommended two distinct levels of disorders: very mild (a rotated tooth or slight crowding or spacing between teeth) and severe disorders (presence of maxillary overjet of 9mm or greater, mandibular overjet, anterior crossbite equal to or greater than the size of one tooth, open bite, midline shift 4mm or greater, or crowding or spacing 4mm or greater).

The OHS 97 questionnaire assessed oral hygiene, eating habits, use of dental services, and non-nutritive sucking habits in childhood (Table 1). Application of the questionnaire and the oral examination were performed in the adolescents' homes. The field team consisted of eight examiners and eight data recorders who participated in the training and standardization (calibration) sessions before the fieldwork. The

Table 1

Information collected in the Oral Health Study 1997 (OHS 97) on adolescents 15 years of age. 1982 Pelotas (Brazil) birth cohort.

Oral conditions and target information	Indices/Criteria/Variables/Categories
Dental crown caries	DMF-T (WHO) [16]
Malocclusions	WHO [16]
Oral lesions	Presence of oral lesion(s) *
	Which lesion? (gingivitis, ANUG, white lesion, candidiasis, leukoplatia, carcinoma, other)
Eating habits	How many meals do you eat a day?
	Do you normally eat or snack between meals? *
	What do you usually eat for snacks? (sweets, salted snacks, fruits)
	Do you often eat chocolate or candy? *
	Do you often chew gum? *
Oral hygiene	Do you brush your teeth? If so, how often? (> 2 times/day, 1-2/day, 3-6 times/week, 1/week)
	Do you have your own toothbrush?
	Do you use toothpaste? *
	Do you clean between your teeth? *
	What to you use to clean between your teeth? (dental floss, sewing thread, toothpick, other)
	Do you use any mouthwash? *
Use of dental services	Did you visit the dentist in the last year? If so, how often do you visit?
	Have you ever been to the dentist?
	Where do you usually go to the dentist? (private office, public health clinic, health plan, trade union, dentistry school, emergency department, school)
Childhood habits	Did you use a pacifier? If so, until how old?
	Did you suck your thumb/fingers? If so, until how old?

ANUG: acute necrotizing ulcerative gingivitis; DMF-T: number of decayed, missing, and filled teeth; WHO: World Health Organization.
* These were dichotomous (yes-or-no) questions.

calibration process was performed with 25 individuals the same age as the adolescents from the cohort. Inter- and intra-examiner agreement was calculated using the kappa statistic, tooth-by-tooth for dental caries, and the lowest resulting value was 0.65. The lowest kappa value for oral lesions was 0.55.

The adolescents that participated in the study in 1997 were contacted to be visited at their homes in 2006 (OHS 06), the year in which they completed 24 years of age, to conduct new interviews and dental examinations. The adolescents in the study were found through an address bank from the most recent follow-up (in 2004-2005). When the young person was not located, the interviewers checked with the neighbors for information on how to locate the family. After obtaining authorization for participation in the study, the home visits were conducted.

The interviewers used a questionnaire containing questions on the use of dental services, oral hygiene habits, and episodes of toothache in the four weeks prior to the study. During the oral examination, information was collected on dental crown caries, gingival bleeding and calculus, periodontal pocket, use of and/or need for dental prostheses, quality of restorations in posterior teeth, and soft tissue lesions (Table 2), after which the examination was performed. All examinations began with the upper right quadrant and ended with the lower right quadrant.

Assessment of dental crowns for caries followed the WHO diagnostic guidelines [17] as defined in the 4th edition of the instructions manual for oral health epidemiological surveys, thus allowing calculation of the DMF-T index, caries prevalence (DMF-T ≥ 1), and healthy teeth index (sum of healthy teeth and plus the filled component of the DMF-T index) [18]. For detection of gingival bleeding, all the teeth were probed in six sites (three on the buccal side and three on the lingual or palatal side of each tooth) with a WHO-model periodontal probe (Trinity; Campo Mourão, Brazil), waiting 10 seconds after probing to verify the presence or absence of bleeding. The study recorded bleeding prevalence (bleeding present in at least one tooth), mean number of bleeding teeth per individual, and proportion

Table 2

Information collected in the Oral Health Study 2006 (ESB-06) on young adults 24 years of age. 1982 Pelotas (Brazil) birth cohort.

Target conditions	Indices/Criteria/Variables/Categories
Dental crown caries	DMF-T index (WHO) [17]
Gingival bleeding, calculus, and periodontal pocket	All teeth examined for bleeding, calculus, and periodontal pocket. Ratio between affected and natural present teeth (WHO) [17]
Use of or need for dental prostheses	WHO [17]
Quality of restorations in posterior teeth	da Rosa Rodolpho et al. [19]
Soft tissue lesions	Presence of lesion (yes/no)
	Location (tongue, floor, cheek mucosa, palate, gums, lips, maxilla, mandible)
	Type of lesion (ulcer, white spot, reddish spot, brownish spot, white plaque, erosion, papule or nodule, vesicle or blister)
	Size of lesion in mm (0.1-0.5; 0.6-1.0; 1.1-2.0; 2.1-4.0; > 4.0)
Use of dental services	Have you ever been to the dentist's office? (no, yes, don't know)
	Since <month> last year, have you been to the dentist? (no, yes, don't know)
	Where did you go to the dentist the last time? (private office, health plan, dentistry school, public health clinic, workplace, other)
Habits and behaviors related to oral hygiene	Do you brush your teeth? (never, yes or sometimes, don't know)
	How many times do you usually brush your teeth per day? (number of times, not every day, don't know)
	When you brush your teeth, do you use toothpaste? (never, always, sometimes)
	Do you use dental floss? (never, always, sometimes, don't know)
	How many times per day do you use dental floss? (number of times, not every day, don't know)
Toothache	Toothache in the last 4 weeks, pain intensity, main reason for toothache

DMF-T: number of decayed, missing, and filled teeth; WHO: World Health Organization.

of teeth with bleeding. All teeth were examined at three different points on the buccal and lingual sides for evaluation of calculus and periodontal pocket. Calculus and pocket were considered present if detected on at least one of the surfaces examined. Periodontal pocket was classified as shallow (≤ 5mm) or deep (≥ 6mm). The use of and/or need for dental prostheses was based on the presence of prosthetic spaces according to WHO guidelines [17]. Quality of restorations was assessed on the premolars and molars, considering the type of cavity, type of restoration material, time since restoration, quality of the restoration, and unsatisfactory classification ratio, when applicable [19]. Identification of soft tissue lesions was based on the presence or absence of a basic lesion (macula, papule, vesicle, blister, or ulcer), size of the lesion in millimeters, and location of the lesion (Table 2).

The oral examinations and interviews were performed by six dentists and four students from the final year of dentistry at the Pelotas Federal University (Universidade Federal de Pelotas – UFPel). All examiners and interviewers underwent prior training that consisted of 8 hours of theoretical classes and 8 hours of practice. The theoretical component covered the study's diagnostic criteria and details on each of the indices, in lecture format, provided by the researchers with experience in this kind of evaluation, using multimedia visual resources. During the practical exercises, each individual examined 20 patients (from 20 to 27 years of age), recruited among students and employees at the UFPel School of Dentistry (Faculdade de Odontologia), under supervision by the researchers. During the training period a "gold standard" examiner was selected, who demonstrated the greatest theoretical and practical affinity with the researchers [20]. Calibration of the examiners was performed at two different moments with 25 Brazilian Army recruits, since the first calibration failed to produce satisfactory reproducibility for gingival bleeding. Diagnostic reproducibility was measured with the simple and weighted kappa statistic (categorical variables) and through the intra-class correlation coefficient (continuous and discrete variables), showing good reproducibility after two weeks of intensive training (the lowest kappa value was 0.60, for gingival bleeding, but most of the kappa scores were 1.0).

Prior to the fieldwork, the instruments were tested with 10 individuals and a pilot study was conducted with individuals of the same age, but from outside the sample. An instructions manual was prepared for the field researchers, used dur-

ing the training and throughout the data collection period. The field supervision was done by doctoral and Master's students from the Graduate Studies Program in Epidemiology (Programa de Pós-graduação em Epidemiologia) at UFPel. The dental examination was performed in the homes in the room with the best lighting, using dentist's white coats, masks, caps, and disposable gloves, headlights, number 5 flat oral mirror, millimeter periodontal probe (Trinity), with the instruments previously sterilized by autoclave at the UFPel School of Dentistry. The team spent from 30 to 40 minutes at each home. Quality control was performed by the field supervisors in 10% of the sample, by telephone, repeating several questions that had already been answered during the home visit. Losses were defined as sample subjects with whom the team was unable to conduct the interview after four visits to the household on different days of the week and at different times of the day. Families that had moved elsewhere within a radius of 500km from Pelotas were contacted and visited to reduce losses to follow-up. The fieldwork lasted 12 weeks, from February to April 2006.

A dataset was created in Epi Info 6.04 (Centers for Disease Control and Prevention, Atlanta, USA), with double data entry by two different data processers, allowing for checking the databank consistency and correction of errors. Prevalence rates and indices of oral health problems were compared according to family income at birth using the chi-square test and Kruskal-Wallis test, respectively. Family income at birth was categorized according to number of times the monthly minimum wage: < 1; 1.1-3; 3.1-6; 6.1-10; and > 10 [15]. Family income recorded at birth and 15 and 23 years of age was also categorized into tertiles on each of these occasions. During each follow-up wave, individuals in the middle and upper income tertiles were classified as "non-poor" and those in the lowest tertile as "poor" [21]. Trajectories were analyzed in order to estimate the lifetime family income trajectory, using PROC TRAJ Macro, SAS version 9.1 (SAS Inst., Cary, USA) [22,23]. Modeling of family income trajectories used a *logit* distribution model, based on the classification of the family income variable at each point in time (poor or non-poor). Determination of the parameters for the trajectories model was based on maximum likelihood with Bayesian criteria to assist the identification of the correct number of groups for the family income trajectory. Thus, four groups were constructed: those who had never been poor (family income in the middle and upper tertiles at all the time points), those who had always been poor (family income in the lowest tertile in all the follow-up waves), those whose income had increased from birth to adulthood, and those whose income had decreased during the same period.

The oral health variables were analyzed according to income trajectory, and the mean healthy teeth index was compared according to family income trajectories using the Kruskal-Wallis test. Finally, the evolution in the mean number of healthy teeth from 15 to 24 years of age was analyzed in each income trajectory group using the Wilcoxon paired test. This type of analysis was not possible for the other oral conditions, since the corresponding data were not collected in the two follow-up waves.

The studies were approved by the UFPel Institutional Review Board (case nº. 17/05). Free informed consent was obtained from all subjects. In addition, participants in whom the team detected the need for dental treatment or suspicion of malignant lesions were referred to the UFPel School of Dentistry.

Results

Table 3 shows the sample distribution according to demographic and socioeconomic characteristics in the original cohort and in OHS 97 and ESB-06. The proportion of male subjects was similar in the three samples (51.1%, 54.1%, and 52.6%, respectively), as was the proportion of white individuals (82.1%, 72.1%, and 71.2%, respectively). The proportion of families with family incomes greater than 10 times the minimum wage increased over the years, from 4.3% at birth to 11.1% at 24 years of age.

Of the 888 individuals examined in 1997, 81.2% were examined and interviewed in 2006 (n = 720). Mean DMF-T was 5.1 (SD = 3.8) at 15 years of age and 5.6 (SD = 4.1) at 24 years, ranging from 0 to 26 teeth in the latter. Some 90% of the subjects presented some tooth with caries at OHS 97, and a similar proportion was observed in 2006 (91.3%). Meanwhile, the proportion of individuals with at least one filled tooth increased from 51.9% in 1997 to more than 70% in 2006. Gingival bleeding, calculus, periodontal pocket, and soft tissue lesions were observed in 37.5%, 87.4%, 3.3%, and 23.3%, respectively, at 24 years of age. Toothache was reported by 22.8% of the subjects in OHS 06. The proportion of individuals that brushed their teeth at least twice a day increased from 68.8% at 15 years to nearly 95% at 24 years of age. Approximately half of the subjects reported having visited a dental service in the year prior to the study. Of those that had visited dental services, the majority had used private dental offices or clinics, both in 1997 (54.4%) and

Table 3

Characteristics of sample in the original cohort (1982) and oral health sub-studies in 1997 (OHS 97) and 2006 (OHS 06). Pelotas, Rio Grande do Sul State, Brazil.

Variables	Original cohort (N = 5,914) n (%)	OHS 97 (N = 888) n (%)	OHS 06 (N = 720) n (%)
White			
Male	3,037 (51.4)	480 (54.1)	379 (52.6)
Female	2,876 (48.6)	408 (45.9)	341 (47.4)
Skin color *			
White	4,851 (82.1)	631 (72.1)	505 (71.2)
Black (black + brown)	1,060 (17.9)	244 (27.9)	204 (28.8)
Family income (no. times minimum wage) **			
> 10	30 (4.3)	170 (19.4)	77 (11.1)
6.1-10	49 (5.5)	148 (16.9)	108 (15.5)
3.1-6.0	187 (21.2)	274 (31.1)	283 (40.7)
1.1-3.0	457 (51.7)	224 (25.6)	195 (28.0)
< 1	161 (18.2)	59 (6.7)	33 (4.7)
Maternal schooling (complete years)			
0-4	1,960 (33.2)	181 (20.9)	229 (32.3)
5-8	2,454 (41.5)	491 (56.8)	318 (44.9)
9-11	654 (11.1)	131 (15.1)	74 (10.5)
≥ 12	839 (14.2)	62 (7.2)	87 (12.3)
Dental caries (DMF-T ≥ 1)	-	809 (91.1)	657 (91.3)
Untreated decayed teeth (D component ≥1)	-	666 (75.0)	355 (49.3)
Missing teeth (M component ≥ 1)	-	179 (20.2)	301 (41.8)
Filled teeth (F component ≥ 1)	-	461 (51.9)	527 (73.2)
Healthy teeth		208 (23.4)	227 (31.5)
Gingival bleeding (≥ 1 site)	-	-	270 (37.5)
Dental calculus (≥ 1 tooth)	-	-	629 (87.4)
Periodontal pocket (shallow/deep ≥ 1 site)	-	-	24 (3.3)
Toothache	-	-	164 (22.8)
Soft tissue lesions (≥ 1 lesion present)	-	69 (7.8)	168 (23.3)
Unsatisfactory posterior restorations	-	-	230 (10.6)
Severe malocclusion	-	281 (31.6)	-
Tooth-brushing ≥ 2 times/day	-	600 (68.8)	667 (94.3)
Visit to dentist in previous year		477 (53.7)	384 (55.6)
Place of last dental visit ***			
Private office/Health plan	-	259 (54.4)	267 (69.7)
Braziliam Unified National Health System (SUS)		74 (15.5)	64 (16.7)
Other		143 (30.1)	52 (13.6)

* Original cohort: mother's skin color. OHS 97 and OHS 06: self-reported skin color;

** Original cohort and OHS 97, equivalent of US$ 100.00. OHS 06, equivalent of US$ 168.00;

*** OHS 97: n = 476; OHS 06: n = 383.

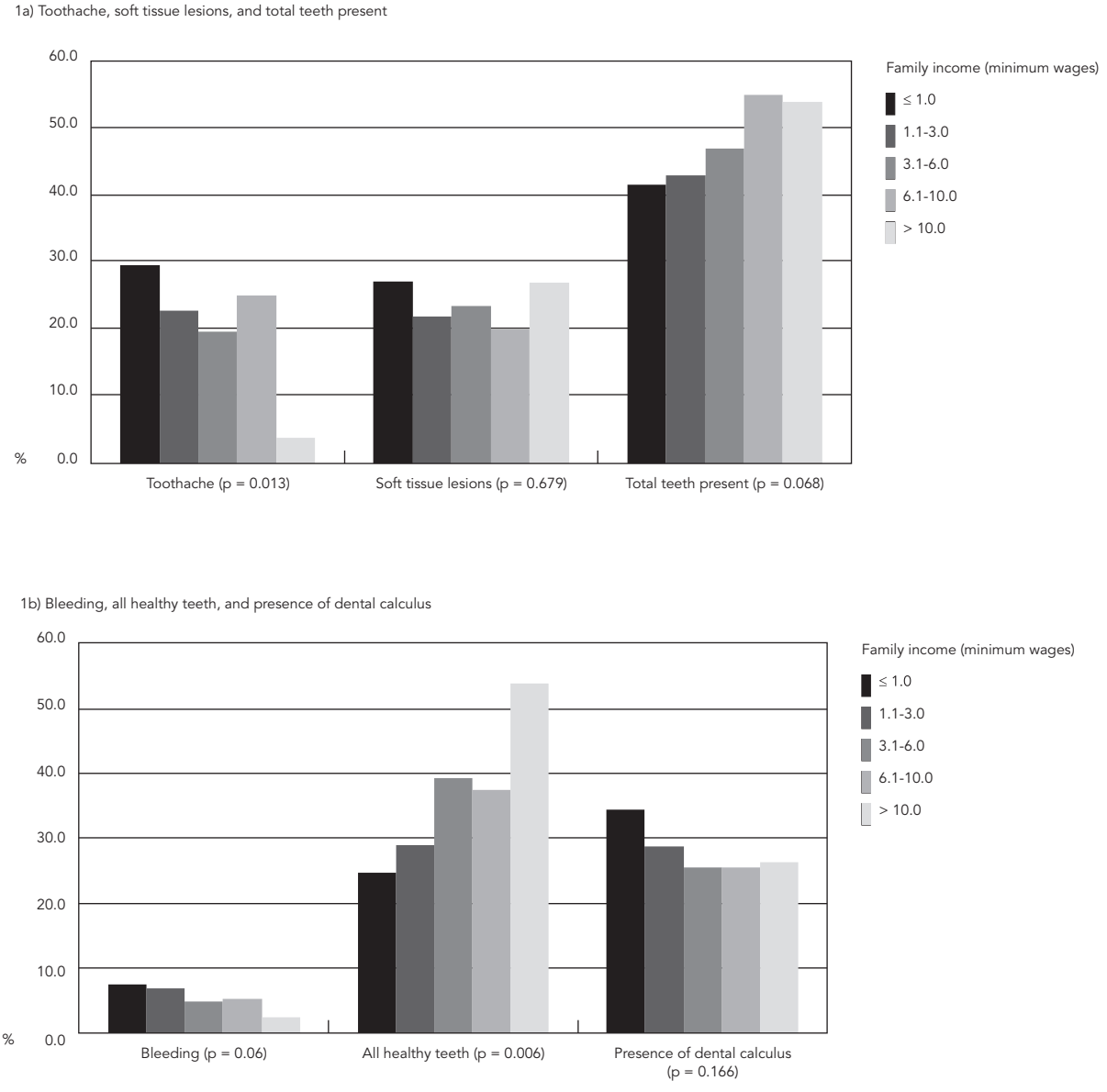
Note: original cohort and OHS 06: maximum of 29 individuals with missing information. OHS 97: maximum of 23 individuals with missing information.

in 2006 (69.7%), and the proportion of restorations classified as unsatisfactory at 24 years of age was only 10.6% (Table 3).

Figure 1 shows the distribution of the main oral health problems, oral health behaviors, and use of dental services according to family income

Figure 1

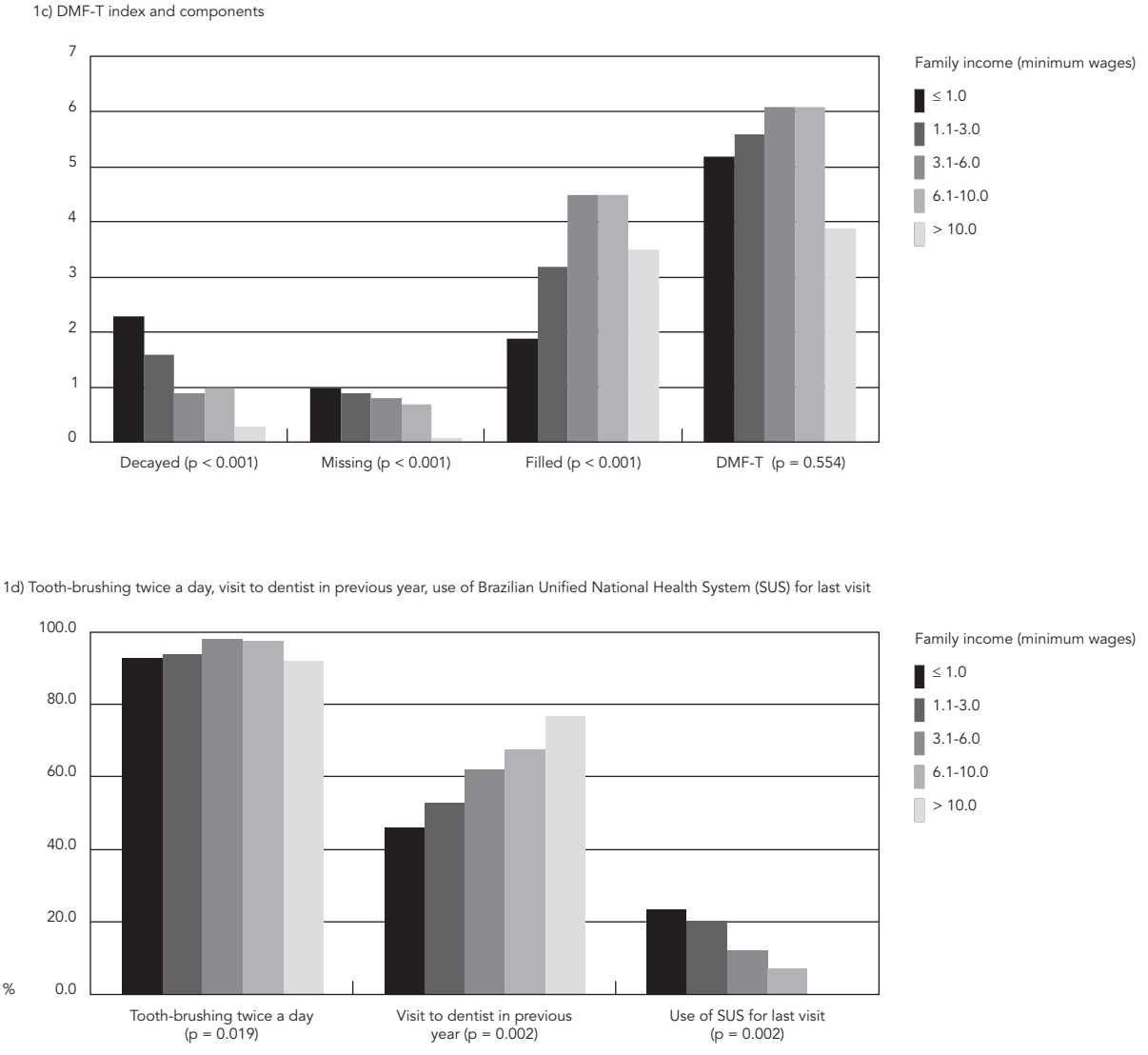
Presence of toothache, soft tissue lesions, oral health-related behaviors, and use of dental services according to family income at birth (p-value for trend). Pelotas, Rio Grande do Sul State, Brazil, 2006.



(continues)

at birth. The higher the family income at birth, the lower the prevalence of toothache (p = 0.013) and the higher the proportion of healthy teeth (p < 0.001). Meanwhile, the mean number of untreated decayed teeth (p = 0.01) and missing teeth due to caries (p = 0.01) was inversely related to income; the mean number of filled teeth at 24 years was positively associated with family income at birth (p < 0.01). Proportionally more individuals with higher family income at birth had visited the dentist in the previous year (p = 0.02), but the opposite was true when the dental visit was in the public Brazilian Unified National Health System, or SUS (p = 0.02).

Figure 1 (continued)



Four trajectories income groups were identified for family income from birth to adulthood among the 720 participants: never been poor (46.1%), downward family income (18.2%), upward family income (13.1%), and always been poor (22.6%). When the oral health variables were analyzed according to these family income trajectories, the worst indicators were seen in the "always been poor" group. Among the poorest, proportionally fewer individuals had visited the dentist in the previous year at 15 and 24 years of age. Meanwhile, receiving oral hygiene orientation at 15 years, having a dental checkup, and mean number of healthy teeth at 24 years were higher among the "never been poor" group (Table 4).

Table 5 shows the mean number of healthy teeth at 15 and 24 years of age according to family income trajectory, highlighting the higher average number of healthy teeth among the "never been poor" group at both 15 and 24 years of age, although with borderline statistical significance at 15 years. When analyzing the difference between mean number of healthy teeth at 15 and 24 years of age in each family income group, the only significant increase was in the "never been poor" group.

Table 4

Oral health variables according to family income trajectory at 24 years of age. 1982 Pelotas (Brazil) birth cohort.

Variables	Total (n = 720; 100.0%) %	Never been poor (n = 332; 46.1%) %	Decreasing family income (n = 131; 18.2%) %	Increasing family income (n = 94; 13.1%) %	Always been poor (n = 163; 22.6%) %	p-value *
Visited dentist in previous year; 15 years of age (n = 710)	53.0	66.2	51.9	45.7	31.3	< 0.01
Received orientation on oral hygiene at last visit; 15 years (n = 710)	90.9	94.8	88.6	90.4	85.0	0.04
Visited dentist in previous year; 24 years (n = 691)	55.6	60.7	61.2	51.7	41.9	0.01
Checkup as reason for last visit; 24 years (n = 720)	22.1	29.5	19.1	24.5	8.0	< 0.01
Smokers at 24 years (n =519)	26.6	20.1	29.4	26.9	35.7	0.01
Healthy teeth * 24 years – mean (median) (n = 720)	25.0 (26)	25.3 (27)	25.1 (26)	24.9 (26)	24.3 (25)	< 0.01
Teeth with calculus (n = 720)	28.6	28.7	27.8	25.5	31.0	0.49

* Sum of healthy teeth plus filled teeth without caries.

Table 5

Mean number (standard deviation) of healthy teeth at 15 and 24 years of age according to family income trajectories from birth to 24 years of age (n = 720). 1982 Pelotas (Brazil) birth cohort.

Family income trajectories	15 years Mean (SD)	24 years Mean (SD)	p-value *
Never been poor	24.91 (3.36)	25.34 (4.58)	0.003
Downwardly trajectory	24.59 (3.34)	25.10 (3.07)	0.206
Upwardly trajectory	24.44 (3.84)	24.88 (3.35)	0.373
Always been poor	24.17 (3.50)	24.29 (4.00)	0.425
p-value **	0.076	< 0.001	
Total	24.62 (3.45)	25.00 (4.07)	0.001

* Wilcoxon paired test between ages in the same family income trajectory group;

** Kruskal-Wallis test between family income trajectories at each age.

Discussion

This is the only population-based birth cohort study in Brazil, and one of the few in the world, that investigated oral health conditions in adolescents and young adults and associated factors from birth to adulthood. Internationally standardized indices and criteria, high diagnostic reproducibility, and a high follow-up rate from 15 to 24 years (81.1%) were positive aspects of the study. At 15 years, the target outcomes were dental caries, oral lesions, and malocclusions. At 24 years, dental caries and oral lesions were reinvestigated and new outcomes and oral conditions were added, like episodes and intensity of toothache, use of and/or need for prostheses, soft tissue lesions, and quality of restorations in posterior teeth. In addition, periodontal condi-

tions were investigated at 24 years, evaluating all the teeth for each of the target conditions (bleeding, calculus, and pocket depth).

The proportional participation by gender was similar in the sample at 24 years, as was the proportion according to skin color, suggesting that the losses did not introduce a selection bias. The investigators were unaware of the past exposures, thus minimizing the occurrence of interviewer bias.

When dental caries was analyzed using the DMF-T index, there was slight variation in the index from 15 to 24 years, which can be attributed at least in part to the change in criteria used in the period [24]. This is a known limitation to the DMF-T index, partially overcome by separate analysis of its components. For example, there was a proportional increase in the filled component (F) of the DMF-T index according to family income at birth, contributing to the increase in the proportion of healthy teeth (restored teeth added to healthy teeth). The opposite happened with the D and M components. Since this index is closely associated with the use of dental services, it is important to analyze its components.

The main oral health problems were statistically associated with lower family income at birth. Studies investigating the influence of family income trajectory from birth to adolescence [25] or to adulthood [5] have shown that upward family income does not completely reverse the adverse effects of exposure to poverty in childhood. These findings corroborate the accumulated lifetime risk model [26] and reinforce the hypothesis of social origin as the principal determinant of health problems. Low-income groups were less exposed to dentifrices and fluoridated water, brushed their teeth less, and used dental services less, all factors heavily associated with dental caries and consequently with toothache and tooth loss resulting from caries and gingival bleeding. Other outcomes like periodontal pocket and soft tissue lesions were not associated with family income (periodontal pocket showed low prevalence in this population, still too young to show a higher prevalence of this condition). Both conditions increased in prevalence as a result of increase in exposure factors like smoking [27]. On-going longitudinal studies will allow analyzing the incidence of periodontal disease and soft tissue lesions in this population.

The lifetime approach for understanding health determinants has received growing attention in recent years, especially in developed countries. Longitudinal studies are thus needed, despite the numerous difficulties in this kind of study design.

One of this article's approaches is the description of methodological issues. The success of cohort studies lies at least in part in the control of losses to follow-up. Pelotas is a medium-sized municipality with a low migration rate, which helps limit the losses. In addition, the population's receptiveness to answering the team's questions in their homes also contributed to the high response rate, along with the updated list of cohort members' names and addresses.

When analyzing the main oral health problems, we chose to use the indices and criteria found most commonly in the literature. However, we observed that for follow-up studies, greater detail is needed on some oral conditions, for example by using the DMF-S index in addition to DMF-T. Another important methodological issue is the analysis of diagnostic reproducibility. Weighted kappa index and intra-class correlation coefficient were used in the study at 24 years of age, providing more adequate measures as compared to those obtained with the simple kappa score [28]. Inclusion of quality of restorations in the analysis at 24 years of age can be considered another improvement in this type of study. Dentists spend considerable time in their clinical practice replacing restorations [29], and few population-based studies (none of which in a birth cohort) have evaluated the impact of individual patient factors on quality of restorations [30]. More detailed analysis of oral lesions in the follow-up at 24 years of age should contribute to prevention and early diagnosis of some oral disorders, thus favoring their treatment and prognosis [31]. However, the inclusion of investigation of oral lesions in epidemiological studies remains a challenge. Although the WHO recommends examining soft tissues and the oral mucosa in its manual for epidemiological surveys [17], it proposes a diagnostic classification that is not always possible to obtain through clinical investigation alone, often requiring histopathological examination. The difficulty in applying diagnostic codes and criteria to oral lesions makes population-based studies rare [32,33], so that the majority come from specialized studies [33].

In addition, oral health studies could expand their scope by incorporating questions on self-rated oral health into the data collection instrument, plus instruments that seek to measure quality of life.

Two oral health studies were conducted with the 1982 Pelotas (Brazil) birth cohort, and the main challenge is to continue following these individuals throughout adulthood. During this period of life, the odds increase that these individuals will move out of the municipality in search of work opportunities, thus greatly hindering this

population's follow-up. Other oral health studies have already been included in the more recent Pelotas cohorts (1993 and 2004). These studies will help support the discussion on the oral health transition in recent decades.

Resumo

Descreveu-se a metodologia e os resultados dos estudos de saúde bucal em uma coorte de nascimentos. Em 1997, uma amostra da coorte de nascimentos de Pelotas, Rio Grande do Sul, Brasil, (n = 900) foi sorteada para o estudo de saúde bucal (15 anos) e os mesmos indivíduos foram novamente investigados aos 24 anos. Agravos bucais, cuidados com a saúde bucal e uso de serviços odontológicos foram avaliados. Participaram do estudo 888 adolescentes aos 15 anos e 720 (81,1%) aos 24. O índice CPO-D médio variou de 5,1 (DP = 3,8) a 5,6 (DP = 4,1) no período. Ter pelo menos um dente restaurado passou de 51,9% aos 15 anos para mais de 70% aos 24. A proporção do uso de serviços e a média de dentes saudáveis foram menores dentre os sempre pobres quando comparados àqueles nunca pobres. Indivíduos com trajetórias econômicas descendente ou ascendente tiveram valores intermediários. Aumento de dentes saudáveis dos 15 aos 24 anos foi observado apenas dentre aqueles nunca pobres. Apresentar pelo menos um episódio de pobreza ao longo da vida impactou na saúde bucal na vida adulta.

Serviços de Saúde Bucal; Saúde Bucal; Adolescente

Contributors

K. G. Peres conceived the article, conducted the data analysis, and wrote the article. M. A. Peres contributed to the research, data analysis, and elaboration of the article's discussion section. F. F. Demarco, S. B. C. Tarquínio, and D. P. Gigante participated in the writing and critical analysis of the article. B. L. Horta collaborated in the article's revision and critical analysis.

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