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# Dental caries and associated factors among young male adults between 1999 and 2003 in Southern Brazil

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***Objective:*** To assess the prevalence, severity and distribution of dental caries and associated factors among young male adults from Florianopolis (Southern Brazil) and to compare these results with those from a previous study. ***Method:*** A cross-sectional study (n=414) was conducted among Brazilian Army subjects in 2003. Dental caries experience was recorded using the DMF-T Index (WHO, 1997). Non-clinical data were obtained through a questionnaire. The analyses included DMF-T descriptive statistics, calculation of the Gini coefficient to assess inequality in the distribution of caries and non-conditional multiple logistic regression, following a hierarchical approach. ***Results:*** The response rate was 95.6%. High values of intra- and inter-examiner agreement were achieved (Kappa > 0.83). Reductions of 18.6% in prevalence and 26.7% in caries severity were accompanied by an increase of 18.6% in dental caries inequality. Individuals with eight or less years of study (OR 8.1 : $CI_{95\%}$ 1.9-34.7), raised by mothers with eight or less years of study (OR 2.9 : $CI_{95\%}$ 1.7-5.0) were more likely to have dental caries. Subjects whose families earned less than six Brazilian minimum wages per month were also more likely to have dental caries (OR 2.3 : $CI_{95\%}$ 1.4-3.8). ***Conclusions:*** Decreases in caries prevalence and severity were followed by an increased inequality in caries distribution. Low level of schooling, low maternal schooling and low monthly family income were statistically associated with dental caries.

*Key words: Brazil, dental caries, inequality, socioeconomic conditions, young adults.*

## Introduction

Epidemiological studies of oral health amongst all ages are recommended by the World Health Organization (Aggeryd, 1983). Nevertheless, the majority of studies are concentrated on schoolchildren rather than on other age groups (Truin *et al*., 1993).

Reductions in prevalence and severity of dental caries in schoolchildren have been reported in developed (Peterson and Bratthall, 1996) and developing countries, including Brazil (MS, 2004). Such phenomena make it possible to extend oral health services and programmes to others age groups, specifically at-risk and the elderly.

The Brazilian Ministry of Health performed the first national oral health survey in 1986, in sixteen of the larger cities. The mean DMF-T index found among individuals aged 15 to 19 years was 12.7 (MS, 1988). In 2003, in a study of 250 cities from all national regions, the mean DMF-T index was 6.2 in the same age group (MS, 2004).

Some investigations of dental caries in young adults have been conducted among Army applicants (Hopcraft and Morgan, 2003; Sgan-Cohen *et al.*, 2000). The underlying idea is that these populations may provide excellent opportunities to capture representative samples of different socioeconomic and geographical backgrounds. However, there is limited data describing such groups in Brazil as well as in other developing countries.

Links between poor health and socioeconomic conditions have been well established. A number of studies have demonstrated the relationship between social status and dental caries. The British study of children's dental health (O'Brien, 1994) stands out as an example, demonstrating that those from the higher social classes were more likely to have no experience of dental caries and less likely to have widespread tooth decay. Accordingly, data from a study carried out in Brazil by Antunes *et al.* (2002) showed that, despite the overall improvement of dental indices, it had not spread in a homogeneous way, so that caries continues to present higher levels in deprived areas.

In Southern Brazil, two studies drew attention to the association between dental caries and socioeconomic factors in 18-year-old males. The first study involved Army subjects from Florianopolis in 1999 and the mean DMF-T was 4.5. Low parental schooling was significantly associated with higher levels of dental caries (Gonçalves *et al.*, 2002). The other study took place in Blumenau, a medium-sized city located in Santa Catarina State and found a mean DMF-T of 5.7. Again subjects from families with low educational level presented poorer dental health (Peres *et al.*, 2005).

The purpose of this study was twofold. Firstly, to assess the prevalence, severity and distribution of dental caries and associated factors among 18 year-old young males who enlisted in the Brazilian Army compulsory service in Florianopolis (Southern Brazil). Secondly, to compare the current levels of caries experience and distribution with those reported previously, in 1999 (Gonçalves *et al.* 2002). The association between dental caries and socioeconomic factors was also investigated.

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## Methods

A cross-sectional study was carried out among 3,735 young males aged 18 years who enlisted in the service in Florianopolis, a 360,000-inhabitant city located in a relatively developed area of Brazil, the Santa Catarina State. Florianopolis is not representative of Southern Brazil and its socioeconomic profile can be obtained through census data (IBGE, 2001) and through the website www.pmf.sc.gov.br.

As part of a major project (Traebert, 2004), this study adopted a sample size of 394 individuals with additional 5% to compensate for eventual refusals, which resulted in a sample of 414 applicants. The sample size mentioned was considered adequate for the present study purpose, since assuming a level of significance of 5%, an estimated dental caries prevalence of 81% (Gonçalves *et al.*, 2002), and a sample error of 5%, 217 individuals would have to be included in such a study.

In Brazil, there is a mandatory law that obligates every 18-year-old male to attend the Brazilian Army in order to participate in a selection process, through which those who are considered eligible may be recruited. Brazilian citizens who are politically, religiously or philosophically opposed to mandatory conscription may be exempted from military activities. Additionally, individuals with physical deficiency and clergymen or other participants in religious orders are not obliged to serve.

In 2003, when all 18-year-old males from Florianopolis were assembled at one Army Quarter to take part in the selection process, non-clinical and clinical data were collected. Between August and September, seventeen subjects were selected randomly during each of the first 14 days and 16 subjects during each of the last 11 days, giving a total of 414 subjects. Those who were not inhabitants of the city and/or were older were excluded from the study.

Collection of clinical data followed the same procedures as in 1999 (Gonçalves *et al.*, 2002). The same diagnostic criteria were utilised in both studies (WHO, 1997). Training and calibration was conducted by the same supervisor (MAP), who applied similar methods of assessing validity and reliability in caries diagnoses to those adopted in the 1999 study (Gonçalves et al., 2002; Peres et al., 2001). One in 10 subjects were re-examined to test for intra- and inter-examiner agreement during the fieldwork. Dental examinations were performed using natural light and a mirror. Non-clinical data were collected through a questionnaire. Subjects were not re-interviewed to test for reliability of the questionnaire during the fieldwork.

Confidence intervals (95%) were calculated for caries prevalence and severity. DMF-T descriptive statistics, including its components D, M and F, were also performed. As proposed by Antunes *et al.* (2002), the Gini coefficient was used as an outcome variable to assess inequality in the distribution of dental disease. This measurement was calculated as the ratio of areas comprised under and over the corresponding Lorenz curve, varying from "0" (homogeneous distribution) to a theoretic value of "1" (maximum inequality).

The DMF-T index was recorded as an outcome also. Independent variables were arranged in three blocks. Block 1 included socioeconomic variables, such as parental and subject's schooling (in full years of study) and monthly family income. Family income was registered in Brazilian currency (Real) and later converted to Brazilian minimum wages (1 Brazilian minimum wage = approximately U$80.00).

Socioeconomic status was determined by the length of schooling of the parents and of the subjects and on family income. Theoretically, parental schooling portrayed the subjects' early socioeconomic conditions, while subjects' schooling represented their current social status. Information about family income was collected considering the idea that revenue is strongly related to material conditions so that subjects from more affluent families are more likely to live in good quality housing, be offered more opportunities to develop good oral health behaviour, have access to a variety of oral hygiene and caries-preventive items, such as fluoridated toothpastes, and to make healthy choices in their diet.

Block 2 was composed of the following oral-health-related variables: frequency of toothbrushing, frequency of flossing and use of fluoridated dentifrice. Block 3 gathered variables related to use of oral health services, including questions about the number of dental visits, if any, and the type of dental care – private or public/others.

Data were analysed through the Social Pack for Social Sciences for Windows (SPSS), version 10.0. Unconditional multivariate logistic regression analysis with estimation of odds ratio and respective confidence intervals were performed to test relationships between outcome and independent variables. Analysis completion followed a hierarchical model (Figure 1).

The associations were tested using univariate analysis between independent variables and the outcome. The variables were grouped into a hierarchical model from distal to proximate determinants, arranged in three blocks (Figure 1). For each block, stepwise backward procedure was carried out to select the best predictors at these levels (variables with p-value$\leq$0.20). To these variables, those in the following hierarchical block were added and excluded if p>0.05 and so forth. The p level for keeping variables in the model was set at 0.05. Variables were considered as risk factors if the significance were 0.05 or less.

Ethical clearance was obtained from The Ethics Committee of the Federal University of Santa Catarina. A letter was handed over to the young adults explaining the aim, characteristics and importance of the study and asking for their consent. Applicants were reassured that refusal to participate in the study would not be held against them.

## Results

A total of 396 subjects were examined and interviewed (95.6% response rate). Intra- and inter-examiner agreement were high (Kappa $\geq$ 0.84). Taking the years 1999 and 2003, dental caries prevalence decreased from 81.0% ($CI_{95\%}$ 78.0 – 84.0) to 65.9% ($CI_{95\%}$ 62.9 – 65.9), which represents a reduction of 18.6%. The mean DMF-T declined from 4.5 ($CI_{95\%}$ 4.0 – 4.9) in 1999 to 3.3 ($CI_{95\%}$ 2.9 – 3.6) in 2003, corresponding to a reduction of 27.6%. DMF-T means, quartiles and extreme values are illustrated in Figure 2. The filled (F) component decreased from 3.0

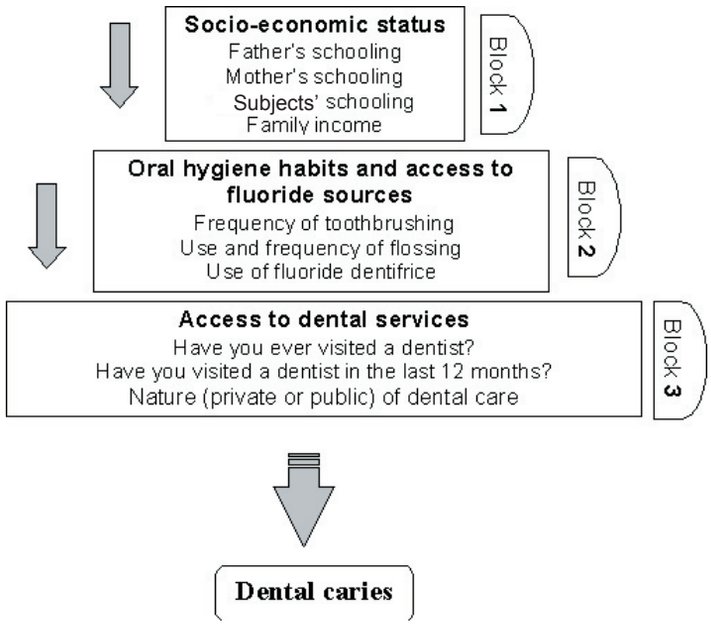


**Figure 1.** *Hierarchical model adopted to offer better guidance on the non-conditional multiple logistic regression.*

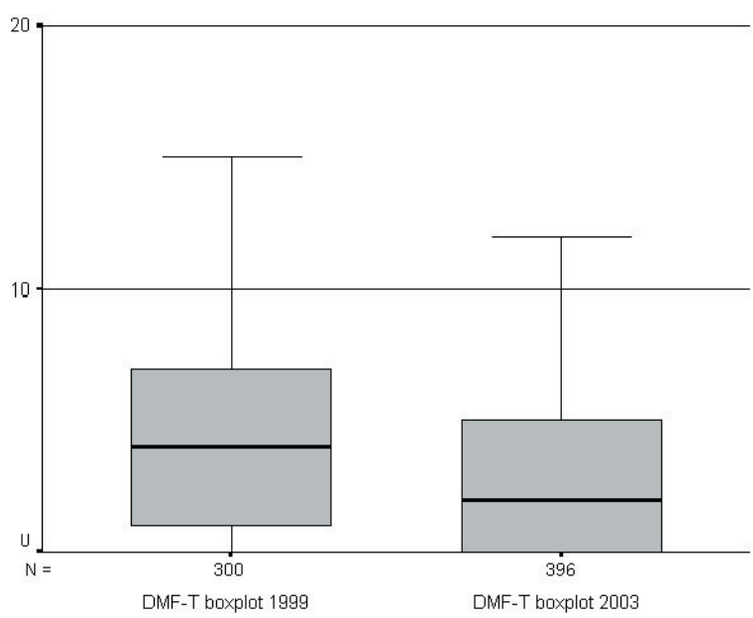


**Figure 2.** *Box plot of DMF-T scores in 1999 (n=300) and 2003 (n=396) among 18 year-old young male adults in Southern Brazil.*

**Table 1.** Decayed, missing and filled teeth and DMFT index in 1999 (n=300) and 2003 (n=396) among 18 year-old young male adults from Southern Brazil, 2003.

| Year | Decayed teeth | | | Missing teeth | | | Filled teeth | | | DMFT index | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | mean | $CI_{95\%}$ | % | mean | $CI_{95\%}$ | % | Mean | $CI_{95\%}$ | % | mean | $CI_{95\%}$ | % |
| 1999 | 1.2 | 1.0-1.4 | 24.9 | 0.3 | 0.2-0.4 | 7.6 | 3.0 | 2.7-3.4 | 67.5 | 4.5 | 4.1-5.0 | 100.0 |
| 2003 | 1.2 | 1.0-1.4 | 37.7 | 0.3 | 0.2-0.4 | 8.3 | 1.8 | 1.5-2.0 | 54.0 | 3.3 | 2.9-3.6 | 100.0 |

to 1.8, representing 67.5% of the DMF-T index in 1999 and 54.0% of it in 2003. Decayed (D) and missing (M) components remained the same in this time period: 1.2 and 0.3, respectively. On the other hand, they increased their relative weight in the DMF-T score in 2003, as seen in Table 1.

Although caries levels have improved, there is an indication that its distribution has become more positively skewed over time. The Gini coefficient of caries distribution increased from 0.48 to 0.59, a relative increase of 18.6%. In other words, the ratio of the areas over and under the Lorenz curve has shifted towards 1, meaning

that increased disease inequality was observed in 2003.

Table 2 presents multiple logistic regression analyses. In the socioeconomic block, parental and applicants' schooling and family income were associated with dental caries experience. After adjusting by the stepwise backward procedure, only fathers' schooling lost its statistical significance. In the second block, toothbrushing and use of fluoridated dentifrice were excluded from the analysis, since they were poorly distributed among participants. The remaining variable of this block was weakly associated with the outcome and did not remain in the model. In third block, visiting non-private dental care was associated with the outcome. Having visited a dentist at least once and having visited a dentist in the last 12 months were not associated with dental caries.

The last step was to include all predictors from each block and run a stepwise forward procedure under the cited hierarchical model. The variable 'type of dental care in the last dental visit' lost significance (Table 3). Low maternal schooling, low subjects' schooling and low monthly family income remained statistically significant in the model.

## Discussion

Epidemiological studies to assess trends in young adults' caries experience are rarely found in Brazil. Moreover, discrepancies in methods – including sampling, data collection and controlling for confounding factors – adopted by different studies make comparisons among them undependable. In this case, both studies conducted in 1999 and 2003 applied similar methods in training and calibration of the examiners and in caries diagnosis. Furthermore, high Kappa scores were obtained on these two occasions and a similar target population was considered for sampling. However, the results presented cannot be generalized to Southern Brazil or to any other region in the country.

Mean family income per capita was equal to $618.1 Reais (Brazilian currency) in this study, while mean family income per capita of the Florianopolis was R$701.4 (IBGE, 2001). Among subjects' parents, 47.1% had either eight or less than eight years of schooling. Taking the age group of 25 years and over, 34.3% inhabitants of Florianopolis had eight or less years of schooling (IBGE, 2001). This was also verified in the study carried out in 1999, when schooling and income per capita were nearly comparable between these two populations.

Conversely, the main limitation of both studies is the absence of data concerning the female gender, which is worth a consideration since women hypothetically attend health services more regularly and may have distinct health-related behaviours.

Dental caries experience is also reported in international studies focusing on similar age groups (Hopcraft and Morgan, 2003; Sgan-Cohen *et al.*, 2000; Truin *et al.*, 1993). Hopcraft and Morgan (2003) found a DMF-T score of 3.59 in a military population ranging from 17 to 20 years of age. Comparisons must be carefully made with this study, since clinical and radiographic findings were recorded simultaneously, increasing the likelihood of over-reporting dental caries. Another study among young Israeli adults (Sgan-Cohen *et al.*, 2000), found the average DMF-T level of 8.49, higher than 3.3 reported in the present study. The survey carried out in Israel followed the WHO/1987 (WHO, 1987) diagnostic criteria, but applied similar examination procedures to those followed by the present study.

Fluoridated dentifrice and access to fluoridated water supplies are considered the main factors responsible for the caries decline during the second half of the 20$^{th}$ century. However, in the case of this study, they may have not played a major role. Unexpectedly, the observed reduction in the mean DMF-T level could be attributed to a decrease in the number of filled teeth (FT). Nieuwenhuysen et al. (1998) described a similar phenomenon in Belgium. In the present study, this may be interpreted as a result of changes in criteria for placement of fillings over time. For example, Traebert et al. (2005) carried out a study in the same city and found that dental graduates for less than 10 years and those that attended postgraduate courses were associated with a less interventionist approach in dentistry. Florianopolis is a city where graduate and postgraduate courses in this area of knowledge are available, so that a higher proportion of younger and/or more specialized dental professionals could have contributed to the decline in FT. Alternatively, it could be argued that the difference in mean FT from 3.0 to 1.8 may have been smaller than it actually was. If we considered the range of values in both confidence intervals, the difference between the upper 95% confidence limit from 2003 and the lower limit from 1999 would equal 0.7 (2.7 – 2.0 = 0.7) in the mean number of FT (Table 1), so that the observed reduction in FT cold have been smaller. Also, restricted access to oral health services could have contributed the observed difference in FT during the study period.

With regard to the relative increase in the Gini coefficient, Antunes et al. (2002) have pointed out the same pattern in 11- and 12-year-old schoolchildren from 131 towns of the State of Sao Paulo (Brazil). In an attempt to explain this finding, Nugent et al. (2002) proposed that the overall health interventions might be more effective in the part of population with less disease. Accordingly, if health interventions take place before the removal of social inequalities, the relative position of the underprivileged in respect to disease prevalence can be worsened**.** Measures to improve oral health may be reducing caries levels and, concurrently, widening the gap in the experience of caries among socioeconomic groups. Therefore, health programmes for improving equity in health should target individuals at risk and monitor inequalities across time periods.

In this study, individuals with eight or less years of study, who were raised by mothers with eight or less years of study and whose families earned less than six Brazilian minimum wages per month, were more likely to have dental caries.

Finally, even though reductions in caries prevalence and severity have been reached, the reasons for these reductions must be investigated so that all groups can experience these reductions.

**Table 2**. Unconditional multiple logistic regression analysis for dental caries and association with socioeconomic, behavioural and access to dental services conditions among 18 year-old young male adults from Southern Brazil, 2003.

| *VARIABLES* | *DMF-T* | | | | $OR^c$ ($CI_{95\%}$) | $OR^a$ ($CI_{95\%}$) |
|---|---|---|---|---|---|---|
| | *0* | | *≥ 1* | | | |
| | *n* | *%* | *n* | *%* | | |
| **Block 1 - Socioeconomic conditions** | | | | | | |
| *Father´s schooling** | | | | | | |
| > 8 years | 94 | 48.5 | 96 | 50.5 | 1.0 | |
| ≤ 8 years | 33 | 19.4 | 137 | 80.6 | 4.0 (2.5-6.5) | |
| p | | | | | <0.001 | |
| *Mother´s schooling* | | | | | | |
| > 8 years | 101 | 48.1 | 109 | 51.9 | 1.0 | 1.0 |
| ≤ 8 years | 34 | 18.3 | 152 | 81.7 | 4.1 (2.6-6.6) | 2.9 (1.7-5.0) |
| p | | | | | <0.001 | < 0.001 |
| *Subject's schooling* | | | | | | |
| > 8 years | 129 | 39.2 | 200 | 60.8 | 1.0 | 1.0 |
| ≤ 8 years | 6 | 9.0 | 61 | 91.0 | 6.5 (2.7-15.6) | 8.1 (1.9-34.7) |
| p | | | | | <0.001 | 0.005 |
| *Family income* | | | | | | |
| ≥ 6 BMW | 96 | 48.5 | 102 | 51.5 | 1.0 | 1.0 |
| < 6 BMW | 39 | 19.7 | 159 | 80.3 | 3.8 (2.4-6.0) | 2.3 (1.4-3.8) |
| p | | | | | <0.001 | 0.002 |
| **Block 2 - Oral hygiene** | | | | | | |
| *Brushing frequency* | | | | | | |
| ≥ 2/day | 127 | 34.3 | 243 | 65.7 | 1.0 | |
| < 2/day | 8 | 30.8 | 18 | 69.2 | 1.2 (0.5-2.8) | |
| p | | | | | 0.712 | |
| *Use of dental floss* | | | | | | |
| Yes | 57 | 37.5 | 95 | 62.5 | 1.0 | |
| No | 78 | 32.1 | 166 | 67.9 | 1.3 (0.8-2.0) | |
| p | | | | | 0.271 | |
| *Frequency of dental floss* | | | | | | |
| ≥ 1/day | 58 | 37.2 | 98 | 62.8 | 1.0 | |
| < 1/day | 77 | 32.1 | 163 | 67.9 | 1.3 (0.8-1.9) | |
| p | | | | | 0.296 | |
| **Block 3 - Access to dental service** | | | | | | |
| *Have you ever visited a dentist?* | | | | | | |
| Yes | 129 | 34.1 | 249 | 65.9 | 1.0 | |
| No | 6 | 33.3 | 12 | 66.7 | 1.0 (0.4-2.8) | |
| p | | | | | 0.945 | |
| *Have you visited your dentist in the last 12 months?* | | | | | | |
| Yes | 79 | 33.9 | 154 | 66.1 | 1.0 | |
| No | 56 | 34.4 | 107 | 65.6 | 1.0 (0.6-1.5) | |
| p | | | | | 0.926 | |
| *Establishment of the last dental attendance*** | | | | | | |
| Private | 100 | 40.0 | 150 | 60.0 | 1.0 | 1.0 |
| Others | 17 | 19.8 | 69 | 80.2 | 2.7 (1.5-4.9) | 2.3 (1.3-4.3) |
| p | | | | | 0.001 | 0.006 |

*unavailable for 36 individuals
**unavailable for 60 individuals
$OR^c$ – Crude Odds ratio
$OR^a$ – Adjusted Odds ratio by *stepwise backward procedure* in order to select the best predictors
BMW – Brazilian minimum Wages (September/2003)

**Table 3.** Multiple logistic regression analysis under a hierarchical approach for association between dental caries experience and related factors among 18 year-old young male adults from Southern Brazil, 2003.

| *Variables* | *OR[c] (CI 95%)* | *OR[a] (CI 95%)* |
|---|---|---|
| **Block 1 – Socioeconomic conditions** | | |
| *Mother's schooling* | | |
| > 8 years | 1.0 | |
| ≤ 8 years | 2.9 (1,7-5.0) | |
| p | < 0.001 | |
| *Subject's schooling* | | |
| > 8 years | 1.0 | |
| ≤ 8 years | 8.1 (1.9-34.7) | |
| P | 0.005 | |
| *Family income* | | |
| ≥ 6 BMW | 1.0 | |
| < 6 BMW | 2.3 (1.4-3.8) | |
| p | 0.002 | |
| **Block 3 – Access to dental service** | | |
| *Establishment of the last dental attendance*** | | |
| Private | 1.0 | 1.0 |
| Others | 2.3 (1.3-4.3) | 1.2 (0.6-2.3) |
| p | 0.006 | 0.615 |

**unavailable for 60 individuals
OR[c] – Crude Odds ratio
OR[a] – Adjusted Odds ratio by *stepwise forward procedure*
BMW – Brazilian Minimum Wages (September/2003)


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