

## OCCUPATIONAL EXPOSURE TO CHEMICAL SUBSTANCES AND SELF-ASSESSMENT OF ORAL HEALTH: RESULTS OF THE NATIONAL HEALTH SURVEY 2013

## EXPOSIÇÃO OCUPACIONAL A PRODUTOS QUÍMICOS E AUTOAVALIAÇÃO DA SAÚDE BUCAL: RESULTADOS DA PESQUISA NACIONAL DE SAÚDE 2013

Nayara Silva Alves<sup>1</sup>, Mery Natali Silva Abreu<sup>2</sup>, Ada Ávila Assunção<sup>3</sup>**Resumo**

A exposição a produtos químicos no ambiente laboral tem sido associada a condições bucais. O objetivo deste estudo foi examinar a associação entre manuseio de produtos químicos e autoavaliação da saúde bucal em uma amostra de trabalhadores brasileiros. Estudo transversal utilizou dados da Pesquisa Nacional de Saúde (PNS), realizada em 2013, no Brasil. A amostra de 36.442 trabalhadores de ambos os sexos e idade  $\geq 18$  anos. Foram descritas características socioeconômicas, demográficas, ocupacionais, hábitos de vida e situação de saúde. Para a percepção da saúde bucal foi considerada a variável de desfecho. Para a exposição ocupacional a produtos químicos, a variável explicativa. Análises bivariadas e multivariadas foram desenvolvidas por meio do programa estatístico *Stata* versão 12.0. Idade, raça/cor e região de residência estavam significativamente associadas à maior prevalência de autoavaliação negativa da saúde bucal. Maior prevalência de autoavaliação negativa da saúde bucal entre os indivíduos expostos a produtos químicos (RP=1,15[1,10-1,21] para sexo masculino e RP=1,23[1,16-1,31] para o sexo feminino). Essas associações permaneceram significativas no modelo multivariado para ambos os sexos. Concluiu-se que existe maior prevalência de percepção negativa da saúde bucal entre os trabalhadores expostos ao manuseio de produtos químicos no ambiente laboral.

**Palavras-chave:** Saúde do trabalhador; Exposição ocupacional; Odontologia em saúde pública; Inquéritos de saúde bucal; Estudos transversais.

**Abstract**

Exposure to chemicals in the work environment has been associated with oral conditions. The aim of this study was to examine the association between handling chemical products and self-rated oral health in a sample of Brazilian workers. A cross-sectional study used data from the National Health Survey (PNS), carried out in 2013, in Brazil. The sample consisted of 36,442 workers of both sexes and aged  $\geq 18$  years. Socioeconomic, demographic, occupational, lifestyle and health status characteristics were described. For the perception of oral health, the outcome variable was considered. For occupational exposure to chemicals, the explanatory variable. Bivariate and multivariate analyzes were developed using the *Stata* version 12.0 statistical program. Age, race/color and region of residence were significantly associated with a higher prevalence of negative self-rated oral health. Higher prevalence of negative self-assessment of oral health among individuals exposed to chemical products (PR=1.15[1.10-1.21] for males and PR=1.23[1.16-1.31] for the women). These associations remained significant in the multivariate model for both sexes. In conclusion, there is a higher prevalence of negative perception of oral health among workers exposed to handling chemical products in the workplace.

**Keywords:** Occupational health; Occupational exposure; Public health dentistry; Dental health surveys; Cross-sectional studies.

1. PhD student in Public Health, Federal University of Minas Gerais, Brazil. (UFMG)

2. PhD in Public Health. Senior Professor of the Medical School of Federal University of Minas Gerais, Brazil. (UFMG)

3. PhD in Public Health. Assistant Professor of the Nursing School of Federal University of Minas Gerais, Brazil. (UFMG)

**How to cite this article:**

Alves NS, Abreu MNS, Assunção AA. Occupational exposure to chemical substances and self-assessment of oral health: results of the National Health Survey 2013. *Nav Dent J*. 2021; 48(2): .05-16.

Received: 08/07/2021

Accepted: 10/09/2021

## INTRODUCTION

Oral health is an essential dimension of the individual's health and well-being, as it implies the integrity of the structures of the craniofacial complex and the oral mucosa, absence of lesions and oral and dental disorders, as well as being free from chronic orofacial pain (1). Oral health problems are highly prevalent, thus constituting a public health problem. Worldwide, in 2017, 3.5 billion cases were estimated, with emphasis on periodontal disease, caries and tooth loss (2). In addition to the impact on people's well-being and quality of life (3,4) as a result of complaints of pain and discomfort, disturbances at different levels of human functionality are common, such as in chewing, communication, and social interaction.

Oral conditions considered precarious are avoidable through greater access to dental care (1,4). Clinical indicators of oral diseases, including tooth decay, periodontitis, and orofacial cancer, as well as oral health self-assessment (AASB) were formulated to assess this dimension of health in populations (4). As for the latter, its advantages for planning public health services are recognized (5-7). Among them, the shift in emphasis from purely biological aspects to psychological and social aspects stands out (5). The global AASB is a single-item measure that asks a general question about an individual's perception of their general health status or quality of life in that specific period. Answers are categorized, ranging from excellent to bad (3). The use of this indicator must consider biological factors, individual social determinants, and contexts, since the literature has frequently shown that there are great differences between socioeconomic groups in relation to the AASB (8). Thus, approaches to oral conditions, in addition to specific programs for the economically active population, are desirable, given the evidence on the need for dental care in adulthood (9).

Adults in the job market may be exposed to the effects of working conditions, which concern a range of factors: management model and organization of production, working hours and shifts, exposure to biological, mechanical, physical, and chemical agents (9,11,12). Overall, the effects of these conditions have been

associated with the prevalence of illness in groups of workers, including gingival and tooth diseases (9,11-13). Occupational stress, for example, has been associated with caries, tooth loss, increased sensitivity to cold drinks and foods, pain, and temporomandibular disorders (12,14).

In the dental literature, the effects of chemical agents used in work processes on oral tissues, such as periodontitis (13,15), are recognized. Exposure to silica dust and acid mist, in turn, are etiological factors for dental erosion (16). When interviewed, they associated these problems with precarious working conditions. The high prevalence of dental caries was observed in a sample of civil construction workers (17). High prevalence of toothache led to absences in a sample of municipal employees (18). In the meat processing sector, a higher prevalence of absences related to orofacial pain was identified in the group of workers with negative AASB compared to the group with better AASB (11).

As far as is known, in Brazil, a nationwide study that investigated the perception of the oral health situation associated with exposure to chemical products in the workplace has not yet been published. In view of this, the need for generalizable knowledge about oral health related to occupational exposures is kept in mind.

The objective was to examine the association between exposure to chemicals at work and self-assessment of oral health status in a national sample of workers. The hypothesis for this investigation is the increased chance of negative AASB when individuals work exposed to chemical products.

## METHODOLOGY

### Study design

This is an observational cross-sectional study that used data from the National Health Survey (PNS), carried out in 2013, in Brazil. The PNS is a nationwide household-based survey, the result of an agreement between the Ministry of Health and the Brazilian Institute of Geography and Statistics (IBGE). All PNS data, including sample planning, technical information, and the dissemination

of microdata, can be accessed at <https://www.ibge.gov.br/estatisticas/sociais/saude.html> (19). The PNS was approved by the National Research Ethics Committee, of the National Health Council, in June 2013 (n° 10853812.7.0000.0008) (19).

## **Inclusion and exclusion criteria**

In the PNS, 64,348 households were selected to participate in the survey. Of these, 60,202 individuals responded to the individual questionnaire. People at least 18 years of age, included in the employed population, were considered eligible, that is, employed adults who answered question E11 “How many jobs did you have in the week of July 21 to 27, 2013 (reference week)?”. Respondents who were unemployed or who were not looking for a job were considered ineligible. The final sample consisted of 36,442 employed individuals, of both sexes, that is, in the reference week, they were working in exchange for money or other remuneration or helping another person in their household or without direct remuneration, or even were temporarily away from paid work.

## **Construction of variables**

Variables were divided into three blocks. The first included those related to socioeconomic and demographic conditions (age, race/color, marital status, geographic region, area of residence, level of education and income); the second block included variables related to occupational factors (occupation, position in the occupation and occupational exposures). Finally, in the third block, variables related to health status were included (perception of health status and oral health, tooth loss, limited feeding capacity, toothbrushing, dental appointments, diabetes, smoking habit, and alcohol consumption).

## **Outcome variable: perception of the oral health situation**

The outcome variable, perception of the oral health situation, was elaborated according to the answer obtained to the

module’s question on oral health: U005 “In general, how do you evaluate your oral health (teeth and gums)?”: 1. Very good; 2. Good; 3. Regular; 4. Bad; 5. Very bad. The answers were analyzed using a dichotomous variable 1. Positive AASB (very good and good); 2. Negative AASB (regular, bad, and very bad).

## **Main explanatory variable: occupational exposure to chemicals**

Exposure to chemicals in the work environment was considered the main explanatory variable, based on the answer to question M11. “Considering all your work, are you exposed to any of these factors that can affect your health? A. Handling of chemical substances”: 1. no; 2. yes.

## **Co-variables**

The variables considered likely to influence the association between occupational exposures and oral health were age (18-34, 35-44, 45-59, ≥ 60 years old); self-declared race/color (white and non-white), marital status (lives with and without a spouse or partner), geographic region (South, Southeast, Midwest, North and Northeast), area of residence (urban and rural). The level of education was analyzed in two categories: 1. ≥ complete secondary education: people with complete secondary education; complete or incomplete higher education and postgraduate studies; and 2. < complete secondary education: people without education; incomplete or complete primary education or equivalent; incomplete secondary education or equivalent.

Per capita family income was calculated in four stages. In the first stage, we summed the monthly gross income of household residents related to paid work, retirement or pension, alimony, rent or lease, unemployment insurance, welfare benefit (LOAS, Bolsa Família or other government programs), income from savings account or interest on financial investments or other income. In the second stage, the total family income was divided by the number of residents in the household. Then, in the third stage, the average income of household residents was divided by the

value of the minimum wage in Brazil at the time. In the final stage, the participants were classified as belonging to families with a family income per capita greater than or equal to 1 minimum wage.

Respondent occupation was examined. The answers about the position, function, profession, or occupation that the person held were grouped into four categories, according to the *International Standard Classification of Occupations (ISCO)*: 1. Managers and professionals; 2. Technicians and associate professionals; 3. Clerical support, service, and sales workers; 4. Manual workers.

Regarding the position in the occupation, the answers were classified into four categories: 1. Private employee (Private sector employee); 2. Public employee (military, navy, air force, military police or military fire brigade) and Public sector employee (including mixed-capital companies); 3. Domestic worker (Domestic worker) and; 4. Autonomous (Employer; Self-employed; Unpaid self-employed worker or employer who was a member of the household; Unpaid worker helping an employee who was a member of the household).

As for oral health, four variables of interest were obtained: tooth loss (<13 teeth or  $\geq$ 13 teeth); limited feeding capacity: absent (none) or present (mild/moderate, intense); toothbrushing (at least 2 times a day or more than 2 times a day); dentist appointment in the last 12 months (yes or no). Variables on general health status (positive or negative), diabetes (no or yes), smoking habit (never smoked, current smoker and former smoker) and alcohol consumption (no or yes) were included.

## Statistical analysis

All analyses were performed using the *Stata* statistical program version 12.0 (20) and took into account the weights imposed by the study's sampling design. Preliminarily, descriptive analyses of the data were performed, by calculating the relative frequencies, so as to know the distribution of the variables under study and characterize the sample and the distribution of variables

in relation to gender. The significance level adopted was 5%, with a statistical power of 80%. Multivariate analysis was performed in blocks (block 1: socioeconomic and demographic conditions; block 2: occupational factors and; block 3: health and behaviors). Additionally, the *Prevalence Ratio* (PR) values were estimated, with a 95% confidence interval (95% CI), in the bivariate and multivariate analyses..

## RESULTS

The final sample consisted of 36,442 (100%) individuals, 47.1% men and 52.9% women. Tables 1 and 2 show the sample distribution (percentage with sample weight), according to the variables of interest and stratified by gender. Except for the variables race/color, limitation for feeding capacity and diabetes ( $p > 0.05$ ), gender differences were observed.

There was a predominance of individuals aged 18 and 44 years (58.0%), non-white (51.2%), living together (61.3%), in the Southeast region of Brazil (43.8%), in an urban area (87.5%), with education level  $\geq$  complete high school (52%) and earning per capita household income  $\leq$  1 minimum wage (72.7%) (Table 1).

The prevalence of exposure to chemical products was 16.9%, being more marked among men (19.4%). Most were inserted in predominantly manual occupations (46.1%) and were inserted in the private sector (44.1%) (Table 1).

As for the outcome, the prevalence of negative self-assessment of oral health was 30.9% (33.0% men versus 29.1% women). As for the health variables, most (80.3%) had lost less than 13 teeth, denied limited eating capacity (91.1%), brushed their teeth at least twice a day (92.9%), consulted the dentist at least an year ago (47.8%), reported positive health status (69.8%), did not report diabetes (94.4%), had never smoked (68.1%) and did not consume alcoholic beverages (55.5%) (Table 2). With the exception of diabetes, gender differences were observed, at a significant level ( $p$ -value  $< 0.05$ ), between the analyzed variables.

The prevalence of exposure to chemical products was 16.9%, being more marked

**Table 1** - Characterization of the study population (n=36,442) according to socioeconomic, demographic, and occupational factors by gender, in 2013, PNS, Brazil.

Variables	Percentual*			p-value
	In the full sample	Among men	Among women	
<b>Age (years)</b>				
18-34	37.5	39.1	36.0	<0.001
35-44	20.5	19.7	21.2	
45-59	24.1	24.6	23.6	
≥60	18.0	16.7	19.2	
<b>Race/color:</b>				
White	48.7	47.9	49.5	0.178
Non-white	51.2	52.2	50.5	
<b>Lives with spouse</b>				
Yes	61.3	67.5	55.8	<0.001
No	38.7	32.5	44.2	
<b>Geographical region</b>				
South	14.8	14.9	14.7	
Southeast	43.8	43.4	44.1	
Midwest	7.4	7.7	7.3	
North	7.4	26.5	7.2	
Northeast	26.6	47.1	26.7	
<b>Area of residence</b>				
Urban	87.5	85.1	89.7	<0.001
Rural	12.5	14.9	10.3	
<b>Schooling level</b>				
≥Complete secondary education	52.0	46.5	56.9	<0.001
<Complete secondary education	48.0	53.5	43.1	
<b>Household income per capita in minimum wages**</b>				
> 1	27.3	31.2	23.8	<0.001
≤1	72.7	68.8	76.2	
<b>Occupational Factors</b>				
<b>Chemical Handling</b>				
No	83.1	80.6	85.3	<0.001
Yes	16.9	19.4	14.7	
<b>Occupation</b>				
Managers and professionals	16.2	13.7	18.3	<0.001
Technicians and associate professionals	8.1	8.6	7.7	
Clerical support. services and sales	29.7	21.1	37.3	
Manual workers	46.1	56.6	36.8	
<b>Position in occupation</b>				
Employed in the private sector	44.1	51.8	37.3	<0.001
Public employee	14.6	10.6	18.2	
Domestic worker	8.4	1.04	14.9	
Autonomous	33.0	36.6	29.7	

p-value:  $\chi^2$  test for comparison between sexes.

\*considering the sample weighting.

\*\*Value of the minimum wage (MW) in 2013: R\$ 678.00.

among men (19.4%). Most were inserted in predominantly manual occupations (46.1%) and were inserted in the private sector (44.1%) (Table 1).

As for the outcome, the prevalence of negative self-assessment of oral health was 30.9% (33.0% men versus 29.1% women). As for the health variables, most (80.3%) had lost less than 13 teeth, denied limited eating capacity

(91.1%), brushed their teeth at least twice a day (92.9%), consulted the dentist at least an year ago (47.8%), reported positive health status (69.8%), did not report diabetes (94.4%), had never smoked (68.1%) and did not consume alcoholic beverages (55.5%) (Table 2). With the exception of diabetes, gender differences were observed, at a significant level (p-value <0.05), between the analyzed variables.

**Table 2 - Characterization of the study population (n=36,442) according to variables related to health, habits, in 2013, PNS, Brazil.**

Variables	Percentual*			p-value
	In the full sample	Among men	Among women	
<b>Perception of the oral health situation</b>				
Positive	69.1	67.1	70.9	<0.001
Negative	30.9	33.0	29.1	
<b>Tooth loss</b>				
<13 teeth	80.3	82.7	78.2	<0.001
≥13 teeth	19.7	17.3	21.8	
<b>Limitation of feeding capacity</b>				
Absent	91.1	91.7	90.5	0.040
Present	8.9	8.3	9.5	
<b>Toothbrushing</b>				
≥2 times/day	92.9	89.6	95.8	<0.001
< 2 times/day	7.1	10.4	4.2	
<b>Dentist appointment in the last 12 months</b>				
Yes	47.8	42.2	52.9	<0.001
No	52.2	57.8	47.1	
<b>Perception of the general health situation</b>				
Positive	69.8	73.6	66.4	<0.001
Negative	30.2	26.4	33.6	
<b>Diabetes (n=31,975)</b>				
No	94.4	94.7	94.2	0.360
Yes	5.6	5.3	5.8	
<b>Smoking habit</b>				
Never smoked	68.1	60.7	74.7	<0.001
Current smoker	14.7	18.6	11.2	
Former smoker	17.2	20.7	14.1	
<b>Consumption of alcohol</b>				
No	55.5	42.1	67.5	<0.001
Yes	44.5	57.9	32.5	

p-value:  $\chi^2$  test for comparison between sexes.

\*considering sample weighting.

The prevalence of negative AASB disaggregated by gender and the results of the associations of this outcome with each variable under study was observed using the univariate Poisson regression model with robust variances (Tables 3 and 4). The prevalence of negative AASB is higher in the group over 34 years of age, of non-white race/

color, living with a wife (only for men), living in the North and Northeast regions and rural areas, with lower schooling levels and household income per capita of up to 1 minimum wage ( $p < 0.05$ ). There was a higher prevalence of negative AASB in the group that reported performing manual work and for autonomous workers ( $p < 0.05$ ).

**Table 3 - Bivariate analysis of socioeconomic, demographic, and occupational factors, according to the perception of the oral health situation, stratified by gender (n=36,442), in 2013, PNS, Brazil.**

Variables	Men		Women	
	% SB negative	PR [CI 95%]	% SB negative	PR [CI 95%]
<b>Age (years)</b>				
18-34	27.0	1.00	23.8	1.00
35-44	35.2	1.21[1.15-1.27]	30.3	1.22[1.15-1.30]
45-59	37.4	1.35[1.29-1.42]	32.7	1.33[1.26-1.41]
≥60	37.7	1.39[1.29-1.49]	33.0	1.27[1.15-1.41]
<b>Race/color:</b>				
White	28.5	1.00	22.9	1.00
Non-white	37.0	1.30[1.23-1.38]	35.6	1.42[1.32-1.52]
<b>Lives with spouse</b>				
Yes	35.3	1.00	30.4	1.00
No	28.2	0.90[0.86-0.94]	27.4	0.96[0.92-1.01]
<b>Geographical region</b>				
South	29.0	1.00	24.3	1.00
Southeast	27.5	0.97[0.90-1.04]	26.1	1.04[0.95-1.14]
Midwest	32.0	1.07[0.99-1.17]	26.4	1.09[0.99-1.20]
North	43.7	1.35[1.26-1.45]	35.0	1.35[1.23-1.47]
Northeast	41.3	1.38[1.29-1.48]	35.7	1.47[1.35-1.59]
<b>Area of residence</b>				
Urban	30.9	1.00	27.8	1.00
Rural	44.8	1.41[1.35-1.47]	39.6	1.35[1.27-1.43]
<b>Schooling level</b>				
≥Complete secondary education	24.9	1.00	23.7	1.00
<Complete secondary education	40.0	1.67[1.61-1.75]	36.1	1.70[1.62-1.78]
<b>Household income per capita in minimum wages</b>				
>1	25.5	1.00	20.6	1.00
≤1	36.3	1.42[1.36-1.49]	31.7	1.71[1.60-1.82]
<b>Occupational Factors</b>				
<b>Chemical Handling</b>				
No	31.7	1.00	28.6	1.00
Yes	38.4	1.15[1.10-1.21]	31.9	1.23[1.16-1.31]
<b>Occupation</b>				
Managers and professionals	20.8	1.00	19.9	1.00
Technicians and associate professionals	23.9	0.82[0.76-0.88]	19.3	0.93[0.87-1.01]
Clerical support, services, and sales	29.1	1.41[1.24-1.61]	28.4	1.62[1.52-1.73]
Manual workers	38.7	1.28[1.23-1.33]	36.3	1.33[1.25-1.41]
<b>Position in occupation</b>				
Employed in the private sector	30.3	1.00	23.8	1.00
Public employee	24.7	1.28[1.15-1.44]	24.4	1.20[1.05-1.36]
Domestic worker	33.9	1.53[1.41-1.68]	37.5	1.60[1.47-1.75]
Autonomous	39.1	2.04[1.88-2.21]	34.2	2.17[2.00-2.36]

\*Percentage (%) with negative SB sample weight: perception of negative oral health situation (regular, bad or very bad).

**Table 4** - Bivariate analysis of oral health/health conditions and habits, according to self-assessment of oral health (n=36,442), in 2013, PNS, Brazil.

Variables	Men		Women	
	% SB negative	PR [CI 95%]	% SB negative	PR [CI 95%]
<b>Tooth loss</b>				
< 13 teeth	31.6	1.00	26.78	1.00
≥ 13 teeth	39.5	1.38[1.32-1.45]	37.3	1.47[1.39-1.55]
<b>Limitation of feeding capacity</b>				
Absent	28.9	1.00	25.5	1.00
Present	78.0	2.50 [2.42-2.60]	63.3	2.64[2.53-2.77]
<b>Toothbrushing</b>				
≥2 times/day	30.8	1.00	28.5	1.00
< 2 times/day	51.4	1.72[1.64-1.80]	45.1	1.71[1.58-1.86]
<b>Dentist appointment in the last 12 months</b>				
Yes	25.4	1.00	24.6	1.00
No	38.4	1.48[1.41-1.54]	34.1	1.47[1.40-1.54]
<b>Perception of the general health situation</b>				
Positive	25.7	1.00	21.3	1.00
Negative	53.3	2.06[1.98-2.14]	44.4	2.19[2.09-2.29]
<b>Diabetes (n=31,975)</b>				
No	30.8	1.00	27.8	1.00
Yes	39.7	1.33 [1.21-1.45]	36.4	1.45[1.32-1.60]
<b>Smoking habit</b>				
Never smoked	27.5	1.00	26.6	1.00
Current smoker	44.4	1.62[1.55-1.69]	40.3	1.43[1.34-1.53]
Former smoker	38.6	1.44[1.37-1.51]	33.1	1.27[1.20-1.36]
<b>Consumption of alcohol</b>				
No	32.8	1.00	30.4	1.00
Yes	33.1	1.05[1.01-1.09]	26.2	0.97[0.92-1.01]

\*Percentage (%) with negative SB sample weight; perception of negative oral health situation (regular, bad or very bad).

**Table 5** - Multivariate analysis evaluating socioeconomic and demographic conditions, occupational factors, health situation and life habits associated with the perception of oral health status, according to data from the PNS, Brazil, 2013.

		Prevalence Ratio (95% CI)				
		Gross	Adjusted Block 1 Model – Socioeconomic and demographic variables	Adjusted Block 2 Model - Occupational factors	Adjusted Block 3 Model - Health and habits	Adjusted final model
Variables						
<b>Men</b>						
<b>Handling of chemical substances</b>						
No		1.00	1.00	1.00	1.00	1.00
Yes		1.15[1.10-1.21]	1.15[1.09-1.20]	1.09[1.04-1.14]	1.09[1.04-1.14]	1.08[1.03-1.13]
<b>Women</b>						
<b>Handling of chemical substances</b>						
No		1.00	1.00	1.00	1.00	1.00
Yes		1.23[1.16-1.31]	1.19[1.13-1.27]	1.15[1.08-1.22]	1.15[1.09-1.22]	1.12[1.05-1.18]

CI 95% = 95% Confidence Interval; p-value adjustment of the final model = 1.000.

Block 1 (socioeconomic and demographic conditions): age, race/color, geographic region, area of residence, level of education, per capita household income in minimum wages.

Block 2 (occupational factors): occupation, occupation position.

Block 3 (health situation and life habits): tooth loss, limitation of feeding capacity, toothbrushing, time of the last dentist's appointment in the last 12 months, perception of general health status, smoking habit, alcohol consumption.



In the multivariate analysis, after the adjustments made by the blocks of the variables included in the study, the covariates that remained in the final model for men were age, race/color, region of residence, schooling level, income, occupation, tooth loss, difficulty in feeding, frequency of brushing, time of last consultation, general health situation, smoking habit and alcohol consumption. For women, the variables were age, race/color, region of residence, level of education, income, occupation, position in occupation, difficulty feeding, frequency of brushing, time of last consultation, general health and smoking habit. The association with occupational exposure to chemicals lost the strength of the association, but remained significant for both sexes: PR=1.08[1.03-1.13] for men and PR=1.12[1.05-1.18] for women (Table 5).

## DISCUSSION

In an unprecedented nature, this study representative of the Brazilian population showed a significant association between AASB and exposure to chemicals in the work environment. These results contribute to the updating and advancement of knowledge about the oral health of the economically active population in the country. Regarding the perception of oral health, it is a validated method, as well as acknowledged as a reliable health indicator (6,7). Regarding occupational exposure to chemicals, previous evidence was obtained from circumscribed occupational samples, preventing the generalization and comparison of results (9,12,13,16,24). Furthermore, no previous study inquired on the association with AASB.

Almost one third of workers negatively assessed their oral health, and this prevalence was higher in the groups of men and women exposed to chemicals at work. A variety of products handled in work environments seem to be harmful to oral tissues, such as acids, formaldehyde, caustic soda, solvents, pesticides, polycyclic aromatic hydrocarbons and chlorine. These products are present in the celluloid industry, cleaning sector, dry cleaners, electric accumulator factories, extraction, manufacture and finishing of metals, fertilizer and detergent

production, glass industry, and other sectors (13,15,21).

Previously, it was observed that exposure to chemical agents increased the 88% chance of dental caries in workers from six Brazilian states (22). In the metallurgical industry, a high prevalence of chronic periodontal disease was found in the group that, in addition to being exposed to sulfuric and hydrochloric acid mists, reported infrequent use of flossing (23). There was a high prevalence of non-caries cervical lesions among workers exposed to acid mists (24). In more than two-thirds of the workers in a glass industry, tooth erosion was observed (16). The literature on gender issues in oral health outcomes is not convergent (22,26). In Japan, men were 61% more likely to report a negative oral health situation compared to women (26). In a sample of industry workers in Brazil, there was no statistical difference between men and women regarding the prevalence of caries (22).

Some hypotheses can be speculated about the loss of significance in the groups of individuals with older age, when compared to the younger group. Firstly, older people lived at a time when the deterioration of dentition at advanced ages was naturalized. Tooth loss, masticatory function deficits, discomfort or aesthetic aspects, among other factors, would have been accepted as natural effects. In advanced ages, these individuals with low expectations about their oral conditions would tend to better self-qualify their health (18). In this case, there is a possible underestimation of negative AASB among older people. Cultural factors influence the perception of health, as already suggested. Modulators of the AASB related to the generation of a given time are expected.

The effects of structural racism, such as lower schooling and income, in addition to lower access to dental services, would explain, at least partially, the higher prevalence of negative AASB in the non-white race/color groups, regardless of gender (27). In Brazil, data from the national oral health study, SB-Brasil-2003, showed racial inequities for all indicators analyzed (caries, tooth loss, pain and need for prosthesis) (28).

Higher prevalence of negative AASB in

groups with lower schooling and income, regardless of gender, confirms the specialized literature (18,24,26). The higher the schooling, the greater access to information and greater access to preventive practices, such as more frequent tooth brushing. Previously, the most educated use of preventive dental services was identified as among those with higher schooling level when compared to those with less access to formal education.

Not surprisingly, negative AASB was associated with geographic region, regardless of gender. Respondents living in the North and Northeast regions were more likely to report negative AASB when compared to those in the South region. Similar results were previously found (28). Interregional social and economic inequalities explain the results. Historically, greater access to oral health services is concentrated in the resident groups of the South and Southeast regions (27,28). Moreover, the proportion of adults who did not get access to dental services when they needed them was higher in the capitals of the North and Northeast regions (27).

On the oral conditions of individuals inserted in predominantly manual occupations, a similar result was found by the authors who evaluated the impact of the socioeconomic situation on this dimension of health (29). In addition to exposure to occupational risks, in which chemicals are included, this group obtains lower income, has lower schooling level, and suffers restrictions on access to health services when compared to other occupational levels.

Regarding the position in the occupation, it is worth remembering that in the IBGE classification, the autonomous category includes self-employed workers, unpaid workers, or employer who was a member of the household (19). The lack of consensus on employment relations creates barriers towards comparisons. Nevertheless, worse oral health outcomes have been evidenced in groups in unstable employment situations, such as the "autonomous" category in Brazil.

The limits of the study should be highlighted. First, the question does not include the nature of the exposure, i.e. the PNS questionnaire does not mention either the type of chemical or the dose and duration of

exposure. The cross-sectional design, secondly, disallows speculation about causality. Finally, methodological differences between studies that addressed the associations focused are barriers towards comparisons.

The treatment of information collected at home included the use of sample weights to avoid, for example, overrepresentation of men or women or individuals living in a specific geographic region. In addition to this advantage, the analysis benefited from a probabilistic sample calculation appropriate to the objective of generalizing the results for the Brazilian adult population. It is also worth mentioning that the sample size made it possible to analyze different covariates. These advantages are promising when the outcome concerns oral health, which is admittedly related to health behaviors, health situation and context factors, including working conditions (9,11-13,16).

The results presented raise studies to evaluate time trends, as well as clarify still unexplored points, such as gender differentials in oral health outcomes. In addition, they are clues to guide oral health intervention strategies in line with the reality of the working population. Within this perspective, we face the challenge of fulfilling the principles of equity and integrality in oral health in Brazil. Oral health surveillance systems focused on specific groups, such as industry workers exposed to chemicals, would be useful in identifying the magnitude of problems, as well as formulating and monitoring prevention measures. Information of this type is a subsidy for the planning and adjustment of public health interventions. That is, it is useful in planning oral health programs in order to meet the needs of specific population groups, for example, workers exposed to chemicals.

## CONCLUSION

Self-assessment of oral health in occupational groups was significantly associated with occupational exposure in men and women. It was observed that individuals exposed to chemicals in the work environment were more likely to have negative AASB, confirming our hypothesis.

The authors declare no conflict of interest.

## Corresponding author:

Nayara Silva Alves

Federal University of Minas Gerais (UFMG)

Faculdade de Medicina UFMG. Núcleo de estudos saúde e trabalho.

Rua Alfredo Balena, n° 190, 7° andar, sala 733. Santa Efigênia, Belo Horizonte, Minas Gerais, 30310-450, Brazil.

E-mail: dranayaraalves@gmail.com

## REFERENCES

1. Petersen PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century - the approach of the WHO Global Oral Health Programme. *Community Dent Oral Epidemiol.* 2003;31:3–24 (Accessed January 15, 2020) Available at: <https://onlinelibrary.wiley.com/doi/full/10.1046/j.1600-0528.2010.00542.x>
2. Bernabe E, Marcenes W, Hernandez CR, Bailey J, Abreu LG, Alipour V, et al. Global, Regional, and National Levels and Trends in Burden of Oral Conditions from 1990 to 2017: A Systematic Analysis for the Global Burden of Disease 2017 Study. *J Dent Res.* 2020;99(4):362–73 (Accessed January 15, 2020) Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7088322/>
3. Baiju R. Oral Health and Quality of Life: Current Concepts. *J Clin Diagnostic Res.* 2017;11(6):ZE21–6 (Accessed January 15, 2020) Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5535498/>
4. Peres MA, Macpherson LMD, Weyant RJ, Daly B, Venturelli R, Mathur MR, et al. Oral diseases: a global public health challenge. *Lancet.* 2019;394(10194):249–60 (Accessed January 15, 2020) Available at: [https://www.thelancet.com/journals/lancet/article/PIIS0140-6736\(19\)31146-8/fulltext](https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)31146-8/fulltext)
5. Tsakos G, Oliver J. Avaliação das necessidades pela abordagem socio-odontológica. In: Pinto VG, editor. *Saúde bucal coletiva.* 7th ed. Rio de Janeiro: Guanabara Koogan; 2019. p. 472.
6. Blizniuk A, Ueno M, Zaitsu T, Kawaguchi Y. Association between self-reported and clinical oral health status in Belarusian adults. *J Investig Clin Dent.* 2017;8(2):e12206 (Accessed January 15, 2020) Available at: <https://onlinelibrary.wiley.com/doi/10.1111/jicd.12206>
7. Kim SY, Kim JE, Kim HN, Jun EJ, Lee JH, Kim JS, et al. Association of Self-Perceived Oral Health and Function with Clinically Determined Oral Health Status among Adults Aged 35–54 Years: A Cross-Sectional Study. *Int J Environ Res Public Health.* 2018;15(8):1681 (Accessed January 15, 2020) Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6121354/>
8. Pattussi MP, Peres KG, Boing AF, Peres MA, Costa JSD. Self-rated oral health and associated factors in Brazilian elders. *Community Dent Oral Epidemiol.* 2010;38(4):348–59 (Accessed January 25, 2020) Available at: <https://onlinelibrary.wiley.com/doi/10.1111/j.1600-0528.2010.00542.x>
9. Macedo CG, Queluz DP. Quality of life and self-perceived oral health among workers from a furniture industry. *Braz J Oral Sci.* 2011;10(4):226–32 (Accessed January 15, 2020) Available at: [http://revodonto.bvsalud.org/scielo.php?script=sci\\_arttext&pid=S1677-32252011000400001](http://revodonto.bvsalud.org/scielo.php?script=sci_arttext&pid=S1677-32252011000400001)
10. Boing AF, Bastos JL, Peres KG, Antunes JLF, Peres MA. Social determinants of health and dental caries in Brazil: a systematic review of the literature between 1999 and 2010. *Rev Bras Epidemiol.* 2014;17(suppl 2):102–15 (Accessed January 15, 2020) Available at: <https://www.scielo.br/j/rbepid/a/jYr5RTyTHPdHG8dFWwkkTmL/?lang=en>
11. Nardi A, Michel-Crosato E, Biazevic MGH, Crosato E, Pizzatto E, Queluz DP. Relationship between orofacial pain and absenteeism among workers in Southern Brazil. *Braz J Oral Sci.* 2009;8(1):50–4 (Accessed January 15, 2020) Available at: <https://periodicos.sbu.unicamp.br/ojs/index.php/bjos/article/view/8642350>
12. Cengiz Mİ, Zengin B, İcen M, Köktürk F. Prevalence of periodontal disease among mine workers of Zonguldak, Kozlu District, Turkey: a cross-sectional study. *BMC Public Health.* 2018;18(1):361 (Accessed January 15, 2020) Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5857090/>
13. Chen WL, Chen YY, Wu WT, Lai CH, Sun YS, Wang CC. Examining relationship between occupational acid exposure and oral health in workplace. *BMC Public Health.* 2020;20(1):1371 (Accessed January 15, 2020) Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7487460/>
14. Sato Y, Tsuboya T, Aida J, Saijo Y, Yoshioka E, Osaka K. Effort–reward imbalance at work and tooth loss: a cross-sectional study from the J-SHINE project. *Ind Health.* 2020;58(1):26–34 (Accessed January 15, 2020) Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6997713/>
15. Vianna MIP, Santana VS. Exposição ocupacional a névoas ácidas e alterações bucais: uma revisão. *Cad Saude Publica.* 2001;17(6):1335–44 (Accessed January 15, 2020) Available at: <https://www.scielo.br/j/csp/a/nHFLvtZXBzNPjQPSj3MsBHx/abstract/?lang=pt>
16. Chaturvedi P. Assessment of Tooth Wear Among Glass Factory Workers: WHO 2013 Oral Health Survey. *J Clin Diagnostic Res.* 2015;9(8):ZC63–6 (Accessed January 15, 2020) Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4576644/>
17. Tomita NE, Chinellato LEM, Lauris JRP, Kussano CM, Mendes HJ, Cardoso MTV. Oral health of building construction workers: an epidemiological approach. *J Appl Oral Sci.* 2005;13(1):24–7 (Accessed January 15, 2020) Available at: <https://www.scielo.br/j/jaos/a/w3Bdr4kXSjwBKwDf3KDymXk/?lang=en>
18. Miotto MHMB, Almeida CS, Barcellos LA. Impacto das condições bucais na qualidade de vida em servidores públicos

- municipais. *Cien Saude Colet*. 2014;19(9):3931–40 (Accessed January 15, 2020) Available at: <https://www.scielo.br/j/csc/a/8V GybkZ9SG7wLQ97zMvHPwf/?lang=pt>
19. IBGE [Internet]. Pesquisa nacional de saúde - PNS. Instituto Brasileiro de Geografia e Estatística. 2015 (Accessed January 15, 2020). Available at: <https://www.ibge.gov.br/estatisticas/sociais/justica-e-seguranca/9160-pesquisa-nacional-de-saude.html?=&t=o-que-e>
20. StataCorp [Internet]. Stata Statistical Software: Release 12. College Station, TX: StataCorp LLC.; 2011 (Accessed January 15, 2020). Available at: <https://www.stata.com>
21. Awan KH, Hegde R, Cheever VJ, Carroll W, Khan S, Patil S, et al. Oral and pharyngeal cancer risk associated with occupational carcinogenic substances: Systematic review. *Head Neck*. 2018;40(12):2724–32 (Accessed January 15, 2020) Available at: <https://onlinelibrary.wiley.com/doi/10.1002/hed.25486>
22. Cangussu MCT, Silva KMG, Mello MV, Vianna MIP, Lima LS. Cárie dentária em trabalhadores da indústria atendidos pelo sesi no brasil e fatores associados. *Rev Saúde Coletiva da UEFS*. 2017;6(2):8 (Accessed December 15, 2020) Available at: <http://periodicos.uefs.br/index.php/saudecoletiva/article/view/11157>
23. Almeida TF, Vianna MIP, Santana VS, Gomes Filho IS. Occupational exposure to acid mists and periodontal attachment loss. *Cad Saude Publica*. 2008;24(3):495–502 (Accessed March 15, 2020) Available at: <https://www.scielo.br/j/csp/a/mkSsWxDcx9GWBy5CP6KMzjc/?lang=en>
24. Bomfim RA, Crosato E, Mazzilli LEN. Relations between oral health and work ability among administrative workers. *Braz J Oral Sci*. 2015;14(1):41–5 (Accessed January 15, 2020) Available at: <https://www.scielo.br/j/bjos/a/3nYXpzSdwyLXP5 YDyZhWcrg/?lang=en>
25. Assunção AÁ, Abreu MNS, Souza PSN. Exposição a agentes químicos no trabalho no Brasil: resultados da Pesquisa Nacional de Saúde, 2013. *Rev Saude Publica*. 2020;54(92):1–13 (Accessed March 15, 2020) Available at: <https://www.scielo.br/j/rsp/a/Zg3fMBNbgcpSCh7QHBMzqYJ/?lang=pt>
26. Tsuboya T, Aida J, Kawachi I, Katase K, Osaka K. Early life-course socioeconomic position, adult work-related factors and oral health disparities: cross-sectional analysis of the J-SHINE study. *BMJ Open*. 2014;4(10):e005701 (Accessed January 15, 2020) Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4187658/>
27. Peres MA, Iser BPM, Boing AF, Yokota RTC, Malta DC, Peres KG. Desigualdades no acesso e na utilização de serviços odontológicos no brasil: Análise do sistema de vigilância de fatores de risco e proteção para doenças crônicas por inquérito telefônico (VIGITEL 2009). *Cad Saude Publica*. 2012; 28(suppl):90–100 (Accessed January 15, 2020) Available at: <https://www.scielo.br/j/csp/a/wXmVLWT7fTsB8jHMTxYNZjC/?lang=pt>
28. Guiotoku SK, Moysés ST, Moysés SJ, França BHS, Bisinelli JC. Iniquidades raciais em saúde bucal no Brasil. *Rev Panam Salud Pública*. 2012;31(2):135–41 (Accessed January 15, 2020) Available at: <https://www.scielosp.org/article/rpsp/2012.v31n2/135-141/pt/>
29. Sanders AE, Spencer AJ. Social inequality in perceived oral health among adults in Australia. *Aust N Z J Public Health*. 2004;28(2):159–66 (Accessed January 15, 2020) Available at: <https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-842X.2004.tb00930.x?sid=nlm%3Apubmed>