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Edentulism and other variables associated with self-reported health status in Mexican adults

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ACDEF 1,2 Carlo Eduardo Medina-Solís
ADE 1 América Patricia Pontigo-Loyola
ADE 2,3 Eduardo Pérez-Campos
ADE 2,3 Pedro Hernández-Cruz
ADE 4 Leticia Avila-Burgos
ADE 1 Martha Mendoza-Rodríguez
ACDE 5,6 Gerardo Maupomé

1 Academic Area of Dentistry of Health Sciences Institute, Autonomous University of Hidalgo State, Pachuca, Hidalgo, Mexico
2 Research Centre in Medical and Biological Sciences, School of Medicine and Surgery, Autonomous University "Benito Juarez" of Oaxaca, Oaxaca, Mexico
3 Biochemistry Unit ITO-UNAM, Oaxaca, Mexico
4 Health Systems Research Centre, National Institute of Public Health, Cuernavaca, Morelos, Mexico
5 Indiana University/Purdue University at Indianapolis, School of Dentistry, Indianapolis, IN, U.S.A.
6 The Regenstrief Institute, Inc. Indianapolis, Indiana, IN, U.S.A.

Corresponding Author: Carlo Eduardo Medina Solís, e-mail: cemedinas@yahoo.com
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Background: To determine if edentulism, controlling for other known factors, is associated with subjective self-report health status (SRH) in Mexican adults.

Material/Methods: We examined the SRH of 13 966 individuals 35 years and older, using data from the National Survey of Performance Assessment, a cross-sectional study that is part of the technical collaboration between the Ministry of Health of Mexico and the World Health Organization, which used the survey instrument and sampling strategies developed by WHO for the World Health Survey. Sociodemographic, socioeconomic, medical, and behavioral variables were collected using questionnaires. *Self-reported health* was our dependent variable. Data on edentulism were available from 20 of the 32 Mexican states. A polynomial logistic regression model adjusted for complex sampling was generated.

Results: In the SRH, 58.2% reported their health status as *very good/good*, 33.8% said they had a *moderate* health status, and 8.0% reported that their health was *bad/very bad*. The association between edentulism and SRH was modified by age and was significant only for *bad/very bad* SRH. Higher odds of reporting *moderate health* or *poor/very poor health* were found in women, people with lower socio-economic status and with physical disabilities, those who were not physically active, or those who were underweight or obese, those who had any chronic disease, and those who used alcohol.

Conclusions: The association of edentulism with a self-report of a poor health status (*poor/very poor*) was higher in young people than in adults. The results suggest socioeconomic inequalities in SRH. Inequality was further confirmed among people who had a general health condition or a disability.

Keywords: Self-Reported Health • Oral Health • Edentulism • Socioeconomic Inequalities

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Background

In general, there are 2 ways to measure the health status of a population. One is a subjective approach by asking the individual, and then using the self-reported health status to summarize symptoms, disease, injuries, or disability. The other is by using normative method using skilled health personnel and a clinical exam [1]. In the first case, the individual notices changes in his/her normal state of wellness. These perceptions (deviations from the "normal" state) are subjective, and are based on the accumulation of past experiences, both by the individual and by those around him/her. In the second case, the criteria are based on a normative assessment by health personnel that meets clinical standards of what constitutes a structural and/or functional deviation for the tissue, organ, system, or the body as a whole [2]. For several years there has been growing interest in measures of self-perceived health status in clinical scenarios, in therapy programs, and in health surveys. Self-reported health is one of the most frequently used measures of health perceptions evaluated in social epidemiology [3,4]. It is a common synthesis of health conditions that, despite lacking direct clinical equivalence, correlates with more complex health measures. It incorporates a bio-psychosocial construct not captured by other morbidity measures [5]. By its very nature, self-rated (self-perceived) health has a subjective component that reflects objective health evaluations of the past as well as future expectations. It is a relatively stable measure over time, and shows high test–re-test reliability [4,6]. It has also been demonstrated that self-rated health is a powerful predictor of both morbidity [6,7,8] and mortality [9,10].

In Latin America and Mexico there have been few studies concerning self-reported health [11–15]. Several variables have been associated with self-reported poor health. Studies around the world have found changes associated with variables such as age [6,15–18], sex [6,18–21], physical activity [15,22], various indicators of socioeconomic position [4,12,15,17–19,21,22] chronic diseases, body-mass index (BMI) and other health conditions [6,12,15,18,21,23], physical activity [12,15,18,22,24], having a healthy diet [18], religiosity [18], sleep quality [18], and consumption of alcohol and tobacco [15,25,26], among others.

Although studying variables associated with self-reported general health is not new, the association with oral conditions has not been fully studied. The information applicable to Mexico is non-existent in this area. The objective of the present study was to determine if edentulism, socioeconomic position, socio-demographic variables, and presence of other health problems or disabilities were associated with self-reported general health in a Mexican adult population.

Material and Methods

Study design and population

The present study was derived from secondary analyses of health survey data from a nationally representative sample in Mexico. Further details of the survey are available elsewhere [27–30]. Briefly, the National Performance Evaluation Survey 2002–2003 (ENED), a cross-sectional study, was part of the technical collaboration between the Ministry of Health of Mexico (SSA) and the World Health Organization, which used the survey instrument and sampling strategies developed by WHO for the World Health Survey (WHS) [31]. Information was collected from 38 746 households, with a mean of 1250 households for each State. The sample design was probabilistic, multistage, stratified, through conglomerates, and was calculated to provide representative information at the State level, and across urban and rural areas. The sample size considered 9% as the smaller proportion to estimate; State estimations with a maximum relative error of 25%; a confidence level of 95%; non-response rate of 15%; and a design effect of 1.7. The complete WHS instrument was not used in every State. Data on dental conditions were only available for 20 out of the 32 States of Mexico, leading to a total of 24 159 households included in the present study. Three strata were considered: a) cities or metropolitan areas (locations with more than 100 000 inhabitants); b) urban settings (locations from 2500 to 99 999 inhabitants), and c) rural areas (locations with fewer than 2500 inhabitants). The final sample comprised 13 966 participants.

Data collection

The ENED survey had 2 different questionnaires, with 1 questionnaire inquiring about household conditions and the other inquiring about individual subject factors. In the first questionnaire, information was gathered on neighborhood public services, income, expenses, and health insurance. The second questionnaire gathered information including health status, health risk factors, presence of key diseases, use of health services, non-clinical expectations of the population, and insurance coverage of certain clinical services. The interview time was approximately 110 minutes per household.

Variables and instruments

Dependent variable

Self-reported health was our dependent variable, and was assessed by an item consisting of 5 alternatives. The first option entailed completely good health ("*very good*"). The second option was a straightforward "*good*". The third option was neutral, coded as "*moderate*". The fourth and fifth options were "*bad*" and "*very bad*". In this study, self-reported health was

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categorized into *good* (the two first alternatives), *moderate,* and *bad* (the 2 remaining options).

Independent variables

The main independent variable was *edentulism*, which refers to the absence of any natural teeth in the mouth; it was gathered through question *Q6757, "Have you lost all of your natural teeth?"* In addition, a series of socio-demographic, socio-economic factors, and variables related to health were included: age (35 to 98 years), sex (male or female), residence (rural, urban, metropolitan), marital status (single, married, divorced, widowed, cohabitating), indigenous ethnicity status ("*Do you speak an indigenous language?*": no or yes), schooling (less than elementary, complete elementary, complete secondary, high school/equivalent, college studies/higher), occupation (employed in the public sector, employed outside the public sector, self-employed, or not working or doing volunteer work), health insurance (insured or non-insured), socioeconomic level (in tertiles), having a disability (none or yes), physical activity (high activity or low activity), chronic disease (none or any), body mass index (BMI; underweight <18.5, normal 18.5–24.9, overweight 25.0–29.9, or obesity ≥30), and tobacco use (never/not currently, sometimes, or daily) and alcohol use (Never and low: fewer than 4 servings for women and 5 for men in the last week on 1 occasion; or high: 4 servings and more for women, and 5 for men in the last week on 1 occasion) [32]. Valid data were BMI values between 10 and 58; for height, we considered valid data between 130 and 200 cm [33]. We excluded from analysis data outside acceptable limits for BMI (n=24) and for height (n=48).

Disability

This variable was constructed through interviewer's reporting problems with walking, being confined to a wheelchair, or using cane, crutches, or walker. Those reporting at least 1 limb paralyzed or amputated, and those with medically diagnosed mental health problems, were also included in this category.

Socio-economic level

The household survey included general topics, such as building materials of the house and ownership of consumable goods, which led to a Wealth Index using principal components analysis (PCA). Owning a refrigerator, washing machine, dishwasher, personal computer, car, bicycle, television, etc., were the goods combined in the polycoric PCA [34]. The aspects incorporated to assess features of the home included the building materials for walls and floor, the number of rooms, the characteristics of bathroom and kitchen, the source of potable or indoor water, having electricity and heating, and an estimate of whether the household could be considered overcrowded.

There were some missing data for weight (n=243), height (n=367), indigenous ethnicity status (n=113), insurance (n=30), and socio-economic level (n=1), which were imputed through regression imputation [35].

Statistical analysis

First, a univariate analysis was conducted to report the summary measures per case (for nominal and ordinal variables, frequencies and percentages; for continuous variables, dispersion and central tendency measures). Assuming an ordinal behavior of the dependent variable, a model of ordered logistic regression was used. It was later changed for the multinomial (polytomous) logistic regression model, since the assumption of similar coefficients among categories was not met (proportional odds assumption) in some independent variables in the bivariate analyses [34]. In the multinomial logistic regression, results are established based on a comparison category. In our case, we selected as the comparison category for the dependent variable the *"very good/good"* category of self-reported health. The role of each of the variables was thus identified while controlling for the remaining variables, and for their interactions, thus offering an overview of the associations between variables and the performance of the model as a whole [36]. We first ran the model using bivariate techniques, reporting odds ratio (OR), 95% confidence intervals (CI 95%), and p-value of the test. Finally, a multivariate multinomial logistic regression model was constructed and incorporated all variables available that at the bivariate analysis level exhibited a p-value <0.25, to control for possible confusion.[37] The criterion for inclusion of variables in the multivariate model was its association with health perception at a level of p <0.05, but we considered a p<0.10 as a trend to be associated with the response variable. We used the module *svy* (complex samples) of the statistical package STATA 9®.

Ethical consideration

The Medical Research Committee of the National Institute of Public Health in Mexico granted ethics approval. Participation in the survey was voluntary. All individuals provided written informed consent.

Results

In this analysis, we included only individuals 35 years old and older (n=13,966), representing 29 853 607 inhabitants of 20 States of Mexico. Tables 1 and 2 show the descriptive data of the study. The majority of participants (40.4%) were 35–44 years old and 57.9% were women. The highest percentage (49.5%) lived in a metropolitan zone, 67.2% were married, and 8.1% were considered of indigenous ethnicity. In relation to

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Table 1. Socio-demographic and socio-economic characteristics of the study population across categories of self-reported general health (estimated population N=29,853,607).

Variable	n	N (% weighted)		VG/G	Moderate	B/VB	p value
Age							
35–44 years	5,095	12,053,147	(40.4)	67.9	27.6	4.5	0.0000
45–59 years	4,658	10,224,403	(34.2)	55.9	36.0	8.1	
60 and more years	4,213	7,576,057	(25.4)	45.9	40.8	13.4	
Sex							
Male	5,975	12,557,585	(42.1)	63.2	30.5	6.3	0.0000
Female	7,991	17,296,022	(57.9)	54.5	36.3	9.2	
Residence							
Rural	4,132	7,956,031	(26.7)	57.0	34.3	8.7	0.2730
Urban	3,970	7,110,123	(23.8)	56.9	35.5	7.6	
Metropolitan	5,864	14,787,453	(49.5)	59.4	32.8	7.8	
Marital status							
Single	997	1,802,953	(6.0)	63.2	29.3	7.5	0.0000
Married	8,867	20,073,180	(67.2)	60.1	32.8	7.1	
Divorced	1,011	1,854,057	(6.2)	56.3	35.2	8.4	
Widowed	2,023	3,358,374	(11.2)	43.7	43.4	12.9	
Cohabitating	1,068	2,765,043	(9.3)	60.0	31.6	8.4	
Indian ethnicity status							
No	13,154	27,439,358	(91.9)	57.6	34.4	8.0	0.0050
Yes	812	2,414,249	(8.1)	65.5	26.9	7.6	
Schooling							
Less than elementary	3,151	6,308,017	(21.1)	52.1	36.0	11.9	0.0000
Complete elementary	6,834	14,594,709	(48.9)	55.1	36.7	8.2	
Complete middle school	1,911	4,401,463	(14.7)	64.3	30.3	5.4	
High School/equivalent	1,176	2,698,823	(9.0)	69.5	25.4	5.1	
College and higher	894	1,850,595	(6.2)	72.2	24.3	3.4	
Occupation							
Government Employee	1,243	2,300,766	(7.7)	70.0	27.5	2.5	0.0000
Non-Government Employee	1,349	3,070,293	(10.3)	71.5	23.6	4.9	
Self-Employed	4033	8,672,457	(29.0)	61.2	32.7	6.0	
Employer	46	61,221	(0.2)	61.9	26.2	11.8	
Volunteer Worker	51	111,870	(0.4)	62.8	35.4	1.8	
Does not work	7244	15,637,000	(52.7)	52.1	37.4	10.5	
Health insurance							
Non-insured	8,442	18,251,697	(61.1)	58.4	33.5	8.1	0.7948
Insured	5,524	11,601,910	(38.9)	57.8	34.4	7.8	
Socio-economic level							
1 tertile (lowest)	4,656	9,690,079	(32.5)	57.3	34.1	8.6	0.0076
2 tertile (middle)	4,701	9,301,266	(31.2)	55.5	36.3	8.2	
3 tertile (highest)	4,609	10,862,262	(36.4)	61.3	31.5	7.2	

VG/G – very good/good; B/VB – bad/very/bad.

the socioeconomic position indicator variables, we observed that 48.9% of the subjects had completed elementary school; most of them did not work or worked on a voluntary basis without remuneration (52.7%) and of these the majority were women (82.8%); 61.1% did not have health insurance. In the health-related variables, we observed that 10.2% (representing 3 052 263 individuals) were edentulous; a similar percentage had physical disabilities; 92.2% reported performing moderate to vigorous physical activity; 16.6% had a diagnosed chronic disease; a considerable proportion of the population were overweight/obese (42.1% and 19.7%, respectively); 77.3% had never smoked; and 59.7% said that they did not drink alcohol.

As for the percentages of the self-reported general health, we noted that the majority (58.2%, N=17,373,754) reported their health status as *very good/good*, 33.8% (N=10,099,035) said

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Table 2. Characteristics related to health of the population across categories of self-reported general health (estimated population N=29, 853,607).

Variable	n	N (% weighted)		VG/G	Moderate	B/VB	p value
Edentulism							
No	12,285	26,801,344	(89.8)	60.0	33.0	7.0	0.0000
Yes	1,681	3,052,263	(10.2)	42.8	40.9	16.3	
Disability							
No	12,449	26,800,380	(89.8)	61.1	32.8	6.2	0.0000
Yes	1,517	3,053,227	(10.2)	33.1	43.2	23.6	
Physical activity							
No	1,139	2,342,223	(7.8)	49.1	32.0	18.9	0.0000
Yes	12,827	27,511,384	(92.2)	59.0	34.0	7.0	
Chronic disease							
No	11,497	24,909,024	(83.4)	63.4	30.6	6.1	0.0000
Yes	2,469	4,944,583	(16.6)	32.1	50.2	17.7	
BMI							
Underweight <18.5	278	528,581	(1.8)	51.7	30.5	17.8	
Normal BMI (18.5–24.9)	5,108	10,884,813	(36.5)	61.1	32.1	6.8	0.0000
Overweight (25.0–29.9)	5,820	12,564,208	(42.1)	59.2	33.5	7.4	
Obesity (≥30)	2,760	5,876,005	(19.7)	51.2	38.2	10.6	
Smoking (current)							
Never	10,872	23,083,604	(77.3)	58.1	33.8	8.1	
Sometimes	1,964	4,592,591	(15.4)	58.9	33.8	7.3	0.9747
Daily 1–5	614	1,244,635	(4.2)	58.2	32.8	9.1	
Daily >5	516	932,777	(3.1)	57.7	35.3	7.0	
Alcohol use (current)							
Never	7,276	15,429,942	(51.7)	59.7	32.8	7.4	0.0328
Low	6,393	13,901,545	(46.6)	56.2	35.2	8.6	
High	297	522,120	(1.7)	64.6	27.7	7.8	

VG/G – very good/good; B/VB – bad/very/bad.

they had a *moderate* health status, while 8.0% (N=2,380,818) mentioned that their health was *bad / very bad*.

Bivariate analysis

Tables 1 and 2 show the bivariate distribution of self-reported general health status across the categories of the independent variables included in the study. Table 3 presents the bivariate analysis using polynomial logistic regression (statistically significant variables are presented). We observed that only age, sex, marital status, edentulism, disability, physical activity, presence of chronic disease, BMI, education, occupation, belonging to an indigenous ethnic group, and socioeconomic level were variables significantly associated in the bivariate analysis.

Multivariate model

Table 4 presents the results of the multivariate polynomial logistic regression model; we obtained 11 main effects and an interaction between edentulism and age. Thus, the association of edentulism with self-reported health was modified by age. We can consider: 1) the association of edentulism when age is constant (e.g., 35 years old, which was the minimum age included in the study) on the self-report of *moderate* health status ($OR=exp^{0.7179}=2.05$, P=0.194) and of *very bad/bad* status ($OR=exp^{2.8658}=17.56$, p<0.001) and 2) the association of edentulism for each year that age increases (e.g., 35–36 years) on the self-reported health with a *moderate* status ($OR=exp^{0.7179+(-.0090)}=2.03$, p>0.05) or a *very bad/bad* status ($OR=exp^{2.8658+(-0.0372)}=16.92$, p=0.001)) to reach an OR of 1.68 (p=0.001) at 98 years old (which was the maximum age found in the study) in the self-report of health as *very bad/bad* status. The result for the category *moderate* was not statistically significant, indicating that the association of edentulism with self-reported health as *bad/very bad* was higher in young people than in older people, decreasing about 3.6% per each year that age increased. Also, women had higher odds of reporting *moderate* health (OR=1.35) or *bad/very bad* health (OR=1.67) compared with men (p<0.05).

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Table 3. Bivariate multinomial logistic regression analyses for self-rated health and independent variables (only statistically significant results).

Variable	Likelihood of moderate *vs.* good		Likelihood of bad/very bad *vs.* good	
	OR (95% CI)		OR (95% CI)	
Age				
35–44 years		1*		1*
45–59 years	1.58	(1.39–1.81)†	2.19	(1.76–2.74)†
60 and more years	2.18	(1.84–2.59)†	4.41	(3.18–6.13)†
Sex				
Male		1*		1*
Female	1.38	(1.15–1.65)‡	1.69	(1.33–2.14)†
Marital status				
With partner		1*		1*
Without partner	1.33	(1.14–1.55)†	1.64	(1.31–2.06)†
Edentulism				
No		1*		1*
Yes	1.73	(1.39–2.16)†	3.26	(2.51–4.25)†
Disability				
No		1*		1*
Yes	2.43	(1.97–3.00)†	7.02	(5.23–9.43)†
Physical activity				
No		1*		1*
Yes	0.88	(0.71–1.10)n/s	0.31	(0.23–0.42)†
Chronic disease				
No		1*		1*
Yes	3.24	(2.75–3.83)†	5.75	(4.55–7.28)†
BMI				
Underweight <18.5	1.13	(0.74–1.71)n/s	3.10	(1.79–5.37)†
Normal BMI (18.5–24.9)		1*		1*
Overweight (25.0–29.9)	1.08	(0.91–1.27)n/s	1.12	(0.87–1.44)n/s
Obesity (≥30)	1.42	(1.20–1.68)†	1.87	(1.29–2.69)‡
Schooling				
Elementary or less		1*		1*
Complete middle school	0.70	(0.58–0.84)†	0.49	(0.35–0.69)†
High School/equivalent	0.54	(0.43–0.68)†	0.43	(0.28–0.65)†
College and higher	0.50	(0.37–0.68)†	0.28	(0.13–0.58)‡
Occupation				
Government employee		1*		1*
Non-government employee	0.84	(0.55–1.29)n/s	1.93	(1.02–3.68)¶
Self-employed	1.35	(1.04–1.77)¶	2.79	(1.65–4.72)†
Does not work/volunteer worker	1.82	(1.38–2.40)†	5.61	(3.40–9.24)†
Indigenous ethnicity status				
No		1*		1*
Yes	0.69	(0.49–0.96)¶	0.83	(0.52–1.33)n/s
Socio-economic level				
1 tertile (lowest)		1*		1*
2 tertile (middle)		1*		1*
3 tertile (highest)	0.82	(0.70–0.97)¶	0.79	(0.62–1.00)n/s

* Reference category; n/s – not significant; † p<0.001; ‡ p<0.01; ¶ p<0.05.

The results for the socio-economic status indicator variables included in the multivariate model (Table 4) showed that individuals with occupations placed lower in the socioeconomic scale were more likely to report *moderate* health status

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Table 4. Associated variables in the final multinomial logistic regression model for self-rated health.

Variable	Likelihood of moderate *vs.* good		Likelihood of bad/very bad *vs.* good	
	AOR (CI 95%)		AOR (CI 95%)	
Edentulism				
No	1*		1*	
Yes	2.05	(0.69–6.08)$^{n/s}$	17.56	(4.22–73.03)†
Age	1.01	(1.01–1.02)†	1.02	(1.01–1.03)†
Interaction	0.99	(0.97–1.01)$^{n/s}$	0.96	(0.94–0.98)‡
Sex				
Male	1*		1*	
Female	1.35	(1.10–1.64)‡	1.67	(1.31–2.13)†
Occupation				
Employed non-manual occupation	1*		1*	
Employed manual occupation	1.27	(1.03–1.56)¶	1.49	(0.96–2.30)§
Schooling				
Less than college	1*		1*	
College and higher	0.71	(0.60–0.85)†	0.62	(0.42–0.90)¶
Socio-economic level				
1 & 2 tertile (lowest & middle)	1*		1*	
3 tertile (highest)	0.79	(0.68–0.93)‡	0.71	(0.54–0.93)¶
Disability				
No	1*		1*	
Yes	1.65	(1.33–2.05)†	3.69	(2.73–4.99)†
Physical activity				
No	1*		1*	
Yes	1.06	(0.86–1.33)$^{n/s}$	0.47	(0.34–0.65)†
BMI				
Underweight <18.5	1.04	(0.68–1.59)$^{n/s}$	2.59	(1.42–4.73)‡
Normal BMI (18.5–24.9)	1*		1*	
Overweight (25.0–29.9)	1.10	(0.93–1.30)$^{n/s}$	1.18	(0.91–1.55)$^{n/s}$
Obesity (≥30)	1.36	(1.16–1.59)†	1.69	(1.11–2.55)¶
Chronic disease				
No	1*		1*	
Yes	2.65	(2.25–3.12)†	3.68	(2.88–4.71)†
Alcohol use (current)				
Never	1*		1*	
Low	1.31	(1.13–1.52)†	1.59	(1.26–2.00)†
High	1.14	(0.75–1.74)$^{n/s}$	2.05	(1.00–4.22)§

AOR – Adjusted Odds Ratio by variables contained in the tables. * Reference category; $^{n/s}$ not significant; † p<0.001; ‡ p<0.01; ¶ p<0.05; § p<0.10. The interaction term is explained in the results section.

(OR=1.27; p<0.05). However, the significance was considered marginal for those who were considered to have *bad/very bad* health (OR=1.49; p<0.10). On the other hand, having achieved higher levels of education decreased the likelihood of reporting *moderate* health (OR=0.71) or *bad/very bad* health (OR=0.62) (p<0.05). Individuals with better socioeconomic position had lower odds of reporting *moderate* health (OR=0.79) or *bad/very bad* health (OR=0.71) than their counterparts with lower socioeconomic level (p<0.05).

Table 4 also shows data on health variables. For individuals with a disability, the odds of reporting *moderate* health were 1.65 times (95% CI=1.33–2.05) compared to individuals without disabilities; this contrast was even starker in those reporting *bad/very bad* health, 3.69 (95% CI=2.73–4.99). Physical activity was not associated with a *moderate* health report (p>0.05), however, individuals who had physical activity had lower probabilities of reporting *bad/very bad* health (OR=0.47, 95% CI=0.34 to 0.65).

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Although being underweight or overweight were not associated with a report of *moderate* health status (p>0.05), obesity itself showed a positive association (OR=1.36, p <0.001). This situation changed when reporting *bad/very bad* health: when participants were considered underweight (OR=2.59, 95% CI=1.42–4.73) or obese (OR=1.69, 95% CI=1.11–2.55), the odds increased. Being overweight was not significant (p>0.05).

Those who had chronic disease had higher odds of reporting *moderate* health (OR=2.65; p<0.001), and were even more likely to report having *bad/very bad* health (OR=3.68; p<0.001).

Finally, low alcohol consumption was associated with a *moderate* health self-report (OR=1.31; p<0.001); interestingly, high consumption of alcohol was not associated with *moderate* health (p>0.05). In an analogous way, those who had low alcohol consumption were 59% (p<0.01) more likely to report *bad/very bad* health, whereas for those with high alcohol consumption, reporting *bad/very bad* health was marginally significant (OR=2.05; p=0.051).

Discussion

Using national survey data, the present study found that the degree of association between edentulism, socioeconomic status, socio-demographic variables, and the presence of general health problems or disabilities were associated with self-reported general health status among Mexican adults.

Self-evaluations of health generally integrate and synthesize various objective health indicators, its functions, and social and cultural values [21]. We observed a predominance towards health reported as *very good/good* (58.2%), which was similar to a study in Brazil (60%) [15] but lower than that observed by Laaksonen et al. [4] in Finland, and by Bennet et al. [19] and Jerant et al. [38] in the United States (>70%). In another study performed in Brazil using the same methodology (World Health Survey), the observed percentage of self-reported health as *very good/good* was 53.3% [16], lower than our figures. In general, the figures for self-reported *good/very good* health are higher in industrialized than non-industrialized countries.

It is generally accepted that a key element of overall health is oral health. While oral diseases and their sequelae are largely preventable [39–44], many adults experience poor oral health [40,41,45]. Although there are no studies that directly link edentulism to self-report of general health, there is evidence of the relationship between deficient oral health and various health conditions and quality of life. For example, in a study conducted in Brazil [46], edentulism was associated with high blood pressure compared to individuals who had more than 10 teeth. In Japan, Aida et al. [47] observed that mortality from cardiovascular disease and respiratory disease was higher among those who had more missing teeth. Recently in Mexico, Medina et al. [29] found that angina pectoris was associated with edentulism. In the U.S., people who reported *bad health* also indicated having lower quality of life related to oral health [45]. The overall trend from these studies suggests that oral health, specifically tooth loss, is strongly associated with general health. In the case of our study, it should be noted that edentulism was associated with self-reported *bad/very bad* health (but not on *moderate* health) depending on age, the effect being greater among young people than in older adults.

In terms of health, the variables of sex (biological construct) and gender (behavioral and social construct) are recognized as useful parameters for research and action, as differences determine specific diseases for men and for women [48]. In this regard, the observed differences between men and women have been well documented by other authors [16,18,20,21], as well as in our own study, with women reporting worse health status than men. One of the main explanations for such a difference is that women may recognize pain and discomfort more easily than men [16]. Other explanations that have been proposed are: 1) the specific conditions of women (maternal conditions, risk exposures, poverty and social exclusion, empowerment), especially in developing countries; 2) conditions associated with increased longevity in women (arising from aging and chronic diseases); 3) conditions resulting from the interaction of sex and gender (depressive symptoms); and 4) gender-based conditions (e.g., violence) [48].

With regard to socioeconomic status, the current literature has documented that the position of an individual in society is generally a strong predictor of both morbidity and mortality. In addition, several authors [49] support the existence of an association between health status and social status: in general, individuals with better socioeconomic status have better health. The results from the present study are consistent with the observed association in other publications about self-reported health and socioeconomic status variables. This relationship has been reported using different indicators [4], such as the highest level of education (schooling) [12,15,18,19,21], poverty level [21], type of occupation [17,22], household size [22], or even renting the residence where people live [15]. In the present study, it was consistently observed in all the three indicator variables that remained in the final model (occupation, education [measured by schooling], and socioeconomic status) that individuals with better socio-economic status reported better health status than those with worse socio-economic status. Among the hypotheses that can explain this association would be access to health services, access to health information, and better nutrition. No definitive interpretation is feasible from the current data.

Self-reported health is a valuable measure in epidemiology because it correlates with present and future morbidity, with

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different causes of death, and with health services utilization. As a result of several factors, including the aging of the population, a greater proportion of people develop what has been called *multimorbidity*, with important economic implications [50]. Various authors around the world have found that health conditions are strong predictors of poor overall health at the individual level [21]. Likewise, people with chronic health conditions such as hypertension and diabetes [12,15] or various disabilities [18] reported worse health levels. In the U.S., Ayyagari et al. [6] observed that conditions such as angina, arthritis, congestive heart failure, diabetes and renal disease were associated with worse reported health levels. The results of the present study are consistent with those findings. It is not surprising therefore that certain presentations of BMI (obese individuals) were associated with worse health reports. Similar results have been observed in the U.K. where overweight and obese patients reported worse self-rated health, and more co-morbidities and biological risk factors [23]. A similar situation was found in adults from Brazil [15], as well as in the present study, in that such association was observed only among the obese subjects and not with merely overweight people. However, unlike the Brazilian study, the present study found that individuals characterized as underweight also reported worse general health status.

Like other studies carried out in populations of adolescents [22] and adults [15,18,24], the results of the present study showed that physical activity may be a protective factor against self-reported poor health. A sedentary lifestyle and irregular physical exercise have been previously associated with self-reported poor health in Mexican women [12]. According to the WHO, physical inactivity is the fourth leading risk factor affecting overall mortality, and is the cause of almost 6% of all deaths. It is generally accepted that physical activity is an important element of a healthy lifestyle – it improves lipid profile, blood pressure, metabolic syndrome, muscle strength and bone density, and is associated with a reduction in excess weight, emotional problems, and depressive symptoms [22,51].

Numerous studies have explored the relationship between alcohol consumption and health. Compared with abstention, moderate alcohol consumption has been linked to better health, including subjective health. On the other hand, excessive and harmful consumption of alcohol is associated with increased morbidity and mortality [15,25,26]. Green and Pollen [25] mentioned that studies relating alcohol to health have failed to take into account the possible heterogeneity in health history and alcohol consumption among non-drinkers and former drinkers, by combining them with lifetime abstainers in the analysis. To the extent that former drinkers stop drinking due to illness, this could increase the risk of the non-drinking category and underestimate the adverse effects of alcohol consumption on health; diseases that lead to abstention are related to alcohol. In our study, those who had low alcohol consumption in the previous week had a higher risk of reporting *moderate* and *bad/very bad* health, along with the strong tendency to select the category *of bad/very bad* health. These differences could be due to methodological issues, such as the fact that in our study alcohol consumption was measured only for the previous week without taking into account the former drinkers' history; whereas in other studies the time base was between 6–12 months. Besides the different epidemiological designs used in other studies and in ours, it is possible [52] that by collapsing categories of those who currently drink no alcohol, we may be in fact combining people who are no longer using alcohol after substantial abuse with life-long abstainers.

The present study has limitations and strengths that should be taken into consideration when analyzing conclusions. The main limitation is the inability to pinpoint causality between different variables, which is an inherent weakness in cross-sectional studies. However, the ENED provided reliable and internationally comparable information about a wide variety of health indicators, including measures of general health of the population and the effectiveness of health systems. Our data represent most of the country's adult population, and our study provides an initial assessment of the importance of complete loss of teeth in the context of self-perception of general health.

Conclusions

The association between edentulism and self-reported poor health status (*bad/very bad*) in the Mexican adult population was stronger in the younger segment of the population studied. We observed not only socioeconomic inequalities in relation to the self-report of general health, but also that people with a chronic illness or a disability reported their perceived general health status as less favorable.

Conflict of interest statement

None.

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