

# Acculturation, depression and oral health of immigrants in the USA

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**Objectives:** The objectives were to describe the oral health status of immigrants in the USA, describe the association between acculturation and oral health by accounting for the effects of depression and to explore the effects of interaction between acculturation and depression on the oral health of immigrants. **Methods:** Data were from the 2011–2012 National Health and Nutrition Examination Survey (NHANES). Oral health status was assessed by both self-rated oral health and clinically diagnosed periodontitis, each coded as a binary outcome. Acculturation was operationalised as length of stay in the USA and speaking English at home. Depression was assessed using the Patient Health Questionnaire-9. Multiple logistic regression models were used to examine the association of acculturation and depression status with oral health. **Results:** In 2011–2012, 36.6% immigrants reported poor oral health and 53.0% were diagnosed with periodontitis. A length of stay in the USA of 30+ years (adjusted odds ratio [AOR] = 0.43, 95% confidence interval [95% CI]: 0.21–0.89) reduced the odds of having periodontitis in comparison with a length of stay in the USA of fewer than 5 years. Speaking English at home (AOR = 0.64, 95% CI: 0.43–0.96) reduced the odds of having periodontitis compared with speaking other languages. Depression was negatively associated with self-reported good oral health (AOR = 0.43, 95% CI: 0.20–0.92) and positively associated with clinically diagnosed periodontitis (AOR = 1.89, 95% CI: 1.18–3.04). The effects of acculturation did not differ according to depression status. **Conclusion:** A longer stay in the USA and speaking English at home were associated with less periodontitis among the immigrants.

**Key words:** Acculturation, depression, oral health, immigrants

## INTRODUCTION

The foreign-born population has been growing quickly in the USA. It is projected that, in 2060, immigrants will account for 19% of the population, up from 13% in 2014<sup>1</sup>. Acculturation, a process whereby immigrants adjust to the cultural norms and behaviours in the host country, may influence health behaviour, which may ultimately affect health outcomes<sup>2</sup>. Studies in the USA have shown that acculturation has a positive effect on the use of health services<sup>3</sup>, yet negative effects on alcohol use<sup>4</sup>, diet<sup>5</sup> and hypertension<sup>6</sup>.

A positive impact of acculturation on oral health has been reported in the USA<sup>7–9</sup>. However, previous studies used limited samples, such as focussing only on Mexican Americans<sup>8</sup> or convenience samples<sup>7</sup>. Evidence of acculturation effects on immigrants of differing race/ethnicity is still very limited. Another factor

that impacts oral health is depression. Research has shown that depression affects oral health behaviour<sup>10,11</sup> which, in turn, contributes to poor oral health status<sup>12,13</sup>. Furthermore, research has shown that immigrants are at higher risk of being depressed compared with their US-born counterparts<sup>14,15</sup> as a result of the stressful transition during the immigration process, although longer residency may reduce the risk of depression<sup>16,17</sup>. Immigrants may experience hardship in adapting to a new language, new customs and new social norms<sup>18,19</sup>. It is not known whether the effects of acculturation on oral health differ in the presence of depression.

To our knowledge, no research has described the association between acculturation and oral health in immigrant populations independent of the effects of depression often seen during the acculturation process. This study aimed to: (i) describe the oral health status of immigrants in the USA; (ii) describe the association

between acculturation and oral health accounting for the effects of depression; and (iii) explore the interactive effects between acculturation and depression on the oral health of immigrants.

## METHODS

### Study design

Data from the 2011–2012 National Health and Nutrition Examination Survey (NHANES) were used in this study. NHANES is a stratified multistage probability sample of the civilian non-institutionalised population in the USA. Additional information about the survey, including the sampling design, can be found online ([www.cdc.gov/nchs/nhanes.htm](http://www.cdc.gov/nchs/nhanes.htm)). Data were collected from participants through in-home interviews that were conducted, in either English or Spanish, by trained field interviewers. Dental examinations were conducted in mobile examination centres by dental professionals. The two outcome variables examined in this analysis, namely self-rated oral health and periodontitis, were obtained from the oral health questionnaire and the dental examinations, respectively. The study sample included immigrants (i.e. not born in the USA) 30 years of age and older, the age group that completed the oral health examination. We excluded 26 participants who identified as being ‘other race/multi-racial’. The final sample consisted of 1,458 subjects who completed the oral health questionnaire and, of those, 1,097 who participated in the dental examinations.

### Measures

#### *Self-reported oral health status*

In the oral health questionnaire, participants were asked to rate the condition of their teeth and gums as poor, fair, good, very good or excellent. In this analysis, the overall oral health status was classified into a binary variable. We re-coded good, very good or excellent as ‘good’ (and allocated a value of 1) and re-coded fair or poor as ‘poor’ (and allocated a value of 0).

#### *Clinically classified periodontitis*

The 2011–2012 NHANES survey used a full-mouth periodontal examination protocol, reducing the error of misclassification for periodontitis cases<sup>20</sup>. The presence of periodontitis was determined based on the Centers for Disease Control and Prevention (CDC) and the American Academy of Periodontology (AAP) total periodontitis case definition, defined as the sum of severe, moderate and mild periodontitis cases. A detailed definition can be found elsewhere<sup>21</sup>. In this analysis, periodontitis was

measured as a binary outcome (Yes = 1 [mild, moderate or severe periodontitis]/No = 0).

### *Acculturation*

Across research studies, acculturation has been defined using various measures, including length of stay, English language proficiency, media use and preferences, and/or citizenship<sup>7,8</sup>. In this study, acculturation was operationalised as both English spoken at home and length of stay in the USA. The 2011–2012 NHANES included an acculturation module, where, according to their self-identified race/ethnicity, respondents were asked whether they speak English or another language (e.g. Spanish or other language) at home. In this study, English spoken at home was coded as ‘1’ if respondents answered that they spoke English at home; otherwise, it was coded as ‘0’. In the public-use data set, length of stay in the USA was recorded in nine categories: 1 = under than 1 year; 2 = 1 year or more but fewer than 5 years; 3 = 5 years or more but fewer than 10 years; 4 = 10 years or more but fewer than 15 years; 5 = 15 years or more but fewer than 20 years; 6 = 20 years or more but fewer than 30 years; 7 = 30 years or more but fewer than 40 years; 8 = 40 years or more but fewer than 50 years; and 9 = 50 years or more. Based on descriptive statistics, length of stay in the USA was classified into four groups: ‘1’ = fewer than 5 years; ‘2’ = 5 years or more but fewer than 15 years; ‘3’ = 15 years or more but fewer than 30 years; and ‘4’ = 30+ years.

### *Depression status*

In NHANES, respondents’ depression status was assessed using the Patient Health Questionnaire-9 (PHQ-9)<sup>22</sup>. The nine symptom questions are scored from ‘0’ (not at all) to ‘3’ (nearly every day) to reflect how often the depressive symptoms were experienced within the previous 2 weeks<sup>22,23</sup>. In this analysis we first summed the score of responses to the nine questions (to yield a total score ranging from 0 to 27) and then classified depression into a binary variable: depression (Yes was coded ‘1’ [i.e. a score of 10 or higher, indicating moderate, moderately severe or severe depression]) *versus* no depression (No was coded ‘0’ [i.e. a score of lower than 10, indicating minimal or mild depression])<sup>23</sup>.

### *Sociodemographics*

Sociodemographic variables included age as a continuous variable, sex, race/ethnicity using the categories defined in the NHANES (non-Hispanic White, Mexican American, other Hispanic, non-Hispanic Black and non-Hispanic Asian), marital status (married or

living with partner [coded 1] *vs.* others [coded 0]), health insurance coverage (Yes = 1/No = 0), education level (<12 years of education, 12 years or more and some college education) and annual family income (<\$20,000, \$20,000–\$44,999, \$45,000–\$99,999, \$100,000+).

### Statistical analyses

We compared the differences in participants' characteristics according to self-reported oral health and clinically diagnosed periodontitis status using chi-square or *t*-tests where appropriate. We then used a series of logistic regression models to describe the association of acculturation factors with self-reported oral health and periodontitis status outcomes, controlling for sociodemographic variables (Model I), depression status (Model II) and the two interaction terms (length of stay and English spoken at

home) × depression as a group (Model III). The clinical examination sampling weights were used in the model for periodontitis and the 2-year survey weights were used in the model for self-rated oral health status. Stata 13 (Stata Corp LP, College Station, TX, USA) was used for data analyses.

### RESULTS

*Table 1* presents the characteristics of immigrants, stratified according to self-described oral health and periodontitis status. Overall, the two samples differed slightly in sociodemographic variables and therefore cannot be directly compared. For self-rated oral health, most of the respondents in each group, other than those of Mexican origin, rated their oral health as good ( $P < 0.01$ ). A significantly higher percentage of female immigrants and immigrants with a college education or higher, an annual family income of \$45,000 or more or

**Table 1** Characteristics of immigrants according to self-rated oral health and periodontitis status: 2011–2012 National Health and Nutrition Examination Survey (NHANES)

Characteristics	Self-rated oral health ( <i>n</i> = 1,458)			Periodontitis ( <i>n</i> = 1,097)		
	Whole sample	Good	Poor	Whole sample	Yes	No
Age in years (mean)	48.4	48.6	48.0	46.8	50.0	43.3***
Sex						
Female	52.2	66.7	33.3*	51.2	44.6	55.4***
Male	47.8	59.8	40.2	48.8	61.8	38.2
Race/ethnicity						
Non-Hispanic White	14.8	63.2	36.8**	14.0	30.3	69.7**
Mexican American	25.1	48.1	51.9	26.6	62.9	37.1
Other Hispanic	27.4	61.7	38.3	26.9	54.6	45.4
Non-Hispanic Black	7.2	80.2	19.8	6.6	54.4	45.6
Non-Hispanic Asian	25.7	75.8	24.2	26.0	53.1	46.9
Marital status						
Married/living with partner	72.8	63.2	36.8	76.2	53.3	46.7
Other	17.2	63.8	36.2	23.8	51.9	48.1
Education level						
Less than high school	37.2	54.0	46.0***	35.7	64.7	35.3***
High school	17.5	58.3	41.7	16.8	67.9	32.1
Some college and above	45.3	73.2	26.8	47.5	39.0	61.0
Annual family income						
Less than \$20,000	24.0	50.9	49.1***	21.7	60.8	39.2***
\$20,000–\$44,999	30.0	58.1	41.9	30.5	60.1	39.9
\$45,000–\$99,999	30.8	69.2	30.8	31.3	47.9	52.1
\$100,000+	15.1	83.2	16.8	16.5	33.6	66.4
Having health insurance						
Yes	64.1	71.5	28.5***	63.6	47.5	52.5***
No	35.9	48.9	51.1	36.4	62.7	37.3
Years in USA						
<5 years	10.2	55.9	44.1	10.8	48.9	51.1
5–14 years	27.9	62.8	37.2	28.7	52.8	47.2
15–29 years	35.6	63.2	36.8	36.5	54.3	45.7
30+ years	26.3	70.9	29.1	24.1	51.0	49.0
English spoken at home						
Yes	47.4	72.0	28.0***	47.8	41.0	59.0**
No	52.6	55.8	44.2	52.8	64.0	36.0
Having depression						
Yes	7.9	42.7	57.3*	7.4	66.5	33.5*
No	92.1	64.7	35.3	92.6	52.2	47.8
Overall		63.4	36.6		53.0	47.0

Values are given as weighted mean for age and weighted percentages for the other characteristics. \* $P < 0.05$ ; \*\* $P < 0.01$ ; \*\*\* $P < 0.001$ .

health insurance coverage rated their oral health as good ( $P < 0.001$ ). Immigrants who spoke English at home ( $P < 0.01$ ) were more likely to report good oral health, while immigrants with depression were less likely to report good oral health ( $P < 0.01$ ).

Older immigrants were more likely to have periodontitis ( $P < 0.001$ ), while female immigrants, non-Hispanic White immigrants, those with a college level of education or higher, an annual family income of more than \$45,000 or health insurance coverage were less likely to have periodontitis ( $P < 0.01$ ). Immigrants who spoke English at home ( $P < 0.01$ ) were less likely to have periodontitis, while immigrants with depression were more likely to have periodontitis ( $P < 0.05$ ) (Table 1).

Overall, in 2011–2012, 63.4% of the participants rated their oral health as good and 53.0% were diagnosed with periodontitis. Length of stay in the USA was not significantly associated with oral health status as self-rated or periodontitis in the bivariate analyses. English spoken at home was significantly associated with both self-rated oral health and periodontitis (Table 1).

Tables 2 and 3 present the results from logistic regression models for the two outcomes. In Model I, the associations between acculturation and both oral health outcomes were assessed, controlling for other variables. In Model II, the depression variable was added to Model I. In Model III, the following two interaction terms were added to Model II:

depression  $\times$  length of stay in the USA and depression  $\times$  speaking English at home. Neither of the interaction terms was significant. An omnibus test for the significance of adding these two variables to the model was not significant ( $F = 1.25$ ,  $P = 0.33$  in the self-rated oral health model;  $F = 1.50$ ,  $P = 0.26$  in the periodontitis model). Thus, we did not present the Model III results for either outcome. For brevity, only significant results for Models I and II are included in the tables and introduced below.

As shown in Model I within Table 2, female immigrants were more likely to report their oral health as good. Non-Hispanic Black and non-Hispanic Asian immigrants were more likely to report good oral health compared with non-Hispanic White immigrants. Annual family income of \$100,000+ and health insurance coverage were associated with a higher likelihood of reporting good oral health. When depression was added to the model (Model II), the sociodemographic associations were essentially unchanged. Those who had depression were less likely to report good oral health.

In the periodontitis models (Table 3), the results in Model I showed that older immigrants were more likely, while female immigrants were less likely, to have periodontitis. Immigrants of other race/ethnicities (i.e. Mexican, other Hispanic, non-Hispanic Black or non-Hispanic Asian) were more likely to have periodontitis than their non-Hispanic White counterparts. Immigrants with a length of stay of 30+ years in the

**Table 2** Logistic regression results\* of variables associated with self-rated good oral health among immigrants ( $n = 1,458$ ): 2011–2012 National Health and Nutrition Examination Survey (NHANES)

Characteristics	Model I		Model II	
	AOR (95% CI)	P value	AOR (95% CI)	P value
Sex				
Female	1.33 (1.05–1.70)	0.020	1.37 (1.08–1.74)	0.012
Male	Reference		Reference	
Race				
Non-Hispanic White	Reference		Reference	
Mexican American	1.15 (0.55–2.43)	0.700	1.19 (0.57–2.49)	0.627
Other Hispanic	1.54 (0.62–3.82)	0.329	1.69 (0.67–4.27)	0.249
Non-Hispanic Black	3.28 (1.31–8.24)	0.014	3.38 (1.34–8.50)	0.013
Non-Hispanic Asian	2.21 (1.08–4.53)	0.032	2.26 (1.09–4.69)	0.030
Annual family income				
<\$20,000	Reference		Reference	
\$20,000–\$44,999	1.26 (0.82–1.95)	0.271	1.24 (0.81–1.90)	0.311
\$45,000–\$99,999	1.49 (0.99–2.25)	0.056	1.43 (0.95–2.15)	0.086
\$100,000+	2.96 (1.57–5.57)	0.002	2.83 (1.51–5.30)	0.003
Having health insurance				
Yes	1.73 (1.21–2.46)	0.005	1.78 (1.25–2.54)	0.003
No	Reference		Reference	
Having depression				
Yes			0.43 (0.20–0.92)	0.031
No			Reference	

95% CI, 95% confidence interval; AOR, adjusted odds ratio.

\*Only variables with significant results are presented. Other variables in the model included age, marital status, education, years in the USA and speaking English at home.

**Table 3** Logistic regression results\* of variables associated with periodontitis among immigrants ( $n = 1,097$ ): 2011–2012 National Health and Nutrition Examination Survey (NHANES)

Characteristics	Model I		Model II	
	AOR (95% CI)	P value	AOR (95% CI)	P value
Age	1.07 (1.05–1.08)	<0.001	1.07 (1.05–1.09)	<0.001
Sex				
Female	0.38 (0.27–0.53)	<0.001	0.37 (0.27–0.52)	<0.001
Male	Reference		Reference	
Race				
Non-Hispanic White	Reference		Reference	
Mexican American	2.73 (1.39–5.37)	0.006	2.71 (1.37–5.40)	0.007
Other Hispanic	1.93 (1.07–3.48)	0.031	1.81 (0.98–3.33)	0.057
Non-Hispanic Black	2.62 (1.08–6.34)	0.035	2.56 (1.05–6.26)	0.041
Non-Hispanic Asian	2.69 (1.25–5.79)	0.014	2.69 (1.26–5.76)	0.014
Years in USA				
<5 years	Reference		Reference	
5–14 years	0.74 (0.34–1.60)	0.425	0.72 (0.33–1.56)	0.385
15–29 years	0.77 (0.39–1.54)	0.439	0.75 (0.38–1.48)	0.382
30+ years	0.44 (0.21–0.88)	0.024	0.43 (0.21–0.89)	0.026
English spoken at home				
Yes	0.65 (0.44–0.96)	0.032	0.64 (0.43–0.96)	0.034
No	Reference		Reference	
Having depression				
Yes			1.89 (1.18–3.04)	0.011
No			Reference	

95% CI, 95% confidence interval; AOR, adjusted odds ratio.

\*Only variables with significant results are presented. Other variables in the model included marital status, income, education and health insurance.

USA were less likely to have periodontitis in comparison with those recent immigrants who had been in the USA for fewer than 5 years. Immigrants who spoke English at home were less likely to have periodontitis than those who did not speak English at home. These associations remained significant when depression was added to the model (Model II). Immigrants who had depression were at higher risk of periodontitis.

## DISCUSSION

Using a large national representative sample, the analyses performed in our study assessed the oral health status of immigrants in the USA and described the impact of acculturation on oral health, independent of depression, another risk factor for oral health. The 2011–2012 NHANES data showed that 37% of immigrants rated their oral health as poor. Approximately 53% of the immigrants were clinically diagnosed with periodontitis. This finding may indicate a low level of oral health literacy and self-awareness among immigrants. It could also reflect a low expectation of what constitutes good oral health among many immigrants.

Among the two acculturation factors examined in this study, speaking English at home reduced the odds of having periodontitis but no significant association was observed for self-rated good oral health; similarly, length of stay was a significant factor for periodontitis

but was not significant for self-perceived oral health. In this study, the two oral health outcome measures are different in that self-rated oral health is reported at the time of survey while periodontitis is the accumulation of oral health problems over a longer period of time. This might explain the different results obtained.

Longer length of stay in the USA and greater use of the English language at home may enable immigrants to become more familiar with the health-care system and overcome barriers in accessing the system. In addition, those with a longer length of stay may tend to have better health literacy overall and larger social networks. This could help immigrants not only to navigate the health-care system but also actually to use dental services within the system. For instance, our recent work based on the 1997–2000 National Health Interview Survey (NHIS) data found that dental service utilisation increased with a longer length of stay in the USA in Asian adults<sup>24</sup>.

Among immigrants, a longer length of stay in the USA reduced the odds of having periodontitis, independent of income level, education level and health insurance coverage. It should also be noted that the effect of the length of stay in the USA on periodontitis was significant only for those immigrants who had stayed in the USA for 30+ years in comparison with those who had been in the USA for fewer than 5 years. Length of time in the USA was not significant for those with a length of stay between 5 and



29 years. It is possible that long-term immigrants are more likely to have better oral health knowledge and better oral-hygiene behaviours, partly as a result of exposure through social networks, and have had more accumulated preventive dental care than newer immigrants. Previous studies found that many new immigrants are not aware of the importance of preventive dental care and may not adhere to good oral-health hygiene practices<sup>25</sup>. Community outreach programmes that target immigrants, especially newer immigrants, and provide both oral health education and dental services, could be important to improve oral health overall as well as quality of life in this population.

In general, the results of this study were consistent with the results of previous studies. Yet, it is difficult to make direct comparisons of the results of this particular study with previous research because of different samples and varied measures of acculturation. While our study used a national sample and included first-generation immigrants from several major racial/ethnic groups in the USA, other studies used small/regional samples and/or focussed on one immigrant group. Nonetheless, most previous research in the USA has reported a positive impact of acculturation on oral health<sup>26</sup>. One study, using the 1982–1984 Hispanic Health and Nutrition Examination Survey (HHANES), found that Mexican American participants with higher levels of acculturation had a lower prevalence of gingivitis and periodontal pocketing than did those with lower acculturation status. Their measure of acculturation included eight items with a focus on preferred language of communication and specific generation of immigrant status<sup>8</sup>. Another study of Haitian immigrants in New York City found that higher acculturation levels were associated with fewer decayed and missing teeth and a lower severity of periodontitis. Their measures of acculturation included language knowledge and use in communication, media use and preferences, social interactions and food preferences<sup>27</sup>. A third study of Hispanic people in south Florida found that Hispanic adults with higher acculturation levels suffered less from pain and its complications. Their measure of acculturation included English literacy and place of birth (i.e. a proxy measure of the length of stay in the USA)<sup>9</sup>. Different findings of acculturation factors have also been reported. For example, a study of immigrants in New York City in 2009 found that neither length of stay nor language preference was associated with oral disease<sup>7</sup>.

No significant interactive effects between depression and acculturation factors were found. Our estimate of depression reflected symptom endorsement only over the previous 2 weeks. We acknowledge that depression is a dynamic disease and that the previous 2 weeks may not necessarily reflect a general pattern of depressive symptoms over the past few months or years. The

relationships among acculturation, depression and oral health are complex. Very little of the association between acculturation and periodontitis is the result of depression. Nevertheless, the study results showed a significant main effect of depression in that it was a significant risk factor for both self-rated oral health and clinically diagnosed periodontitis, which was consistent with the results of previous studies. For instance, the National Survey of American Life data showed that adults with major depression were twice as likely to have fair or poor self-rated oral health<sup>28</sup>. The Behavioral Risk Factor Surveillance System data also revealed that adults with current depression were more likely to have tooth loss<sup>11</sup>. In addition, studies have found that depression is associated with poor periodontal health<sup>29</sup>.

Last, interestingly, when accounting for all socio-economic variables, acculturation factors and depression status, the study results (Self-Rated Oral Health Model II) showed that non-Hispanic Black immigrants and non-Hispanic Asian immigrants were more likely to rate their oral health as good than were non-Hispanic White immigrants. A possible explanation is that these findings could be a result of the lower oral health literacy level among some immigrants who may have over-rated their oral health status. They might not have adopted the view of those who are native-born with regard to health. Thus, their self-reported oral health may not truly reflect their actual oral health condition. In fact, our study results in the periodontitis model indicated disparities between non-Hispanic White immigrants and other race/ethnicity immigrants, with immigrants of other race/ethnicity being more likely to have periodontitis. These findings suggest that acculturation has not mitigated the ‘inherent’ effect associated with race/ethnicity identity.

Limitations of this study included the measurement of acculturation. Only two variables related to acculturation were available in the 2011–2012 NHANES. Thus, the measure of acculturation can potentially be inadequate as many researchers have suggested the multidimensions of acculturation<sup>30</sup>. Nevertheless, these measures do capture some important facets of acculturation. In addition, our analyses did not control for immigration age because specific age at immigration was not available in the public data set (and could not be derived from the length of stay in the USA as length of stay is recorded at the ordinal level). Yet, the length of stay in their origin country could have had accumulative effects on oral health because of the cultural norms regarding oral health in their home country before they immigrated to the USA. Third, location of residence was not controlled in this study because such data are not available in NHANES. We also acknowledge that immigrants in some ethnic enclaves may not undergo the same

acculturation process as others, and some immigrants may be more reluctant to participate in national surveys. Last, given that the main objective of this study was to investigate the association between acculturation, depression and oral health status, we did not include other factors in these analyses that could potentially be related to oral health status, including health behaviour (e.g. smoking, dietary habits) and physical health status. Future research will further investigate these complex relationships.

## CONCLUSION

Immigrants in the USA had considerable oral health problems. More than one-third of immigrants reported having poor oral health and more than half had periodontitis. Acculturation was associated with oral health, independently of the effects of depression. A higher level of acculturation, that is, a longer stay in the USA, as well as speaking primarily English at home, reduced the odds of having periodontitis. No interaction effects between depression and acculturation factors were found. Oral health promotion in immigrants could especially target those immigrants who have newly arrived and provide assistance in improving English language proficiency. A more proficient use of the English language could help immigrants to navigate the health-care system and obtain important dental health information in English. Improving English language proficiency could be an important part of oral health education.

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## Conflict of interest

The authors declare no conflict of interest in this manuscript.

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