

# Increasing dental health-care utilisation for all: understanding individual factors and place factors in Hawaii

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**Introduction:** Dental service utilisation is an important global health problem. Studies report that when people are able to access oral health care, they are more likely to receive basic preventive services than emergency care. Previous studies also report that dental-care utilisation varies according to individual patient and place factors. However, studies on the interplay of individual and place factors are limited. This study investigated the associations of dental-care utilisation according to urban/rural setting and individual patient factors, such as demographic, health care, health behaviour and financial autonomy. **Methods:** The association of dental-care utilisation according to individual factors and place was investigated by analysing information obtained from the Hawaii Behavioral Risk Factor Surveillance Survey (BRFSS). The BRFSS is a health-related telephone survey system that collects state data on US residents regarding their health-related risk behaviours, chronic health conditions and use of preventive services. **Results:** We found that health care, behaviours and financial autonomy were not substantially different between urban sites and rural sites in terms of the odds of dental-service utilisation. Our results showed that individual factors, such as financial autonomy, were more consistently associated with dental-service utilisation. **Discussion:** Financial autonomy, as well as socio-economic factors, need to be considered to improve dental-service utilisation in Hawaii.

**Key words:** Access to oral care, Hawaii, dental-care utilisation, oral health policy, socio-economic status

## INTRODUCTION

Oral health is an integral part of general health and wellbeing and a basic human right<sup>1,2</sup>. When people are able to access oral health care they are more likely to receive basic preventive services and education on how to attain and maintain good oral health<sup>3</sup>. They are also more likely to have oral diseases detected at earlier stages<sup>3</sup>. Despite these well-established public health interventions, inequality in dental-service utilisation persists as a global health problem<sup>4</sup>.

Previous studies have shown associations between dental-service utilisation and individual-level factors, such as demographics<sup>5–7</sup>, general health behaviour<sup>5,8</sup> and financial barriers<sup>9</sup>. Dental-service utilisation has also been reported to be related to place factors, such as geographical location (rural *vs.* urban)<sup>10</sup>. Rural

differences in dental care related to transportation<sup>11,12</sup> and availability of providers<sup>11</sup> have been cited in studies, and issues in accessing dental health care in Hawaii have been noted in reports<sup>13</sup>.

There has been no study that has comprehensively and quantitatively investigated dental-care utilisation in Hawaii. To improve the oral health of all, including underserved minority communities and those living on the neighbour islands, we must understand how individual factors (e.g. demographics, health behaviours) and place factors (e.g. urban *vs.* rural) interplay in dental-service utilisation.

Therefore, this study investigated how individual-level factors, such as demographics, health care, health behaviour and financial autonomy, interact with dental health-care utilisation according to place (urban *vs.* rural) in Hawaii.

## METHODS

### Study design

The utilisation of dental services in Hawaii was studied using the Behavioral Risk Factor Surveillance Survey (BRFSS) for the years 2011–2014. The BRFSS is a nationally representative survey of non-institutionalised adults conducted yearly by the Centers for Disease Control and Prevention. Data were provided by the Hawaii Department of Health, which collects more detailed ethnic data than available nationally. Participants' ethnicity included Caucasian, Filipino, Japanese, Native Hawaiian, other Asians, other Pacific Islanders (PI) and other. The University of Hawaii Institutional Review Board (IRB) granted the study an exemption from review.

### Variables

The study outcome variable was dental-service utilisation based on the answer to a question asking participants if they had visited a dentist in the past year. Analyses included individual-level factors, such as demographic variables, health care, health behaviours and financial autonomy. Demographic variables included age, gender, ethnicity, education, income and marital status. Age was categorised into four groups: 18–24, 25–44, 45–64 and  $\geq 65$  years. Ethnicity included Caucasian, Filipino, Japanese, other Asians, Native Hawaiian, other PI and other. Education was classified as high school or less, attending college or technical school, and graduation from college or technical school. Income was classified as  $< \$25,000$ ,  $\$25,000$ – $\$34,999$ ,  $\$35,000$ – $\$49,999$ ,  $\$50,000$ – $\$74,999$  and  $\geq \$75,000$ . Marital status was defined as married/unmarried couple, never married, divorced/separated and widowed. Health-care variables included yes or no for having a personal doctor, health coverage and not being able to see a doctor because of medical cost. Health behaviours assessed were smoking status (current, former or never), soda consumption (per day, per week, per month or never) and exercising in the past 30 days. Financial autonomy was determined based on participant's job type (salaried or not salaried), home ownership status and if they had enough money to pay their mortgage (always/usually, rarely/sometimes, never, not applicable).

Rural/urban status was determined by responses to a question asking the participant's geographical location. There are seven inhabited islands in the State of Hawaii, six of which are publically accessible. The island of Oahu is the most populated publically accessible island, and it is reported that 992,605 individuals lived within the City and County of Honolulu as of 2016<sup>14</sup>. The remaining five publically accessible

neighbour islands were designated as 'rural' for this study. The cities on neighbour islands have fewer than 50,000 residents, and access to specialised health-care services requires an airline flight to Honolulu, Oahu. [The Census Bureau identifies urbanized areas (UAs) as comprising  $\geq 50,000$  people<sup>8</sup>]. Therefore, for the purposes of this study we defined Oahu as the sole urban location and all of the other neighbour islands as rural. The study population included a total of 14,564 individuals, with 7,754 (53%) from Oahu (urban) and 6,810 (47%) from the combined (rural) neighbour islands.

Dental utilisation, the primary study outcome, was classified as yes or no. Visiting a dentist in the past year was the reference category.

### Data analysis

Descriptive statistical significance of demographic variables, health care, health behaviours and financial autonomy by Oahu and neighbour islands were tested using Rao-Scott chi-square tests and summarised using frequencies and percentages. Multivariable logistic regression models were performed separately for Oahu and neighbour islands to obtain both unadjusted odds ratios (ORs) and ORs adjusted for demographic variables. Some models tested interactions between other study variables and residence on Oahu or neighbour islands. In these analyses, three models were fit: one without the interaction term for Oahu; one without the interaction term for the neighbour islands; and one including both interaction terms [i.e. indicators for residence on Oahu or on the neighbour islands multiplied by the study exposure (e.g. home ownership)]. The results of logistic regression models were reported as ORs and 95% CI.

All analyses included stratification and weight variables to account, appropriately, for the complex survey design of the BRFSS, and the results were analysed using SAS version 9.4 (SAS Institute Inc., Cary, NC, USA). A value of  $P < 0.05$  was considered statistically significant.

## RESULTS

All demographic variables, with the exception of gender, were significantly different between urban and rural sites (*Table 1*). The 'urban' Oahu site had younger residents (age 18–24 years), a greater percentage were Japanese (26%), a higher proportion were college graduates (30%) and a higher proportion were residents with incomes of  $> \$75,000$  (37%) compared with people residing on the 'rural' neighbour island. Rural residents were less likely to have a personal doctor, to have seen a dentist in the past year and were less likely to have health insurance or see a

**Table 1** Comparison of Oahu (urban) and neighbour island (rural) place according to individual factors of demography, health care and behaviours, and financial autonomy

Variable	Total ( <i>n</i> = 14,564)	Island		<i>P</i>
		Oahu ( <i>n</i> = 7,754)	Neighbour islands ( <i>n</i> = 6,810)	
<b>Demographic variables</b>				
Age group (years)				
18–24	1,135 (11.6)	742 (12.1)	393 (10.4)	<0.001
25–44	3,767 (33.7)	2,267 (34.8)	1,500 (31.3)	
45–64	5,535 (34.3)	2,730 (32.8)	2,805 (37.8)	
≥65	4,127 (20.4)	2,015 (20.3)	2,112 (20.6)	
Gender				
Male	6,850 (49.9)	3,702 (49.9)	3,148 (49.8)	0.888
Female	7,714 (50.1)	4,052 (50.1)	3,662 (50.2)	
Race				
Caucasian	5,581 (31.7)	2,231 (26.4)	3,350 (44.2)	<0.001
Filipino	1,774 (16.9)	1,001 (17.0)	773 (16.8)	
Japanese	2,729 (22.3)	1,812 (25.7)	917 (14.4)	
Native Hawaiian	1,941 (12.4)	977 (11.5)	964 (14.7)	
Other Asians	1,016 (8.9)	834 (11.4)	182 (3.2)	
Other	662 (5.4)	378 (5.7)	284 (4.9)	
Other Pacific Islanders	306 (2.2)	202 (2.3)	104 (2.1)	
Education				
≤High school	4,615 (39.4)	2,250 (36.6)	2,365 (46.0)	<0.001
Attended college or technical school	4,115 (33.5)	2,108 (33.4)	2,007 (33.6)	
Graduated from college or technical school	5,810 (27.1)	3,378 (30.0)	2,432 (20.4)	
Income				
<\$25,000	3,486 (24.9)	1,594 (22.4)	1,892 (30.8)	<0.001
\$25,000–\$34,999	1,482 (11.4)	714 (10.5)	768 (13.7)	
\$35,000–\$49,999	1,943 (14.4)	985 (14.0)	958 (15.4)	
\$50,000–\$74,999	2,201 (16.4)	1,181 (16.5)	1,020 (16.2)	
≥\$75,000	4,026 (32.8)	2,494 (36.7)	1,532 (23.9)	
Marital status				
Married/unmarried couple	7,468 (53.6)	3,918 (53.4)	3,550 (54.3)	<0.001
Never married	3,423 (28.9)	2,059 (30.1)	1,364 (26.4)	
Divorced/separated	2,234 (10.6)	1,073 (10.0)	1,161 (11.9)	
Widowed	1,385 (6.8)	664 (6.5)	721 (7.5)	
<b>Health care</b>				
Personal doctor				
No	2,090 (15.1)	1,016 (13.6)	1,074 (18.5)	<0.001
Yes	12,444 (84.9)	6,719 (86.4)	5,725 (81.5)	
Visited a dentist in past year				
No	4,251 (29.1)	2,141 (27.4)	2,110 (31.1)	<0.001
Yes	10,266 (70.9)	5,590 (72.6)	4,676 (68.9)	
Could not see doctor because of medical cost				
No	13,184 (91.1)	7,126 (92.2)	6,058 (88.4)	<0.001
Yes	1,366 (8.9)	620 (7.8)	746 (11.6)	
Health coverage				
No	1,198 (9.0)	585 (8.4)	613 (10.4)	0.007
Yes	13,334 (91.0)	7,151 (91.6)	6,183 (89.6)	
<b>Health behaviours</b>				
Smoking status				
Never	8,156 (59.9)	4,623 (61.2)	3,533 (54.4)	<0.001
Former	4,137 (25.9)	1,953 (24.2)	2,184 (29.6)	
Current – some day	612 (4.4)	308 (4.1)	304 (5.0)	
Current – every day	1,352 (9.9)	696 (9.4)	656 (10.9)	
Soda consumption				
Never	3,536 (44.6)	1,916 (44.4)	1,620 (45.0)	0.807
Per day	659 (10.4)	408 (10.6)	251 (9.9)	
Per week	732 (11.7)	461 (11.9)	271 (11.1)	
Per month	2,266 (33.4)	1,313 (33.1)	953 (34.0)	
Exercise in past 30 days				
No	2,748 (19.3)	1,499 (19.6)	1,249 (18.6)	0.299
Yes	11,812 (80.7)	6,253 (80.4)	5,559 (81.4)	
<b>Financial autonomy</b>				
Have enough money to pay mortgage				
Always/usually	787 (11.4)	430 (10.7)	357 (13.1)	0.009
Rarely/sometimes	2,058 (34.7)	1,156 (33.7)	902 (36.9)	
Never	3,230 (50.8)	1,855 (52.6)	1,375 (46.7)	
Not applicable	206 (3.1)	91 (3.0)	115 (3.3)	

(continued)

**Table 1** continued

Variable	Total ( <i>n</i> = 14,564)	Island		<i>P</i>
		Oahu ( <i>n</i> = 7,754)	Neighbour islands ( <i>n</i> = 6,810)	
Home ownership				
Own	8,149 (63.4)	4,031 (62.0)	4,118 (66.5)	<0.001
Rent	4,586 (25.1)	2,645 (26.0)	1,941 (23.1)	
Other arrangement	1,630 (11.5)	957 (12.0)	673 (10.4)	
Salaried job				
Salaried	1,664 (38.8)	1,083 (42.0)	581 (31.0)	<0.001
Not salaried	2,433 (61.2)	1,360 (58.0)	1,073 (69.0)	

Data are given as *n* (%). The weighted column percentages means that the column percentages were estimated using the complex survey design of the BFRSS. Unweighted percentages would be the percentages ignoring the complex survey design. Rao-Scott chi-square tests were used to account for the complex sampling design.

**Table 2** Odds of dental-service utilisation according to the individual factors of demography, health care and behaviours, and financial autonomy

Variable	OR	95% CI	<i>P</i>
<b>Demographic variables</b>			
Age group (years)			
18–24	Ref.	Ref.	Ref.
25–44	0.83	0.68–1.01	0.069
45–64	1.34	1.10–1.64	0.003
≥65	1.60	1.30–1.96	<0.001
Gender			
Male	Ref.	Ref.	Ref.
Female	1.36	1.22–1.52	<0.001
Race			
Caucasian	Ref.	Ref.	Ref.
Filipino	0.77	0.65–0.92	0.004
Japanese	1.50	1.28–1.75	<0.001
Native Hawaiian	0.57	0.48–0.67	<0.001
Other Asians	1.38	1.11–1.73	0.004
Other	0.53	0.41–0.68	<0.001
Other Pacific Islanders	0.37	0.26–0.52	<0.001
Education			
≤High school	0.32	0.28–0.36	<0.001
Attended college or technical school	0.55	0.48–0.63	<0.001
Graduated from college or technical school	Ref.	Ref.	Ref.
Income			
<\$25,000	0.23	0.20–0.27	<0.001
\$25,000–\$34,999	0.38	0.31–0.46	<0.001
\$35,000–\$49,999	0.61	0.51–0.74	<0.001
\$50,000–\$74,999	0.68	0.56–0.82	<0.001
≥\$75,000	Ref.	Ref.	Ref.
Marital status			
Married/unmarried couple	Ref.	Ref.	Ref.
Never married	0.49	0.43–0.55	<0.001
Divorced/separated	0.46	0.39–0.54	<0.001
Widowed	0.64	0.53–0.78	<0.001
<b>Health care</b>			
Personal doctor			
No	0.41	0.36–0.48	<0.001
Yes	Ref.	Ref.	Ref.
Could not see doctor because of medical cost			
No	Ref.	Ref.	Ref.
Yes	2.81	2.36–3.35	<0.001
Health coverage			
No	0.35	0.29–0.42	<0.001
Yes	Ref.	Ref.	Ref.
<b>Health behaviours</b>			
Smoking status			
Never	Ref.	Ref.	Ref.
Former	0.90	0.80–1.03	0.117
Current – some day	0.39	0.31–0.51	<0.001

(continued)

Table 2 continued

Variable	OR	95% CI	P
Current – every day	0.38	0.32–0.46	<0.001
Soda consumption			
Never	Ref.	Ref.	Ref.
Per day	0.50	0.38–0.65	<0.001
Per week	0.72	0.56–0.94	0.015
Per month	0.83	0.69–0.99	0.042
Exercise in past 30 days			
No	0.69	0.60–0.78	<0.001
Yes			
Financial autonomy			
Have enough money to pay mortgage			
Always/usually	Ref.	Ref.	Ref.
Rarely/sometimes	1.57	1.21–2.04	0.001
Never	2.69	2.10–3.45	<0.001
Not applicable	2.29	1.36–3.85	0.002
Home ownership			
Own	Ref.	Ref.	Ref.
Rent	0.39	0.35–0.44	<0.001
Other arrangement	0.45	0.38–0.53	<0.001
Salaried job			
Salaried	Ref.	Ref.	Ref.
Not salaried	0.50	0.41–0.63	<0.001

OR, odds ratio.

medical doctor because of cost compared with urban residents. Urban residents were more likely to be never-smokers but consumed similar amounts of soda drinks and had exercise levels comparable with their rural counterparts. Among rural residents, financial autonomy was slightly more favourable in that a higher proportion always paid their mortgage, owned a own home and were non-salaried workers compared with urban residents.

Table 2 examines the odds of dental-service utilisation according to individual factors. Dental-service utilisation rates varied between ethnic groups, with lower utilisation among Caucasians than those of Japanese/other ethnicity. Higher dental-service utilisation was also found among older individuals and women. Lower dental-service utilisation was observed with lower education, lower incomes, non-married status, not having a personal doctor and no health coverage. Lower dental-service utilisation was also found among those who consumed any amount of soda, were active smokers or did not exercise. Individuals who were unable to pay their mortgage regularly were more likely to seek dental-service utilisation but not if they did not own their home or were non-salaried.

Table 3 presents the results adjusted for all demographic variables and stratified according to urban *vs.* rural residence to examine whether ‘place’ influences the relationship between health-care access, behaviours and financial autonomy with dental-service utilisation. We found that health-care access, behaviours and financial autonomy were not substantially different between urban and rural sites in terms of odds of dental-service utilisation. Consequently, we

combined both sites to examine the adjusted odds for dental-service utilisation. In this final model (Table 4), the individual factors that were positively associated with dental-service utilisation were older age (>65 years), not seeing a doctor because of medical costs and never having enough money to pay the mortgage (OR range: 1.73–1.99; *P*-value range: <0.001–0.023). Lower dental-service utilisation was significantly associated with poverty level based on income (<\$25,000), having less than a college education, being divorced/separated, not having a personal doctor, lacking health coverage, being an active smoker, not exercising, not having home ownership and not being salaried (OR range: 0.47–0.77; *P*-value range: <0.0001–0.026).

## DISCUSSION

Dental-service utilisation is an important factor known to be associated with better dental care (i.e. early screening and treatment of dental diseases). Access to dental services is a necessary precursor to dental-service utilisation but it is not sufficient to ensure oral-health or dental-health equality. In this study, we examined individual demographic, health and financial factors across a single urban site (Oahu) compared with rural sites (neighbour islands) to obtain a clearer understanding of the influence of place and individual factors on dental-service utilisation. Our results found no significant differences between individual factors and dental-service utilisation according to place. This finding contrasts with other studies which found that individuals living in rural areas have a lower frequency of dental-service

**Table 3** Adjusted\* odds of dental-service utilization and individual factors (health care and behaviours, and financial autonomy) stratified according to place [Oahu (urban) *vs.* neighbour islands (rural)]

Variable	Oahu			Neighbour islands			Interaction <i>P</i>
	OR	95% CI	<i>P</i>	OR	95% CI	<i>P</i>	
<b>Health care</b>							
Personal doctor							
No	0.59	0.47–0.75	<0.001	0.54	0.42–0.68	<0.001	0.816
Yes	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Could not see doctor because of medical cost							
No	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Yes	2.01	1.48–2.72	<0.001	1.43	1.11–1.84	0.006	0.086
Health coverage							
No	0.56	0.42–0.75	<0.001	0.56	0.42–0.73	<0.001	0.828
Yes	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Health behaviours							
Smoking status							
Never	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Former	0.84	0.68–1.03	0.091	0.95	0.78–1.16	0.599	0.528
Current – some day	0.54	0.36–0.81	0.002	0.62	0.42–0.94	0.023	0.494
Current – every day	0.58	0.44–0.77	<0.001	0.64	0.49–0.84	0.001	0.405
Soda consumption							
Never	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Per day	0.70	0.48–1.01	0.055	0.98	0.62–1.55	0.939	0.187
Per week	0.80	0.55–1.16	0.239	0.90	0.57–1.43	0.654	0.496
Per month	0.88	0.67–1.16	0.354	0.96	0.71–1.30	0.807	0.535
Exercise in past 30 days							
No	0.76	0.62–0.95	0.013	0.74	0.60–0.91	0.005	0.573
Yes	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Financial autonomy							
Have enough money to pay mortgage							
Always/usually	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Rarely/sometimes	1.13	0.76–1.67	0.557	1.56	1.07–2.30	0.022	0.488
Never	1.59	1.07–2.37	0.023	2.35	1.57–3.54	<0.001	0.670
Not applicable	1.86	0.69–5.01	0.217	1.62	0.80–3.27	0.180	0.545
Home ownership							
Own	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Rent	0.64	0.52–0.79	<0.001	0.78	0.62–0.97	0.026	0.063
Other arrangement	0.81	0.61–1.08	0.150	0.67	0.49–0.90	0.009	0.433
Salaried job							
Salaried	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.	Ref.
Not salaried	0.70	0.51–0.96	0.029	0.85	0.59–1.24	0.409	0.604

Interaction term, variable \* island. \*The results for the variables in the tables are adjusted for one another’s effects. All models included age, gender, race, education, income and marital status. OR, odds ratio.

utilisation<sup>4</sup>. One potential explanation is that questions on availability of transportation and dental/oral health-care providers were not included in this survey. Availability of transportation and dental/oral health-care providers are often discussed and descriptive reports are available<sup>13</sup>.

The large number of individual factors associated with lower dental-service utilisation found in our study is consistent with the existing literature<sup>5–9</sup>. Some of the important exceptions are that ethnic minorities and sex were not significantly associated with the utilisation of dental services in our final model. The lack of ethnic dental disparities may be related to the fact that Hawaii’s state populations are characterised by five major ethnic groups and no single dominant ethnic group. Thus, ethnic relationships are complex and nuanced, in contrast to those in most US states. Rather, we found that overall financial autonomy factors were more uniformly associated

with dental-service utilisation. This finding suggests that social determinants (housing, jobs, etc.) have a critical role in dental-services utilisation, and thus dental and oral health. In a dental-health insurance environment, in which public health insurance programmes, such as Medicaid and Medicare, do not provide comprehensive dental-health coverage for adults, the cost of private dental-health premiums and co-payments may be out of reach of many who face financial challenges. This has important public health implications for improving dental-service utilisation throughout the State.

### Limitations

The current study has several limitations. First, the BRFSS is a cross-sectional survey of health behaviours and risk factors. Thus, it is not possible to ascertain cause-and-effect of the factors on dental utilisation.

**Table 4** Adjusted\* odds of dental-service utilization and individual factors of demography, health care and behaviours, and financial autonomy in combined Oahu (urban) and neighbour islands (rural) places

Variable	OR	95% CI	P-value
<b>Demographic variables</b>			
Age group (years)			
18–24	Ref.	Ref.	Ref.
25–44	0.83	0.54–1.27	0.391
45–64	1.22	0.78–1.91	0.393
≥65	1.99	1.10–3.59	0.023
Gender			
Male	Ref.	Ref.	Ref.
Female	1.25	1.00–1.58	0.053
Race			
Caucasian	Ref.	Ref.	Ref.
Filipino	0.82	0.58–1.17	0.278
Japanese	1.03	0.75–1.43	0.846
Native Hawaiian	0.78	0.55–1.10	0.157
Other Asians	1.12	0.71–1.76	0.621
Other	0.59	0.34–1.03	0.065
Other Pacific Islanders	0.74	0.35–1.53	0.409
Education			
≤High school	0.56	0.42–0.75	<0.001
Attended college or technical school	0.72	0.54–0.96	0.026
Graduated from college or technical school	Ref.	Ref.	Ref.
Income			
<\$25,000	0.47	0.32–0.69	<0.001
\$25,000–\$34,999	0.67	0.45–1.01	0.055
\$35,000–\$49,999	0.78	0.54–1.10	0.159
\$50,000–\$74,999	0.89	0.64–1.22	0.460
≥\$75,000	Ref.	Ref.	Ref.
Marital status			
Married/unmarried couple	Ref.	Ref.	Ref.
Never married	0.80	0.59–1.07	0.137
Divorced/separated	0.57	0.40–0.79	0.001
Widowed	0.79	0.41–1.53	0.480
<b>Health care</b>			
Personal doctor			
No	0.58	0.49–0.68	<0.001
Yes	Ref.	Ref.	Ref.
Could not see doctor because of medical cost			
No	Ref.	Ref.	Ref.
Yes	1.73	1.40–2.13	<0.001
Health coverage			
No	0.53	0.43–0.66	<0.001
Yes	Ref.	Ref.	Ref.
<b>Health behaviours</b>			
Smoking status			
Never	Ref.	Ref.	Ref.
Former	0.88	0.75–1.02	0.086
Current – some day	0.58	0.43–0.79	<0.001
Current – every day	0.61	0.49–0.75	<0.001
Soda consumption			
Never	Ref.	Ref.	Ref.
Per day	0.70	0.48–1.01	0.055
Per week	0.80	0.55–1.16	0.239
Per month	0.88	0.67–1.16	0.354
Exercise in past 30 days			
No	0.75	0.64–0.88	<0.001
Yes	Ref.	Ref.	Ref.
<b>Financial autonomy</b>			
Have enough money to pay mortgage			
Always/usually	Ref.	Ref.	Ref.
Rarely/sometimes	1.24	0.92–1.67	0.151
Never	1.75	1.30–2.37	<0.001

(continued)

**Table 4** continued

Variable	OR	95% CI	P-value
Not applicable	1.74	0.93–3.28	0.086
Home ownership			
Own	Ref.	Ref.	Ref.
Rent	0.68	0.58–0.80	<0.001
Other arrangement	0.77	0.62–0.96	0.022
Salaried job			
Salaried	Ref.	Ref.	Ref.
Not salaried	0.75	0.58–0.97	0.026

Interaction term, variable \* island. \*The results for the variables in the tables are adjusted for one another's effects.

All models included age, gender, race, education, income and marital status.

OR, odds ratio.

Second, the BRFSS may not adequately capture the health-care utilisation of highly vulnerable populations in Hawaii (e.g. homeless and institutionalised adults) as the survey is conducted by telephone. Third, this study does not take into account how current dental-workforce shortages may have affected the participant responses to questions in the BRFSS. Lastly, the data collected using the BRFSS do not allow the inclusion of other predictors of dental utilisation (i.e. 'perceived need for care'<sup>12</sup>, 'transportation'<sup>11,12</sup>, 'fear'<sup>11</sup> and 'distance from dental clinic'<sup>11</sup>). Nonetheless, this study provides sufficient sample sizes of both urban and rural populations within a State that is unique in its multi-ethnic population and thus provides novel insights to the residual causes of dental-utilisation inequality.

## CONCLUSION

The implications of this study are that utilisation of dental services is significantly associated with social determinants, such as financial autonomy (home ownership and jobs), education (college graduate) and social relationships (marital status), in addition to the well-known correlates of health-care coverage and available service providers (dentists/doctors). While ethnicity has been reported as an important predictor of dental-service utilisation in previous studies, our study suggests that in the context of and the lack of a dominant ethnic group, other social determinants seem to contribute more significantly to the observed inequalities of dental-service utilisation. In summary, future plans for reducing oral-health inequalities and improving dental health may need to consider a multipronged approach that includes improving the overall standard of living for all individuals while maintaining broad dental-health coverage to all locations with adequate dental providers that is focussed on comprehensive dental care.

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## Conflict of interest

None.

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## Ethic statement

The University of Hawai'i Institutional Review Board (IRB) granted the study an exemption from review. This analysis has been carried out in full accordance with the World Medical Association Declaration of Helsinki. The authors did not obtain consent from participants as the study was a secondary data analysis of a de-identified data set.

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