Comparing the Impact of Oral Disease in Two Populations of Older Adults: Application of the Geriatric Oral Health Assessment Index

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Abstract

Objectives: This study compares the distributional and psychometric properties of the Geriatric Oral Health Assessment Index (GOHAI) in two samples of older adults, and examines how the self-perceived impact of oral disease, as measured by the GOHAI, varies in accordance with sample sociodemographic and health characteristics. Methods: Results are based on survey data from two samples of older men: a Medicare sample of patients using community physicians (n=799; mean age=74) and users of VA ambulatory health care (n=542; mean age=72). Results: The findings indicated significant differences between samples in mean GOHAI scores, with the VA sample exhibiting worse scores. A number of similarities in psychometric properties of the instrument across the two samples were found: high internal consistency reliability and similar inter-item and item-scale correlations. Factor analyses revealed somewhat different structures between the two samples, but explained similar amounts of variance; regression analyses indicated that income and self-rated oral health were significant predictors of GOHAI scores in both samples. Conclusions: The GOHAI exhibits satisfactory psychometric properties in both samples and is sensitive to sociodemographic differences among and between two samples of older men. Results suggest continued use of the GOHAI as an indicator of the impact of oral conditions on functioning and well-being in a variety of samples. [J Public Health Dent 1997;57(4):224-32]

Key Words: quality of life, oral health, health status indicators, geriatric assessment, outcomes and process assessment (health care).

In recent years dental researchers have become increasingly interested in assessing patients' perceptions of the social and functional impact of oral conditions. Attention to such concerns has focused most frequently on older adults, among whom the cumulative impact of dental disease is highest (1,2). Patient-based assessments of the effects of oral conditions on functioning and well-being provide information distinctly different from that obtained through professional clinical assessments of oral disease (3-6). The two types of measures complement, rather than replace, each other. Measures of patients' perceptions of the impact of oral conditions are particularly useful as epidemiologic indices of the burden of oral disease in populations, as treatment need indicators, and as assessments of treatment outcomes (7-9).

Interest in developing better measures of patients' perceptions of the impact of oral conditions on functioning and well-being has led to the development of a variety of such indicators.

These include the Oral Health Impact Profile (OHIP) (2), which assesses the social and psychological impact of oral conditions, and the Dental Functional Status Questionnaire (10), which measures the extent to which a patient is able to perform oral functions such as chewing, smiling, and speaking. The perceived impact of dental disease was assessed as part of the Rand Health Insurance Experiment (HIE) (11), and a related measure of Oral Health-related Quality of Life (OHQOL) (12) is currently in use in a number of studies conducted in the Department of Veterans Affairs health care system (VA). Another wellknown instrument, the Geriatric Oral Health Assessment Instrument (GO-HAI) (13), was designed specifically to assess the impact of oral disease in elderly individuals and populations.

Each of these instruments provides a method for measuring patients' perceptions of the impacts of oral conditions on functioning and well-being (quality of life). Unfortunately, little is known about their relative merits, since individual investigators have tended to use only a single measure in a single sample, and little information is available on overlap and corroboration among the various instruments (14). Furthermore, the sensitivity of the measures to differences within and between samples is unknown, which might be differentially associated with the impact of oral conditions. Thus, measured differences in the impacts of oral conditions on functioning and well-being might be spurious, result-

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ing from differences in sample characteristics. This dearth of information limits the interpretability and generalizability of these measures.

The purpose of the present study is to examine factors associated with scores on the GOHAI in a sample of older male patients using VA health care and a sample of Medicare patients using community physicians. A secondary goal was to compare the distributional and psychometric properties from the administration of the GO-HAI in the two different samples. We hypothesized that individuals with worse general health and lower socioeconomic status would report worse oral health within each sample, as well as a greater negative impact of oral conditions on functioning and wellbeing, as measured by the GOHAI. Further, we expected that such differences between samples also would be associated with different GOHAI scores. This new information about the properties of this scale in two different samples can then enhance our knowledge about the generalizability of previous findings, the ways in which the impact of oral disease may vary in accordance with sample characteristics, and the sensitivity of this particular measure to detect such differences.

Methods

Samples. Atchison and Dolan (13) developed and administered the GO-HAI to two independent samples — a convenience sample of oral health screening attendees as a pilot test and subsequently to participants in a Medicare Screening and Health Promotion Trial (MSHPT). The present study includes data from the 799 men in the final MSHPT sample who provide the basis for the most direct comparisons with the second sample used in this research, which was composed of only men. The GOHAI was administered in a telephone interview to a total sample of 1,911. [Note that Atchison and Dolan (13) had reported results from 1,755 interviews completed by April 1989 (15,16).]

The second sample was the Veterans Health Study (VHS), an ongoing two-year longitudinal study of health and quality of life begun in 1993 (17). VHS study participants were identified in clinics at four sites in the metropolitan Boston area, and they were eligible if they were patients in the clinic at any time in the prior year. This sample is nearly representative of the sampling frame of all users of VA ambulatory care services. As part of a mailed questionnaire, 542 participants (aged 65 years and older) in the VHS completed the GOHAI between 1993 and 1995.

Measures. The GOHAI was originally developed from the results of interviews with patients and health care providers and literature reviews focusing on the measurement of oral health status and the psychosocial impact of oral disease. Twelve items reflecting three hypothesized dimensions, or domains of impact, were included in the instrument: physical function (e.g., eating, speaking, swallowing; items 1-4 in Figure 1); psychosocial function (e.g., satisfaction with appearance, worries or concern about oral health, inhibition of social contacts due to such concerns; items 6, 7,9–11); and pain or discomfort (either with eating or with sensitivity to hot, cold, or sweets; items 5, 8, 12). Atchison and Dolan (13) did not specify the items belonging within each dimension; the specifications noted here reflect our view of the item classification and should not be taken as the gold standard method of assigning each item to a particular domain. The total GOHAI score is derived by summing the scores on each of the items. Three items are reversed so that a higher total GOHAI score reflects fewer impacts of oral conditions on functioning and well-being (13). For respondents who answer at least 10 items, sample item means are substituted for missing data. Respondents missing more than two items are deleted from the sample.

Atchison and Dolan (13) had originally reported results with the GOHAI items that had been scored on a sixpoint scale (always, very often, often, sometimes, seldom, never). Because the VHS GOHAI responses were scored on a three-point scale (always, sometimes, never), for purposes of comparability the MSHPT results were recoded into six categories on a scale ranging from 1 to 3 (a zero value was recoded as 1, 1 was recoded as 1.4, 2 was recoded as 1.8, 3 was recoded as 2.2, 4 was recoded as 2.6, and 5 was recoded as 3). The two sets of scores thus are now on the same metric, although the MSHPT scores' range has been compressed to accomplish this and the value of the "sometimes"

FIGURE 1 GOHAI Items

In the past three months...

1. How often did you limit the kinds or amounts of food you eat because of problems with your teeth or dentures? (function*) 2. How often did you have trouble biting or chewing any kinds of food, such as firm meat or apples? (function) 3. How often were you able to swallow comfortably? (function) 4. How often have your teeth or dentures prevented you from speaking the way you wanted? (function) 5. How often were you able to eat anything without feeling discomfort? (pain/discomfort) 6. How often did you limit contacts with people because of the condition of your teeth and gums, or dentures? (psychosocial) 7. How often were you pleased or happy with the looks of your teeth and gums, or dentures? (psychosocial) 8. How often did you use medication to relieve pain or discomfort from around your mouth? (pain/discomfort) 9. How often were you worried or concerned about problems with your teeth, gums, or dentures? (psychosocial) 10. How often did you feel nervous or self-conscious because of problems with your teeth, gums, or dentures? (psychosocial) 11. How often did you feel uncomfortable eating in front of people because of problems with your teeth or dentures? (psychosocial) 12. How often were your teeth or gums sensitive to hot, cold, or sweets? (pain/discomfort)

^{*}Text in parentheses indicates into which dimension we hypothesize item fits.

	_	VHS		MSHPT			
Patient Characteristic	n	%	GOHAI Mean	n	%	GOHAI Mean	
Overall	542	100	31.77	794	100	33.36	
Age (years)							
65-74	399	73.6	31.70	505	63.6	33.33 ^a	
75–84	134	24.7	32.00	263	33.1	33.56 ^a	
>85	9	1.7	31.56	26	3.3	32 ^b	
Race							
White	519	95.8	31.78	700	88.2	33.45 ^a	
Nonwhite	23	4.2	31.57	94	11.8	32.72 ^b	
Married							
Yes	350	64.6	31.97	644	81.1	33.55 ^a	
No	192	35.4	31.41	150	18.9	32.55 ^b	
Education							
≤12 years	357	65.9	31.61	282	35.7	33.07 ^a	
>12 years	185	34.1	32.09	509	64.3	33.53b	
Income							
<\$30K	374	77.0	31.43 ^a	294	39.5	32.55 ^a	
\$30K-\$50K	87	17.9	32.62 ^{ab}	219	29.4	33.72 ^b	
≥\$50K	25	5.1	33.48 ^b	231	31.0	34.02 ^b	
Self-rated oral health							
Excellent	57	10.8	33.51ª	133	16.8	34.68 ^a	
Very good	99	18.7	33.39 ^a	204	25.7	34.36 ^a	
Good	186	35.2	32.58 ^a	252	31.7	33.59 ^b	
Fair	112	21.2	30.67 ^b	144	18.1	32.25 ^c	
Poor	75	14.2	27.97°	61	7.7	28.83 ^d	
Self-rated oral health* mean value (SD)		3.09 (1.18)			2.74 (1.16)		

TABLE 1 Mean GOHAI Scores by Demographic Characteristics and Self-reported Oral Health Among Two Samples of Older Men

Note: different superscript letters indicate significant differences between groups. $P \le .05$. ANOVA results are from Duncan's multiple range test. *Higher scores=worse oral health.

score is no longer in the exact midpoint of the scale because the 1–6 scale does not have such a midpoint. However, because the MSHPT scores' distribution has been preserved, we believe this approach is reasonable for creating GOHAI scores that can be compared. Thus, the present MSHPT results differ somewhat from those presented previously (13) because the scale scoring is now on a different metric.

Self-reported dental health was measured in both samples using a single item with five response categories, including excellent, very good, good, fair, or poor — with a higher score indicating worse oral health.

The socioeconomic variables included education (dichotomized to \leq 12 years, or >12 years), income (categories: <\$30,000, \$30,000-49,999, \$>50,000), age, race (white or nonwhite), and marital status (married or not).

Analyses. We examined psychometric properties of the scale in each sample by replicating several of the analyses Atchison and Dolan had originally conducted with the MSHPT sample (13), using a rescored GOHAI. We examined mean scores, and computed inter-item and item-scale Pearson correlations, and internal consistency reliability (Cronbach's alpha). We compared bivariate associations between the GOHAI score and sociodemographic measures and self-reported oral health using analysis of variance. We tested differences between the two samples' overall GO-HAI scores, self-reported oral and overall health, and age with T-tests. We compared distributions of sociodemographic factors between samples (race, marital status, education,

and income) with chi-square analyses. We examined the structure of the GO-HAI and the possibility of underlying separate dimensions within the GO-HAI by conducting factor analyses, utilizing oblique rotation because we assumed that the items and resulting factors would be correlated with one another. This technique is commonly used to examine whether there are underlying separate dimensions among multiple variables or items. Finally, we examined the relative contributions of sociodemographic and oral health factors to the total GOHAI scores within each sample, using linear regression analysis.

Results

Sample Differences. As illustrated in Table 1, the majority of the male MSHPT sample members were married (81%) and white (88%), with more

than a high school education (64%). The mean age of the sample was 74 years, and 40 percent of the sample had incomes under \$30,000. The VHS patients were all men, mostly married (65%), white (96%), and only 34 percent had more than a high school education. These participants had a mean age of 72 years, and also had relatively low incomes (77% below \$30,000). In addition, these men had a relatively heavy illness burden, often with multiple disabilities or chronic illnesses (18). These VA patients have poorer health status than their counterparts in non-VA systems of care (19).

The VHS sample was younger than the MSHPT sample [VHS mean=71.68; MSHPT mean=73.25; T(542,794)= -4.06, P<.001], but they had less education (chi-square=117.66, P<.001), lower incomes (chi-square=186.37, P<.001), and they were less often married (chi-square=46.23, P<.001). Finally, the VHS sample rated their oral health worse than the MSHPT sample [VHS mean=3.09; MSHPT mean=2.74, T(529,794)=5.31, P<.001]. In addition, they rated their overall health slightly worse than did the MSHPT respondents on a single five-point scale question on self-rated health.

Distribution of GOHAI Scores. First, we compared the total GOHAI scores in the two studies. On average, scores from the MSHPT sample were higher (better) than those from the VHS [mean male MSHPT GOHAI= 33.36 (SD=2.87) versus 31.77 (SD=3.76) in the VHS; *T*(541,793)= -8.33, *P*<.001]. Sixteen percent of the male respondents in the MSHPT had a maximum GOHAI score, as did a similar proportion of the VHS sample (15%).

We examined the mean GOHAI scores by sociodemographic factors

using one-way analyses of variance (Table 1). No significant age differences were found in the VHS sample in GOHAI scores; but in the MSHPT sample, the younger two age groups had more positive GOHAI scores than did the oldest age group. In the MSHPT, married and white individuals had higher GOHAI scores; there were no such differences in the VHS. Also, no educational differences were found in GOHAI scores in the VHS sample; but in the MSHPT sample, individuals with more than a high school education had slightly higher GOHAI scores. Individuals with higher incomes had higher GOHAI scores in both samples.

Finally, individuals in both samples reporting either excellent or very good oral health had significantly higher GOHAI scores than those reporting fair or poor oral health. An additional

 TABLE 2

 Correlations Among GOHAI Items and Total Score in Two Samples of Older Men

	GOHAI Item												
Label		1	2	3	4	5	6	7	8	9	10	11	12
Limit food	VHS												
	MSHPT												
Trouble	VHS	0.60											
biting	MSHPT	0.65											
Swallow	VHS	0.01	0.02										
comfortably	MSHPT	0.17	0.11										
Prevented	VHS	0.32	0.40	-0.01									
speaking	MSHPT	0.37	0.45	0.13									
Eat without	VHS	0.18	0.22	0.36	0.15								
discomfort	MSHPT	0.22	0.21	0.14	0.19								
Limit contacts	VHS	0.30	0.27	0.00	0.42	0.07							
	MSHPT	0.27	0.28	0.15	0.41	0.12							
Pleased w/	VHS	0.26	0.28	0.09	0.29	0.15	0.26						
looks	MSHPT	0.22	0.25	0.15	0.21	0.20	0.14						
Use medica-	VHS	0.24	0.17	0.03	0.23	0.05	0.15	0.12					
tion	MSHPT	0.20	0.22	0.10	0.14	0.14	0.10	0.14					
Worried or	VHS	0.35	0.30	0.07	0.33	0.15	0.26	0.37	0.32				
concerned	MSHPT	0.43	0.44	0.16	0.45	0.16	0.30	0.36	0.25				
Nervous/self-	VHS	0.44	0.37	0.03	0.44	0.14	0.43	0.41	0.34	0.65			
conscious	MSHPT	0.36	0.39	0.17	0.50	0.19	0.40	0.31	0.20	0.51			
Uncomfortable	VHS	0.45	0.44	0.06	0.43	0.16	0.40	0.34	0.14	0.35	0.55		
eating	MSHPT	0.37	0.39	0.21	0.47	0.14	0.45	0.18	0.20	0.45	0.61		
Teeth/gums	VHS	0.21	0.16	-0.02	0.19	0.07	0.19	0.22	0.27	0.31	0.32	0.19	
sensitive	MSHPT	0.24	0.21	0.13	0.26	0.11	0.11	0.18	0.21	0.33	0.23	0.19	
GOHAI total	VHS	0.64	0.64	0.29	0.60	0.46	0.51	0.60	0.41	0.67	0.74	0.65	0.44
	MSHPT	0.68	0.69	0.36	0.62	0.50	0.45	0.56	0.40	0.70	0.67	0.61	0.47

Note: all numbersnot in bold are significant at P<.01 level. VHS N=542; MSHPT N=794.

multivariate analysis of variance examined whether the significant difference in GOHAI scores between the two samples persisted after controlling for sociodemographics (income and education) and self-rated general health. The results from this analysis (not shown) indicated that even after controlling for these factors, the VHS scores remained significantly lower (VHS=32.10 vs MSHPT=33.12, F= 30.15, P<.001).

Inter-item Correlations. We computed Pearson correlations among the 12 individual GOHAI items and the total GOHAI score, comparing findings between the samples (Table 2). We used $P \le .01$ as our criterion of significance to account for the multiple comparisons. Despite the differences in sample characteristics, the pattern and relative strength of the correlations among items were remarkably similar, with less than 20 percent of the correlations differing by more than 0.1.

Two of the three strongest interitem correlations were observed between the same sets of items in both samples. These included the correlations between limiting food because of teeth and trouble biting certain foods (VHS r=.60; MSHPT r=.65; this was the strongest correlation in the MSHPT sample), and between feeling nervous or self-conscious due to one's teeth and being uncomfortable eating in front of others (VHS r=.55 and MSHPT r=.61). The strongest correlation in the VHS measured the association between feeling nervous or self-conscious due to one's teeth and experiencing worry or concern about problems with teeth (r=.65). The weakest significant correlations in both samples were among the items concerning pain and discomfort.

Generally, the inter-item correlations were similar in magnitude in the two studies. Of a total of 66 pairs of inter-item correlations, only one had a difference of a magnitude of .20 or greater (this was between eating without discomfort and swallowing comfortably; VHS r=.36, MSHPT r=.14). The biggest gaps were found between correlations assessing swallowing comfortably and (1) feeling uncomfortable eating in front of others (VHS r=.06; MSHPT r=.21) and (2) limiting kinds or amounts of food (VHS r=-.01; MSHPT r=.17). The internal consistency reliability (an overall assessment of the extent of interrelations among the items) for the GOHAI was tested in each sample using Cronbach's alpha. Reliability was high in each sample (VHS alpha=.74; MSHPT alpha=.77).

Item-scale Correlations. The patterns of correlations between specific GOHAI items and the total scale score are similar for the two samples, with no difference greater than 0.07. A number of the strongest item-scale

TABLE 3 Factor Loadings of GOHAI Items in VHS and MSHPT Samples of Older Men

ltem	VHS (N=542)	MSHPT (N=794)		
In the Past Three Months:	Factor 1	Factor 2	Factor 1	Factor 2	
How often did you limit the kind or amounts of food you eat because of problems with your teeth or dentures?	55	18	0	72	
How often did you have trouble biting or chewing any kinds of food, such as firm meat or apples?	47	28	4	71	
How often were you able to swallow comfortably?*	-15	46	17	12	
How often have your teeth or dentures prevented you from speaking the way you wanted?	58	2	52	20	
How often were you able to eat anything without feeling discomfort?*	0	52	4	29	
How often did you limit contacts with people because of the condition of your teeth and gums, or dentures?	54	-5	58	-3	
How often were you pleased or happy with the looks of your teeth and gums, or dentures?*	46	8	13	31	
How often did you use medication to relieve pain or discomfort from around your mouth?	43	-12	6	29	
How often were you worried or concerned about problems with your teeth, gums, or dentures?	69	-7	37	39	
How often did you feel nervous or self-conscious because of problems with your teeth, gums, or dentures?	84	-10	69	9	
How often did you feel uncomfortable eating in front of people because of problems with your teeth or dentures?	60	14	73	2	
How often were your teeth or gums sensitive to hot, cold, or sweets?	45	-14	10	32	
Percent variance explained	29	10	25	24	
Total percent variance explained	3	3	3	3	

*Items reversed.

Note: bolded items indicate significant loadings on each factor.

correlations in the VHS were also the strongest in the MSHPT; these included experiencing worry or concern about problems with one's teeth (VHS r=.67; MSHPT r=.70; this was the strongest item-scale correlation in the MSHPT), limiting kinds or amounts of foods (VHS r=.64; MSHPT r=.68), and having trouble biting or chewing (VHS r=.64; MSHPT r=.69). In the VHS, feeling nervous or self-conscious was the most strongly correlated with the total score (r=.74). The item least associated with the total GOHAI score in both the VHS and in the MSHPT was being able to swallow comfortably (VHS r=.29; MSHPT r=.36).

Structure of GOHAI. We conducted factor analyses using Promax (oblique; we assumed the factors were correlated with one another) rotation to examine the underlying dimensions among items comprising the GOHAI in each sample and to examine whether such dimensions reflected the three theoretical dimensions upon which the GOHAI was constructed (Table 3). The results of a scree plot (20) and examination of the eigenvalues suggested a two-factor solution in the VHS, which explained 33 percent of the overall variance. All items except the discomfort and swallowing items loaded on the first factor (explaining 29 percent of the variance) and the swallowing and discomfort items significantly loaded on the second factor (explaining an additional 10 percent of the variance; these figures add to greater than 29 percent because the factors are correlated and explain some of the same variance).

A scree plot of the MSHPT data also suggested a two-factor solution, which explained 33 percent of the total variance. The first factor consisted of items concerned with the psychosocial impact of oral conditions, explaining 25 percent of the variance; the second factor included functional limitations and worry/concern, explaining an additional 24 percent of the variance. Five items (swallowing, discomfort, using medication to relieve pain, happy with looks of teeth, and sensitive teeth) did not load significantly on either factor, suggesting that items representing the pain/discomfort dimension were not strongly associated with the other scale items, nor was the item about happiness with looks of one's teeth.

Regression Analyses. Multiple re-

TABLE 4 Unstandardized Regression Coefficients of Sociodemographic and Oral Health Factors on GOHAI Scores in VHS and MSHPT Samples

	GOHAI Scores					
	VH	łS	MSHPT			
Sociodemographic Factors	β	SE	β	SE		
Age	~	~	~	~		
Education	~	~	~	~		
Income	0.17*	0.08	0.14†	0.03		
Marital status	~	~	0.51*	0.25		
Race	~	~	~	~		
Self-rated oral health	-1.41†	0.13	-1.15†	0.08		
Sample (1=MSHPT; 0=VHS)	~	~	~	~		
Intercept	33.53†	2.66	33.98†	1.47		

*P<.05.

†P<.001.

Total R² (VHS)=.22, F(6, 484)=22.93, P<.0001.

Total R^2 (MSHPT)=.27, F(6, 735)=46.04, P<.0001.

Total R² (MSHPT and VHS)=.28, F(7, 1,225)=68.52, P<.0001.

~ indicates variables not significant in final model.

gression analyses were conducted to examine the relative influence of the sociodemographic factors on the total GOHAI score in each sample. As shown in Table 4, income was positively associated with the GOHAI score in the VHS sample, explaining 3 percent of the overall variance in GO-HAI scores. An identical regression model with MSHPT data yielded slightly different results: income and marital status were significantly associated with GOHAI scores, together explaining 6 percent of the variance.

Discussion

The purpose of this research was to examine factors associated with scores on the GOHAI within two samples of older adults. A secondary goal was to compare the distributional and psychometric properties of the GOHAI in the two different samples of older men, which have different health and sociodemographic characteristics.

VA ambulatory care patients have worse self-reported physical health and lower socioeconomic status than patients in non-VA health care systems, including multispecialty groups and health maintenance organizations (19), so we hypothesized that they also would report a greater negative impact of oral conditions on functioning and well-being, as measured by the GOHAI. The differences found in overall mean GOHAI scores were consistent with this hypothesis; the VHS sample reported worse mean GOHAI scores. However, results from a MA-NOVA examining whether the sample differences in GOHAI scores persisted after controlling for income, education, and general health indicated that the significant differences in GOHAI scores remained even after such adjustments. These results suggest there may be differences in oral health status or other factors that influence GOHAI scores between the two samples. Since the VHS also reported worse self-rated oral health, presumably they have more impacts of oral conditions on their functioning and well-being. The lower GOHAI scores found in the VHS sample support this notion. In this study, we did not have any data on oral health status that might have explained such findings. Future research including both self-reported and clinical oral health status data can better elucidate such associations.

In both the VHS and MSHPT we found within-sample differences in GOHAI scores by income and selfrated oral health, and within the MSHPT additional differences by race, marital status, and education. These results lend support to the general notion that the GOHAI is sensitive to differential perceptions of the effects of oral conditions on functioning and well-being, which appear to be associated with differences within and between samples. The high internal consistency reliability of the GOHAI found in each sample also supports its use in a variety of samples.

The results from the analyses of variance suggested that there were important differences in GOHAI scores with age in the MSHPT, which is consistent with previous findings noting declines in oral health with age (21). However, this trend was not linear ---the differences noted were between the oldest group and the two younger groups, suggesting that the most significant declines in oral health and associated reports of functioning and well-being were among the 85 years and older group. In contrast, in the VHS there appeared to be no differences in GOHAI scores by age. This absence of age differences on the GO-HAI, a self-reported assessment, may reflect the accommodation of the VHS participants over time to worsening oral health. Alternatively, significant age differences in oral health status might not exist among the VHS men. This latter explanation is consistent with the growing consensus that declines in oral health with aging are not inevitable, but rather are due to untreated disease or age-related comorbidities (22). However, VA patients are constituted in part by way of health problems related to military service; younger patients are likely to have more severe health problems and, perhaps, worse oral health, thus minimizing differences with their older peers. Another possible explanation for this lack of age differences in the VHS is the small number of participants in the highest age range (>85 years), in comparison with the MSHPT sample, a sample characteristic that diminished the potential of detecting any existing age differences.

The variations observed in the ANOVAS of GOHAI scores by demographic and socioeconomic factors are consistent with previous reports (23). Other studies of oral and physical health have noted that minority individuals frequently report worse health (24,25), so it is not surprising that in the present results from the MSHPT sample, minority individuals reported greater impacts of oral conditions on functioning and well-being than their white counterparts. The absence of such differences in the VHS in part may reflect the very small percentage of minorities in the sample (~4%). The finding that married MSHPT respondents and participants with higher incomes in both samples reported better GOHAI scores (reflecting fewer impacts of oral conditions) is also consistent with previous findings documenting better health among married and more affluent individuals (23). Likewise, GOHAI scores increased with more education in the MSHPT sample; however, this relationship was not observed in the VHS sample.

The associations between higher GOHAI scores and better self-reported oral health in both samples are consistent with the original findings from Atchison and Dolan's investigation of the associations between perceptions of the impact of oral health and self-perceived oral health (13). Because we did not have measures of actual oral health status available for the VHS sample, we could only examine the measure's association with self-perceived oral health. In our future research we will include clinical oral health status measures so as to examine their associations with reported impacts of oral conditions more closely.

With regard to correlations among the GOHAI items in each sample, the strongest correlations in both samples were between the items representing the psychosocial and functional domains. In contrast, the weakest interitem correlations in both samples were those involving items assessing discomfort. The items most strongly associated with the total GOHAI score in both samples were psychosocial items (VHS: being nervous or self-conscious; MSHPT: worry or concern). The next strongest item-scale correlations in the VHS were also psychosocial items, while in the MSHPT they were functional items.

This finding is an interesting distinction, suggesting that the salience of different domains of impacts of oral conditions may vary between these samples. These findings imply that for the VHS participants, less socioeconomically advantaged and sicker men, psychosocial impacts of oral conditions may be most important, while among the MSHPT participants, who perceive themselves to be healthier and who are more socioeconomically advantaged, the functional impact of oral conditions also may be salient. Perhaps this finding indicates that among individuals with better health, compromised oral function is noticeable and problematic, while among individuals with worse health, function may have already declined and is perceived as less important than one's psychosocial functions and activities. Alternatively, since the VHS men have less financial resources and may be less likely or able to have their oral conditions treated, they may experience more psychosocial impact (e.g., worry) from their oral conditions because they anticipate that such problems are less likely to be alleviated. Previous reports have shown that the MSHPT sample has a high level of dental utilization (16); hence, these individuals may be less concerned about the psychosocial impacts of oral conditions because they know any conditions they have will likely be treated.

The factor analysis results suggest somewhat different structures of associations among the 12 GOHAI items in the two samples. The factor solution in the VHS suggests a nearly unidimensional structure (with only discomfort items on the second factor), while the results from the MSHPT more clearly suggest two underlying dimensions psychosocial impacts and worry/ function. This latter finding differs from results reported by Atchison and Dolan (13) about the MSHPT sample as a whole, where they reported a unidimensional structure.

These differences suggest that there may be sex differences in the perceived impact of oral conditions on functioning and well-being or that the item rescoring may have contributed to the different findings. These results also suggest that there may be distinctions among the various domains of impacts for individuals such as those in the MSHPT sample, who perceived that they had better oral health. For the VHS men who reported worse oral health, it appears that all types of impacts of oral conditions on functioning and well-being are similarly perceived. Interestingly, neither factor solution suggested that the GOHAI should be viewed as measuring three separate dimensions of impact, as originally theorized by Atchison and Dolan (13), but rather that the construct is better viewed as one or two dimensions.

The multiple regression results contained some interesting differences from the ANOVA results with regard to which sociodemographic factors were significantly related to GOHAI scores. In the VHS, once all sociodemographic variables were included, only income and self-rated oral health remained significant. Although we ran an additional regression model to see if these different results were due to interactions among the variables due to high intercorrelations, the interaction terms in these models were not significant. In the MSHPT, bivariate differences in GOHAI scores by age and education were not significant in the multiple regression model, leaving only income, marital status and selfrated oral health differences. As with the VHS, we ran an additional regression model with interaction terms for education and income and marital status and income; again, these terms were not significant.

The fact that income emerged as the most consistent predictor of GOHAI scores is notable, suggesting that financial resources, found in previous research to be associated with use of dental care (26), are in turn positively associated with favorable perceptions of the impact of oral health on functioning and well-being. Maybe historical differences in the use of dental care related to income resulted in different GOHAI scores in later life. Our crosssectional data cannot answer the question of causality (e.g., dental care leading to better oral health, which in turn leads to fewer impacts of oral conditions); however, future longitudinal studies should examine this potential sequence of events.

Taken together, we view the correlational results (acceptable internal consistency reliability, similar but not identical inter-item and item-scale correlations), factor analytic results (somewhat different factor structures explaining the same amount of total variance), and regression results (similar significant predictors) as indicating that the GOHAI exhibits satisfactory psychometric properties in both samples. We also view these findings as support for the continued use of the GOHAI in other populations. Although the results of these analyses were not identical between the samples, we would not have expected this to be the case, given the differences between the VHS and MSHPT and the rescoring of the original results. Thus, the diversity in results argues for the

sensitivity of the measure to differences we would expect it to detect.

The challenge in interpreting the findings from this research raises an important point. It is difficult to understand results from measures such as the GOHAI without a full appreciation of the individuals being studied. Without complete information about an individual's sociodemographic background, and his or her values and attitudes about oral health, we cannot place results from the GOHAI, or other self-reported outcomes assessments, in context. An individual who places little value on the appearance of his or her teeth is probably less likely to report limiting contacts because of the condition of his or her dentition, regardless of oral health status. Further, such an individual may score similarly to someone who has no oral conditions, and no resulting impact on functioning and well-being.

The absence of a full understanding of intraindividual characteristics, such as values and attitudes, results in a lack of context within which to interpret findings from the applications of such instruments. This issue is pertinent not just to the GOHAI, but to all measures of the impact of oral conditions on functioning and well-being. Such intraindividual characteristics might explain some of the differences in this study — the less educated and poorer VHS participants might place less value on their oral health, or might have fewer resources to expend on achieving an optimal, esthetic, perfectly functioning oral health status, or they might be less concerned with or able to care for their teeth, and the cumulative effect of these factors might result in worse oral health and greater impacts of oral conditions on functioning and well-being. The lack of data on oral health-related attitudes and values in this sample prohibits us from testing these hypotheses; nevertheless, future research should incorporate such measures.

Since the VHS sample is made up of male users of the VA health care system, it is not clear how results from this sample are generalizable to a comparable sample of women veterans, or to women or men who do not use VA health care. However, the comparison of results from this sample to results from the MSHPT sample, which included men who are users of community-based physicians (and are presumably not VA users, although we did not have the data to confirm or deny this), has shown many similarities in the relationship of GOHAI scores to sociodemographic factors within each of the two samples. Further, differences across the samples were also in similar directions, providing further evidence of the sensitivity of the GOHAI to both between- and within-sample differences.

The significance of these findings to dental public health is methodological. The GOHAI was one of the first measures developed that could be used to assess the impact of oral disease in populations; yet it has been applied in very few samples. Thus, its performance in samples with differing characteristics has not been fully studied previously. These results (particularly those indicating that the GOHAI is sensitive to racial and socioeconomic differences) validate the appropriateness of the GOHAI measure for this use to assist in determining perceived need for dental care in underserved populations. In fact, these results may highlight the need for increased availability of dental care within the VA; currently access to VA dental services is very restricted, and these results from the VHS can be seen as an indication for increased access to such care.

Since the GOHAI scores did not differ between individuals reporting excellent or very good oral health (or even the good category, in the VHS), perhaps these findings suggest that the measure is most sensitive to the extreme differences likely exhibited among individuals with few to none or severe decrements in oral health, and argue for its use in samples with such a wide range of oral health status.

This research has several limitations. Different methodologies used in data collection for the respective studies could have contributed to some of the differences observed between the two samples. Although we hypothesized that differences in general health between the two samples would be associated with differences in the impact of oral conditions in each, we were able to directly contrast the samples only on the single-item self-reported health measure, and with this we detected only slight differences on the unadjusted scores. Such slight differences are unlikely to account for the full width of differences observed on GOHAI scores between the samples. However, it is clear from other evidence that this sample has worse health and socioeconomic status than patients from the general population who do not use the VA (19).

In summary, these results indicate that the GOHAI is a measure reasonably sensitive to sociodemographic differences within and between samples and to the different perceptions of impacts of oral conditions within and between samples, as measured by the GOHAI. These findings argue for expanded use of the GOHAI in epidemiologic and other assessments of the impact of oral conditions on older adults' functioning and well-being. Future research should examine how the GOHAI relates to other measures of impact of oral conditions on functioning and well-being, so that researchers and clinicians can better understand which instruments are most appropriate for different uses.

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