Research

Eating Competence and Oral Health in Supplemental Nutrition Assistance Program Eligible Populations

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Abstract

Purpose. To determine the association of eating competence and Mediterranean diet adherence with oral health and to examine if they lessen any impact of food insecurity on oral health of SNAP-eligible persons.

Methods. Free clinic patrons (n=93) in Pennsylvania evaluated oral health nutrition education via an online survey. The Satter Eating Competence Inventory, Mediterranean diet and USDA Food Security scores were compared to tested measures of oral health as assessed by self-report.

Results. Respondents noted food insecurity (33%), food selection (32%), and oral health problems that interfered with life satisfaction (30%), and unafforded dental care (60%). Mediterranean diet adherence was associated with annual dental visits (82% vs. 46%, p=.026). Competent eaters had greater food security and less frequently reported oral health issues interfering with life satisfaction (13% vs. 43%; p=.002) or avoiding particular foods (18% vs 45%; p=.006). These relationships remained significant controlling for low-income (p=.008, p=.006 respectively) but not when controlling for food security. **Conclusions.** Competent eaters had fewer oral health issues except when controlling for food security, a considerable challenge to oral health.

Keywords: access to care, oral health, nutrition, food insecurity, eating competence, Mediterranean diet

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Introduction

Concerns regarding oral health and barriers to care are well documented in Healthy People 2020, the national health-promotion and disease-prevention goals of the United States.[1] Poor dental/oral health outcomes are more prevalent among individuals with low and very low food security than among those with high food security.[2,3] Relationships between food security, socioeconomic status, nutrition behaviors and oral health are complex, however studying these relationships may provide insight needed to develop effective and sustainable nutrition education interventions, especially directed toward children and their parents. The evaluation of one such intervention, *Eating for Healthy Teeth and a Great Smile* [4] in a low-income venue provided an opportunity to examine the interface of oral health problems, income, food security, eating behaviors and attitudes.

Eating competence and the Mediterranean diet are two approaches to eating associated with health. The Mediterranean diet pattern, consisting of regular meals of fruits, vegetables, fish, nuts, olives, wine, and fermented low-fat dairy products is associated with reduced health risks[5] and a greater health-related quality of life.[6] The Mediterranean diet has a known beneficial effect on oral and pharyngeal cancers,[7] but the impact of this diet on oral health has not been explored.

Eating competence has been defined as an intra-individual approach to food selection and eating behaviors focused on enjoyment, internal regulation of intake, food acceptance, and food resource management skills to plan, purchase, and prepare meals and snacks.[8] Interestingly, eating competence has emerged as a hallmark of health and well-being. For example, competent eaters have higher diet quality,[9,10] more healthful eating behaviors,[11-13] better sleep hygiene[14] food resource management skills,[13] and are more physically active.[15] Health metrics such as blood pressure and cholesterol levels are lower in competent eaters at risk for cardiovascular disease.[16] In addition, eating competent parents more frequently model behaviors and skills associated with encouraging fruit

and vegetable intake including greater in-home fruit and vegetable availability.[17] However, the association of eating competence with oral health has not been examined.

The purposes of this study were to determine the association of oral health issues with eating competence and with adherence to a Mediterranean diet and examine their impact on food insecurity and oral health.

Methods

Study design

This study used a cross-sectional survey research design and was given an exempt status by the Rochester Institute of Technology and The Pennsylvania State University Institutional Review Boards. Items about oral health practices were a prelude to viewing and then evaluating *Eating for Healthy Teeth and a Great Smile,*[4] a nutrition education program addressing eating and health behaviors that promote oral health. The theoretical underpinnings of the program follow the Self-Determination Theory of Motivation focusing on education and training that cultivates autonomy, relatedness, and competence about the target behavior.[18,19] The evaluation of *Eating for Healthy Teeth and a Great Smile,* which has been previously reported, included online review of a 2-minute video and responses to questions about usefulness, interest, readability, application of content, specific features and content as well as opinions on design, format, and graphics[20] The video, which could be paused for review or watched multiple times, needed to be viewed once before the nutrition program evaluation items were accessible. Findings from the oral health practice items, which were viewed before the video, are the focus of this study.

Flyers and recruitment cards with study information and a link to access the study description and eligibility items were placed in five free community clinics serving low-income persons in central and northern Pennsylvania. Clinic patients had the option to view the program on a digital screen as they sat in the clinic waiting room before deciding to access the link to participate in the study. Clinic service use requires meeting an income eligibility requirement, which, depending on the clinic, ranges from less than 200% to 300% of the federal poverty guidelines. The inclusion criteria were as follows: (1) ability to speak and read English, (2) being a resident of Pennsylvania, (3) being 18 years of age or older, and (4) not studying to be or practicing as a nutritionist.

Data collection

Data collection was completed using an online survey developed with the Qualtrics platform (Provo, UT). Interested clinic patients clicked the study link and completed the eligibility screener. Eligible persons were able access to the online survey after they read the informed consent and agreed to participate. Following completion of the demographic, behavioral, and oral health items, participants were able to access and view *Eating for Healthy Teeth and a Great Smile,* which was embedded in the study survey before the program evaluation items.

Survey measures

The survey set included questions about oral health and behavior, dietary behaviors, e.g., adherence to the Mediterranean diet, and eating competence, and demographics as required by the Supplemental Nutrition Assistance Program Education (SNAP-Ed) Educational and Administrative Reporting System.[21] Dental care, practices, and problems were assessed with items selected from five oral health surveys: National Health and Nutrition Examination Survey (NHANES),[22] Oral health questions from the National Health Interview Survey of the Centers for Disease Control and Prevention,[23,] Oral Health Performance Measurement of the National Institute of Dental and Craniofacial Research,[24] Medical Outcomes Study Short Form-20,[25] and the Oral Salutogenic Score.[25] More specifically, two questions required affirmation of recent oral health problems such as toothaches, sensitive teeth, bleeding gums, missing teeth, loose teeth, and fillings. An additional three questions determined if dental/oral health issues affected daily life practices or made life less satisfying with response options from 1 (never) to 5 (very often). Nine oral health behaviors were examined: tooth-brushing, flossing, family dentist, last dentist visit, smoking status, reasons for visiting a dentist, and reasons for not visiting a dentist. Toothbrushing frequency was measured with four response options ranging from more than once per day to every few weeks. Flossing and having a family dentist were reported as yes, no or don't know/not sure. Last dental visit was measured with four response options ranging from less than six months to more than three years ago. Three true/false questions about dental insurance, affordability of dental care, and fear of seeing a dentist were recorded as reasons for not visiting a dentist and affirmation on a list of dental concerns were denoted as reasons for visiting a dentist. Respondents also completed three questions about frequency of smoking and tobacco use.

Eating competence was assessed with the Satter Eating Competence Inventory 2.0 (ecSI 2.0™), a reliable measure with criterion validation, consisting of 16 Likert-scaled items that are summed to yield a score ranging from 0 to 48. Values 32 denote being eating competent. The ecSI 2.0™ has

4 subscales that sum to the total score: Eating attitudes and contextual skills (each 5 items, possible score 0 - 15); internal regulation and food acceptance (each 3 items, possible score 0 - 9).[12] Adherence to the Mediterranean diet was evaluated with the 14-item Mediterranean Diet Questionnaire with possible scores ranging from 0 (low) to 14 (highest adherence). Concurrent validity was established by comparison with outcomes from a food frequency questionnaire. Scores ≥ 8 denoted adherence to the Mediterranean diet.[26]

Food security was assessed with the validated 6-item short form of the United States Department of Agriculture Household Food Security Questionnaire, validated with findings from the 1995 Current Population Census. Affirmative responses about household food availability or affordability were summed to provide household raw food security score (possible range 0-6). Participants with scores denoted as high or marginal (score of 0-1) were classified as food secure; those in the low (score of 2-4) or very low (score of 5-6) categories were denoted as food insecure.[27] Respondents indicated their level of worry about money for food (from never to always). Respondents who used at least one assistance program or indicated they often or always worried about money for food were defined as low-income.

Statistical analysis

Data were screened for duplicate Internet Provider and email addresses to assure unique, unduplicated online entries. Data were analyzed using SPSS 25.0 (IBM; Armonk, NY). For all analyses, $p<0.05$ was considered significant. Data were assessed for normal distribution and analyzed using descriptive statistics, measures of central tendency, means testing (e.g., independent t-tests), and additional analytic testing such as Pearson's correlation, chi-square and Fisher's exact tests when appropriate. Responses to questions about oral health impact on life satisfaction, job performance, and food avoidance were grouped into two categories as suggested by Huang and Park,[3] i.e., never, hardly ever vs occasionally, fairly often, and very often. General Linear Model (GLM) univariate analyses were used to compare means controlling for income status or food security as well as eating competence and Mediterranean diet adherence to gauge impact of food security on oral health. Bivariate and partial correlation analyses were performed with Pearson *r*.

Results

Respondent characteristics

The study link was accessed by 96 respondents; 93 respondents agreed to participate. They were from eight central Pennsylvania counties and were primarily white, females with a mean age of 41.2 ± 12.3 years (ranging from 18 to 71) who attended free clinics or a community clinic in Pennsylvania. With the exception of the Internal Regulation subscale items, the ecSI 2.0™ was incomplete for one respondent, which resulted in a sample size of 92 for total ecSI 2.0™ and three subscales. The Mediterranean Diet, Food Security scale, ecSI 2.0™ and subscale scores were all normally distributed. Internal consistency was demonstrated for the food security scale and ecSI 2.0™ with Cronbach alphas of 0.843 and 0.927, respectively. Few had eating practices that adhered to a Mediterranean diet plan and less than half were eating competent. The mean ecSI 2.0™ score was 29.4 ± 9.9, range from 2-48. The ecSI 2.0™ mean subscale scores were: Eating Attitudes 10.3 ± 3.4, range 1-15; Food Acceptance 4.3 ± 2.4, range 0-9; Internal Regulation 6.2 ± 2.2, range 0-9; and Contextual Skills 8.6 ± 3.8, range 0-15. Mean Mediterranean diet score was 4.7 ± 2.2 with a range of 0-10. The Mediterranean diet score or adherence categories were not associated with ecSI 2.0™ score or being eating competent. However, adherence to the Mediterranean diet was positively correlated with the food acceptance (r=.23, p=.035, n=82) subscale score.

More than two-thirds of respondents were overweight or obese (72%). Although 65% fit the definition of low-income, only one-third (33%) were food insecure, i.e., they had low or very low food security. Of the 52% (n=50) who participated in one of 10 income-based assistance programs, 62% (n=31) participated in one or two programs and 26% (n=13) in three programs. Among assistance program participants, the programs most frequently denoted were SNAP (64%), medical assistance (48%), Low Income Home Energy Assistance Program (LIHEAP) (38%), food bank or food pantry (32%), and WIC (16%). Educational level was not related to food security, low-income status, or the perception that oral health status negatively impacted life satisfaction, or school/job performance. Respondent demographic characteristics are presented in Table I.

Oral health practices and food security

Approximately 21% (n=19) were afraid of the dentist. Nearly two thirds (64%; n=59) did not have dental insurance. Dental care was not affordable for 60% (n=55). Oral health practices of respondents are shown in Table II. When asked if life was less satisfying in general because of teeth, mouth, or denture problems, 28 (30%) replied occasionally, fairly or very often, with 8 (9%) denoting very often. Difficulty with jobs or school attendance was attributed to problems with teeth, mouth, or dentures by 10 (11%) respondents. Almost one-third avoided particular foods because of problems with their teeth, mouth, or dentures.

Table I. Respondent demographic and lifestyle characteristics

		n (%)*
Gender, female	**n=89**	63 (71%)
Race, ethnicity	**n=88**	
White		85 (97%)
Black, African American		3 (3%)
Hispanic		1 (1%)
Education	**n=89**	
Did not complete high school		3 (3%)
High school graduate or GED		41 (46%)
Some post-secondary education/training		22 (25%)
4-year college degree		15 (17%)
Post graduate college		8 (9%)
Body Mass Index	**n=82**	
Underweight (<18.5)		2 (2%)
Normal (18.5 to 24.9)		21 (26%)
Overweight (25.0 to 29.9)		21 (26%)
Obese (≥ 30.0)		38 (46%)
Eating Competent**	**n=92**	39 (42%)
Mediterranean Diet Adherence***	**n=83**	
Low adherence (< 8)		72 (87%)
High adherence (≥ 8)		11 (13%)
Food Security	**n=77**	
Very low (5-6)		13 (17%)
Low (2-4)		12 (16%)
High/marginal (0-1)		52 (68%)
Used at least one assistance program	**n=93**	50 (54%)
Low-income****	**n=86**	56 (65%)
Sometimes, often, or always worry about money for food	**n=86**	41(48%)
Smoking/tobacco use status	**n=92**	
Non-smoker/never used tobacco		45 (49%)
Former smoker/tobacco user		23 (25%)
Current smoker/tobacco user		24 (26%)

* Numbers may not sum to 100 because of rounding or selecting more than one response

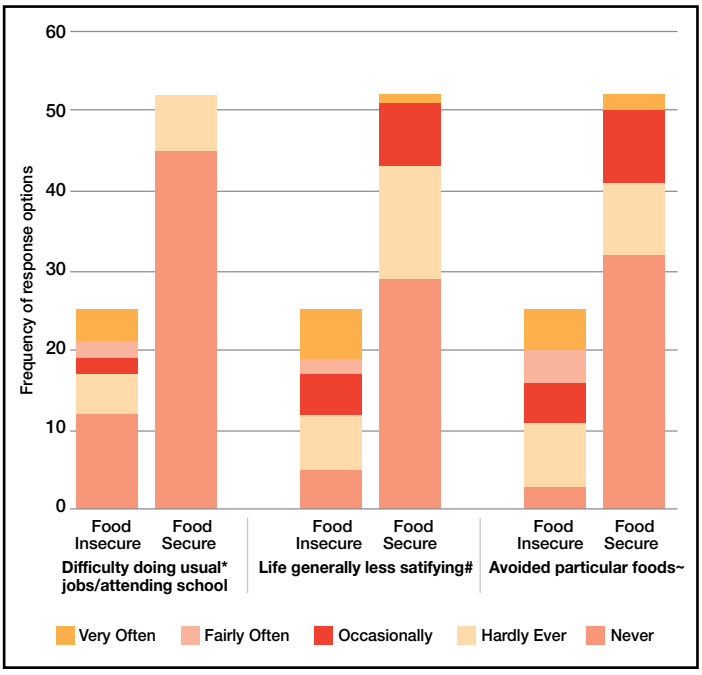
**Satter Eating Competence Inventory 2.0 ≥ 32 (ecSI 2.0™)

***Possible score range 0–14

****Low-income defined as prior use of an assistance program (e.g., WIC or Supplemental Nutrition Assistance Program) or often or always worrying about money for food.

Food insecurity was associated with having more oral health concerns. The greater the score indicating food insecurity the more frequently problems related to teeth, mouth, or dentures impacted being able to perform a job or attend school (r=.47, p<.001, n=77), needing to avoid specific foods (r=.45, p<.001, n=77), and overall satisfaction with life in general (r=.49, p<.001, n=77). Comparing categories of food security and oral health impact affirmed these findings. Food insecure respondents, compared to being food secure, were significantly more likely to report occasionally, fairly or very often (compared to never or hardly ever) that problems with their teeth, mouth, or dentures led to difficulty doing a job or attending school, affected daily life practices, and led them to avoid particular foods (Figure 1). In addition, food insecure respondents were less likely than food secure respondents to indicate that they had no oral health problems in the previous six months (16% vs. 54%; p=.003).

Figure 1. Food secure versus food insecure challenges



Chi square comparisons of never or hardly ever versus occasionally, fairly often or very often between food insecure (n=25) and food secure (n=52) respondents: * p<.001, # p=.002, ~ p=.002

Problems with bleeding gums in the last six months were significantly higher for individuals defined as low-income (93%, p=.012). It is also important to note that 25% of low-income respondents said this was a problem as compared to those who were not low-income (3%). Visiting the dentist for an exam, check-up or consultation was more common in those not low-income (p=.027). Visiting the dentist for reasons other than a check-up was reported by 40% of the

Table II. Oral health practices (n=93)

	n (%)
Family dentist?	
Yes (vs. no/don't know/not sure)	52 (56%)
Last dental visit	
< 6 months ago	32 (34%)
6 months to 1 year	15 (16%)
1 to 3 years	24 (26%)
> 3 years	22 (24%)
Reasons for going to dentist*	
General exam, check-up, or consultation	64 (70%)
Teeth cleaning or polishing	59 (64%)
Cavities	36 (39%)
Chipped or broken teeth	20 (22%)
Gum disease	1 (1%)
Oral surgery	6 (7%)
Other	3 (3%)
Cannot afford dental care*	55 (60%)
During the past 6 months**	
Jaw pain lasting >1 day	13 (14%)
Mouth sores	6 (7%)
Difficulty eating/chewing > 1 day	7 (8%)
Dry mouth for >1 day	12 (13%)
No mouth problems	60 (66%)
Problems during the past 6 months	
Missing fillings	10 (11%)
Bleeding gums	16 (17%)
Missing teeth	7 (8%)
Loose teeth (not injury related)	2 (2%)
No teeth problems	40 (44%)
Uncomfortable to eat food	
Very often	4 (4%)
Fairly often	6 (7%)
Occasionally	18 (19%)
Hardly ever	18 (19%)
Never	47 (51%)
As a result of problems with teeth, gums, or dentures: Avoided particular foods	
Very often	9 (10%)
Fairly often	4 (4%)
Occasionally	18 (19%)
Hardly ever	20 (22%)
Never	42 (45%)
Found life generally less satisfying	
Very often	9 (9%)
Fairly often	3 (3%)
Occasionally	17 (18%)
Hardly Ever	25 (27%)
Never	40 (43%)
Had difficulty doing usual jobs/attend school	
Very often	5 (5%)
Fairly often	3 (3%)
Occasionally	2 (2%)
Hardly Ever	14 (15%)
Never	69 (74%)
Frequency of tooth brushing?	
More than once a day	46 (49%)
Once a day	45 (48%)
Every few days	2 (2%)
Floss? yes (vs. no/don't know/not sure)	51 (55%)

*n=92, ** n=91

low-income sample compared with only 17% of those who were not low-income. Of those who noted an additional reason for a dental visit, 83% (n=27) were low-income.

Food security and eating behaviors

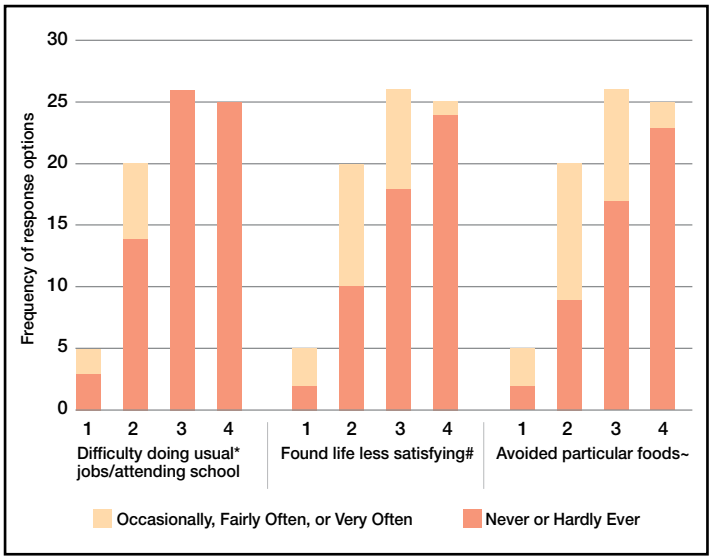
Food security was not associated with the Mediterranean diet score, but was negatively correlated with ecSI 2.0™ score (r=-.30, p=.009, n=76). The ecSI 2.0™ scores were significantly higher (p=.049) for those with high or marginal food security (30.4 ± 9.5, n=51) compared to those with very low food security (23.1 ± 10.3, n=13). The mean ecSI 2.0™ score of those with low food security was 28.8 ± 7.9 (n=12) and did not differ from high/marginal or very low food security categories. Eating attitude and internal regulation subscale scores also differed among food security levels. Mean EA subscale scores were 10.8 ± 3.4 for marginal/high (n=51), 9.0 ± 2.5 for low food security (n=12) and 8.3 ±3.9, for very low food security n=13, (p=.029); mean IR subscales scores were 6.6 ± 2.2, 6.1 ± 2.0, and 4.5 ± 2.2 for marginal/high (n=52), low (n=12), very low (n=13) categories, respectively (p=.008). Low-income status was not associated with level of food security, eating competence, or adherence to a Mediterranean diet.

Eating behaviors and oral health

Only 11 respondents (13%) met the criteria for adhering to the Mediterranean diet; they were more likely to have visited the dentist in the past year than those that didn't follow a Mediterranean diet (82% vs. 46%, p=.026); no other differences in oral health practices or issues were identified.

Eating competence was associated with indicators of oral health. For example, cavities were noted as the reason for a dentist visit by more non-eating competent than eating competent respondents (51% vs 21%, p=.004). Only 13% of eating competent respondents reported life to be less satisfying in general because of teeth, mouth or denture problems, compared to 43% of those not eating competent (p=.002). Eating competent respondents were less likely to avoid particular foods because of oral problems (18% vs 45% not eating competent; p=.006). These relationships remained significant when analyzed with a GLM controlling for low-income (p=.008 and .006, respectively). However, when analyzed using a GLM controlling for food security, responses about these oral health impacts did not differ by eating competence status. The relationship with food security is shown in Figure 2. Of the 26 participants who were not eating competent, but food secure, none reported that their oral health occasionally, fairly or very often made doing their job or attending school difficult, whereas this level of dissatisfaction with their oral health was noted by 30% of the 20 who were not eating competent, but also not food secure. In addition, ecSI 2.0™ scores were inversely correlated with frequency of avoiding foods for oral health reasons (r=-.25, p=.018, n=92), but this correlation did not remain significant after controlling for food security score.

Figure 2. Eating competence and food security



1. Eating competent and food insecure (n=5)
2. Food insecure and not eating competent (n=20)
3. Food secure and not eating competent (n=26)
4. Eating competent and food secure (n=25)

Fisher's Exact test comparison of never or hardly ever versus occasionally, fairly often or very often among the four groups: *p<.001 #p=.001 ~ p=.002

Discussion

Although eating competence has been shown to be related to several biobehavioral and well-being characteristics,[5-14] this is the first study to suggest the relationship between eating competence and oral health. Findings revealed eating competence was associated with self-reported better oral health and that higher satisfaction with life, job and school performance, and food avoidance were less frequently associated with issues with teeth, mouth, and dentures. As shown previously,[28] eating competence was significantly lower in food insecure participants. In fact, food security status was a factor in the response to a nutrition education intervention based on tenets of eating competence.[29] The current study affirmed the well documented relationship of food insecurity with oral health issues[3,30] but also revealed food security as a confounder of the relationship between eating competence and oral health issues.

Oral health problems were abundant in this sample of adults who exhibited an interest in evaluating a digital oral health nutrition program at free clinic venues. The incidence and severity of the oral health problems self-identified by the respondents support the provision of resources for preventive oral health education and treatment suggested by oral health professionals.[31] Although the definition of low-income included needs-based assistance program use and worry about money for food, both of which have been associated with food security in previous studies,[9,32-33] income status did not correlate with food security. The lack of association may be reflective of the fact that the sample, although recruited from clearly defined low-income venues, also participated in programs specifically designed to reduce food insecurity. As shown in Table I, more than two-thirds were food secure and nearly two-thirds were low income. The level of low and very low food security in the study sample (i.e., 33%) was higher than the nearly 12% reported nationally for 2017.[34] Thus, although providing oral health education and integrating this with an approach to enhance eating competence is supported, results suggest oral health professionals need to provide attention to food security. Oral health professionals are encouraged to display and demonstrate support for federal and state food assistance programs and local food pantries. Practices addressing both eating competence and food security include offering meal planning and budgeting

advice, ideas to enhance dietary variety on a budget and how to address eating contexts (e.g., eating as a family, turning off screens, food neutral mealtime conversation) to encourage regular meals and feeling relaxed about eating. In addition, oral health professionals may better serve patients by encouraging tenets of eating competence including portions based on internal regulation, enjoyment of eating, and tuning in and paying attention to eating.[8]

This study has several strengths. All responses were collected with surveys that had been validated or with items from other previously tested surveys and were face valid in similar samples. Recruitment activities did not focus on persons visiting a dentist or health care professional for oral health or dental issues, but rather on persons attending a health clinic who would evaluate a nutrition education program. The data collection method did not place additional burden on clinic staff or health care professionals. Social desirability bias was tempered because responses were not collected at the time of recruitment in front of a researcher or health care professional, but at the convenience of the participant online at the location of their choice. Lastly, the sample was from several communities in two regions of the state.

Study limitations include self-report, rather than observed or clinically documented responses with limited confirmation of respondent identity. Huang and Park[3] noted some discrepancy between self-report and clinical findings in their analyses of NHANES 2005-2008 data for adults 65 years and older. However, the objective measure was limited to tooth count which was the basis for defining chewing difficulty. Survey responses were collected solely online, thus the sample did not include those without online access or discomfort with providing information online. However, in the year of data collection (2015) 86% of adults in the United States used the Internet, with usage by 79% of those earning < $30,000 per year.[35] This corresponds to a usage rate of 69% by a statewide Pennsylvania sample of males (N=101) in 2013 in which 88% had less than 2 years of college and 60% were participants in the Supplemental Nutrition Assistance Program.[32] Daily Internet use was reported by 77% in another statewide Pennsylvania sample (N=512) composed of all females with 77% without a 4-year college degree.[12] Internet usage in 2015 was high among US adults with only a high school education (78%) or some college (92%).[34] Since 71% of the sample graduated from high school or attended some college and 26% had higher educational levels, the requirement to use the Internet was not a significant limitation. Sample homogeneity (i.e., mostly females, not elderly, white, obese, and Pennsylvania residents only) limits generalization of findings to other populations. However, the sample had similar levels of obesity, educational attainment, and eating competence to other statewide samples that were only male[32] or with 42% black, mostly obese/overweight (61%), all female and SNAP participants[9] or in all female with high food security, a very high level of education and younger.[36] In addition, sample obesity rates parallel those reported for the US.[37] Educational attainment levels were comparable to those reported for US adults aged 25 and older and in rural Americans aged 35-44 years.[38] These examples of sample representativeness temper concerns that responder identity was not able to be verified e.g., by phone calls or mail.

Another limitation was that recruitment was from free clinic venues and thus may represent a sample that has health issues, but is also able to seek help from health professionals; which may not be representative of the general population. Income data were not collected from participants because they were recruited from venues serving those with documented incomes indicating poverty. Therefore, a proxy for low-income was developed, i.e., often or always worrying about money for food or participating in an income-based assistance program. One could contend frivolous spending or unplanned expenses led to often or always worrying about money for food. However, the sample was recruited from venues serving those living in poverty, thus pointing to limited discretionary funds and tempering the likelihood funds were sufficient but money for food was lacking because of indiscriminate allocation. Finally, although adherence to the Mediterranean diet aligned with reported usage in the US within the past five years,[39] the limited number of adherent respondents suggests that conclusions about its relationship to oral health issues warrants further investigation.

Conclusion

This observational study suggests that education and interventions that include an eating competence approach (i.e., regular meals, planning for feeding, enjoying meals, eating until satisfied, eating a variety of foods) may have the potential to improve oral health. Overall health concerns explicably follow oral health issues. However, success of an eating competence focused approach must address food insecurity, a considerable challenge to oral health and (because overall health concerns explicably follow oral health issues), consequently, the general health of such vulnerable populations.

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