# The Relationship of Oral Health Literacy and Self-Efficacy With Oral Health Status and Dental Neglect

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*Objectives.* We examined the associations of oral health literacy (OHL) with oral health status (OHS) and dental neglect (DN), and we explored whether self-efficacy mediated or modified these associations.

*Methods.* We used interview data collected from 1280 female clients of the Special Supplemental Nutrition Program for Women, Infants and Children from 2007 to 2009 as part of the Carolina Oral Health Literacy Project. We measured OHL with a validated word recognition test (REALD-30), and we measured OHS with the self-reported National Health and Nutrition Examination Survey item. Analyses used descriptive, bivariate, and multivariate methods.

*Results.* Less than one third of participants rated their OHS as very good or excellent. Higher OHL was associated with better OHS (for a 10-unit REALD increase: multivariate prevalence ratio=1.29; 95% confidence interval=1.08, 1.54). OHL was not correlated with DN, but self-efficacy showed a strong negative correlation with DN. Self-efficacy remained significantly associated with DN in a fully adjusted model that included OHL.

*Conclusions.* Increased OHL was associated with better OHS but not with DN. Self-efficacy was a strong correlate of DN and may mediate the effects of literacy on OHS. (*Am J Public Health.* 2012;102:923–929. doi:10.2105/AJPH.2011.300291)

According to the most recent National Assessment of Adult Literacy Survey, nearly half (43%) of adults in the United States are at risk for low literacy.[1] Consumer health information is frequently written at or above the 10th-grade reading level, meaning that approximately 90 million adult Americans with low health literacy skills struggle to understand fundamental health information such as consent forms, instructions, and drug labels.[2]

"Health literacy" refers to the ability to perform basic reading and numerical tasks necessary to navigate the health care environment and act on health care information.[3] *Healthy People 2010* defines health literacy as

> [t]he degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate health decisions.[4(pp11-15)]

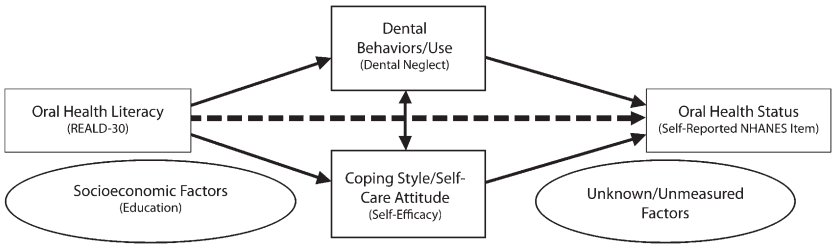
Individuals with low health literacy skills often have poorer health knowledge and health status, unhealthy behaviors, less utilization of preventive services, higher rates of hospitalizations, increased health care costs, and ultimately poorer health outcomes than do those with higher literacy levels.[5–11] Health literacy has been shown to function as a mediator between socioeconomic factors, such as race and education, and health behaviors and health outcomes,[12–14] partly explaining health disparities.[15,16] Paasche-Orlow and Wolf proposed a conceptual model of causal pathways between health literacy and health outcomes in which the effect of literacy on health outcomes is mediated by patient-level and extrinsic factors grouped as (1) access to and utilization of health care, (2) provider–patient interaction, and (3) self-care.[17] Although these pathways have yet to be validated, a recent report by Osborn et al.[18] suggested that self-efficacy, which refers to a person's belief in their own competence, and self-care do indeed mediate the effect of health literacy on health status. Previous investigations had not found any association between health literacy and self-efficacy.[19,20]

The body of literature linking literacy to overall health continues to grow, but studies linking literacy to dental health are relatively new. Oral health literacy (OHL) has been defined as the degree to which individuals have the capacity to obtain, process, and understand basic oral health information and services needed to make appropriate health decisions and act on them.[21]

The network of proximal and distal factors affecting oral health is complex and is not understood completely. These factors include genetic and environmental factors,[22] sociodemographics,[23–25] and personality.[26–28] Although OHL represents one's ability to understand and process relevant health information, other characteristics may modify one's resulting decisions or actions. In this context, recent attention has focused on the role of oral health behaviors[29,30] because, unlike most other factors affecting oral health, behaviors are readily amenable to change.[31] The construct of self-efficacy beliefs is considered to represent an important link between health knowledge, health behaviors, and health outcomes,[32] and it correlates well with other personality characteristics related to health behaviors.[33] Because self-efficacy is a significant determinant of health-related actions initiated or avoided by individuals, its consideration in the oral health context has been advocated.[31,34]

Although conceptual frameworks illustrating possible pathways linking health literacy to health outcomes or health status have been developed in medicine,[12,14,17] little progress has been made in developing such pathways between OHL and oral health status (OHS). Macek et al.[35] recently proposed a conceptual model linking word recognition and conceptual knowledge, decision-making, and communication skills with oral health outcomes. Although this model is not exhaustive, we theorize that OHL likely exerts effects on avoidance of care (i.e., dental neglect [DN]; Figure 1), which may or may not be mediated or modified by individual or systemic characteristics along the lines of the Paasche-Orlow and Wolf model.[17]

To the best of our knowledge, no previous investigation has examined the links of OHL




*Note.* NHANES = National Health and Nutrition Examination Survey; OHL = oral health literacy; OHS = oral health status; REALD = Rapid Estimate of Adult Literacy in Dentistry; WIC = Supplemental Nutrition Program for Women, Infants and Children. Dashed arrow represents effects of OHL on OHS. Solid arrows represent pathways explored and hypothesized to mediate the effect of OHL on OHS. Education and other socioeconomic and unknown or unmeasured factors are also believed to confound or mediate this association (arrows omitted for parsimony).

**FIGURE 1—Conceptual model of the association of self-reported OHS with OHL, self-efficacy, and dental neglect among female WIC participants (n = 1280): Carolina Oral Health Literacy study, North Carolina, 2007–2009.**

with OHS and DN, so we sought to establish these links. Because of the absence of any data linking self-efficacy with OHL, we also sought to examine this association and to empirically investigate the role of self-efficacy as a mediator or modifier[36] of the association between OHL and DN and OHS, without conducting any comprehensive pathway analyses.

## METHODS

The Carolina Oral Health Literacy (COHL) Project collected interview data from 1405 participants from 2007 to 2009.[37] The main goal of the COHL was to examine OHL and its relationship to health behaviors and health outcomes among caregivers, infants, and children enrolled in the Special Supplemental Nutrition Program for Women, Infants and Children (WIC) in North Carolina. A prospective cohort study design was developed to determine OHL levels in a population attending WIC clinics that were selected because of the large number and diverse backgrounds of low-income clients attending those clinics. Nine sites in 7 counties were selected. For the present analysis, we excluded men (n=49; 3.5% of total), Asians (n=12; 0.9%), and those who did not have English as their primary language (n=79; 5.6%).

### Measures

The major explanatory variable was OHL, measured using a validated word recognition test called the Rapid Estimate of Adult Literacy in Dentistry (REALD-30).[38] The REALD-30 scale score ranges from 0 (lowest literacy) to 30 (highest literacy). Our major outcome variables were DN and self-reported OHS.

We used a modified version of the previously validated Dental Neglect Scale (DNS) to evaluate DN.[39–41] Participants were asked to report their agreement with 6 items describing their dental behaviors, with responses ranging from "definitely not" to "definitely yes" on a 4-point Likert scale. These items were: "I keep my dental care at home"; "I receive the dental care I should"; "I need dental care, but I put it off"; "I brush as well as I should"; "I control snacking between meals as well as I should"; and "I consider my dental health to be important." We computed a cumulative score ranging from 6 (least DN) to 24 (most DN) and estimated Cronbach α as a measure of internal consistency and reliability. A recent investigation[42] suggested that 2 factors may be distinguishable within the DNS ("dental neglect" and "avoidance of care"), so we conducted factor analysis (retaining eigenvalue>1) to determine whether this was the case in our study sample.

We assessed OHS using the National Health and Nutrition Examination Survey item "How would you describe the condition of your mouth and teeth?" with possible responses of "excellent," "very good," "good," "fair," or "poor." We evaluated self-efficacy as a potential effect mediator or modifier,[43] and we measured it using the 10-item General Self-Efficacy Scale (GSES).[44] Items in the GSES are related to one's ability to cope with general life demands (e.g., "I can always manage to solve difficult problems if I try hard enough" and "I can remain calm when facing difficulties because I can rely on my coping abilities"). The construct of self-efficacy refers to one's coping ability across a wide range of demanding situations,[44] and the GSES has been shown to have good psychometric properties across diverse populations.[45] The scale's scores range from 10 (lowest self-efficacy) to 40 (highest self-efficacy). We obtained Cronbach α for the GSES to determine its reliability in the context of our study.

We evaluated demographic characteristics and dental use as potential confounders. We collected demographic information for age, race, and educational attainment. Age was measured in years and was coded as a quintile-categorical indicator variable. Race was coded as an indicator variable with terms for White, African American, and American Indian/Alaskan Native. Education was coded as a 4-level categorical variable (1=did not finish high school, 2=high school diploma or GED, 3=some technical education or some college, and 4=≥college education). Dental use referred to the time since the last dental visit and was coded as a 4-level categorical variable (4=<12 months, 3=12–23 months, 2=2–5 years, 1=>5 years).

### Statistical Analyses

We generated descriptive statistics of OHL and DN sorted by demographic characteristics, dental use, and OHS. We tested the normality assumption for DN, OHL, and self-efficacy scores by means of a combined skewness and kurtosis evaluation test[46] and a $P<.05$ criterion. To examine the association of self-efficacy scores with OHL and DN, we used graphical methods that were based on local polynomial smoothing functions to illustrate the bivariate associations and corresponding 95% confidence intervals (CIs). To further quantify these associations we computed Spearman's correlation coefficients (ρ) for their pairwise combinations and 95% CIs using bootstrapping (1000 repetitions). For all analyses we used the computed OHL, DN, and self-efficacy scores with no standardization, as in previous investigations.[34,35,37–41]

We used multivariate modeling based on log binomial regression to obtain prevalence ratios (PRs) and 95% CIs for the association of OHL with OHS (excellent/very good vs good/fair/poor). We chose log binomial regression

instead of traditional logistic regression because odds ratios tend to overestimate the PR when the outcome is common (>20%).[47] Moreover, PR estimates obtained from log binomial models have a more straightforward interpretation in cross-sectional study designs.[48]

We considered race, age, education, and dental use to be a priori confounders of the association among OHL, DN, and health status; therefore, we included them in the minimal model (model A) and all subsequent analytical models. We empirically examined self-efficacy as an effect mediator in the association between OHL and health status by adding this variable (model B) and computing a "percentage change in estimate" using model A as the referent. This approach is analogous to a confounding evaluation. We evaluated effect measure modification by self-efficacy in the context of statistical interaction and a $P<.1$ criterion for the coefficient of an interaction term between self-efficacy and OHL. Its inclusion (model C) was also assessed with a change-in-estimate criterion of greater than or equal to 10% as follows: change=$[\ln(PR_{full})-\ln(PR_{reduced})/\ln(PR_{reduced})]\times 100$.

The addition of the interaction term between OHL and self-efficacy was also evaluated with a likelihood ratio test (LRT $\chi^2$), comparing the full model (model C) and nested model (model B) and using a $P<.1$ criterion. We also employed a second multivariate model based on linear regression to obtain adjusted DN score differences and 95% CIs for the impact of literacy and self-efficacy on DN. We used Stata version 11.1 (StataCorp LP, College Station, TX) to conduct all analyses.

## RESULTS

The demographic characteristics, dental use, and OHS of our analytical sample (n=1280), along with the corresponding REALD-30 scores and DNS distribution characteristics, are presented in Table 1. The racial representation for Whites, African Americans, and American Indians/Alaska Natives was 2:2:1, and their mean age was 26.6 years (SD=6.9). Two thirds of participants had a high school education or less, and less than one third rated their oral health as very good or excellent.

The overall distribution of REALD-30 and DNS scores is illustrated in Figure 2. OHL scores were normally distributed ($\chi^2=1.53$; $df=2$; $P>.05$), with a mean of 15.8 (SD=5.3) and a range of 0 to 30. DN scores were positively skewed, with a mean of 11.9 (SD=3.2) and a range of 6 to 23. Self-efficacy scores were negatively skewed, with a mean of 33.4 (SD=4.1) and a range of 15 to 40. Self-efficacy scores were positively correlated with DN and did not show any important pattern of association with OHL. Factor analysis confirmed that DN items loaded on 1 principal factor (eigenvalue=1.5). Cronbach α for DN and self-efficacy was 0.62 and 0.81, respectively. Figure 2 also illustrates the bivariate relationships of self-efficacy with OHL and DN, and includes 2 histograms that illustrate the

**TABLE 1—Distribution of REALD-30 and DNS Scores by Demographic Characteristics, Dental Use, and Oral Health Status Among Female WIC Participants: Carolina Oral Health Literacy Study, North Carolina, 2007–2009**

| | | | REALD-30[b] | | DNS[c] | |
|---|---|---|---|---|---|---|
| Characteristic | No.[a] | % or Mean (SD) | Mean (SD) | Median | Mean (SD) | Median |
| All | 1280 | 100 | 15.8 (5.3) | 16 | 11.9 (3.2) | 12 |
| Race | | | | | | |
| White | 503 | 39.3 | 17.4 (4.9) | 17 | 12.0 (3.2) | 12 |
| African American | 522 | 40.8 | 15.3 (5.1) | 15 | 11.9 (3.2) | 12 |
| American Indian/Alaska Native | 255 | 19.9 | 13.7 (5.3) | 14 | 11.5 (3.3) | 12 |
| Education | | | | | | |
| Did not finish high school | 306 | 23.9 | 13.0 (4.8) | 13 | 11.1 (3.6) | 12 |
| High school diploma or GED | 479 | 37.4 | 15.0 (4.9) | 15 | 11.9 (3.1) | 12 |
| Some technical or college training | 430 | 33.6 | 18.0 (4.7) | 18 | 11.8 (3.1) | 12 |
| College degree or higher | 65 | 5.1 | 20.7 (4.8) | 21 | 11.0 (3.2) | 11 |
| Age, y, quintiles | | | | | | |
| Q1 (range: 17.2–20.9) | 256 | 19.5 (0.8) | 14.2 (4.8) | 15 | 11.4 (3.4) | 11 |
| Q2 (range: 20.9–23.4) | 256 | 22.1 (0.7) | 15.5 (5.2) | 15 | 12.1 (3.2) | 12 |
| Q3 (range: 23.4–26.5) | 256 | 24.8 (0.9) | 16.5 (5.0) | 16 | 11.6 (3.1) | 12 |
| Q4 (range: 26.5–30.9) | 256 | 28.6 (1.3) | 16.3 (4.8) | 16 | 12.1 (3.2) | 12 |
| Q5 (range: 30.9–65.6) | 256 | 37.7 (6.1) | 16.6 (6.0) | 17 | 12.0 (3.2) | 12 |
| Dental use (time since last dental visit) | | | | | | |
| <12 mo | 727 | 57.1 | 15.8 (5.2) | 16 | 10.9 (3.2) | 11 |
| 12–23 mo | 218 | 17.1 | 16.1 (5.5) | 16 | 12.5 (3.0) | 12 |
| 2–5 y | 177 | 13.9 | 15.8 (5.6) | 16 | 13.3 (2.6) | 13 |
| >5 y | 151 | 11.9 | 15.4 (4.7) | 15 | 13.9 (2.6) | 14 |
| "How would you describe the condition of your mouth and teeth?" | | | | | | |
| Excellent | 118 | 9.3 | 16.1 (5.6) | 17 | 9.0 (2.5) | 9 |
| Very good | 258 | 20.2 | 16.8 (5.3) | 17 | 10.3 (2.7) | 10 |
| Good | 481 | 37.7 | 15.6 (5.1) | 16 | 11.7 (2.8) | 12 |
| Fair | 287 | 22.5 | 15.5 (5.1) | 15 | 13.5 (2.8) | 13 |
| Poor | 131 | 10.3 | 15.4 (5.6) | 15 | 14.7 (3.1) | 15 |

*Note*. DNS = Dental Neglect Scale; REALD-30 = Rapid Estimate of Adult Literacy in Dentistry; WIC = Supplemental Nutrition Program for Women, Infants, and Children. The sample size was n = 1280.
[a]Column figures may not add up to total because of missing values.
[b]The REALD-30 is a validated word recognition test in which scale score ranges from 0 (lowest literacy) to 30 (highest literacy).
[c]The DNS asks participants to report their agreement with 6 items describing their dental behaviors, with responses ranging from "definitely not" to "definitely yes" on a 4-point Likert scale (6 = least dental neglect; 24 = most dental neglect). These items are: "I keep my dental care at home"; "I receive the dental care I should"; "I need dental care, but I put it off"; "I brush as well as I should"; "I control snacking between meals as well as I should"; and "I consider my dental health to be important."

univariate distribution of OHL and DN. Pairwise Spearman's correlation coefficients among GSES score, OHL, and DN were $\rho_{DNS,GSES}=-0.26$ (95% CI=−0.31, −0.20); $\rho_{REALD\text{-}30,GSES}=0.10$ (95% CI=0.04, 0.15); and $\rho_{REALD\text{-}30,DNS}=-0.02$ (95% CI=−0.08, 0.04).

Higher DN scores were associated with worse OHS. We noted marked differences in OHL levels between education levels, ages, and racial groups (Table 1). Independent of race, age, education, and dental use, higher OHL was associated with better OHS (PR=1.03; 95% CI=1.01, 1.04), an estimate that corresponded to a 29% (95% CI=8%, 54%) increase in prevalence of excellent/very good versus good/fair/poor oral health for a 10-point increase in OHL (Table 2, model A). Inclusion of self-efficacy in the model resulted in an 11% reduction in the measure of association between OHL and OHS (Table 2, model B). Furthermore, the interaction term between OHL and self-efficacy was retained in model C ($P<.1$), and its inclusion improved the model fit significantly ($\chi^2=4.7$; $df=1$; $P<.1$).

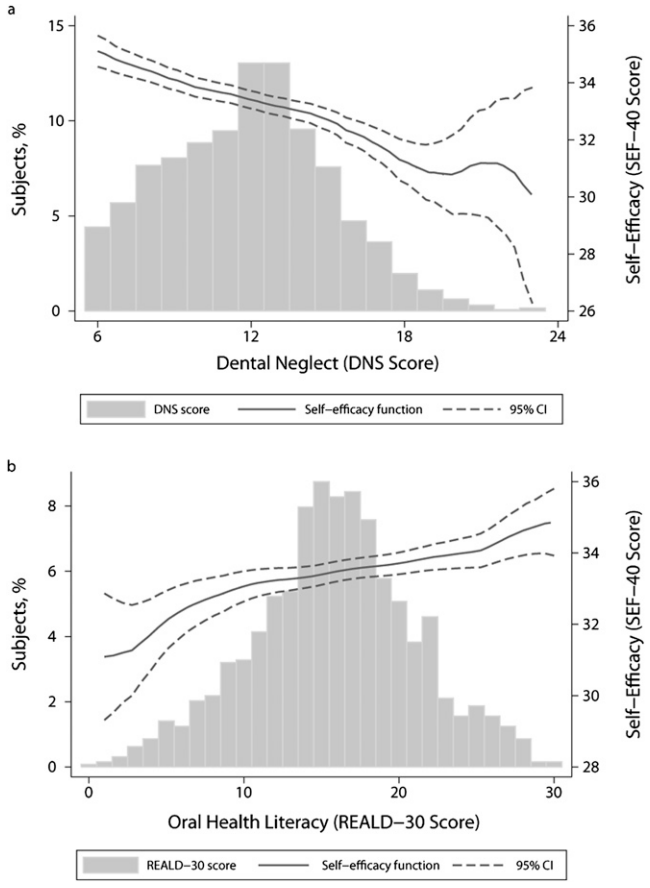
The final model to determine the impact of OHL and self-efficacy on DN is presented in Table 3. When OHL and self-efficacy were jointly considered with regard to DN and independently of race, age, and education, self-efficacy and dental use were associated with significant decreases in DN scores, whereas OHL showed no pattern of association. Dental use could be considered as a "downstream" event of OHS in a hypothetical model, with worse dental condition leading to more dental visits, so we performed an iteration of our multivariate model that removed this variable. Exclusion of dental use from the multivariate model resulted in no change in the estimate of OHL (data not shown).

## DISCUSSION

Our investigation is the first to our knowledge to examine and report on the association of OHL with self-reported OHS and DN. We found that WIC clients with higher OHL were more likely to report excellent/very good OHS than good/fair/poor OHS. There was a poor correlation between OHL and DN. However, we found that lower self-efficacy was strongly correlated with DN, and this association persisted after adjustment for age, race, education, dental use, and OHL. Literacy, on the other hand, demonstrated a modest association with OHS after adjustment for age, race, education, and dental use.

The important role of self-efficacy in OHS provides support to conceptual models that place appropriate decision-making between conceptual knowledge and oral health outcomes.[35,43] Increased self-efficacy may be a factor that enables individuals to engage in positive dental behaviors, which is consistent with theories of planned behavior,[26] locus of control theory,[24] and the social cognitive theory.[32] As illustrated in our conceptual model (Figure 1), it is likely that personal characteristics such as self-efficacy mediate or modify the impact of literacy on oral health behaviors. We used the general self-efficacy measure instead of one specific to oral health. Although instruments that could capture dental care–specific dimensions have been developed and validated in dentistry,[49-51] they have not been widely tested. By contrast, the role of general self-efficacy as a determinant, modifier, or moderator of health behavior change or maintenance is well-supported.[33,34,52-55]

Our data revealed a poor correlation between OHL and DN. Thomson and Locker[41] defined the construct of DN as "failure to take precautions to maintain oral health, failure to obtain needed dental care, and physical neglect of the oral cavity." This construct may be too narrow to encompass the entire spectrum of self-care, preventive attitudes, and dental attendance all together. Further work is warranted to identify these pathways that could be potential targets for oral health interventions.




*Note.* CI = confidence interval; DNS = Dental Neglect Scale; REALD = Rapid Estimate of Adult Literacy in Dentistry; SEF = Self-Efficacy Scale; WIC = Supplemental Nutrition Program for Women, Infants and Children.

**FIGURE 2—Univariate distributions of (a) dental neglect scores and (b) oral health literacy overlaid by polynomial fit functions with self-efficacy among female WIC participants (n = 1280): Carolina Oral Health Literacy study, North Carolina, 2007–2009.**

**TABLE 2—Associations With Self-Reported Oral Health Status (Excellent/very good vs Good/fair/poor) Among Female WIC Participants: Carolina Oral Health Literacy Study, North Carolina, 2007–2009**

| | Model A, PR (95% CI) | Model B, PR (95% CI) | Model C, PR (95% CI) |
|---|---|---|---|
| REALD-30 (OHL) score[a,b] | 1.03 (1.01, 1.04) | 1.02** (1.00, 1.04) | 0.88 (0.78, 1.00) |
| GSES score[b,c] | – | 1.05 (1.03, 1.08) | 0.98 (0.93, 1.05) |
| Interaction (self-efficacy × OHL) | – | – | 1.00* (1.00, 1.01) |
| Race | | | |
| White (Ref) | 1.00 | 1.00 | 1.00 |
| African American | 0.96 (0.79, 1.16) | 0.89 (0.73, 1.07) | 0.88 (0.72, 1.06) |
| American Indian/Alaska Native | 1.22 (0.98, 1.52) | 1.18 (0.95, 1.47) | 1.18 (0.95, 1.47) |
| Age (quintiles) | 0.91 (0.85, 0.97) | 0.92 (0.86, 0.98) | 0.91 (0.86, 0.97) |
| Education level | 1.17 (1.06, 1.31) | 1.14 (1.03, 1.27) | 1.15 (1.03, 1.27) |
| Dental use | 0.77 (0.69, 0.84) | 0.78 (0.70, 0.85) | 0.77 (0.70, 0.85) |

*Note.* CI = confidence interval; GSES = General Self-Efficacy Scale; OHL = oral health literacy; PR = prevalence ratio; REALD-30 = Rapid Estimate of Adult Literacy in Dentistry; WIC = Supplemental Nutrition Program for Women, Infants, and Children. Estimates calculated by multivariate log binomial regression modeling. The sample size was n = 1280.
[a]The REALD-30 is a validated word recognition test in which scale score ranges from 0 (lowest literacy) to 30 (highest literacy).
[b]Estimates correspond to a 1-unit increase.
[c]The GSES is a 10-item scale that is used to measure the construct of self-efficacy, which refers to one's coping ability across a wide range of demanding situations. The scale's scores range from 10 (lowest self-efficacy) to 40 (highest self-efficacy).
*$P$ = .02; **$P$ = .01.

Although the effect estimates for the association of OHL and self-efficacy with OHS are small (PR=1.02 and 1.05, respectively, in model B), they correspond to 1-point changes in these variables. On the basis of these multivariate model–derived coefficients for the association of literacy and self-efficacy with OHS, we estimate that a 10-unit increase in REALD-30 scores corresponds to a PR of 1.25 (95% CI=1.05, 1.49), and a 10-unit increase in GSES scores corresponds to a PR of 1.64 (95% CI=1.31, 2.06). Moreover, the synergistic interaction between literacy and self-efficacy in model C, although small in magnitude, indicated that the effect of literacy was more pronounced among individuals with higher self-efficacy and that the effect of self-efficacy was more pronounced among individuals with higher literacy.

The rationale for considering both effect mediation and effect measure modification is supported by the fact that the determination of a variable as a mediator is context-specific and requires previous knowledge of underlying theory stating that the variable of interest is on a causal pathway between exposure and outcome.[36] Previous studies examining health behaviors have indeed considered self-efficacy both as a mediator and as a modifier (moderator).[56] In the context of OHL, no previous studies have examined the relationship between literacy and self-efficacy. Although some previous studies in medicine did not find an association between health literacy and self-efficacy,[19,20] evidence from 2 recent investigations supports the link.[18,57] Self-efficacy was also found to be a strong correlate of oral hygiene behaviors among Australian dental patients.[49]

Although we did not conduct formal pathway analyses to support the proposed conceptual model, we did find a marked effect attenuation of the OHL–OHS association when self-efficacy was entered into the model (contrast of models A and B). This finding indicates that OHL may confer its effect on OHS via self-efficacy, as has been suggested for health literacy and health status.[17,52] This finding should be interpreted with caution until future studies formally investigate these pathways. Similarly, when DN was examined as the analytical endpoint, self-efficacy was significantly inversely correlated with neglect, but OHL did not show any material association.

Our finding of an interaction between literacy and self-efficacy constitutes evidence of effect measure modification that underscores the importance of considering both dental-specific factors and personality measures as correlates or antecedents of oral health behaviors and outcomes.[31] Evidence indicates that self-efficacy may be improved via knowledge enhancement.[58,59] Thus, providing individuals with the necessarily skills to obtain, understand, and act on dental-related information may increase their ability to cope with the demands of oral health maintenance and may ultimately lead to improved oral health outcomes.

Along these lines, Bandura[60] suggested that "belief in one's efficacy to exercise control is a common pathway through which psychosocial influences affect health functioning." If this paradigm were used when planning interventions, a determination could be made that certain individuals may benefit more from the use of visual materials to communicate key information, depending on literacy or self-efficacy criteria.

**TABLE 3—Associations With Dental Neglect Among Female WIC Participants: Carolina Oral Health Literacy Study, North Carolina, 2007–2009**

| | B (95% CI) |
|---|---|
| REALD-30 (OHL) score[a,b] | 0.01 (–0.02, 0.05) |
| Race | |
| White (Ref) | 1.00 |
| African American | 0.25 (–0.12, 0.62) |
| American Indian/Alaska Native | –0.39 (–0.85, 0.07) |
| Age quintiles | 0.14 (0.02, 0.26) |
| Education level | –0.16 (–0.38, 0.05) |
| Dental use | –1.05 (–1.20, –0.90) |
| GSES score[b,c] | –0.18 (–0.22, –0.14) |

*Note.* CI = confidence interval; GSES = General Self-Efficacy Scale; OHL = oral health literacy; REALD-30 = Rapid Estimate of Adult Literacy in Dentistry; WIC = Supplemental Nutrition Program for Women, Infants, and Children. Estimates calculated by multivariate linear regression modeling. The sample size was n = 1280.
[a]The REALD-30 is a validated word recognition test in which scale score ranges from 0 (lowest literacy) to 30 (highest literacy).
[b]Estimate corresponds to a 1-unit increase.
[c]The GSES is a 10-item scale that is used to measure the construct of self-efficacy, which refers to one's coping ability across a wide range of demanding situations. The scale's scores range from 10 (lowest self-efficacy) to 40 (highest self-efficacy).

Conversely, others may benefit from behavior reinforcement and motivational interviewing,[61] a patient-centered, directive therapeutic technique designed to enhance readiness for change by helping individuals explore and resolve ambivalence[59] and potentially increase their coping skills.[61] Motivational interviewing has been used successfully for the treatment of health behavior–based problems,[62] and it has been recently tested in the dental arena as a strategy for caregivers to use in prevention of early childhood caries.[63] Stewart et al.[59] and other recent reports[64–66] described effective applications of such approaches in improving dental patients' knowledge, self-efficacy, and behaviors.

These results should be considered in light of the study's limitations. The data were collected from a nonprobability convenience sample of clients from North Carolina WIC clinics. Our sample characteristics prevent generalization of results beyond females enrolled in WIC and attending the specific clinics in North Carolina during the time of this study. Future research should draw from a population-based probability sample. REALD-30 has been validated in English only, so our recruitment was limited to English-speaking patients. Also, our measurement of OHL is based on a word recognition test.[37] Although word recognition instruments measure only selected aspects of literacy skills and are not comprehensive, comparable word recognition instruments have been used with success in medicine, and they are correlated strongly with reading fluency. Our initial investigations compared the REALD-30 to a dental functional health literacy test and found a high correlation between them.[67] More recent reports comparing functional literacy estimates with word recognition and numeracy assessments have also confirmed the high correlation between these measures.[68]

Although our participants were recruited from a nonprobability convenience sample of WIC clients in a single US state and thus may have limited external validity, we feel that this population is an important one to examine. WIC was established by the Food and Nutrition Service of the US Department of Agriculture to target low-income women, infants, and children who are at risk nutritionally. WIC's goal is to improve the health outcomes of its clients by providing nutritious foods, nutritional education, counseling, and medical or dental referrals to facilitate good health care during pregnancy, the postpartum period, infancy, and early childhood. WIC has a huge reach, serving more than 9.1 million individuals annually and more than one third of all infants born in the United States.[69] WIC is often the first contact that poor people have with the health care system. Because of its repeated contact with vulnerable populations, WIC is uniquely positioned to identify families with low health literacy.

To date, research in OHL has been based on only a few studies of care-seeking participants. This investigation is the first to our knowledge to report on the relationships among OHL, self-efficacy, DN, and self-reported OHS in a cohort of participants in a large public health program. On the basis of our findings, we advocate for the consideration of personality traits, such as self-efficacy, along with OHL as risk factors or screeners for poorer oral health outcomes and as important factors to consider when planning oral health intervention programs. ■

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## Contributors

J. Y. Lee oversaw the project, developed research aims, and assisted with data collection and data analysis. K. Divaris conducted the data analysis. A. D. Baker oversaw data collection and conducted interviews. R. G. Rozier and W. F. Vann Jr assisted with developing research aims. All authors participated in the writing of the article.

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## Human Participant Protection

This study protocol was approved by the biomedical institutional review board at the University of North Carolina at Chapel Hill.

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