

# Development and psychometric validation of a Health Literacy in Dentistry scale (HeLD)

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**Background:** Oral health literacy is emerging as a new public health challenge and poor oral health literacy is increasingly seen as an important predictor of poor oral health outcomes. Within Indigenous populations, there may be benefits to research in using a culturally acceptable, internally consistent and valid instrument to assess oral health literacy. We translated a general health literacy measure, the Health Literacy Management (HeLM) scale to make a dentally relevant scale; Health Literacy in Dentistry (HeLD). **Objective:** This study describes the development and assessment of the reliability and validity of the HeLD in an Indigenous Australian population. **Design and Methods:** The 29 item HeLD scale assesses the components of oral health literacy. The reliability and validity of the seven HeLD subscales were evaluated in a convenience sample of 209 Indigenous Australians with mean age 35 years (range 17–81) and of which 139 were female. **Results:** The scale was supported by exploratory factor analysis and established seven distinct and internally consistent domains of oral health literacy: Communication, Access, Receptivity, Understanding, Utilisation, Support and Economic Barriers (Cronbach's  $\alpha=0.91$ ). Discriminative ability was confirmed by HeLD associations with socio-demographic variables and self-reported health ratings in the expected direction. The convergent validity and predictive validity were confirmed by HeLD scores being significantly associated with toothbrush ownership, use of a toothbrush, time since last dental visit and knowledge of the effect of cordial on the teeth. **Conclusions:** The HeLD appears to be an internally valid and reliable instrument and can be used for measuring oral health literacy among rural Indigenous Australian adults.

**Key words:** oral health literacy, Indigenous Australians, internal consistency, validity, scale development

## Introduction

Health literacy is often defined as the degree to which an individual has the capacity to obtain, process or interpret and understand basic health information and services needed to make appropriate health decisions in ways that are health enhancing (Nielsen-Bohlman, 2004; Sihota and Lennard, 2004). Health literacy is crucial to health outcomes as it represents the cognitive and social skills which determine the motivation and ability of individuals to gain access to, understand and use information in ways which promote and maintain good health (Kanj and Mitic, 2009; Kickbusch, 2001). Adequate levels of health literacy are seen to provide individuals with protection against poor health outcomes, with populations displaying adequate levels of health literacy offering important population-level opportunities to consolidate and improve health. A growing body of evidence suggests that people without the skills or capacity to make sound health decisions in the context of everyday life are more vulnerable to poorer health outcomes (Kickbusch, 2001; Carmona, 2006).

A logical extension of the importance of health literacy is to demonstrate that oral health literacy is required to both promote oral health and prevent oral disease (USDHS, 2000). Richman and colleagues (2007) developed the Rapid Estimate of Adult Literacy in Dentistry (REALD), an instrument to measure dental health literacy, which was theoretically based on the

Rapid Estimate of Adult Health Literacy in Medicine (REALM). The REALD-30, a shortened version, was also developed and validated, with participants with poor oral health-related quality of life and poor self-rated oral health having low REALD-30 scores (Lee *et al.*, 2007). Additional oral health literacy instruments include a two-stage form of REALD (Stucky *et al.*, 2011) and the Test for Functional Health Literacy in Dentistry (ToFHLiD, Gong *et al.*, 2007). These oral health literacy instruments have been criticised for being narrow in their assessment of health literacy with declarations that a more relevant instrument is needed (Sabbahi *et al.*, 2009).

Oral health inequalities between Indigenous and non-Indigenous Australians appear to be widening, particularly among children (Jamieson *et al.*, 2006). Research has suggested that the complexity of both verbal and written oral health communications, particularly in the context of Indigenous populations who are already socially vulnerable, promotes substantial barriers to improving oral health (Horowitz and Kleinman, 2008). A large proportion of Indigenous Australians have poor oral health and many have poor oral health-related quality of life (Brennan *et al.*, 2007; Williams *et al.*, 2010).

Oral health literacy has become a new public health challenge for Indigenous oral health in Australia, yet has been little work done in this field. In 2008, the REALD-30 was used to measure oral health literacy among a group of rural-dwelling Indigenous Australians (Parker and Jamieson, 2010). However, this trial of the REALD-30

revealed that some participants felt a sense of discomfort completing the instrument due to feelings of being 'tested' and 'judged' (Parker *et al.*, 2012). A reliable, valid and culturally-acceptable instrument to assess oral health literacy among vulnerable populations was perceived by the researchers to be needed. Development of the Health Literacy in Dentistry scale (HeLD) was a key step to addressing concerns regarding cultural appropriateness.

The Health Literacy Measurement Scale (HeLMS) was used as a foundation for a theoretically driven instrument to measure oral health literacy. HeLMS takes a broad approach to measuring health literacy, addressing many of the limitations of other health literacy tools (Jordan, 2009). It aims to measure *an individual's ability to seek, understand and use health information to make appropriate health decisions* (Jordan, 2009). The HeLMS was developed using a health literacy conceptual framework developed from a patient perspective. The work from Jordan and colleagues (2009), in conceptualising health literacy from the patient perspective, identified eight key related abilities and a range of factors at the healthcare and broader community level that affected health literacy. This foundation was deemed important in the context of cultural appropriateness of an instrument to be administered in an Indigenous population (Jordan *et al.*, 2009).

The constructs represented in the HeLMS were perceived by the authors to be valid for use in a dental setting. These theoretical constructs were used in the development of the HeLMS, and were subsequently altered in this study to suit an oral health context without altering their underlying constructs or domains. We hypothesised that HeLD scores would significantly associate with key self-reported and self-rated health measures, toothbrush ownership and other oral health literacy measures; when a dentist was last seen and knowledge of the effects of cordial (a flavored sugar syrup mixed with water) consumption.

The aim of this study was to develop and validate a culturally-appropriate Health Literacy in Dentistry (HeLD) instrument for use amongst Indigenous Australians.

## Methods

This research was carried out during 2010 and comprised a battery of items in a questionnaire study of a convenience sample of Indigenous Australians aged 18 years or older residing in or around Port Augusta, a small town in South Australia. Participants were recruited using a variety of techniques successfully employed in previous investigations undertaken with this group (Parker and Jamieson, 2010). These techniques included: self-nomination, home visits, word of mouth, visits to community centres and referrals. Posters in community centres and advertisements on the local Indigenous radio station promoted the study. To ensure consistency in delivery, Indigenous project officers used a scripted method to introduce and administer the questionnaire. After being given written and verbal information about the study, participants gave written consent. Then, on completion of the questionnaire either independently by or through interview, participants received a \$20 supermarket gift voucher.

Ethical approval was granted by the Aboriginal Health Council of South Australia and the Human Research

Ethics Committee of the University of Adelaide. The Pika Wiya Board of Management, comprising Indigenous community members who govern the delivery of local health services, also gave approval for the study. The procedures for protecting participant privacy were described in the participants' information sheet.

An oral health literacy instrument, the Health Literacy in Dentistry (HeLD, Figure 1) was developed based on the constructs identified in the HeLMS. The conceptual framework for HeLD is underpinned by theoretical constructs which assume a person's ability to seek, understand and use oral health information is important in being able to access and benefit from oral health care services.

Face and content validity of the scale; the extent to which the HeLD instrument encompasses the relevant aspects of the concepts it aims to measure and the relevance of these aspects, was based on the judgments of oral health experts from the Australian Research Centre for Population Oral Health (ARCPHO) and the study's Indigenous reference group (Parker *et al.*, 2012). All sources indicated the HeLD adequately encompassed the domains under investigation and had a sufficient number of items. The HeLD items replicated the health literacy-related domains and constructs encompassed in the 29 items from HeLMS (Figure 1). Each of these domains was relevant for an oral health context and together they evaluated one dimension of general health literacy as theorised by Jordan (2009). The eight domains measured in the HeLMS consisted of five related to patients' ability to seek, understand and use health literacy, and three focused on broader factors that affect abilities. The focus of the 29 questions which constituted the HeLD was on 'difficulty experienced', with response options graded on a 5-point Likert-type scale ranging from 'Without any difficulty' to 'Unable to do'. Dentist-related responses (reworded from the original HeLMS term) to some questions of 'I don't go to the dentist' were coded as 'missing' in the analysis. Scores were coded 0 to 4, with high scores indicating high oral health literacy. The possible score range was 0–116.

Key behavioural data items that were hypothesised to be associated with HeLD scores in the Indigenous population, and hence with the ability to confirm the scale validity, include toothbrush ownership and toothbrush usage. Participants were asked if they owned a toothbrush and if they brushed yesterday with possible responses being *yes* or *no*, when they last saw a dentist with possible responses being to *less than a year ago* or *more than a year ago*.

Several non-behavioural variables were also used to determine the validity of the HeLD scale. Self-rated general health, self-rated oral health and self-reported oral health impact as measured by OHIP-14, a measure of oral health impact (Slade, 1994). These self-rated health measures quantify hypothesised outcomes of health literacy. Additionally a question about the oral health impact of cordials was asked with the offered responses being *good* or *bad*.

Items for the HeLD were selected for reliability by an assessment of intra-class correlation coefficients (ICC), while measures for internal consistency were determined by using exploratory factor analysis employing the principal axis components method with Kaiser normalisation

- R1. Are you able to find the energy to manage your dental or oral health?  
 R2. Are you able to pay attention to your dental or oral health needs?  
 R3. Are you able to make time for things that are good for your dental or oral health?  
 R4. Are you able to change your lifestyle to improve your dental or oral health?  
 R5. Are you able to find dental health information in a language you understand?  
 U6. Are you able to fill in dental forms eg enrolment forms?  
 U7. Are you able to read written information eg leaflets given to you by your dentist?  
 U8. Are you able to read dental or oral health information brochures left in dental clinics and waiting rooms?  
 S1. Are you able to take family or a friend with you to a dental appointment?  
 S2. Are you able to ask someone to go with you to a dental appointment?  
 S3. Are you able to ask family or friends for help to understand dental or oral health information?  
 F1. Are you able to pay to see a dentist?  
 F2. Are you able to afford transport to dental clinics?  
 F3. Are you able to pay for medication to manage your dental or oral health?  
 A1. Do you know where a dentist can be contacted?  
 A2. Do you know how to get a dentist's appointment?  
 A3. Do you know what to do to get a dentist's appointment?  
 A4. Do you know where you can see a dentist?  
 C1. Are you able to ask a dentist questions to help you understand dental information?  
 C2. Are you able to get the information you need when seeing a dentist?  
 C3. Are you able to follow up with a dentist to understand information about your dental health?  
 C4. Are you able to change to a different dentist to get better dental care?  
 C5. Are you able to get a second opinion about your dental health from a dental health professional?  
 C6. Are you able to look for a second opinion about your dental health from a dental health professional?  
 C7. Are you able to use information from a dentist to make decisions about your dental health?  
 X1. Are you able to discuss your dental or oral health with people other than a dentist?  
 X2. Are you able to follow instructions that a dentist gives you?  
 X3. Are you able to carry out instructions that a dentist gives you?  
 X4. Are you able to use advice from a dentist to make decisions about your dental health?

**Figure 1.** *The Health Literacy in Dentistry (HeLD) instruments 29 items*

followed by varimax rotation to inform scale construction (Costello and Osborne, 2005, p3). Both free and forced eight-factor solutions were tested as hypothesised from HeLMS. Listwise deletion for missing data was employed as there were few missing data. The quality of the factor analysis models was assessed using the Kaiser-Meyer-Olkin (KMO) test and Bartlett's test for sphericity. The KMO test measures the degree of multi-collinearity (based on partial correlations) between the included items, varies between 0 and 1 and should be greater than 0.5-0.6. Bartlett's test is a measure of the probability that the initial correlation matrix is an identity matrix and should be under 0.05. Sphericity testing demonstrates the suitability of the data for factor analysis. (Cabrera-Nguyen, 2010; Jakobsson, 2011).

Cronbach's  $\alpha$  and corrected item total correlations (CITCs) were used to assess the internal consistency of the instrument. Alpha, if deleted, was used for optimal subscale assessment and was determined for each item as a measure of overall item consistency. An appropriate level of reliability for research instruments is 0.80. A Cronbach's  $\alpha$  coefficient of 0.70 or higher is considered satisfactory (Nunnally and Bernstein, 1994; Rosenthal and Rosnov, 1991). A CITC value lower than 0.30 is recommended as the threshold for removing an item. Scree plots were generated and supported the factor analysis.

Convergent validity was measured using Pearson's  $r$  correlations both within scale components and between other health literacy measures to assess associations. The HeLD was compared with other self-rated and self-reported health measures using analysis of variance with

health literacy mean scores (HeLD) as the dependant variable and measures of associations tested using eta squared to determine the predictive and discriminant validity of the instrument.

Statistically significant differences in scale scores between relevant oral health literacy-related factors offer evidence of an instrument's ability to discriminate between groups. Oral health perceptions included self-rated general health, self-rated oral health and oral health impact as defined by the Oral Health Impact Profile (OHIP-14; Slade, 1997). Validity was evaluated by examining the extent to which certain sub-scales correlated to theoretically-related variables or the capacity of the HeLD to detect theoretically-defined associations (Comrey and Lee, 1992).

All data were analysed using SPSS for Windows v19.

## Results

Though 400 Indigenous adults completed the oral health literacy questionnaire, this study's sample was a randomly selected 209 of the 400 leaving the remainder available for later analysis in the development of a shortened sub-scale. The 209 participants had a median age of 35 years (range 17 to 81) with 67% being female. For 75% their highest educational attainment primary or high school and 78% were unemployed with 81% of the sample having a means-tested government health care card. Nearly half (44%) of participants reported five or more people staying in their house the previous night.

Table 1 presents the findings on the 29 items of the HeLD instrument: mean item scores, Chronbachs alpha for sub scales if an item was removed, corrected item-total correlations (CITCs), and both single factor and rotated factor loadings. Exploratory factor analysis extracted seven inter-correlated factors with eigenvalues >1 (Table 1), and all communalities from the analysis showed that the 209 sample size was adequate matching Cabera-Nguyen's (2010) recommended 200 subject minimum for scale development. The highest mean scores came from the Access domain.

To address the theoretical eight component structure proposed by HeLMS, a forced factor solution with varimax rotation with eigenvalues greater than 1 was performed and a seven item factor matrix was produced. Rotated matrix factor loadings indicated that all items designed to assess Receptivity loaded onto Factor 3, three of the four items assessing Understanding loaded onto Factor 4, all items designed to assess Finances loaded onto Factor 7, all items to assess Access loaded onto Factor 2, all items to assess Communication loaded onto Factor 1, all items to assess support loaded onto Factor 6 and three

**Table 1.** Item descriptives and reliability and factor analysis results

HeLD subscale and item	Mean	Reliability		Single factor loading	Rotated loadings from the seven factor solution						
		Alpha if deleted <sup>‡</sup>	CITC <sup>†</sup>		1	2	3	4	5	6	7
<i>Receptivity</i>											
HeLD R1	3.13	0.75	0.66	0.69	0.22	0.08	<b>0.80</b>	-0.02	-0.02	0.09	-0.03
HeLD R2	3.12	0.73	0.71	0.70	0.22	-0.01	<b>0.80</b>	0.09	0.03	0.09	0.11
HeLD R3	3.14	0.76	0.64	0.67	0.18	-0.03	<b>0.79</b>	-0.01	0.02	0.17	0.12
HeLD R4	3.16	0.72	0.61	0.62	0.02	0.20	<b>0.73</b>	0.18	0.20	0.13	0.04
HeLD R5	3.15	0.90	0.34	0.52	0.02	-0.09	<b>0.53</b>	0.47	-0.02	0.06	0.09
<i>Understanding</i>											
HeLD U2	3.36	0.73	0.73	0.78	0.18	0.10	0.03	<b>0.84</b>	0.09	0.08	0.15
HeLD U3	3.51	0.70	0.80	0.87	0.12	0.13	0.00	<b>0.91</b>	0.12	0.07	0.10
HeLD U4	3.52	0.72	0.75	0.83	0.14	0.21	0.02	<b>0.85</b>	0.20	0.05	0.07
<i>Support</i>											
HeLD S1	3.48	0.63	0.67	0.74	0.30	0.03	0.15	0.08	0.00	<b>0.82</b>	0.08
HeLD S2	3.53	0.54	0.75	0.79	0.23	0.06	0.18	0.12	0.02	<b>0.84</b>	0.09
HeLD S3	3.55	0.82	0.45	0.59	0.03	0.20	0.19	0.01	0.21	<b>0.64</b>	0.23
<i>Economic Barriers</i>											
HeLD F1	2.60	0.66	0.57	0.68	0.15	-0.10	0.07	0.09	0.02	0.06	<b>0.80</b>
HeLD F2	2.12	0.75	0.50	0.63	-0.00	0.21	0.13	0.14	-0.02	0.13	<b>0.70</b>
HeLD F3	3.37	0.57	0.65	0.73	0.18	0.05	0.07	0.10	0.06	0.03	<b>0.81</b>
<i>Access</i>											
HeLD A1	3.37	0.87	0.65	0.64	0.35	<b>0.70</b>	-0.03	0.06	0.03	0.03	0.19
HeLD A2	3.62	0.82	0.75	0.75	0.14	<b>0.81</b>	0.11	0.18	0.17	-0.01	-0.19
HeLD A3	3.59	0.81	0.76	0.76	0.20	<b>0.81</b>	0.11	0.18	0.17	-0.01	-0.04
HeLD A4	3.62	0.82	0.75	0.75	0.14	<b>0.84</b>	0.04	0.07	-0.06	0.13	0.06
<i>Communication</i>											
HeLD C1	3.61	0.92	0.75	0.71	<b>0.63</b>	0.49	0.12	0.16	0.24	0.03	0.05
HeLD C2	3.49	0.91	0.77	0.75	<b>0.71</b>	0.47	0.11	0.14	0.24	0.01	0.06
HeLD C3	3.47	0.91	0.79	0.76	<b>0.73</b>	0.35	0.16	0.16	0.30	0.08	0.04
HeLD C4	3.19	0.92	0.73	0.67	<b>0.74</b>	0.31	0.18	0.06	0.16	0.03	0.05
HeLD C5	3.01	0.91	0.76	0.79	<b>0.81</b>	0.07	0.19	0.05	0.15	0.22	0.19
HeLD C6	3.06	0.91	0.83	0.83	<b>0.78</b>	0.09	0.20	0.11	0.11	0.26	0.24
HeLD C7	3.38	0.91	0.82	0.78	<b>0.79</b>	0.11	0.17	0.15	0.23	0.22	0.10
<i>Utilisation</i>											
HeLD X1	3.26	0.91	0.38	0.56	-0.09	0.13	0.05	0.12	<b>0.56</b>	0.43	0.25
HeLD X2	3.61	0.67	0.79	0.87	0.44	0.04	0.09	0.17	<b>0.78</b>	0.08	0.01
HeLD X3	3.61	0.67	0.77	0.81	0.41	0.08	0.08	0.17	<b>0.81</b>	-0.05	0.01
HeLD X4	3.61	0.74	0.65	0.71	0.45	0.13	0.12	0.12	<b>0.75</b>	0.01	0.03
Eigenvalue variance (%)					10.4	2.7	2.35	2.03	1.70	1.49	1.13
Cumulative variance (%)					17.7	12.2	10.3	10.2	9.1	8.0	7.5
Internal reliability					17.7	30.0	40.3	50.5	59.7	67.8	75.3
Cronbach's $\alpha$			0.839		0.94	0.87	0.84	0.86	0.94	0.75	0.75
Kaiser-Meyer-Olkin's test:			0.839								
Bartlett's test of sphericity			<0.011								

Note: **Bold** typeface values indicate the highest exploratory factor loadings.

<sup>‡</sup> Cronbach's alpha if deleted calculated on four items for each sub scale.

<sup>†</sup> CITC = corrected item-total correlation.

of the four items to assess Utilisation loaded onto Factor 5. The eight factor solution proposed by the HeLMS was not evident in the factor analysis, however the overall theoretical structures related to health literacy remained coherent. The eighth factor in HeLMS fully loaded onto the communication factor in the HeLD. The variance reported for each subscale was spread across each latent variable indicating distinctly relevant contributions across all measured domains: Receptivity, 10%; Understanding, 10%; Support, 8%; Economic Barriers, 8%; Access, 12%; Communication, 18%; and, Utilisation, 9%. ICCs (single measures) were 0.65 (95% CI 0.51, 0.75). On the basis of the results for item responses, reliability analysis, factor analysis and scree plot interpretation, seven factors were confirmed and retained for use in the final HeLD scale.

Overall mean scores for all items ranged from 2.12 - 3.62 (possible range 0–4) with the lack of any floor effect indicating an overall endorsement for the items (Lewis-Beck *et al.*, 2004).

Reliability analyses were conducted for all items, subscale and full scale. Internal consistency was high, with an overall Cronbach's  $\alpha$  of 0.91, ranging across subscales from 0.75 for the Support and Economic Barriers subscale, 0.84 for the Receptivity subscale, 0.86 for the Understanding subscale, 0.87 for the Access subscale,

to 0.94 for both the Communication and Utilisation subscales. No subscale was under the recommended 0.70 score for deletion (Nunnally and Bemerton 1994). CITCs were reasonably high for all items and ranged from 0.34 to 0.83 but as all CITC values were higher than 0.30, the recommended minimum threshold for removing items, and all factors retained at least 3 items, (Carmines and Zeller, 1979; Costello and Osborne 2005) all were retained in the scale.

The correlations between each latent variable which constitute the seven domains are shown in Table 2. Item-subscale correlations ranged from 0.19 to 0.5 indicating the multidimensionality of the scale (correlations are low but all significant). Overall mean HeLD subscale scores were: Communication 23.5, se 6.1; Access 14.2, se 3.1; Receptivity 12.5, se 3.5; Understanding 13.9, se 3.3; Utilisation 14.1, se 2.9; Support 10.6, se 2.5; and Economic barriers 6.4, se 3.3. Table 3. This indicates that the dimensions are measuring empirically- and dimensionally-distinct concepts. Exploratory factor analysis with unrotated principal extraction of factors having eigenvalues greater than one revealed a single factor solution which accounted for 73% of the variance, showing strong relatedness of all the variables in the instrument.

**Table 2.** Associations (Pearson's  $r$  correlations) between the seven components of the HeLD scale

<i>Component</i>	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>
1. Receptivity	-						
2. Understanding	<b>0.28</b>	-					
3. Support	<b>0.30</b>	<b>0.26</b>	-				
4. Economic barriers	<b>0.26</b>	<b>0.25</b>	<b>0.23</b>	-			
5. Access	<b>0.21</b>	<b>0.35</b>	<b>0.22</b>	<b>0.19</b>	-		
6. Communication	<b>0.39</b>	<b>0.47</b>	<b>0.38</b>	<b>0.34</b>	<b>0.47</b>	-	
7. Utilisation	<b>0.34</b>	<b>0.49</b>	<b>0.35</b>	<b>0.22</b>	<b>0.26</b>	<b>0.55</b>	-

Correlations all significant at the 0.01 level

**Table 3.** Mean (standard error) scores for HeLD and its subscales by self-rated and self-reported health

	<i>Subscales</i>							
	<i>HeLD</i>	<i>Communi- cation</i>	<i>Access</i>	<i>Receptivity</i>	<i>Underst- anding</i>	<i>Utilisation</i>	<i>Support</i>	<i>Economic barriers</i>
	<i>mean (se)</i>	<i>mean (se)</i>	<i>mean (se)</i>	<i>mean (se)</i>	<i>mean (se)</i>	<i>mean (se)</i>	<i>mean (se)</i>	<i>mean (se)</i>
<i>Would you rate your general health as:</i>								
Excellent to good †	<b>98.7 (1.2)*</b>	24.0 (0.4)	14.2 (0.2)	<b>12.9 (0.2)**</b>	<b>14.2 (0.2)*</b>	<b>14.4 (0.2)*</b>	<b>10.8 (0.1)*</b>	<b>6.7 (0.2)*</b>
Fair or Poor	89.9 (2.7)	22.3 (1.0)	14.2 (0.4)	11.4 (0.5)	13.0 (0.65)	13.3 (0.4)	9.7 (0.1)	5.5 (0.4)
<i>Would you rate your oral health as:</i>								
Excellent to good †	<b>98.0 (1.1)**</b>	<b>24.0 (0.4)*</b>	14.2 (0.2)	<b>13.1 (0.2)**</b>	14.0 (0.2)	14.2 (0.2)	<b>10.8 (0.1)**</b>	<b>6.7 (0.2)**</b>
Fair, poor	86.5 (4.3)	20.7 (1.8)	14.2 (0.3)	9.0 (0.8)	13.1 (0.8)	13.5 (0.6)	9.0 (0.7)	4.7 (0.7)
<i>OHIP-14 items rated 'very often' or 'fairly often' †</i>								
None	<b>98.9 (1.5)*</b>	24.0 (0.5)	14.2 (0.3)	13.0 (0.3)	<b>14.4 (0.2)*</b>	14.2 (0.2)	10.8 (0.3)	<b>7.0 (0.3)*</b>
One or more	94.1 (1.7)	23.0 (0.6)	14.2 (0.3)	12.1 (0.3)	13.4 (0.3)	14.0 (0.2)	10.3 (0.3)	6.0 (0.3)
Overall	96.5 (16.0)	23.5 (6.1)	14.2 (3.1)	12.5 (3.5)	13.9 (3.3)	14.1 (2.9)	10.6 (2.5)	6.4 (3.3)

ANOVA \* $p < 0.05$ , \*\*  $p < 0.01$

† Excellent, very good or good

‡ Calculated as the prevalence of people reporting an OHIP-14 question as 'very often' or 'fairly often'.

**Table 4.** HeLD and subscales associations (Pearson's r coefficients) with key literacy outcomes

<i>Literacy outcomes</i>	<i>HeLD</i>	<i>HeLD subscales</i>						
		<i>Comm- unication</i>	<i>Access</i>	<i>Recept- ivity</i>	<i>Under- standing</i>	<i>Utilisa- tion</i>	<i>Support</i>	<i>Economic barriers</i>
Toothbrush ownership	<b>0.14**</b>	<b>0.21**</b>	0.08	0.07	<b>0.15*</b>	<b>0.15*</b>	0.04	0.09
Did you brush yesterday	<b>0.22*</b>	0.03	0.06	<b>0.20**</b>	0.11	0.05	-0.00	<b>0.20**</b>
When did you last see a dentist?	<b>0.13*</b>	0.09	<b>0.17*</b>	0.04	0.10	0.13	0.04	0.10
Do you think cordial is good for your teeth?	<b>0.14*</b>	<b>0.16*</b>	0.06	0.02	<b>0.17**</b>	-0.05	-0.04	<b>0.23**</b>

\*p<0.05, p<0.01\*\*

Predictive ability was confirmed with oral health perceptions, with higher HeLD scores associated with better self-rated general health for overall HeLD, receptivity, support and economic barriers. 'Excellent, very good or good' self-rated oral health for support and Economic Barriers and no oral health impact as assessed by OHIP-14 for overall HeLD, Communication, Receptivity, Utilisation, Support and Economic Barriers (Table 3).

Evidence for convergent validity was obtained from HeLD scores being significantly associated with toothbrush ownership for total HeLD mean scores and Economic Barriers, Communication, Understanding and Utilisation toothbrush use with total HeLD, Receptivity, and last seeing a dentist less than one year ago with total HeLD and Access subscale and knowing cordial is bad for teeth was significantly associated with total HeLD Communication, Understanding and Economic Barriers subscales (Table 4).

## Discussion

The HeLD demonstrated acceptable internal consistency and evidence of validity in a moderate-sized convenience sample of Indigenous Australian adults. One of the goals of factor analysis was to determine whether we could extract the underlying dimensions that would support our conceptual model defined by HeLMS and this has been shown to be conceptually appropriate overall.

One thing to consider in regard to the transferability of the HeLD is the lack of significant differences in some of the subscales. In circumstances where local level service delivery operates under different constraints, these sub-scales may show stronger or weaker associations. In Australia, these domains have less rigour due to government policies and interventions which may serve to alleviate differences in constraints to access and utilisation. For example, many of our participants were able to receive free dental care through the services offered by the local Aboriginal health clinic potentially explaining the lack of differentiation in Access or Utilisation subscales. The lack of significance in discrimination of some of the subscales with self-rated general and oral health outcomes makes theoretical sense when viewed in an Australian context. Government funding and support of Indigenous health services theoretically removes access and financial barriers as potential predictor variables when discriminating between outcomes. The results

potentially enable the instrument to be used across a variety of policy settings whilst still allowing reliable international comparisons to be made.

The findings indicate that our conceptualisation of the theoretical coherency and multidimensionality of the domains proposed by HeLMS was valid. Construct validity for the HeLD is confirmed for this population. Validity for the HeLD was demonstrated by internal reliability (alpha), for all subscales and overall and reached well above the recommended level for clinical use of a scale. HeLD was able to discriminate between groups, with significant differences in three oral health perception factors (self-rated general health, self-rated oral health and oral health impact). Validity was affirmed by associations in the expected direction between HeLD scores and the key oral health outcome measures (toothbrush ownership, toothbrush use, use of dental services and knowledge of cordials' effect on oral health).

One of the study limitations was the convenience nature of the sample meaning that the psychometric properties of the instrument may alter in a larger, more representative sample. Our study was also based in a regional location, meaning the characteristics of our sample may differ from their more metropolitan-dwelling counterparts. In future studies it would be valuable to test the instrument on a representative sample of Indigenous Australians, as well as with other marginalised and mainstream groups both in Australia and internationally. Lack of test-retest reliability measures due to the cross-sectional nature of the data was a limitation. An important next step will be assessing the external reliability of the instrument in other Indigenous and non-Indigenous populations. The relative homogeneity of the population used to test the HeLD may have limited the capacity for the predictive potential of the instrument.

We envisage a number of potential uses for this instrument. Firstly, public dental services might use it in the context of health service evaluation to measure potential barriers to service delivery and uptake of services with the expectation of improving for example, attendance for oral care and potentially oral health outcomes for communities. Also oral and allied health practitioners may use it to conduct oral health needs assessments of the communities and potentially the individuals, they service and finally, HeLD might be used in research studies which aim to explore the determinants of oral health and develop more concise explanatory models for oral health outcomes.

## Conclusion

We established a seemingly reliable and valid instrument for investigating oral health literacy among rural Indigenous Australians. A culturally relevant oral health literacy scale was seen as an important step to more accurately measuring enablers and barriers to better oral health for Indigenous Australians at both research and clinical levels. The HeLD accounts for the multidimensionality of oral health literacy by encompassing the domains of communication, access, receptivity, understanding, utilisation, support and economic barriers. It is hypothesised to be culturally-acceptable among our group and therefore may be of use, but not limited to, other vulnerable populations. Future work with the HeLD in these populations will be confirmatory. As analysis shows a correlation between the scale and assumed oral health literacy-related outcomes, the instrument may be useful for determining the areas of most need for both communities and individuals.

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## References

- Brennan, D.S., Roberts-Thomson, K.F. and Spencer, A.J. (2007): Oral health of Indigenous adult public dental patients in Australia. *Australian Dental Journal* **52**, 322-328.
- Cabrera-Nguyen, P. (2010): Author guidelines for reporting scale development and validation results in the Journal of Society for Social Work and Research. *Journal of Society for Social Work and Research* **1**, 99-103.
- Carmines, E.G. and Zeller, R.A. (1979): *Reliability and validity assessment*. London: Sage.
- Carmona, R.H. (2006): Health literacy: a national priority. *Journal of General Internal Medicine* **21**, 803.
- Comrey, A.L. and Lee H.B. (1992): *A first course in factor analysis, 2<sup>nd</sup> ed.* Hillsdale, NJ: Lawrence Erlbaum Associates.
- Costello, A.B. and Osbourne, J.W. (2005): Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. *Practical Assessment, Research & Evaluation* **10**, 7. <http://pareonline.net/getvn.asp?v=10&n=7>
- Gong, D.A., Lee, J.Y., Rozier, R.G., Pahel, B.T., Richman, J.A. and Vann Jr., W.F. (2007): Development and testing of the Test of Functional Health Literacy in Dentistry (TOFHLID). *Journal of Public Health Dentistry* **67**, 105-112.
- Horowitz, A. M. and Kleinman, D. V. (2008): Oral health literacy: the new imperative to better oral health. *Dental Clinics of North America* **52**, 333-344.
- Jakobsson, U. (2011): Testing construct validity of the 13-item sense of coherence scale in a sample of older people. *The Open Geriatric Medicine Journal* **4**, 6-13.
- Jamieson, L.M., Armfield, J.M. and Roberts-Thomson, K.F. (2006): Oral health inequalities among indigenous and non-indigenous children in the Northern Territory of Australia. *Community Dentistry and Oral Epidemiology* **34**, 267-276.

- Jordan, J.E., Buchbinder, R. and Osborne, R.H. (2009): Conceptualising health literacy from the patient perspective. *Patient Education and Counseling* **79**, 36-42.
- Jordan, J.E. (2009): Thesis: *Conceptualising and measuring health literacy from the patient perspective*. Department of Medicine (RMH/WH). Melbourne: University of Melbourne. <http://repository.unimelb.edu.au/10187/6776>
- Kanj, M. and Mitic, W. (2009): *Health Literacy and Health Promotion*. Geneva: World Health Organization.
- Kickbusch, I.S. (2001): Health literacy: addressing the health and education divide. *Health Promotion International* **16**, 289-297.
- Lee, J.Y., Rozier, G., Lee, S., Bender, D. and Ruiz, R.E. (2007): Development of a Word Recognition Instrument to Test Health Literacy in Dentistry: The REALD-30 – A brief Communication. *Journal of Public Health Dentistry* **67**, 94-98.
- Lewis-Beck, M.S., Bryman, A. and Liao, T.F. (2004): *The SAGE Encyclopedia of Social Science Research Methods*. Thousand Oaks, CA: Sage. <http://dx.doi.org/10.4135/9781412950589>
- National Institute of Dental and Craniofacial Research, National Institutes of Health, US Public Health Service, Department of Health and Human Services (2005): The invisible barrier: Literacy and its relationship with oral health. A report of a workgroup sponsored by the National Institute of Dental and Craniofacial Research, National Institutes of Health, US Public Health Service, Department of Health and Human Services. *Journal of Public Health Dentistry* **65**, 174-182.
- Nielsen-Bohlman, L.T., Panzer, A.M. and Kindig, D.A. (2004): *Health Literacy: a prescription to end the confusion*. Washington DC: National Academies Press.
- Nunnally, J.C. and Bernstein I.H. (1994): *Psychometric Theory*. New York: McGraw-Hill.
- Parker, E.J., Misan, G., Chong, A., Mills, H., Roberts-Thomson, K., Horowitz, A.M. and Jamieson, L.M. (2012): An oral health literacy intervention for Indigenous adults in a rural setting in Australia. *BMC Public Health* **12**, 461.
- Parker E.J. and Jamieson, L.M. (2010): Associations between indigenous Australian oral health literacy and self-reported oral health outcomes. *BMC Oral Health* **10**, 3.
- Richman, J.A., Lee, J.Y., Rozier, R.G., Gong, D.A., Pahel, B.T. and Vann Jr., W.F. (2007): Evaluation of a word recognition instrument to test health literacy in dentistry: The REALD-99. *Journal of Public Health Dentistry* **67**, 99-104.
- Rosenthal, R. and Rosnow, R.L. (1991): *Essentials of behavioural research: methods and data analysis*. Boston: McGraw-Hill.
- Sabbahi, D.A., Lawrence, H.P., Limeback, H. and Rootman, I. (2009): Development and evaluation of an oral health literacy instrument for adults. *Community Dentistry and Oral Epidemiology* **37**, 451-462.
- Sihota, S. and Lennard, L. (2004): *Health literacy: being able to make the most of health*. London: National Consumer Council.
- Slade, G.D. (1997): Derivation and validation of a short-form oral health impact profile. *Community Dentistry and Oral Epidemiology* **25**, 284-290.
- Stucky, B.D., Lee, J.Y., Lee, S.Y. and Rozier, R.G. (2011): Development of the two-stage rapid estimate of adult literacy in dentistry. *Community Dentistry and Oral Epidemiology* **39**, 474-480.
- United States Department of Health and Human Services (2000): *Healthy People 2010: Understanding and Improving Health, 2<sup>nd</sup> ed.* Washington, DC: US Government Printing Office.
- Williams, S.D, Parker, E.D. and Jamieson, L.M. (2010): Oral health-related quality of life among rural-dwelling indigenous Australians. *Australian Dental Journal* **55**, 170-176.