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Different dimensions of oral health literacy are associated with social determinants of health in Brazilian adults

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Abstract: Social determinants of health (SDH) are strongly associated with oral health outcomes, and oral health literacy (OHL) is a potential factor that can modify this association. This study evaluated the association between SDH and OHL, including functional and interactive dimensions of OHL. The cross sectional study was conducted with 354 adults recruited from public dental clinics in southern Brazil. Functional OHL was measured using the Brazilian version of the Rapid Estimate of Adult Literacy in Dentistry (BREALD-30) and the Health Literacy Dental Scale (HeLD-14), for the evaluation of interactional OHL. SDH was evaluated through a structured questionnaire, and economic class was determined based on the Brazilian Economic Classification Criteria. The statistical analysis involved bivariate and multivariate Poisson regression with robust variance (α=0.05) to estimate rate ratios (RR) and 95% confidence intervals (CI). Among the 354 participants, 284 (80.2%) were women and the mean age was 22.9 ± 4.9 years. The median BREALD-30 score was 24 (1st/3rd quintile: 20/27) and the median HeLD-14 score was 45 (1st/3rd quintile: 37/50). Most participants had up to eight years of schooling (71.5%) and belonged to the "C" Economic Class or lower (94.1%). The multiple regression analysis showed that schooling and economic class were associated with the BREALD-30 and HeLD-14 scores, income and age were associated with the HeLD-14 score, and marital status and occupation were associated with the BREALD-30 score. Different dimensions of OHL were associated with SDH in Brazilian adults. This aspect should be incorporated into strategies for improving OHL levels in individuals or populations.

Keywords: Literacy; Health Literacy; Socioeconomic Factors; Oral Health.

Introduction

The definition of social determinants of health (SDH) adopted by the World Health Organization (WHO) encompasses a set of social conditions in which people live and work. The WHO emphasizes the importance of such determinants to the health status of individuals and populations as well as the need to combat health inequities generated by these

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determinants.[1] Depending on their socioeconomic position, individuals are exposed to different SDH.[2] Studies have shown that oral diseases are more prevalent and severe in socially underprivileged groups.[3-5] Thus, the social situation of an individual or population can determine oral health disparities, such as dental caries,[3] periodontal disease,[4] and oral cancer.[5]

To advance the health equity agenda, it is fundamental for socially underprivileged groups to learn to exercise control over the factors that mold their health and to make adequate decisions regarding health care.[6] Oral health literacy is 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".[7] Lower oral health literacy (OHL) has been associated with worse oral health outcomes, such as a greater number of missing teeth,[8] poorer periodontal status[9] and a higher frequency of dental caries.[10]

The concept of oral health literacy is a complex and difficult measure because it is multidimensional.[11] Several instruments have been proposed to assess different dimensions of OHL, such as reading and listening skills, adequate decision-making in oral health, and task performance skills.[12] The Rapid Estimate of Adult Literacy in Dentistry (REALD-30)[13] and the Health Literacy in Dentistry Scale (HeLD-14)[14] are among the instruments used to assess OHL. REALD-30 is a dental word recognition instrument and consists of 30 words related to oral health listed in ascending order of difficulty that are read aloud to the interviewer. The objective is to determine the individual's basic reading skills and the ability to recognize words related to oral health[13] that are also related to the concept of functional literacy.[15] Health Literacy Dental Scale, in turn, measures broader aspects related to health literacy[14] and assesses personal skills that can be used in everyday situations from interaction with information sources known as interactive literacy.[15] The short-form Health Literacy Dental scale consists of 14 items distributed across seven conceptual domains and provides more comprehensive data on OHL, including an individual's ability to perform specific tasks.[14] Both instruments have been translated and validated for Brazilian Portuguese.[16,17] The concomitant use of different dimensions allows a more comprehensive and in-depth assessment of the concept of oral health literacy.

As SDH are strongly associated with oral health outcomes, it is important to identify the factors involved in this association. A better understanding of the association between OHL and SDH will allow the adoption of strategies for overcoming barriers imposed by different levels of literacy.[18] Furthermore, studies that access the relationship between literacy and SDH should include various dimensions of OHL. Most studies focus on measuring OHL based on reading and writing skills, referred to as functional literacy.[15] However, other aspects of literacy such as the dimension of interaction should be addressed. As SDH changes involving all sectors and civil society are more complex,[1] assessing the relationship between the different dimensions of OHL and SDH can indicate strategies for OHL's improvement.

Although some studies have found an association between OHL and level of schooling,[19] race/ethnicity,[19] number of residents in the household,[20] occupation and income,[21] other studies that have conducted a more complex analysis have found an association between SDH and OHL in a sample of adolescents[22] and among caregivers of children aged 6 to 12 years.[23] These studies consistently find that schooling is associated with OHL even after adjusting for other social determinants.[22,23] However, divergent results are found regarding the association between other social determinants and OHL in these previous studies.[22,23] In addition, the inclusion of different instruments that measure OHL has not yet been explored. Thus, there is a need for further investigations, especially considering the multidimensionality of OHL.

The aim of the present study was to evaluate, through multivariate analysis approach, the relationship between SDH and the functional and interactive dimensions of OHL in a Brazilian population. Our hypothesis is that OHL is associated with SDH and that this association may vary according to the dimensions of OHL.

Methodology

Ethical aspects

This study was conducted in accordance with the ethical precepts of the Declaration of Helsinki and received approval from the Human Research Ethics Committee of the Federal University of Paraná (process number: 82921318.0.3002.0101). All volunteers signed a statement of informed consent to participate in the study.

Study population and sampling

The sample consisted of adults from both sexes, recruited from one dental clinic of the Federal University of Paraná and two primary care units in Curitiba, state of Paraná, Brazil. According to the most recent census conducted by the Brazilian Institute of Geography and Statistics, the city had 1,751,907 residents in 2010, with the current population estimated at 1,933,105. The Municipal Human Development Index is 0.823, which is considered high and places the city in tenth place in the ranking of Brazilian cities.[24]

Data collection was performed from August 2018 to March 2019. Inclusion criteria were participants in any phase of dental treatment, were over 18 years of age, literate, and were native speakers of Brazilian Portuguese. Individuals with reported hearing or vision problems and those older than 80 years were excluded based on the criteria for the administration of the Brazilian version of the Rapid Estimate of Adult Literacy in Dentistry (BREALD-30).[16] Participants who met the inclusion criteria were invited to participate in this study until the proposed sample was reached.

The sample size was calculated based on the estimated average obtained from a pilot study. The standard deviation (SD) in the BREALD-30 score was 4.624. Considering an error of 0.5 and a significance level of 5%, the minimum sample size was set at 329. For the Health Literacy Dental Scale (HeLD-14), the SD was 19.97. Considering an error of 1.5 and a 5% significance level, the minimum sample was 205 participants. As the minimum sample was larger based on the BREALD-30 score, 329 was considered the minimum sample size, to which 20% was added to compensate for possible dropouts, resulting in a maximum sample of 394. Participants were included in the study through convenience sampling.

Pilot study

In a pilot study, the questionnaire specifically designed for this study was administered to 24 parents or guardians of children enrolled in the Pediatric Dentistry Clinic of Federal University of Paraná, Brazil. The aim of this pilot study was to determine the applicability of the questionnaire in obtaining data in line with the objectives of the study. The participants of the pilot study did not participate in the main study. The results of this study showed that no changes to the proposed methods were necessary. The pilot study was carried out from July to August 2018.

Socioeconomic and demographic data

Socioeconomic and demographic data were collected using a questionnaire tested in a pilot study. The demographic characteristics were age, sex, marital status (single, married/stable union, separated/divorced/widowed), and number of residents in the household. The socioeconomic data were occupation, schooling (illiterate, incomplete primary school, complete primary school, incomplete middle school, complete middle school, incomplete high school, complete high school), and family income. The economic classification was based on the criteria of the Brazilian Association of Research Companies,[25] which is a standardized socioeconomic classification based on households, and individuals are categorized in classes according to purchasing power. Points are attributed on a checklist, including schooling of the head of the household, ownership of goods (car, dishwasher, refrigerator, freezer, washing machine, DVD player, microwave oven, motorcycle, clothes dryer), whether the street where the individual lives is paved, and connection to the sewage system in the house. Scores are attributed to each item and individuals are categorized into five economic classes: A (45 to 100 points), B1 (38 to 44 points), B2 (29 to 37 points), C1 (23 to 28 points), C2 (17 to 22 points), and D/E (0 to 16 points).

Oral health literacy

Brazilian Rapid Estimate of Adult Literacy in Dentistry (BREALD-30)

The BREALD-30 consists of a list of 30 words related to oral health arranged in increasing order of difficulty, which are read aloud to the interviewer[13]. Correctly pronounced words receive a score of 1 and incorrectly pronounced words, are scored zero. The final score ranges from 0 (low OHL) to 30 (high OHL). In a private room, participants were asked to read aloud the words related to dentistry in ascending order of difficulty to a trained researcher according to the proposed method.[13]

Before applying the instrument, one of the researchers (HHK) underwent training and calibration using videos that had been used during the translation and validation of the instrument to Brazilian Portuguese,[15] according to the criteria established by Vilella et al.[26] The reliability of the method was analyzed using the kappa coefficient for the analysis of the number of correctly and incorrectly pronounced words and the intraclass correlation coefficient (ICC) considering the total score of each video. The inter- and intra-examiner kappa coefficients were 0.924 and 0.937, and the inter- and intra-examiner ICC values were 0.986 and 0.923, respectively. All coefficients indicated an excellent level of agreement.[27]

Health Literacy Dental Scale (HeLD-14)

HeLD-14 consists of 14 items distributed among conceptual domains: 1. Receptivity ("Are you able to pay attention to dental health needs/ make time to do things that are good for your dental health"); 2. Understanding ("Are you able to fill out dental forms/ read dental or oral health information brochures available in dental clinics and waiting rooms"); 3. Utilization ("Are you able to carry out instructions that a dentist gives you/ use advice from a dentist to make decisions about your dental health"); 4. Economic barriers ("Are you able to pay for dental visits/ pay for dental medications?"; 5. Access ("Do you know how to get a dental appointment/ Do you know what to do to get a dental appointment?"); 6. Communication ("Are you able to get a second opinion about your dental health from a dental health professional/ use information from a dentist to make decisions about your dental health"); and 7. Support ("take a family member or a friend with you to a dental appointment/ ask for support to a dental appointment"). The response options indicate the different degrees of difficulty in performing each task and include: I would not be able to perform the task; I would perform it with considerable difficulty; I would perform it with moderate difficulty; I would perform it with a little difficulty; or I would perform it with no difficulty[17]. The score ranges from 0 to 56, with higher scores revealing higher OHL. The instrument is self-applicable, and the data collection took place in the waiting room before dental treatment in a room separated from other patients, in order to maintain the privacy of the participants and guarantee the confidentiality of the responses.

Statistical analysis

For the descriptive analysis, the quantitative variables were expressed as class intervals for age, *per capita* household monthly income, and BREALD-30 and HeLD-14 scores. The qualitative variables were expressed as absolute and relative frequencies. Univariate and multivariate Poisson regression analyses with robust variance were performed to estimate rate ratios (RR) and respective 95% confidence intervals (CI). Oral health literacy, measured by the BREALD-30 and HeLD-14 scores, was used as a count outcome. The independent variables were categorized into: sex (male; female), marital status (other; married/stable union), per capita income (categorized based on the median as < US$142 and ≥ US$142), number of residents in the household (up to four; five or more), schooling (> eight years; ≤ eight years of study), economic classification (Class B or higher; Class C or lower), and whether the individual works in the health field (yes; no).

Stepwise forward selection was used for the modeling process. All independent variables with a p-value < 0.20 in the univariate analysis were selected and those that remained significant ($p < 0.05$) after the adjustments were maintained in the final model. The goodness-of-fit of the model was

evaluated using Pearson's chi-square test. The degree of multicollinearity among the variables in the final model was determined using the variance inflation factor (VIF), with VIF > 10 indicative of significant multicollinearity.[28] The analyses were performed with the STATA software version 12.0 (StataCorp LP, College Station, United States of America), with the level of significance set to 5%.

Results

A total of 354 individuals participated in the present study (response rate: 89.9%). Forty individuals refused to participate in the study. Table 1 displays the characteristics of the study population. The mean age of the participants was 22.98 years (standard deviation [SD] = 4.914; range:18–65 years) and most of them were between 30–42 years old. The mean monthly per capita income was US$ 180.07 (SD = US$ 180.97) at the time of the study, with most participants having a mean monthly per capita income of less than US$ 496.12. Most participants had more than eight years of schooling (71.5%) and were in Economic Class C or lower (94%). The mean BREALD-30 score was 22.9 (SD = 4.9) and the median score was 24 (range: 4–30). The mean HeLD-14 score was 42.2 (SD = 0.3) and the median was 45 (range: 8–56).

Table 2 shows the results of the univariate and multivariate Poisson regression analyses for the determination of associations between the variables of interests and the BREALD-30 scores. The multivariate model revealed higher OHL scores among participants who were married or in stable union (RR_a = 1.06; 95%CI: 1.01–1.11), those who had more than eight years of schooling (RR_a = 1.17; 95%CI: 1.11–1.24), those in Economic Class "B" or higher (RR_a = 1.08; 95%CI: 1.03–1.14), and those who worked in the health field (RR_a = 1.06; 95%CI: 1.01–1.11). The VIF obtained in this model was 1.07, indicating a low correlation among the variables.

Table 3 shows the results of the univariate and multivariate Poisson regression analyses for associations between the variables of interests and the HeLD-14 scores. The variables that remained associated with higher OHL scores were age (RR_a = 0.99; 95%CI: 0.94–0.99), monthly per capita

Table 1. Characteristics of the study population (n = 354) (Curitiba, Brazil, 2019).

Variables	n (%)
Age in years	
18–30	100 (28.3)
30–42	147 (44.4)
42–54	79 (22.3)
54–66	18 (5.0)
Sex (n,%)	
Female	284 (80.2)
Male	70 (19.8)
Residents per home	
5 or more	106 (30.0)
Up to 4	247 (70.0)
Marital status	
Married or stable union	250 (70.6)
Others	104 (29.4)
Monthly household *per capita* income*	
< 496.12	340 (97.4)
496.1–977.77	5 (1.4)
977.77–1,459.43	2 (0.6)
> 1,459.43	2 (0.6)
Schooling	
> 8 years	253 (71.5)
≤ 8 years	101 (28.5)
Economic classification	
≥ B	21 (5.9)
≤ C	332 (94.1)
Health field**	
No	338 (95.5)
Yes	16 (4.5)
BREALD-30 score	
< 13	14 (4.0)
13–22	106 (30.0)
> 22	234 (66.0)
HeLD-14 score (n,%)	
< 25	29 (8.2)
25– 42	102 (28.8)
> 42	223 (63.0)

SD: Standard deviation; *values in US Dollar; **Worked in the health field. Frequencies lower than 354 are due to lack of data for the variable.

Table 2. Univariate and Poisson regression multivariate models of for association between BREALD-30 score and the variables of interest (Curitiba, Brazil, 2019).

Variables	RR_c (95% CI)	p-value	RR_a (95% CI)	p-value
Sex				
Male	1			
Female	1.03 (0.97–1.10)	0.352	-	-
Age	0.99 (0.99–1.00)	0.827	-	-
Per capita monthly income*				
< 142.00	1			
≥ 142.00	1.08 (1.04–1.13)	< 0.001	-	-
Residents per home				
5 or more	1			
Up to 4	1.01 (0.96–1.06)	0.719	-	-
Marital status				
Others	1		1	
Married or stable union	1.07 (1.02–1.13)	0.010	1.06 (1.01–1.11)	0.017
Years of schooling				
≤ 8 years	1		1	
> 8 years	1.19 (1.13–1.26)	< 0.001	1.17 (1.11–1.24)	< 0.001
Economic classification				
≤ C	1		1	
≥ B	1.15 (1.09–1.21)	< 0.001	1.08 (1.03–1.14)	0.002
Health field**				
No	1		1	
Yes	1.18 (1.11–1.25)	< 0.001	1.06 (1.01–1.11)	0.001

*Values in US Dollar;**worked in the health field. RR_c: crude rate ratio; RR_a: adjusted rate ratio; CI: confidence interval. Statistically significant values are shown in bold. Goodness of fit test (Pearson's chi-square) = 307.4651; GOF = 1.0000.

income ≥ US$ 142.00 (RR_a = 1.05; 95%CI: 1.02–1.08), more than eight years of schooling (RR_a = 1.18; 95%CI: 1.10–1.25), and Economic Class "B" or higher (RR_a = 1.08; 95%CI: 1.01–1.14). The VIF obtained in this model was 1.09, which also indicated a low correlation among the variables.

Discussion

The concept of health literacy can be defined in different ways, both in general and specifically, as it includes multiple dimensions.[11] This study aimed to verify the association between SDH and two different dimensions of OHL: functional and interactive. Functional literacy refers to the basic skills of reading and writing that enable one to deal effectively with everyday situations.[15] The interactive dimension, in turn, includes more advanced cognitive and literacy skills and refers to the ability to communicate and apply new information to changing circumstances.[15] The functional and interactive dimensions of OHL were respectively assessed using the Brazilian versions of the Rapid Estimate of Adult Literacy in Dentistry (BREALD-30)[16] and the Health Literacy Dental Scale (HeLD-14).[17]

The present study showed that SDH is associated with OHL; in some aspects, this association varied according to the dimension of OHL. Individuals with more schooling had higher OHL scores considering both dimensions of OHL. Previous studies have shown that schooling is an important predictor of OHL.[19,21] Although both OHL and schooling are influenced by similar socioeconomic and cultural contexts, they are considered different concepts.[29] Literacy

Table 3. Univariate and Poisson regression multivariate model for association between HeLD-14 score and the variables of interest (Curitiba, Brazil, 2019).

Variables	RR_c (95% CI)	p-value	RR_a (95% CI)	p-value
Sex				
Male	1			
Female	1.04 (0.97–1.11)	0.314	-	-
Age	0.99 (0.93–0.99)	0.014	0.99 (0.94–0.99)	0.041
Monthly per capita income*				
< 142.00	1		1	
≥ 142.00	1.14 (1.08–1.19)	< 0.001	1.05 (1.02–1.08)	0.001
Residents per home				
5 or more	1			
Up to 4	1.05 (0.99–1.11)	0.113	-	-
Marital status				
Others	1			
Married or stable union	1.03 (0.98–1.09)	0.254	-	-
Years of schooling				
≤ 8 years	1		1	
> 8 years	1.21 (1.14–1.30)	< 0.001	1.18 (1.10–1.25)	<0.001
Economic classification				
≤ C	1		1	
≥ B	1.18 (1.12–1.24)	< 0.001	1.08 (1.01–1.14)	0.014
Health field[T]				
No	1			
Yes	1.18 (0.97–1.20)	0.155	-	-

*values in US Dollar; **worked in the health field; RR_c: crude rate ratio; RR_a: adjusted rate ratio; CI: confidence interval. Statistically significant values are shown in bold. Goodness of fit test (Pearson's chi-square): 307.4651; GOF:1.0000.

involves more than just the number of years of formal study, as it also includes prior health knowledge and experience, individual characteristics, health status, and cultural and linguistic preferences.[11] Moreover, the plurality concept of literacy includes the ability to read write, and interpret.[30] Despite the conceptual differences, the present study demonstrated that schooling may be a social determinant that directly affects the level of OHL.

Participants from higher economic classes had higher OHL scores considering both dimensions of OHL compared to those from lower economic classes. The Brazilian Economic Classification used in this study categorizes the population into different economic classes based on the purchasing power and also considers the schooling of the household head.[25] A study conducted with a representative sample of Brazilian pregnant women also found an association between OHL evaluated using the BREALD-30 and the economic classification used in the present study.[20] These findings demonstrate that socioeconomic status is an important aspect to consider in strategies to improve in literacy levels of individuals and populations.

Monthly per capita income was associated with the interactive dimension of OHL. Similar results have been reported in Brazilian adults older than 60 years of age[31] and immigrants in the United States[19] using the HeLD-14. These findings may be due to the specific characteristics of the instrument, which addresses financial issues, such as whether the respondent can afford an appointment or medication. However, no

association was found between income and OHL when evaluated using the BREALD-30. Divergent results with regards to this association are found in the literature. In a study involving the parents of Brazilian children in dental care, income did not remain significantly associated with OHL evaluated using the BREALD-30 after the adjustments for other variables, such as schooling and dental caries experience in the children.[23] In contrast, income was independently associated with the BREALD-30 score after adjusting for schooling, number of residents in the household, marital status, and ethnicity in a study conducted with adolescents in Brazil.[22] This divergence may be related to differences in the categorization of income in the different studies, which should be further investigated. In addition, the different data collection methods and how respondents feel when reporting their income may also influence the results of an investigation. It has been discussed that self-reporting of income may be inaccurate, and can be influenced by misunderstandings, recall problems, and cognitive aspects, *i.e.*, how respondents understand questions about income aspects.[32]

In the interactive dimension, age was associated with OHL, with older individuals having lower HeLD-14 scores. This finding may be related to the broader scope of the HeLD-14 compared to that of the BREALD-30, which only evaluates familiarity with specific words. A systematic review addressing health literacy in older populations found that age may be an influential factor in the capacity for making appropriate health choices.[33] A study involving Americans between 55 and 74 years of age investigated the association between cognitive decline and health literacy using different methods and found no association between age and health literacy evaluated using the REALM instrument, which is a precursor of the BREALD-30 used in medicine. The authors relate this result to the concept of crystallized ability or language skills, which are not affected over time.[34] Further studies should be conducted to investigate the influence of age on OHL and to facilitate the formulation of strategies for identification of literacy levels in different age groups.

Studies in the field of dentistry have demonstrated the importance of marital status in motivation regarding self-care and health-related information.[35] Although the beneficial impact of having a partner on health-related factors is well-reported in the literature,[36] there are divergent results regarding the association between marital status and OHL. A study with Brazilian pregnant women did not find this association using the Brazilian version of the BREALD-30.[20] In another Brazilian study, adolescents whose parents were married had higher BREALD-30 scores.[22] The same study also found that high family cohesion, defined as the emotional connection among family members,[37] was associated with higher levels of OHL.[22] In the present investigation, married individuals and those in a stable relationship had higher BREALD-30 scores, suggesting that individuals who have a partner can develop stronger relationships than their counterparts. However, these findings indicated that specific characteristics of the study population affect the results and therefore deserve further investigation.

Participants who worked in the health field had higher functional OHL scores. This finding may be explained by the dynamics of the instrument, which assesses the respondent's familiarity with words related to dentistry. The capacity of an individual to understand and use information may vary depending on his/her familiarity with the context and the vocabulary used[38]. Thus, individuals who use health-related words in their work routine are more likely to have higher OHL levels.

The main limitation of the present study is the cross-sectional design, which does not allow us to determine the direction of the associations. Nevertheless, most of the variables used in this study to characterize the social determinants of health present little variation over time.[39] It is also important to consider that the sample included only public service users, and this is an important limitation for the generalization of the results. Nonetheless, the training/calibration of the interviewers lends validity to the findings.

The main result of this study was the association of different components of OHL, including the functional and interactive dimensions, with SDH. To date, most studies on health literacy focus on functional health literacy through instruments that exclusively address basic reading and writing

skills.[11] However, interest in the interactive and critical dimensions of oral health literacy, *i.e.*, the cognitive and social skills needed to critically assess the applicability of health information to personal situations, has grown more recently.[40] Given the paucity of studies addressing the relationships between functional, interactive, and critical health literacy, it is too early to suggest a specific instrument aimed at a specific situation. Future research is needed to explore whether the impact of different dimensions of health literacy actually vary between specific health behaviours.

The results of the present investigation indicate that public policies that seek to reduce health inequities must consider the health literacy levels of the target groups. Developing public policies and health education actions and evaluating their impact on the health literacy of populations seems to be a fundamental step towards overcoming health inequities. Furthermore, future research in health education that incorporates strategies to improve OHL should consider the different economic, social, and cultural aspects of the target population.

Conclusion

Different dimensions of oral health literacy are associated with social determinants of health. Schooling and economic class were common determinants associated with the functional and interactive dimensions of OHL. Moreover, income, age, marital status, and occupation were associated at least with one of the OHL dimensions. These findings underscore the importance of considering different economic, social, and cultural aspects in strategies designed to improve levels of health literacy of individuals and populations.

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