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BRIEF COMMUNICATION

Health Literacy, Health Numeracy, and Cognitive Functioning Among Bariatric Surgery Candidates

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Abstract

Inadequate health literacy or numeracy and probable cognitive impairment influence patients' medical outcomes. The study purpose was to examine the prevalence of inadequate health literacy, inadequate health numeracy, and probable cognitive impairment among bariatric surgery candidates and examine associations with undergoing bariatric surgery. Patients ($N = 314$) completed measures assessing these constructs during a required pre-surgical psychological evaluation. Approximately 9.6%, 24.2%, and 29.5% of the sample had inadequate health literacy, inadequate health numeracy, and probable cognitive impairment, respectively. In univariate analyses, those with inadequate levels of health literacy, inadequate health numeracy, and probable cognitive impairment were less likely to undergo surgery. In a multivariate model, inadequate health literacy independently predicted a lower likelihood of undergoing bariatric surgery. Findings underscore the importance of assessing these factors.

Keywords Bariatric surgery · Health literacy · Health numeracy · Cognitive functioning

Introduction

Health literacy refers to an individual's ability to comprehend necessary health information to make informed decisions [1]. Facets of health literacy include print literacy, oral literacy, and numeracy, which refer to reading and writing, spoken and listening, and quantitative abilities, respectively [2]. Health literacy has been studied across many patient populations, some of which include diabetes, immunizations, and HIV [1]. Estimates suggest approximately 26% of individuals have inadequate health literacy [3]. Greater emergency care utilization, hospitalization readmissions, medication nonadherence, and a decreased likelihood of obtaining surgical services (i.e., organ transplantation) have been linked to inadequate health literacy [1, 4].

It is important to examine health literacy among patients undergoing bariatric surgery because the ability to understand medical recommendations could influence adherence to the optimal post-surgical nutritional and vitamin regimen needed in order to avoid nutrient deficiencies and complications [1, 5]. Among individuals with obesity, there is a negative association between numeracy and BMI, suggesting that numeracy abilities could influence success with weight loss after bariatric surgery [6]. Further, inadequate health literacy may impact the ability to provide informed consent for bariatric surgery. Informed consent is necessary to ensure patients understand the risks and benefits of bariatric surgery [7].

The primary goals of this study were to examine prevalence rates of inadequate health literacy and health numeracy as well as determine the relation with cognitive functioning in an ethnically diverse sample of individuals seeking bariatric surgery. Additionally, because inadequate health literacy has been linked to a lower likelihood of undergoing a surgical procedure [4], we hypothesized that those with inadequate levels of health literacy, inadequate health numeracy, and probable cognitive impairment would be less likely to undergo bariatric surgery than those with adequate levels.

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Methods

Patients and Procedure

Retrospective chart reviews were conducted on all patients who completed the required pre-surgical psychological evaluation for bariatric surgery between July 2016 and January 2017 ($N = 314$). Data collected from medical records included whether the patient underwent bariatric surgery, as well as information from the psychological evaluation described below. IRB approval was obtained from the health system. Informed consent was waived due to the retrospective nature of the study.

Measures

Demographic information including age, gender, race/ethnicity, and education level was collected.

The Rapid Estimate of Adult Literacy in Medicine test (REALM-R and REALM-SF) was used to assess health literacy [8]. This measure estimates the reading grade level of the patient and has adequate reliability [8, 9]. Patients were categorized as having adequate health literacy (i.e., a reading grade level of at least 9th grade) or inadequate health literacy (i.e., below a 9th grade reading level).

Health numeracy was assessed using the Brief Medical Numbers Test, which is composed of 4 items designed to measure patient's ability to answer health-related math questions [10]. Patients were considered to have inadequate health numeracy if any of the 4 items were answered incorrectly. This measure has been validated in a patient population seeking surgical intervention (i.e., organ transplantation) [10].

The Montreal Cognitive Assessment (MoCA) was used as a brief screen of cognitive functioning, with a validated cutoff score of below 26 indicating probable cognitive impairment [11]. The MoCA demonstrates high test-retest reliability and has good internal consistency [11].

Analyses

Prevalence rates were calculated with descriptive statistics. Chi-square and independent samples t tests were used to determine univariate associations between health literacy, health numeracy, cognitive functioning, race, years of education, and whether patients underwent bariatric surgery. A multivariate logistic regression was performed to examine whether inadequate health literacy, inadequate health numeracy, and probable cognitive impairment independently predicted a lower likelihood of undergoing bariatric surgery.

Results

The sample was primarily female, married, and identified as either African American or Caucasian (Table 1). Approximately 66.2% of the sample ($n = 208$) underwent bariatric surgery. Rates of inadequate health literacy, inadequate health numeracy, and probable cognitive impairment were 9.6% ($n = 30$), 24.2% ($n = 76$), and 29.5% ($n = 92$), respectively. An association between race/ethnicity and health literacy was observed (χ^2 (1) = 9.41, $p < .01$), such that a greater percentage of African-American participants, as compared with Caucasian participants, had inadequate health literacy. There were not significant differences in health numeracy or cognitive functioning by race/ethnicity. Those with inadequate health literacy were more likely to have inadequate health numeracy (χ^2 (1) = 19.05, $p < .001$) and probable cognitive impairment (χ^2 (1) = 10.15 $p < .01$). Those with inadequate health numeracy were also more likely to have probable cognitive impairment (χ^2 (1) = 28.91, $p < .001$). There were patients without cognitive impairment who exhibited inadequate health literacy (5.9%, $n = 13$) and inadequate health numeracy (15.9%, $n = 35$).

In univariate analyses, those who did not undergo bariatric surgery were more likely to have inadequate levels of health literacy, inadequate health numeracy, and probable cognitive impairment (Table 2). Those who underwent surgery had more years of education ($M = 14.35$, $SD = 2.16$) compared with those who did not undergo surgery ($M = 13.79$, $SD = 2.00$), $t(311) = -2.21$, $p = .028$. The multivariate logistic regression model of the three predictors (i.e., health literacy, health numeracy, and cognitive functioning) was statistically significant (χ^2 (3) = 14.23, $p = .003$), such that 6.2% (Nagelkerke R^2) of the variance in undergoing bariatric surgery was explained by the model. However, health literacy was the only statistically significant variable that predicted whether patients underwent bariatric surgery. Those with adequate health literacy were 2.39 times more likely than those

Table 1 Participant demographics

	M	*SD*
Consult BMI	46.95	8.16
Age, years	46.51	10.44
Education, years	14.16	2.12
	%	*n*
Gender		
Female	82.8	260
Male	17.2	54
Race		
African American	48.5	145
Caucasian	46.5	139
Multiracial/other	5.0	15

Table 2 Health literacy, health numeracy, and cognitive functioning as related to years of education and surgery status

	Years of education				Underwent surgery ($n = 208$)			Did not undergo surgery ($n = 106$)			
	Inadequate *M* (*SD*)	Adequate *M* (*SD*)	*t*	*p*	Inadequate % (*n*)	Adequate % (*n*)	χ^2	Inadequate % (*n*)	Adequate % (*n*)	χ^2	*p*
Health literacy	12.97 (1.83)	14.29 (2.11)	−3.70	.001	6.3 (13)	93.8 (195)	7.78	16 (17)	84 (89)	7.78	0.001
Health numeracy	13.49 (2.07)	14.37 (2.09)	−3.17	.002	19.7 (41)	80.3 (167)	6.78	33 (35)	67 (71)	6.78	0.01
	Probable cognitive impairment	No cognitive impairment	*t*	*p*	Probable cognitive impairment	No cognitive impairment	χ^2	Probable cognitive impairment	No cognitive impairment	χ^2	*p*
	M (*SD*)	*M* (*SD*)			% (*n*)	% (*n*)		% (*n*)	% (*n*)		
Cognitive functioning	13.70 (2.05)	14.38 (2.10)	−2.62	.01	24.8 (51)	75.2 (155)	6.52	38.7 (41)	61.3 (65)	6.52	0.01

with inadequate health literacy to undergo bariatric surgery ($B = -0.87$ (.42), $p = .036$; 95% CI = 0.19 to 0.94). To determine whether health literacy could predict likelihood of undergoing surgery above and beyond years of education, a final logistic regression model was ran with these two predictors, which was statistically significant (χ^2 (2) = 10.36, $p = .01$). Having adequate health literacy was a significant predictor of undergoing bariatric surgery ($p = .02$) ($B = -0.92$ (0.40); 95% CI = 0.18 to 0.87), while education level was not a significant predictor ($p = .08$) ($B = 0.12$ (0.06); 95% CI = 0.99 to 1.25).

Discussion

Findings from our study suggest that there is a significant proportion of patients pursing bariatric surgery who do not have adequate health literacy or health numeracy and probable cognitive impairment. The prevalence of inadequate health literacy in our sample (9.6%) was similar to the only other study in the USA that has examined the prevalence of health literacy of bariatric surgery candidates (7.4%) [12]. However, the rate of probable cognitive impairment in our study was higher than other research which examined other forms of cognitive functioning among bariatric surgery candidates [13]. To our knowledge, this is the first study to examine the prevalence of inadequate health numeracy. In univariate analyses, individuals with inadequate health literacy, inadequate health numeracy, and/or probable cognitive impairment were less likely to undergo bariatric surgery. However, health literacy was the only independent predictor in a multivariate model, which supported previous research that suggested that health literacy is associated with use of health care services [1]. Although those who underwent bariatric surgery completed more years of education, health literacy remained significant even when considering years of education. There are several possible explanations for why patients with adequate health literacy may be less likely to undergo surgery. First, patients with inadequate health literacy are more likely to miss appointments [14], so these patients may be at higher risk to be lost to follow-up before undergoing surgery. Alternatively, patients with limited health literacy often do not tell providers when they do not understand health-related information and providers have difficulty recognizing when patients have limited abilities [15, 16]. Therefore, patients may not understand what they need to do to follow through with surgery or be successful with surgery and may not ask providers for additional help. Notably, of the patients with normal performance on the cognitive screener, there was still a portion of patients who exhibited inadequate health literacy and inadequate health numeracy. These findings support previous research which cautioned against using education level as a proxy for functional status and also suggests that separate measures of

health literacy and numeracy beyond global cognitive functioning may be useful [17].

Clinicians conducting pre-surgical psychological evaluations should consider screening for health literacy, health numeracy, and cognitive functioning in all bariatric candidates. Assessing for these will allow for the potential identification and development of interventions to support those with deficits. If only years of education or cognitive functioning is assessed, there is the potential to miss identifying patients who may need additional support. Once providers are aware of a potential deficit in one of these areas, providers should be aware of the higher potential for miscommunication and take steps to ensure those with inadequate health literacy do not feel stigmatized [16]. It is recommended providers talk slowly, use straightforward language, involve family members in the patient's care, and ask the patient to demonstrate their understanding through teach back [16]. Providing education to patients delivered at their ability to understand could improve knowledge and informed consent for undergoing surgery and potentially lead to better weight loss outcomes [7].

There are limitations of the study that should be noted. First, the rationale for not undergoing surgery was not assessed. Therefore, it is possible other factors (i.e., insurance coverage barriers or medical non-candidacy) influenced whether a patient underwent surgery. Investigating why patients with inadequate health literacy, inadequate numeracy, and/or probable cognitive impairment may be less likely to undergo surgery is necessary. Additionally, we did not assess whether these factors were related to weight loss outcomes following surgery.

This study suggests that a subset of patients pursuing bariatric surgery may lack adequate health literacy, numeracy, and/or cognitive functioning abilities, which could reduce the likelihood of undergoing bariatric surgery. It is recommended that once providers identify those with limited abilities in these areas, they should consider utilizing additional support. Future research investigating the potential implications of inadequate health literacy, inadequate health numeracy, and probable cognitive impairment on post-surgical outcomes, such as weight loss and adherence, is warranted.

Compliance with Ethical Standards

Conflict of Interest The authors declare that they have no conflicts of interest.

Ethical Approval Statement All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. For this type of study formal consent is not required.

Informed Consent Statement Does not apply.

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