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The influence of health literacy on comprehension of a colonoscopy preparation information leaflet

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Abstract

BACKGROUND—Successful bowel preparation is important for safe, efficacious, cost-effective colonoscopy procedures, however poor preparation is common.

OBJECTIVE—We sought to determine if there was an association between health literacy and comprehension of typical written instructions on how to prepare for a colonoscopy to enable more targeted interventions in this area.

DESIGN—Cross-sectional observational study

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SETTING—Primary care clinics and federally qualified health centres in Chicago, Illinois.

PATIENTS—764 participants (mean age: 63 years; Standard Deviation: 5.42) were recruited. The sample was from a mixed socio-demographic background and 71.9% of the participants were classified as having adequate health literacy scores.

INTERVENTION—764 participants were presented with an information leaflet outlining the bowel preparatory instructions for colonoscopy.

MAIN OUTCOME MEASURES—Five questions assessing comprehension of the instructions in an ‘open book’ test.

RESULTS—Comprehension scores on the bowel preparation items were low. The mean number of items correctly answered was 3.2 (Standard Deviation, 1.2) out of a possible 5. Comprehensions scores overall and for each individual item differed significantly by health literacy level (all $p < 0.001$). After controlling for gender, age, race, socio-economic status and previous colonoscopy experience in a multivariable model, health literacy was a significant predictor of comprehension (inadequate vs. adequate: $\beta = -0.2$; $p < 0.001$; marginal vs. adequate: $\beta = -0.2$; $p < 0.001$).

LIMITATIONS—The outcome represents a simulated task and not actual comprehension of preparation instructions for participants’ own recommended behavior.

CONCLUSIONS—Comprehension of a written colonoscopy preparation leaflet was generally low and significantly more so among people with low health literacy. Poor comprehension has implications for the safety and economic impact of gastroenterological procedures such as colonoscopy. Therefore future interventions should aim to improve comprehension of complex medical information by reducing literacy-related barriers.

Keywords

Health literacy; Colonoscopy; Comprehension; Socio-economic status; Preparation

INTRODUCTION

Colonoscopy is considered the ‘gold-standard’ test in order to detect and screen for colorectal cancer^{1,2,3} with millions of procedures performed each year.⁴ The effectiveness of colonoscopy is dependent, to a large degree, on successful bowel purgation. Inadequate bowel preparation can reduce test adenoma detection rate^{5–8} and increase the likelihood of adverse events such as perforation and peritoneal contamination.⁹ Colonoscopies performed on patients with inadequate bowel preparation take longer to perform,¹⁰ are more likely to result in an incomplete procedure and result in higher rates of repeat procedures.⁷ The economic implications of poor bowel preparation are considerable.¹¹

Responsibility for preparing the colon prior to colonoscopy falls largely on the patient and generally involves the consumption of a prescribed purgative and adherence to a strict diet for 1–2 days. Preparing for colonoscopy can be an arduous task for patients and while multiple clinical trials show high rates of efficacy for a range of bowel purgatives,¹² the issue of inadequate preparation in actual practice remains a significant and common problem.^{5,13–17}

Evidence suggests that the root causes of inadequate preparation is unlikely to be motivational¹⁸ and may instead be a result of misunderstanding the often complex requirements.¹⁵ These individual capabilities are generally encompassed by the term ‘health literacy’, defined here as “the degree to which individuals have the capacity to obtain, process, and understand basic health information and services needed to make appropriate

health decisions”.¹⁹ National estimates suggest adequate levels of health literacy are lacking in approximately one in three American adults, with lower socio-economic status groups being overrepresented.²⁰

This paper will report on the comprehension of a hypothetical bowel preparation instruction leaflet in a large cross-sectional cohort of older patients herein referred to as the ‘LitCog’ study. We hypothesized that health literacy would be associated with comprehension, even after controlling for socio-economic variables.

MATERIALS AND METHODS

Participants and procedure

Participants aged 55–74 were recruited from primary care clinics and federally qualified health centres in Chicago, Illinois starting August 2008 through October 2010. A sample of 1768 eligible patients were reached by research staff and invited to participate in the study. Initial screening deemed 192 subjects as ineligible due to severe cognitive or hearing impairment, limited English proficiency, or not being connected to a clinic physician (defined as < 2 visits in two years). In addition, 738 refused, 14 were deceased, and 20 were eligible but had scheduling conflicts. The final sample included 804 participants, for a determined cooperation rate of 51 percent following American Association for Public Opinion Research guidelines. Participants were excluded from analysis if they had missing data on the comprehension measure or socio-demographic variable items ($n = 40$), giving a final sample of 764. Data for income was frequently missing ($n = 41$; > 5%) and, therefore, coded as a separate category and included in the analysis. The Northwestern University Institutional Review Board approved the study procedures and all participants gave informed consent.

Consenting participants were invited to attend an interview involving the completion of a battery of measures including health literacy, comprehension of a colonoscopy preparation task and socio-demographic variables.

Measures

Test of Functional Health Literacy in Adults (TOFHLA;²¹)—The TOFHLA is composed of two-subscales (numeracy and literacy). The numeracy subscale involves the participant answering 17 questions based on presented examples of healthcare information (e.g., clinic appointment details). The reading subscale uses the Cloze procedure²² where participants are presented with three passages, increasing in reading difficulty, describing health relevant information. Each passage has between 14 and 20 gaps and for each, participants must choose the appropriate word to complete the sentence from a list of 4 possibilities. The scores of the two subscales are combined and weighted to provide a composite score of health literacy ranging from 0–100 and categorized into pre-determined groups of inadequate (0–59), marginal (60–74), and adequate (75–100) literacy. These groups were defined by the original authors of the TOFHLA following convergent validation with measures of general literacy.²¹

Bowel Preparation Comprehension—The comprehension measure was developed specifically for this study. Participants were presented with written instructions on how to prepare for a colonoscopy (Figure 1). The instructions consisted of 171 words and required a 9th grade reading level according to the Flesch-Kincaid readability test. A total of 5 open-ended questions were asked verbally in a structured interview and responses noted as either correct or incorrect according to pre-defined answers specified by the researchers. Subjects could ask clarifying questions but interviewers did not assist them in understanding the

material nor did they provide any further interpretation. These items were derived from the content, as the information required to correctly answer each question was contained within the instructions. Participants could refer to the instruction leaflet throughout the task.

Socio-demographic items—Participants completed a questionnaire asking about gender, age (55–59, 60–64, 65+), race (African American, White, Other), education (less than high school, high school graduate, some college, college graduate or higher), income (refused, less than \$24,999, \$25–49,999, \$50,000+) and previous experience of a colonoscopy.

Statistics

Statistical analysis was carried out using SPSS version 18.0. Descriptive statistics were computed for the TOFHLA and comprehension measure. Differences in individual comprehension items as well as total comprehension scores (0–5) by health literacy category were examined using Chi-Square and one-way ANOVA tests, respectively. Multivariable linear regression was used to observe the impact of socio-economic status and health literacy on comprehension of the bowel preparation instructions.

RESULTS

The sample characteristics are described in Table 1. The mean age of participants was 63 years (SD = 5.4). The majority of participants were female (68.1%), Non-Hispanic White (49.9%) or African American (39.5%). The socioeconomic background of participants was mixed, with over half of all participants (51.8%) possessing at least a college graduate degree and similar proportions reported earning more than \$50,000 per year (51.6%). The majority of participants had previously had a colonoscopy (81.9%). Adequate health literacy scores were recorded for 71.9% of participants.

Overall, the mean number of items correctly answered was 3.2 (SD, 1.2) out of a possible 5 (Table 2). Total comprehension scores differed significantly by health literacy group ($p < 0.001$), increasing at each subsequent threshold of health literacy (mean scores ranged from 1.9 (SD = 0.8) to 2.5 (SD = 0.9) and 3.6 (SD = 1.0) for inadequate, marginal and adequate groups respectively). For each individual item, significant differences in the percentage of correct responses were observed across health literacy groups (all $p < 0.001$), with correct responses reducing at each level of health literacy (Table 2). Fewer than 50% of the sample correctly responded to items pertaining to the time to stop eating solid food on the day before the appointment and the volume of water that can be consumed on the day of the procedure; the latter only being correctly answered by 2.2% of those with inadequate health literacy.

In the multivariable model (Table 3), health literacy was the strongest predictor of comprehension (inadequate vs. adequate: $\beta = -0.2$; $p < 0.001$; marginal vs. adequate: $\beta = -0.2$; $p < 0.001$). Compared with participants who had obtained a college degree, those with lower levels of education performed significantly worse on the task (some college: $\beta = -0.1$; $p = 0.04$; high school graduate: $\beta = -0.1$; $p = 0.02$; less than high school: $\beta = -0.1$, $p = 0.01$). African Americans ($\beta = -0.2$, $p < 0.001$) and participants from other ethnic minorities ($\beta = -0.1$, $p < 0.001$) had significantly lower comprehension scores. Finally, individuals refusing to report their income ($\beta = -0.1$; $p = 0.001$) and those earning under \$24,999 ($\beta = -0.2$; $p < 0.001$) demonstrated significantly worse comprehension than those in the highest income category. It was noteworthy that age, gender and previous colonoscopy use were not associated with comprehension scores (all $p > 0.05$). The multivariable model explained 37% of the variance in comprehension scores.

DISCUSSION

In this sample of older American individuals, comprehension of a representative written bowel preparation instruction leaflet was low, particularly for those with limited health literacy. On average these groups were able to understand between two and three of the 5 seemingly simple instructions on the leaflet, despite being able to refer back to the material while answering questions. In a multivariable model controlling for a number of socio-economic factors, inadequate health literacy was the strongest predictor of poor comprehension. Socio-economic factors including education, income and race were also associated with comprehension. Previous experience of colonoscopy was not associated with comprehension, suggesting that assumptions of comprehension should not be made for specific patient groups that frequently undergo preparation.

While previous studies have demonstrated specific socio-demographic variables (e.g., gender and education), that are associated with poor preparation^{14,16} this is the first time a health literacy assessment has been used to demonstrate its association with comprehension of a bowel preparation regimen. First, our findings demonstrate that poor health literacy is a risk factor of at least equal importance to these other well-known covariates. Second, the observed relationship suggests clinicians and policy makers should be encouraged to make use of the techniques employed by the rapidly emerging health literacy field in order to design patient-centered information materials.

The traditional approach to improving comprehension of patient information has been to simplify and shorten words in order to improve the 'readability' of the text.²³⁻²⁵ However, readability statistics have been shown to be unreliable.²⁶ Additionally, merely altering text readability has had limited success at ameliorating differences in performance across patients with limited versus adequate literacy.^{27,28} A more comprehensive approach to improving health information may be needed. For example there are now well-known associations between health literacy and the broader spectrum of cognitive abilities.²⁹⁻³¹ As noted by Wolf and colleagues,³² these recent developments should encourage health literacy experts to engage with researchers from fields such as adult education, cognitive epidemiology and psychology in order to design optimal health information interventions. Furthermore, there is emerging evidence that supplementing print-based information with intensive interventions, such as multimedia video tutorials or health education classes, can improve health-related outcomes and their antecedents.³³ However, consideration would have to be given to the cost-effectiveness of such interventions.

Current recommendations for improving the quality of patient information include, ensuring adequate font size, ordering information so that it is intuitive to the user, using passive language, providing headings to aid navigation, chunking information into more manageable sizes, repetition, use of imagery and making space for frequently asked question sections.^{34, 35} Expressions that are commonly used by clinicians (e.g., clear liquids) have also been shown to be problematic³⁶ and should have their meaning clarified, using language confirmed by patients prior to their use and altered accordingly.³⁷ It has been shown that by providing patients with concrete examples (e.g., apple juice, water, tea) and an easy to follow test for distinguishing between a 'clear' and 'unclear' liquid,³⁵ comprehension and clinical outcomes can be improved. Several research papers and guides exist that provide techniques for patient information design.³⁷

In this study, some items were more difficult to answer than others, with items including time calculation being answered particularly poorly. For example, reporting the correct time to arrive for the appointment required participants to subtract twenty minutes from the stated procedure time of 2:00pm, a task which was completed correctly by only 6.8% of the

inadequate health literacy group, compared with 68% of the adequate literacy group. This finding is particularly troublesome when considering how frequently statements such as these are used prior to gastroenterology appointments. Medical instructions should be made as explicit as possible, which in turn will likely benefit all patients of varying levels of literacy. Additionally, even when instructions are stated explicitly, care should be taken to insure that patients, especially those with limited literacy, demonstrate adequate understanding of the information. Techniques such as the 'teach back' method are particularly effective for this purpose.³⁸

Together with evidence from the field of health literacy, our research from this one sample of instructions suggests that poor bowel preparation could potentially occur due to poor comprehension of the task set.³⁵ This is supported by additional studies that have demonstrated the failure of interventions to improve bowel preparation quality by persuading patients of the benefits of preparation adherence.¹⁸

A strength of this study is the large socio-demographically diverse sample with a range of literacy levels. The findings are, therefore, likely to translate to a wider US population. In addition to improving preparatory instructions for colonoscopy, our findings will assist research teams, clinicians and policy makers that are involved with designing patient information materials for similar procedures, such as Barium Enema, CT Colonography or MR Colonography.

This research has limitations. Specifically, while participants were all eligible for screening by colonoscopy, and their prior experience accounted for, our outcome represents a simulated task and not actual comprehension of preparation instructions for participants' own recommended behavior. As a result, we were unable to link our data to more clinically relevant objective outcomes. As a simulated task, patients might have also applied greater mental effort if this directly applied to an actual, upcoming colonoscopy rather than a hypothetical scenario and therefore participant anxiety levels are unlikely to be equal to patients preparing to undergo a stressful medical procedure. We may reasonably expect individuals that are experiencing this situation to make more mistakes due to this temporary change to their stress levels caused by undergoing such a procedure.³⁹ In addition, the instructions may have been less detailed and less cohesive than those used in current clinical practice, resulting in an overestimation of the lack of comprehension within clinical populations. However, patients were given unlimited time and the assessment was open book, which still appear to suggest that the instructions were difficult. As a final limitation to mention, only one specific example of colonoscopy preparation instructions were tested, which might not represent how all clinical practices educate their patients to the task. A final limitation is the high levels of experience with colonoscopy that were observed. Although this was controlled for, familiarity with the procedure and similar information materials may have improved comprehension thereby underestimating the problem among a general patient sample with less experience.

Future research should collect (in addition to the measures recorded here) clinical outcome data such as objective bowel preparation quality, time to cecum, withdrawal time and need for further investigation. Interventions could then be conducted, similar to those reported by Spiegel and colleagues,³⁵ using preparation instructions encompassing the health literacy principles discussed previously.

In conclusion, bowel preparation prior to colonoscopy is a patient-led activity, which can have major implications for the safety, efficacy, and cost of the procedure. Our findings indicate that comprehension of a written instruction leaflet was poor. Furthermore, individual differences in health literacy were strongly predictive of comprehension over and

above socio-economic factors and colonoscopy experience. These findings have implications for the design of patient information materials for bowel preparation regimens, and also highlight that more attention should be given to patients that are limited in health literacy.

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**Gastroenterology Diagnostic Services
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BOWEL PREPARATION FOR YOUR COLONOSCOPY

DAY BEFORE PROCEDURE

- Drink at least 8 glasses of water throughout the day
- Light breakfast or lunch is OK
- No oral intake from 12:00 p.m. to 4:00 p.m.
- At 4:00 p.m. add enough water to the laxative to fill the container, and mix well. Begin drinking one glass of the solution every 15 minutes until all is consumed. It is best to drink the entire contents within 2 hours. If you develop vomiting, call the physician on call at (888) 555-1212.
- Starting at 8:00 p.m., you may drink clear liquids until bedtime.
- Nothing by mouth after midnight.

DAY OF PROCEDURE

- Early in the morning you may take your usual medications with sips of water
- Clear liquids are allowed up until time of procedure
- Please arrive twenty minutes before your procedure

YOUR PROCEDURE IS SCHEDULED FOR:

June 6, 2004 2:00 p.m

Figure 1.
Preparatory instructions for participants

TABLE 1

Sample characteristics

Variable	n	%
Sex		
Male	244	31.9
Female	520	68.1
Age		
55–59	241	31.5
60–64	241	31.5
65+	282	36.9
Education		
< High school	91	11.9
High school graduate	111	14.5
Some college	166	21.7
College graduate	396	51.8
Race		
African American	302	39.5
White	381	49.9
Other	81	10.6
Income		
Refuse	41	5.4
<\$24,900	219	28.7
\$25,000–\$49,900	110	14.4
\$50,000 or more	394	51.6
Previous colonoscopy		
No	138	18.1
Yes	626	81.9
Health literacy		
Inadequate (0–59)	89	11.6
Marginal (60–74)	126	16.5
Adequate (75–100)	549	71.9

TABLE 2

Comprehension of bowel preparation items by health literacy score (% correct)

Questions	All n = 764	Inadequate n = 89	Marginal n = 126	Adequate n = 549	p
How many glasses of water should you drink on the day before your procedure?	97.6	85.4	99.2	99.5	<0.001
On the day before your colonoscopy, by what time do you need to stop eating solid food?	46.2	34.8	31.0	51.2	<0.001
How much milk can you drink on the morning of your colonoscopy?	85.9	65.2	78.6	91.6	<0.001
What time does the card say you should arrive for your procedure?	53.7	6.8	25.6	68.3	<0.001
How much water can you drink on the day of the procedure?	36.0	2.2	15.1	47.0	<0.001
Total Correct, Mean (SD)	3.2 (1.2)	1.9 (0.8)	2.5 (0.9)	3.6 (1.0)	<0.001

TABLE 3

Multivariable linear regression model predicting comprehension

	β (95% CI)	β	p
Sex			
Male (ref)	-	-	-
Female	0.1 (-0.1, 0.2)	0.0	0.41
Age group			
55–59 (ref)	-	-	-
60–64	0.2 (0, 0.3)	0.1	0.69
65+	0.0 (-0.2, 0.1)	0.0	0.72
Education			
< High school	-0.4 (-0.7, -0.1)	-0.1	0.01
High school graduate	-0.3 (-0.5, 0.0)	-0.1	0.02
Some COLLEGE	-0.2 (-0.4, 0.0)	-0.1	0.04
College graduate (ref)	-	-	-
Race			
African American	-0.4 (-0.6, -0.3)	-0.2	<0.001
Other	-0.5 (-0.8, -0.3)	-0.1	<0.001
White (ref)	-	-	-
Income			
Refuse	-0.6 (-0.9, -0.2)	-0.1	0.001
<\$24,900	-0.4 (-0.6, -0.2)	-0.2	<0.001
\$25,000–\$49,900	-0.2 (-0.4, 0.0)	-0.1	0.04
\$50,000+ (ref)	-	-	-
Previous colonoscopy			
Yes	0.0 (-0.1, 0.2)	0.0	0.56
No (ref)	-	-	-
Health literacy			
Inadequate	-0.9 (-1.1, -0.6)	-0.2	<0.001
Marginal	-0.5 (-0.7, -0.3)	-0.2	<0.001
Adequate (ref)	-	-	-

 $F(14, 749) = 33.04, p < 0.001; R^2 = 0.37.$