The Meaning of Numbers in Health: Exploring Health Numeracy in a Mexican-American Population

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BACKGROUND: Health numeracy can be defined as the ability to use numeric information in the context of health. The interpretation and application of numbers in health may vary across cultural groups.

OBJECTIVE: To explore the construct of health numeracy among persons who identify as Mexican American.

DESIGN: Qualitative focus group study. Groups were stratified by preferred language and level of education. Audio-recordings were transcribed and Spanish groups (n=3) translated to English. An analysis was conducted using principles of grounded theory.

PARTICIPANTS: A purposeful sample of participants from clinical and community sites in the Milwaukee and Chicago metropolitan areas.

MAIN MEASURES: A theoretical framework of health numeracy was developed based upon categories and major themes that emerged from the analysis.

KEY RESULTS: Six focus groups were conducted with 50 participants. Initial agreement in coding was 59–67% with 100% reached after reconciliation by the coding team. Three major themes emerged: 1) numeracy skills are applied to a broad range of communication and decision making tasks in health, 2) affective and cognitive responses to numeric information influence use of numbers in the health setting, and 3) there exists a strong desire to understand the meaning behind numbers used in health. The findings informed a theoretical framework of health numeracy.

CONCLUSIONS: Numbers are important across a range of skills and applications in health in a sample of an urban Mexican-American population. This study expands previous work that strives to understand the application of numeric skills to medical decision making and health behaviors.

KEY WORDS: health numeracy; cross-cultural research; focus groups; Hispanic.

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INTRODUCTION

Health numeracy can be defined as the ability to use numbers and numeric concepts in the context of taking care of one's health. Several conceptual frameworks have been developed to outline the range of skills comprising the construct of health numeracy and their relationship to the process of health communication and medical decision making^{1–7}. However, cross-cultural methods have generally not been used either in the development of these frameworks or in the development of scales to measure this construct. The 2003 National Assessment of Adult Literacy survey reports that the percent of American adults below a basic level of quantitative literacy is greater among Black and Hispanic than White populations⁸. Health numeracy skills assessed in the clinical setting have also been found to be lower in Black and Hispanic compared to White populations⁹.

Existing conceptual frameworks of health numeracy have attempted to define the range of numeric based skills required to function in the context of health. These frameworks generally outline a range of skills from basic arithmetic such as ordering and counting numbers to skills requiring a more conceptual understanding of mathematics such as interpreting probability and statistics^{1–3}. Theoretical frameworks have also been developed to describe the process of how numeric skills influence medical decision making, health behaviors, and medical outcomes. Affective factors including trust and mood have been recognized as important constructs in theoretical models of health numeracy^{4,5}. The objectives of the current study are to explore 1) how numeric information is used in the health context among a study population self-identified as Mexican American and 2) the applicability of existing health numeracy frameworks in this population. The findings were used to broaden existing frameworks of health numeracy and to inform the development of a health numeracy

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measure that has cross-culturally equivalence among Mexican Americans and general populations in the United States¹⁰.

METHODS

We undertook a focus group study among persons of Mexican-American ethnicity. In order to explore perspectives across a range of educational, language, and acculturation backgrounds we obtained a purposeful sample of participants from both community and clinical settings, across a range of educational backgrounds, and who identified Spanish or English as their primary language. Recruitment sites included schools, community centers, hospital-based wellness programs, and primary care clinics in the Milwaukee and Chicago metropolitan areas. Recruitment materials were in Spanish and English; most recruitment occurred on site by a bilingual research assistant or an English-speaking research assistant aided by a professional Spanish interpreter. Focus groups were chosen as a qualitative method to encourage discussion and generation of ideas. Groups were stratified by preferred language (English or Spanish) and education to foster discussion of experiences using numbers in the context of health. An a priori decision was made to have six focus groups. In the process of analysis the investigative team determined that the breadth and depth of data was sufficient to meet the objectives of the study.

A semi-structured interview guide developed in English and translated into Spanish by the bilingual focus group leader before the groups and reviewed by one of the investigators (EJ). The guide was structured with opening questions, key questions with probes, and ending questions (Table 1, Appendix A and B available online). Questions evolved over sessions in response to experience gained from earlier focus groups. Focus groups were held in community sites close to the location of recruitment of participants and observed by two or more investigators. A bilingual focus group moderator facilitated all six focus groups. Focus groups were audio-taped and transcribed. Spanish transcripts were translated into English. A second translator reviewed the audio and written transcripts; 95% agreement was found between the translations with differences resolved by consensus between the translators and an investigator (EJ).

Approach to Analysis and Coding Procedures

An analytic approach based on principles of grounded theory was used^{11,12}. While considering the existing body of work in the area of health numeracy, investigators remained open to new ideas and themes that would emerge during the course of the study. An initial review of two transcripts was undertaken and a preliminary coding scheme developed by each of the four analysts with modifications made upon discussion of the full analytic team. An open coding scheme was used; analysts had the option of revising or adding codes as new ideas emerged in the process of analysis. The initial coding scheme had categories in the following domains 1) types of general numeracy skills,

Table 1. Focus Group Guide Questions

Opening Questions

1. Please tell us your name and something that you enjoy doing in your free time
2. What are some of the ways that you use numbers in your everyday life?
3. Think back to the last time you took a medication, spoke with a doctor, or made a decision about your health. Can you think of a way that you used numbers in that situation?

Key Questions

1. How do you use numbers in your day to day healthcare?
2. How do you use numbers in communicating with your doctor?
3. Is it sometimes hard for you to understand the numbers used by doctors?
4. Do numbers sometimes help you to understand what your doctor is telling you?
5. Many different words are used to talk about numbers in health. I'm going to list some words that are often used with numbers in health and then have you comment on what they mean to you.
 - a. Medical statistics
 - b. Risk
 - c. Probability
 - d. Probably
 - e. Odds
 - f. Chance
 - g. Likely
 - h. Unlikely
6. What do you think makes a good medical study?
7. When a doctor tells you about the expected results from a medication or treatment, do you want them to tell you exactly how certain or uncertain they are about that result?
8. How do you feel about the doctor using numbers when he or she talks to you about your health?
9. How do you feel when the doctor uses numbers to tell you about studies in medicine?

Ending Questions

1. Overall, what do you think are the most important ways that numbers can be used in health care?
2. Overall, what do you think are the most difficult aspects, for you, of using numbers in health care?
3. (After summary of the discussion to highlight key points) Is this an adequate summary of the discussion? Did we miss anything that was important to this topic?

Note: Full focus group guides in English and Spanish including probes available in Appendix A and B

2) ways that general numeracy skills are used in the context of health, and 3) factors that might modify the use of numbers in health such as age and ethnicity. This coding approach was designed in accordance with the primary research objective of exploring the use of numbers in the context of health. Transcripts were divided into text units defined as a segment of text in which one topic or concept was being expressed. Each unit could be coded with one or more codes. Transcripts were coded by two analysts, agreement determined and discrepancies resolved through discussion. Each segment was coded with 0 to 6 codes. Disagreement was counted for each code that was used by one but not both coders. In cases where codes remained discrepant, a third investigator served as the adjudicator. The percent agreement in the initial round of coding ranged from 59%–67% among the six focus groups with 100% agreement reached through face-to-face discussion of the entire analytic team. Data was managed using Atlas.ti

software¹³. Categories and themes were then synthesized into a theoretical framework of health numeracy.

RESULTS

Study Population

Fifty participants, 49 of whom identified as Mexican American, participated in six focus groups. One participant, recruited from the same community center as other participants, was from South America. Because this one individual lived in and identified as being from a Mexican-American community, we refer to the participants as Mexican American hereafter. Groups were uniform in preferred language and in general level of education but included a range of age and gender (Table 2). There were a total of 1606 codes used for 694 text units. Below we present the categories of health numeracy skills that were elicited from the focus groups. We then discuss the three major themes to emerge from the analysis. Finally, we put forth a theoretical framework to illustrate the potential relationship between health numeracy and health behaviors and outcomes.

General Numeracy Skills. We entered into the analysis with an initial idea of a framework of the range of numeracy skills applied in health based on previous work in general populations¹⁻³. We found these categories to be applicable to our study population. The most common skill applied was number sense, a skill which involves counting, ordering, basic calculations, measurement, and estimation (Table 3). Examples of applications discussed in this category were managing prescriptions, scheduling appointments, setting goals, and understanding indicators of health. Examples discussed relevant to skills in using tables and graphs included the use of weight and height graphs, using tables to determine medication dosing, and the desire for information such as cholesterol goals to be presented in a graphic form. Skills discussed related to the use of probability were primarily

Table 2. Description of Focus Group Participants

Focus Group	Number of Participants	Female n (%)	Language	Age Range (years)	Education*
1	10	6 (60)	Spanish	62-90	< 6 th grade
2	7	4 (57)	Spanish	30-35	< 12 th grade
3	9	8 (89)	Spanish	24-56	< 12 th grade
4	8	6 (75)	English	21-38	College Experience
5	5	1 (20)	English	29-57	< 12 th grade
6	11	8 (73)	English	21-84	College Experience

* Education was obtained in either their Country of Origin or United States. The category indicates the highest level obtained for a majority of participants in the given focus group

Table 3. Selected Codes and Frequency of Use in English and Spanish Groups*

Codes	English Mexican-American Groups	Spanish Mexican-American Groups
General Numeracy Skills		
Number Sense	193	164
Tables/Graphs	26	3
Probability	39	40
Statistics	50	13
Contexts in Which Skills are Applied		
Goal Setting & Motivation	61	9
Using Numbers as an Indicator of Health	44	40
Natural History of Disease	43	19
Assessing the Credibility of Information	22	4
Risk Communication	51	38
Communicating Symptoms	21	13
Patient Decision Making	7	11
Physician Decision Making	10	6
Disease Management	79	65
Investing in Health (Costs of health)	21	4
Total	667	429

*The purpose of presenting the frequency of coded segments in these selected code categories is to illustrate that these concepts emerged in both English and Spanish groups. The study was not designed to test a difference of themes across groups according to gender, primary language, or level of education.

focused on risk communication relating to the incidence, severity, and prognosis of disease. Skills discussed related to the use of statistics in the health context were primarily in the realm of descriptive statistics such as interpreting data on disease incidence in a given population. Concepts related to the use of statistics to test medical interventions were less prominent in the focus groups.

Theme 1: Numeracy Skills are Applied Broadly in Health.

Categories were developed to reflect the broad range of numeracy applications in health (Table 3). Some applications relate to improving one's knowledge about health conditions such as setting goals and establishing norms, using a numeric value as an indicator of health, understanding the natural history of disease, and assessing the credibility of evidence regarding treatment efficacy. Others relate to communication and medical decision making. The most widely discussed application was management of chronic diseases such as diabetes or hypertension. Numeric information was also used to assess value and cost of health.

The use of scales was prominent in the focus group discussions. The most common scale mentioned was the pain scale. However, other scales discussed include those that relate to disease severity such as degree of burn, cancer staging, or severity of coronary artery disease. Scales were recognized as a way to clearly communicate these concepts to patients as illustrated in the two quotations below.

In order for things to be expressed to you in terms of understanding they have to be on a type of scale. That

scale is expressed in numbers. Those scales, they are tools that use numbers that measure you. (English-speaking participant with some college experience)

Look, if he (the doctor) says to you from one to ten, one is good and five is moderate and ten is that it is serious, then, you want to know. (Spanish-speaking with less than 12 years of education)

Another example of a common application of numeracy skills was the use of numbers as an indicator of good or poor health. Some participants noted that as long as the number was “good” then they would feel relief about their health. Examples of this experience included communication regarding cholesterol levels, glucose levels, and blood pressure readings. Numbers could help to classify one as “normal” or “not” as illustrated in the following quotation.

With respect to numbers, it is important that the doctor and the person tells you what is normal and what is the risk you run, when a measurement is taken you can tell from the number what is normal, and from here up no, and from here down it also is not. (Spanish-speaking participant with less than 6 years of education)

The categories and concepts discussed above reflect a range of ideas expressed across groups that varied in education and primary language (Table 3).

Theme 2: Affective and Cognitive Responses to Numeric Information

Affective Responses to Numeric Information. Participants conveyed that the use of numbers to communicate in health could lead to an emotional response. Affective responses included positive feelings expressed as confidence in the information presented and reassurance about one's health. In the example below, confidence in the information presented was attributed to the perceived objectivity of numbers.

Numbers are extremely necessary. It needs to be given...because that's what's going to tell you what changes you need to make and by how much, whether it's weight, what you eat, how much sugar you intake, whatever it is...you can't live without numbers...they're pretty much the one truth you have. You can't deny a number. So in that way, they're extremely important. (English-speaking with some college experience)

Another positive perceived attribute was that numbers reflect scientific evidence, leading to increased trust of the information as illustrated in the quotation below.

With a number, you put some time into it... to check actually... “how many people in Chicago had AIDS?”... You gave me a number... I'm thinking you did some study now. You know, you're talking facts to me...I

believe in it more. (English-speaking with less than 12 years education)

Affective responses also included negative feelings such as skepticism regarding health information or fear about one's health. Skepticism was expressed regarding the source of data and validity of diagnostic measures. One commonly raised source of skepticism was the application of general health statistics to people of a particular gender, age, race, or ethnicity. Participants conveyed doubt that general health statistics would be relevant or applicable to their personal situation as illustrated in the quotation below.

I think (using numbers) makes me trust it less. Because they're using the numbers statistically from what everybody else has tested... I want to know about the people that you've tested that are somehow similar to me. (English-speaking with some college experience)

Numbers used to convey risk or indicators of poor health lead to feelings of worry or fear as indicated in the example below.

When they check my blood pressure and they tell me where it is and I think that it is very high but I ask and they say that it is normal. Because if they tell me high numbers I do feel fear (Spanish-speaking with less than 6 years education)

Cognitive Responses to Numeric Information. Participants expressed that numbers could help them to understand the physiologic processes that are related to their health. This view is conveyed in the quotation below.

I think numbers make me feel a little easier ...cause I can't understand medical terms and conditions and things I can't see, the blood levels...so when they use a number, it makes things easier for me to understand. (English-speaking with less than 12 years education)

However, the interpretation of numbers could also cause confusion as expressed in the following quotation.

The blood pressure is what I don't understand. Don't give me so many blood pressure numbers, because I do not know what is a normal level and there's just too many numbers, there should be only one number or one degree... Just that to be at this number is normal and to be above or below this number is bad. (Spanish-speaking with less than 12 years education)

Theme 3: The Desire to Find Meaning in Numbers. A third theme that emerged was the strong desire of people to find and understand the meaning of numbers used in health. Participants described turning to friends or family, especially those with health care experience, to explain the meaning behind the numbers. The desire for health professional to spend more time explaining the meaning behind numeric information was widely expressed. Participants wanted to

understand the connection between a numeric health indicator and the underlying physiologic process.

I had a cholesterol screen, my first ever, and the doctor sent my results back via number and one of my numbers was high ... but it wasn't explained to me what that number really meant... what that said about my health ... where that number came from? (English-speaking participant with some college experience)

So with numbers we should understand more than anything that each number has it's own meaning, when we can understand the meaning of a number, we can understand the degree of the illness. (Spanish-speaking with less than 12 years education).

Below 120 is low pressure. The other is high pressure. But, what is pressure? The pressure is the force that the blood creates in your arteries or veins...so what is that? What can you die from? (Spanish-speaking participant with less than 12 years of education).

Theoretical Framework of Health Numeracy

The categories of numeric skills and themes identified above were used to develop a theoretical framework that posits a relationship between health numeracy and health behaviors and outcomes (Fig. 1). The framework notes the range of general numeracy skills including number sense, tables &

graphs, probability, and statistics. These skills are then applied in the health context as people are faced with the tasks, information, and decisions that arise in the process of taking care of one's health. Affective and cognitive responses to numeric information may then mediate the relationship of general numeracy skills to health behaviors and outcomes.

DISCUSSION

In this paper we sought to explore how numeric information is used in health and the applicability of existing health frameworks among a study population that was self-identified as Mexican American. We chose to examine concepts among both Spanish and English-speaking persons in order to gain insights from a diverse sample in the community. Our study added several new insights into a framework of the use of numeracy skills in the context of health. First, our findings highlight numeracy skills that are applied in health across both Spanish and English language in the urban Mexican-American sample of this study. These skills are consistent with previous studies of health numeracy in general populations. Second, our study identified specific affective and cognitive responses to numeric information that could influence how numbers are understood and applied in the context of health. Finally, our work highlights the strong desire to better understand the meaning behind numbers and the relationship of numeric indicators to the underlying disease and treatment processes.

Figure 1. This figure depicts a theoretical framework for the health numeracy construct among Mexican Americans. The framework describes the relationship between general health numeracy skills and health behaviors and outcomes. The general numeracy skills may be obtained from a variety of sources including formal education and general life experience. These skills are applied to a range of tasks related to health. The use of numbers in health can lead to both affective and cognitive responses that can mediate the relationship between health numeracy and health behaviors and outcomes.

We found that some applications of numbers in health were broadly used. One such example is the use of scales to communicate symptoms or severity of disease. A basic attribute of numeric systems is that they represent an order of magnitude. Our data suggest that scales provide an intuitive way for people to think about severity of symptoms or disease. Although scales are widely recognized and used, cross-cultural research has demonstrated that probabilistic thinking and the response to a scale differs across cultures and ethnic backgrounds^{14–17}. Our study supports the importance of a discussion with the patient of the attributes of a scale (such as directionality) and the interpretation of various levels when it is used in the clinical setting.

Our study has identified both affective and cognitive responses to the use of numeric information in health. The role of affective response to numeric information is consistent with a growing body of literature that suggests there is an interaction between affect and the application of numbers in medical decision making^{4,18} and with previous findings that numeric presentations of risk information can increase trust of information presented¹⁹.

Our study highlights the perceived importance of population specific risk and outcomes information if people are to find health statistics credible and applicable to their personal health. This finding is consistent with previous work that demonstrates the importance of an evidential approach to health communication, i.e., presenting evidence of impact specific to members of a target group¹⁹. If patients are to believe in the applicability of health statistics, it is necessary for them not only to understand statistical information but to believe that it applies to people that are similar to themselves in ways perceived to be significant, including culture and ethnicity.

A salient theme to emerge from our study was the desire to better understand the meaning of numbers. Participants understood that doctors used numbers in decision making. However, they lacked understanding of the connection between the numeric indicator and their health condition. Patients desire a clearer connection between the numeric representation of a disease process or response to therapy and the physiologic process that is occurring. The drive to understand the meaning of numbers was also a component of the theoretical framework of health numeracy developed by Lipkus and Peters⁴.

The theoretical framework of health numeracy presented is consistent with previous work conducted by our group and others in general populations with respect to the categories of numeric skills applied in the health context^{1–3}. A recent review outlines four theoretical approaches relevant to the study of health numeracy: psychophysical, computational, dual-process, and fuzzy trace theory⁶. Our framework incorporates elements of dual-process theory in identifying the role of both cognitive and affective responses to the use of numbers in health. The framework presented is also similar to those developed by Lipkus and Peters in describing the process that one takes in applying numeracy skills to the health care context and using numeric based information to influence health care decisions and outcomes^{4,5}. Our framework is unique in that it is developed based on empiric data obtained from focus groups among Mexican-American community members. This work thus serves to broaden our understanding of the theoretical construct of health numeracy to reflect the experience of a minority population.

Our study has some limitations. The sample was primarily Mexican American but included one participant that was from South America. However, this participant lived and self-identified as being from a Mexican-American community. The study was not designed to directly compare frameworks of health numeracy across language, level of acculturation, or educational groups. However, the themes that emerged in our study reflect perceptions of the roles of numbers in health that have been found in general populations. In addition we found similar themes across English and Spanish-speaking groups. The findings reflect perceptions of the value and limitations of the use of numbers in health among this community.

Despite these limitations, our study supports the relevance of elements of existing frameworks of health numeracy for this population while adding emphasis to other important themes. In particular, our findings emphasize the affective and cognitive responses that can influence the application of numeric information in the context of health.

These findings suggest avenues for interventions to improve patient physician communication. Health communicators can take advantage of attributes of numbers such as clarity and perceived objectivity, to communicate more effectively with patients. However, time and attention are also needed to explain the meaning of numeric information and address concerns regarding how and why general numeric information is applicable to an individual. Empiric cross cultural studies will increase the validity of the health numeracy construct across diverse populations.

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