Development and Validation of the General Health Numeracy Test (GHNT): Implications for Medication Understanding and Adherence

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Acknowledgments

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Background

- Limited health literacy and numeracy are associated with difficulty understanding health information, and poor patient self-care and clinical outcomes.
- Existing numeracy measures may not be optimal to assess “health numeracy” defined as the ability to understand and apply basic numerical information to make appropriate health decisions.
- Available numeracy measures are lengthy, disease-specific, assess a narrow range of skills (e.g., focus on probability or risk), and/or are non-health-related mathematical tests.

Study Objective

- Develop the General Health Numeracy Test (GHNT)
- Evaluate its:
  - psychometric properties
    - internal reliability
    - construct validity
  - predictive validity
    - medication understanding
    - medication adherence

Methods

- Experts reviewed existing numeracy assessment tools and developed a novel set of 63 GHNT items
  - Number hierarchy
  - Calculation skills
  - Probability
  - Fractions/decimals
  - Graphs
- Conducted iterative pilot testing (N=30 to 40) and reduced the GHNT to 21 items
- Conducted psychometric testing (N=205)

Methods

- Administered:
  - 21-item General Health Numeracy Test (GHNT)
  - Health Literacy (REALM)
  - Mathematical Skills (WRAT-3R)
  - Subjective Numeracy (SNS)
  - Medication Understanding (MUQ)
  - Medication Adherence (SDSCA)
- Iterative psychometric testing, resulted in a 6-item version:
  - Internal reliability = Kuder-Richardson coefficient (KR-20)
  - Construct validity = tested *a priori* hypothetical model
  - Predictive validity = Spearman's rho and regression models

General **H**ealth **N**umeracy **T**est

1. Call your doctor if you have a temperature of 100.4 ºF or greater. The thermometer looks like the following:

   Do you call the doctor?

   ANSWER: _____ YES _____ NO

2. If 4 people out of 20 have a chance of getting a cold, what would be the risk of getting a cold?

   ANSWER: _____ %

3. Suppose that the maximum heart rate for a 60 year old woman is 160 beats per minute and that she is told to exercise at 80% of her maximum heart rate. What is 80% of that woman's maximum heart rate?

ANSWER: _____ beats per minute

4. You ate half the container of carrots. How many grams of carbohydrates did you eat?

Nutrition Facts	
Serving Size: 1 cup (85g) (3 oz.)	
Servings Per Container: 2.5	
Amount Per Serving	
Calories 45	Calories from Fat 0
	% Daily Value*
Total Fat 0g	0%
Saturated Fat 0g	0%
Cholesterol 0mg	0%
Sodium 55 mg	2%
Total Carbohydrate 10g	3%
Dietary Fiber 3g	12%
Sugars 5g	
Protein 1g	

ANSWER: _____ grams

5. Your doctor tells you that you have high cholesterol. He informs you that you have a 10% risk of having a heart attack in the next 5 years. If you start on a cholesterol-lowering drug, you can reduce your risk by 30%.

   What is your 5-year risk if you take the drug?

   ANSWER: _____ %

6. A mammogram is used to screen women for breast cancer. False positives are tests that incorrectly show a positive result. 85% of positive mammograms are actually false positives. If 1,000 women receive mammograms, and 200 are told there is an abnormal finding, how many women are likely to actually have breast cancer?

   ANSWER: _____ women

Patient Characteristics (N = 205)	M ± SD or n (%)
Age	55.0 ± 13.8
Gender, Female	133 (65)
Race, Caucasian/White	144 (70.2)
African American/Black	53 (25.9)
Other	8 (4)
Education, years	14.4 ± 2.9
< High School	13 (6.4)
High School	54 (26.6)
> High School	136 (67)
Income, <19K	47 (23.4)
20-39K	57 (28.3)
40-59K	23 (11.4)
>60K	74 (36.8)
Insurance status, Public	60 (29.3)
Private	143 (69.8)

Measures	M ± SD or n (%)
Health Literacy (REALM)	
< 9th grade	37 (18)
≥ 9th grade	168 (82)
Mathematical Skills (WRAT-3R)	
< 9th grade	126 (61.8)
≥ 9th grade	78 (38.2)
Subjective Numeracy, range 1-6 (SNS)	3.8 ± 1.2
Medication Understanding, % correct (MUQ)	81.7 ± 17.4
Medication Adherence, % adherent (SDSCA)	90.7 ± 20.5

Results

- 6-item GHNT correlated with 21-item GHNT, rho = 0.88, $p < .001$
- 6-item GHNT, M = 42%, SD = 30%
  - Internal reliability, KR-20 = 0.79
  - Construct validity
    - **Education**, rho = 0.41, $p < .001$
    - **Income**, rho = 0.40, $p < .001$
    - **Health Literacy**, rho = 0.45, $p < .001$
    - **Mathematical Skills**, rho = 0.65, $p < .001$
    - **Subjective Numeracy**, rho = 0.58, $p < .001$

Results

- Predictive validity
  - Bivariate
    - **Medication Understanding**, rho = 0.24, p < .001
    - **Medication Adherence**, rho = 0.16, p = .02
  - Adjusted (age, gender, racial status, income)
    - **Medication Understanding**, β = 0.14, p = .02
    - **Medication Adherence**, AOR= 0.40, p = .11

Discussion

- The 6-item GHNT is a brief, reliable and valid tool for assessing general health numeracy.
- There is evidence of predictive validity with medication understanding.
- There may be predictive validity with self-reported medication adherence.
  - Small sample size
  - Heterogeneity of the sample

Limitations

- Results may not generalize to other populations
  - English-only version
  - Academic medical center patient population
- Reliance on self-reported outcomes
  - Medication adherence
- Did not test predictive validity with clinical outcomes

Future Directions

- Future research should examine the relationship between the GHNT and additional health behaviors and clinical outcomes, and explore the GHNT's utility in clinical care settings.