

# Subjective Numeracy Scale as a Tool for Assessing Statistical Numeracy in Older Adult Populations

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## Key Words

Objective numeracy · Subjective numeracy · Older adults · Risk communication · Informed medical decision making

## Abstract

**Background:** Statistical numeracy, necessary for making informed medical decisions, is reduced among older adults who make more decisions about their medical care and treatment than at any other stage of life. Objective numeracy scales are a source of anxiety among patients, heightened among older adults. **Objective:** We investigate the subjective numeracy scale as an alternative tool for measuring statistical numeracy with older adult samples. **Methods:** Numeracy was assessed using objective measures for 526 adults ranging in age from 18 to 93 years, and all participants provided subjective numeracy ratings. **Results:** Subjective numeracy correlated highly with objective measurements among oldest adults (70+ years;  $r = 0.51$ , 95% CI 0.32, 0.66), and for younger age groups. Subjective numeracy explained 33.2% of age differences in objective numeracy. **Conclusion:** The subjective numeracy scale provides an effective tool for assessing statistical numeracy for broad age ranges and circumvents problems associated with objective numeracy measures.

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Statistical numeracy is an essential ingredient of informed decision-making. But for many patients, understanding risks and benefits of treatment options presents a major challenge. To grasp the meaning of disease risks and treatment outcomes requires a basic understanding of statistical concepts of probability, reported to be poor among patient groups and the general public [1]. People face more decisions about medical care and treatment in older age than at any other stage of life. Statistical numeracy, which relates to understanding concepts of percentages, frequencies, and probabilities, is reported to diminish in older age [2], presenting a major challenge for informed decision-making of elderly patients.

Communicating risks of disease and benefits of treatment in numeric form is commonplace in medical consultation and the media [3]. With numeric information serving such an important role in health care, poor numerical ability can have worrying consequences for the informed medical choices of patients and their health and well-being. For example, Black et al. [4] found that poorer numerical ability among 40- to 50-year-old women was linked to overestimations of the risks of developing and dying of breast cancer. Poor numerical skills have been linked also to misinterpretations of the risks and benefits of cancer treatment options among women with early-stage breast

cancer [5], and numerical skills are equally important for men's understanding of the lifetime risks of developing prostate cancer [6]. Older adults face more health choices and dilemmas of this kind than any other age group, charging the importance of assessing the numerical abilities of the elderly (as well as younger age groups), and older adults are reported to have poorer decision-making abilities in health care settings than younger adults, which is linked partly to poorer numeracy skills [7].

Beyond informed decision-making, less numerate older adults have greater difficulty understanding their medical condition, following medical instruction, and inadequate statistical numeracy is linked to poorer mental and physical health among older adults [8], heightening a need to examine the numerical abilities of the elderly. The widely used numeracy scale developed by Schwartz et al. [1] presents three general questions about chance and probability, combined by Lipkus et al. [9] with eight additional items specific to interpreting disease risk, to form the 11-item objective numeracy scale. Numerical ability represents an aspect of mental functioning that is separate from general cognitive ability and intelligence. Wood et al. [7] identified numeracy as an independent predictor of decision-making abilities in the health domain after controlling for cognitive ability across a wide age range of adults. In a review of the literature, Reyna et al. [10, p. 34] concluded that 'On the basis of studies that have controlled for education, intelligence, literacy, and other factors, we can be reasonably sure that numeracy is a separate faculty.'

Researchers have raised a host of concerns regarding the use of objective numeracy measures that are particularly relevant to assessing the numerical ability of older adults. Criticisms of their use center on the negative feedback received from participants [11, 12]. There is also concern for poor completion rates and difficulty in administering objective measures via the internet and telephone, as participants are required to hold in mind multiple pieces of information for answering each item of objective numeracy scales. Perhaps most relevant to older adults are concerns that people are not generally receptive to assessments of their objective numerical ability [11]. Anxiety associated with aptitude tests (such as in mathematics and statistics) for many individuals compromises their ability to attend to assessment tasks and disrupts cognitive processing [13]. Aptitude test anxiety can become heightened in older age [13], and as a result, objective numeracy measures are a potential source of discomfort and anxiety for older adults. For example, the numeracy measure developed by Schwartz et al. [1] asks how many out of 1,000 rolls will a fair, six-

sided die come up even. Answers to such questions are not intuitively obvious and may generate anxiety and discomfort, especially among older adults.

The Subjective Numeracy Scale (SNS) developed by Fagerlin and colleagues [11, 12] provides a self-report measure of perceived numerical ability, and examines preferences for the presentation of numeric and statistical information without the need for participants to make mental calculations or interpret statistical information directly. Among the benefits of the SNS over objective numeracy measures is that it takes less time to administer, is better suited to internet and telephone surveys due to its less taxing nature, and is reported by participants to be more pleasant to complete [11, 14]. Research studies have validated the SNS as a proxy for objective numeracy, demonstrating high correlations between SNS ratings and measures of objective numeracy using nationwide internet surveys [6] and representative national samples [8]. However, no previous study has examined whether the SNS provides a valid tool for measuring numeracy among older adults.

The SNS circumvents problems associated with objective numeracy measures, and thus potentially provides a powerful alternative for assessing the numerical skills of older adults. Our present objective was to validate the SNS in older adult samples as a proxy for measuring statistical numerical ability among older adult populations.

## Method

### Participants

Participants (overall  $n = 526$ ; age range = 18–93; mean age = 43.01;  $SD = 21.05$ ) were recruited in three ways. Community-dwelling older adults ( $n = 106$ ; mean age = 72.80;  $SD = 12.77$ ) were invited to Scripps College, Calif., USA, from the local community, and received 10 USD as compensation for their travel expenses. Advertisements online ( $n = 210$ ; mean age = 35.37;  $SD = 16.71$ ) and via Mechanical Turk on Amazon ( $n = 210$ ; mean age = 35.61;  $SD = 13.72$ ) were used to sample individuals among younger age ranges. Participants recruited via online advertisements received no compensation, and those recruited via Mechanical Turk were paid a token amount of 0.25 USD.

Demographic characteristics of participants are provided in table 1. Education level was positively related to age (age treated as a continuous variable; Spearman  $\rho(526) = 0.26$ ,  $p < 0.001$ ). A minority indicated 'less than high school' as their highest educational attainment (18–69 years = 2 of 450, 0.4%; 70+ years = 2 of 76, 2.6%), some indicated 'completed high school' as their highest attainment (18–69 years = 50 of 450, 11.1%; 70+ years = 12 of 76, 15.8%), and a majority indicated either 'some college' (18–69 years = 134 of 450, 29.8%; 70+ years = 11 of 76, 14.5%) or 'college or higher' (18–69 years = 264 of 450, 58.7%; 70+ years = 51 of 76, 67.1%) as their highest attainment.