

Numeracy predicts risk of critical pre-hospital decision delay

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If you were having chest pains, how long would you wait before calling 911?

Many patients delay seeking medical attention during acute coronary syndromes (ACS), profoundly increasing their risk for death and major disability. We found that statistical numeracy – a person's practical ability to solve problems involving probability – is among the strongest predictors of decision delay in ACS. This finding opens new possibilities for interventions based on tailored risk communication and emphasizes the importance of patient deliberation and risk understanding during decision making.

A pressing societal problem

- ACS survival and outcomes can be improved by up to 50% when treatment is administered within one hour of initial symptom onset.
- However, the average time it takes to seek care for chest pain is much longer than that (>2h) in every country studied.
- Efforts to improve patient decision making through increased knowledge of symptoms have generally been unsuccessful.

Numeracy and risk literacy

- Statistical numeracy is a strong predictor of general decision making skill and risk literacy – the ability to understand and make good decisions about risk. Can numeracy predict decision delay?



Method

- A retrospective study of 102 ACS survivors (mean age=58, 32-74; 84% male) in a Spanish hospital. About 5 days after the cardiac event, participants completed a questionnaire including measures of:
 - **Numeracy:** *Objective:* 3 items, Schwatz et al. (1997): "If you flip a fair coin 1000 times, how many times do you think it will come back heads?"; *Subjective:* Subjective Numeracy Scale, Fagerlin et al. (2007).
 - **Decision delay:** self-reported time that elapsed from the start of symptoms until the decision to seek medical attention (e.g., call an ambulance)
 - **Other relevant factors:** e.g., anxiety, depression, travel delay, symptom severity, disease severity, knowledge, demographics, education, etc.
 - **Cardiac troponin on arrival:** a protein that is released when the heart muscle has been damaged; an objective, highly sensitive measure of delay.

Suggested readings

(a) Petrova, D., Garcia-Retamero, R., Catena, A., Cokely, E., Heredia Carrasco, A., Arrebola-Moreno, A., & Ramírez Hernández, J. A. (in press). Numeracy predicts risk of pre-hospital decision delay: A retrospective study of acute coronary syndrome survival. *Annals of Behavioral Medicine*. (b) Cokely, E. T., Galesic, M., Schulz, E., Ghazal, S., & Garcia-Retamero, R. (2012). Measuring Risk Literacy: The Berlin Numeracy Test. *Judgment & Decision Making*, 7(1), 25-47. (c) Cokely, E. T., Feltz, A., Allan, J., Ghazal, S., Petrova, D., & Garcia-Retamero, R. (in press). Decision making skill: From intelligence to numeracy and expertise. In: Ericsson A, ed. *Cambridge Handbook on Expertise and Expert Performance*. 2nd ed. Cambridge University Press. (d) Nelson, W., Reyna, V. F., Fagerlin, A., Lipkus, I., & Peters, E. (2008). Clinical implications of numeracy: theory and practice. *Annals of behavioral medicine*, 35(3), 261-274.

Results

- Independent of the influence of all other assessed factors, a patient with high (vs. low) numeracy was about four times more likely to seek medical attention within the critical first hour after symptom onset (OR_{high-low}=3.84 [1.127, 11.65]).
- A relationship comparable in size to the most influential demographic and situation-related risk factors, including symptom severity (OR=.63 vs OR=.64).

Figure 1. Percentage of patients in each numeracy group that reported decision delay longer than one hour .

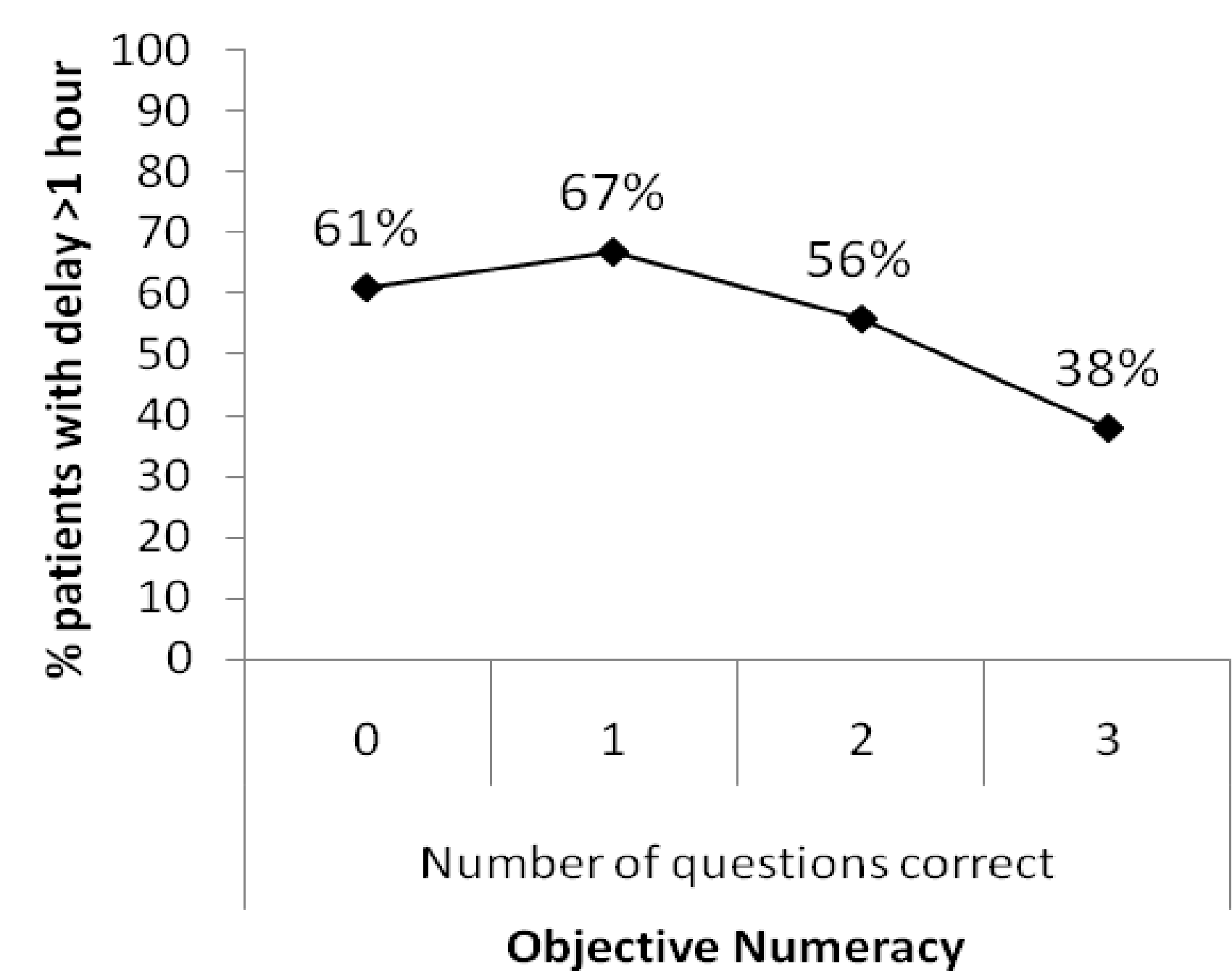
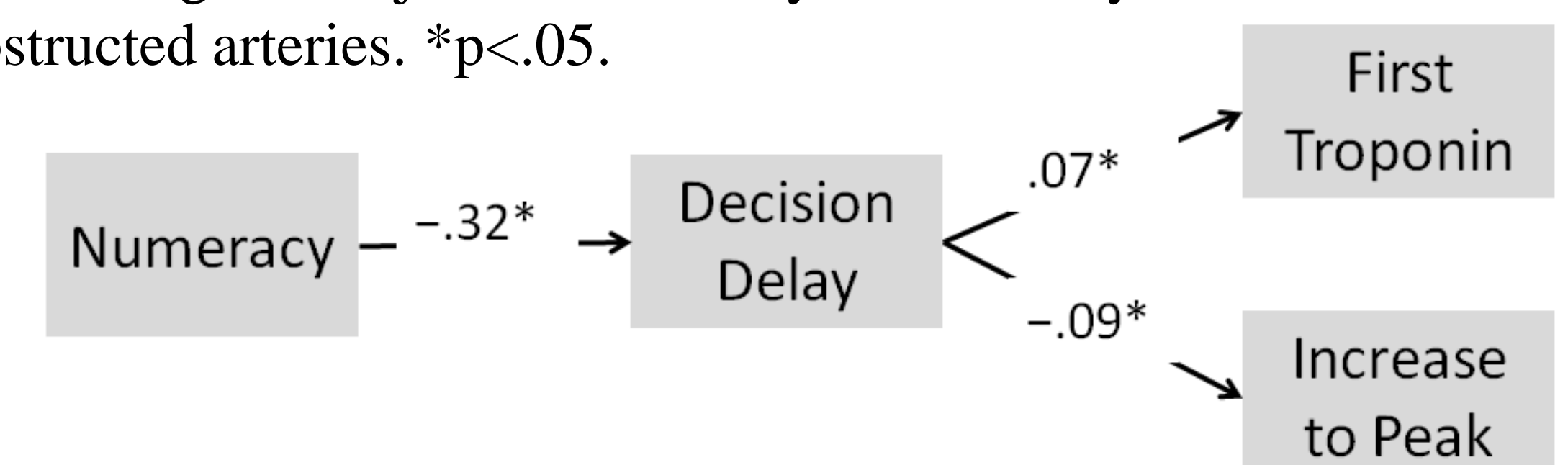


Figure 2. Indirect effect of objective numeracy on troponin levels of ACS patients via decision delay. Coefficients are unstandardized B from models controlling for subjective numeracy, travel delay, and number of obstructed arteries. *p<.05.



Implications

- Brief numeracy tests can predict which patients are at greater risk for life-threatening decision delay, and can facilitate the design of tailored risk communications.
- Opportunity for theoretical advances related to underlying decision making skills identified using numeracy tests (e.g., deliberation, memory for risks, meta-cognitive heuristics).