Numeracy and Diabetes Self-Efficacy Mediate the Effects of Race on Glycemic Control

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NIH SUMMIT: THE SCIENCE OF ELIMINATING HEALTH DISPARITIES

WHAT WE KNOW…

- Limited literacy and lower numeracy have been associated with difficulty understanding food labels in patients with diabetes (Rothman et al., 2006).

- Limited literacy (Shillinger et al., 2002) and lower numeracy have been associated with poor glycemic control (Cavanaugh et al., 2008).

- There are race/ethnic disparities in diabetes outcomes.

REDUCING DISPARITIES

Limited literacy may contribute to disparities:

- PSA level (Wolf et al., 2006)
- Health status (Howard et al., 2006)
- Work impairing condition (Sentell & Halpin, 2006)
- HIV medication adherence (Osborn, et al. 2007)

Has not been looked at in diabetes!

OBJECTIVES

1. Establish race difference in glycemic control.

2. Assess whether literacy and/or numeracy explain this difference.

3. Explore associations between race, literacy, numeracy, self-efficacy, self-management behaviors, and glycemic control.

METHODS

Patients with diabetes from 3 clinics in Nashville, TN and Chapel Hill, NC.

Conducted in-person interviews in a private room.

Measures:

- Patient demographics
- Health literacy [REALM]
- Numeracy [WRAT-3, DNT]
- Perceived self-efficacy to manage diabetes [PDSMS]
- Self-management behaviors [SDSCA]
- Glycemic control [A1C]

Demographics n (%) or mean (SD)	White	African American	ALL
Race	249 (65%)	149 (35%)	383 (100%)
Age (years)	54 (13.6)	54 (12)	55 (46 to 64)
Female	107 (43%)	86 (64%)	193 (50%)
Income, < $20,000	84 (34%)	82 (62%)	166 (44%)
Education, ≤ HS or GED	89 (36%)	78 (59%)	167 (43%)
Private Insurance	135 (54%)	50 (37%)	185 (48%)
Literacy (%), < 9th grade	45 (17%)	75 (56%)	120 (31%)
Numeracy (%), < 9th grade	147 (59%)	119 (89%)	266 (69%)
Literacy	61.5 (10.3)	54 (15.1)	59 (12.5)

Diabetes-specific n (%) or mean (SD)	White	African American	ALL
Diabetes: Type 2	199 (80%)	128 (95%)	327 (85%)
Years of diabetes diagnosis	12 (10)	10 (8.4)	9 (3 to 17)
Body mass index (kg/m^2)	33 (7.4)	35 (9.2)	32 (28 to 38)
A1C (%)	7.4 (1.5)	7.9 (1.9)	7.7 (6.4 to 8.3)
Diabetes Numeracy	30 (8.8)	19 (10.4)	26 (10.6)

HYPOTHESIS: *African Americans have higher A1C levels than Whites.*

Analytic Strategy

Stepwise Regression

- Race was related to A1C controlling for:
  - **age, diabetes type, gender, income, insulin, and years of diagnosis**

Chi-square & T-test

- Examined racial differences on significant variables in the model to rule out confounds

Race Differences in A1C

Variables	Model 1 Beta	Model 2 Beta	Model 3 Beta
(1) Insulin	.28***		
(2) Insulin		.25***	
Age		-.19***	
(3) Insulin			.27***
Age			.18***
Race			**.16*** **
R^2	.08	.11	.14
F for R^2 change	**31.64*** **	**14.86*** **	**10.84*** **

ns: DM type, gender, income, yrs of dx

Chi-square

Insulin and race were independent

T-test

No race differences in age

STRUCTURAL EQUATION MODELING

HYPOTHESES:

1. Numeracy explains racial differences in glycemic control (A1C).
2. Numeracy predicts diabetes self-efficacy.
3. Self-efficacy predicts self-management behavior, and such behavior predicts A1C

Path Analysis

- Capable of analyzing complex relationships
- Competing hypotheses are statistically testable

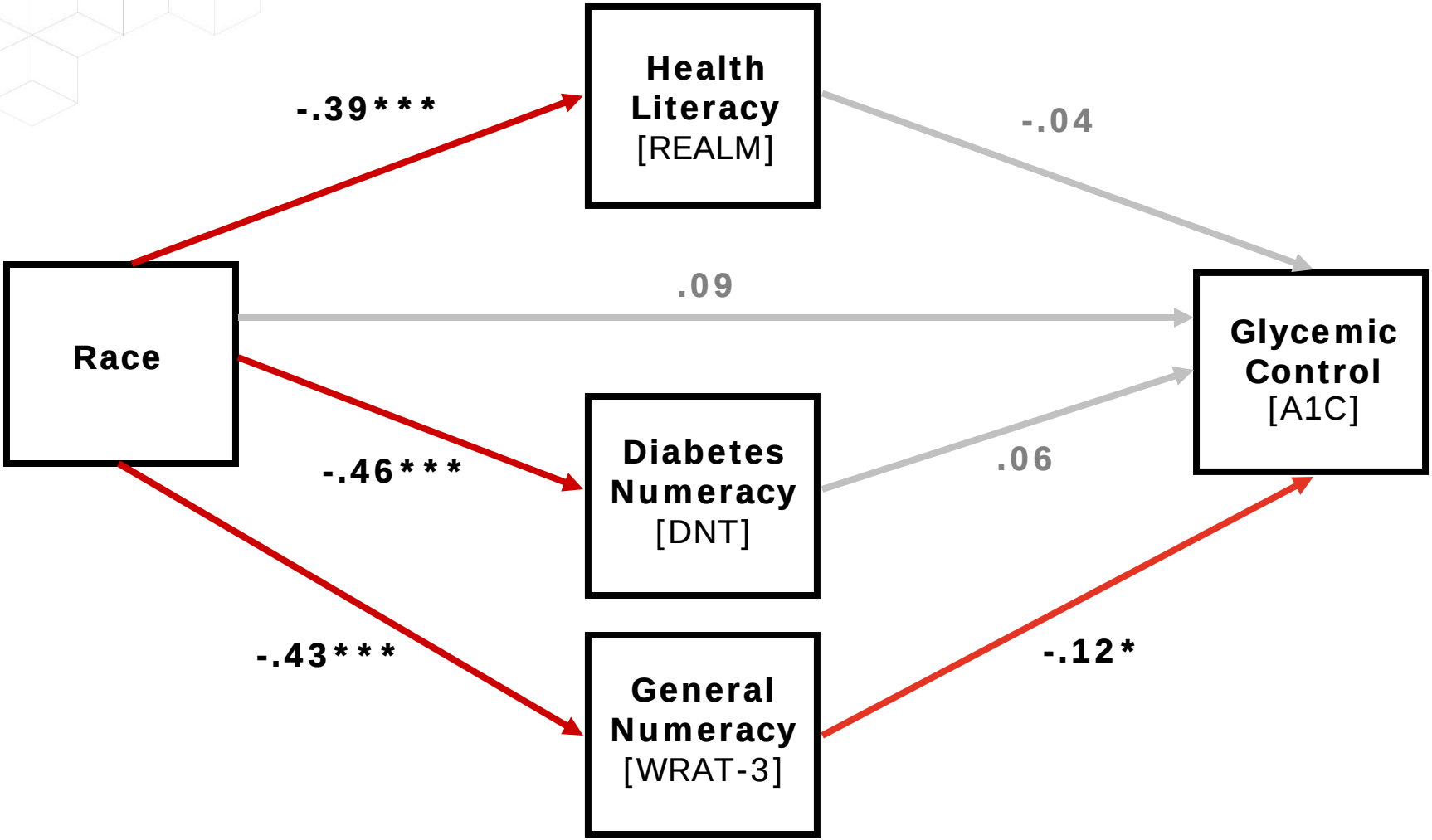
AMOS 16.0

- Estimated 3 models
- Tested path coefficients
- Tested model fit: Chi-square, CFI, RMSEA

General Numeracy Explains Race Differences in A1C

$\chi 2(3)=271.54$, $p=.00$; CFI=.47; RMSEA=.48(90% CI:.44-.53)

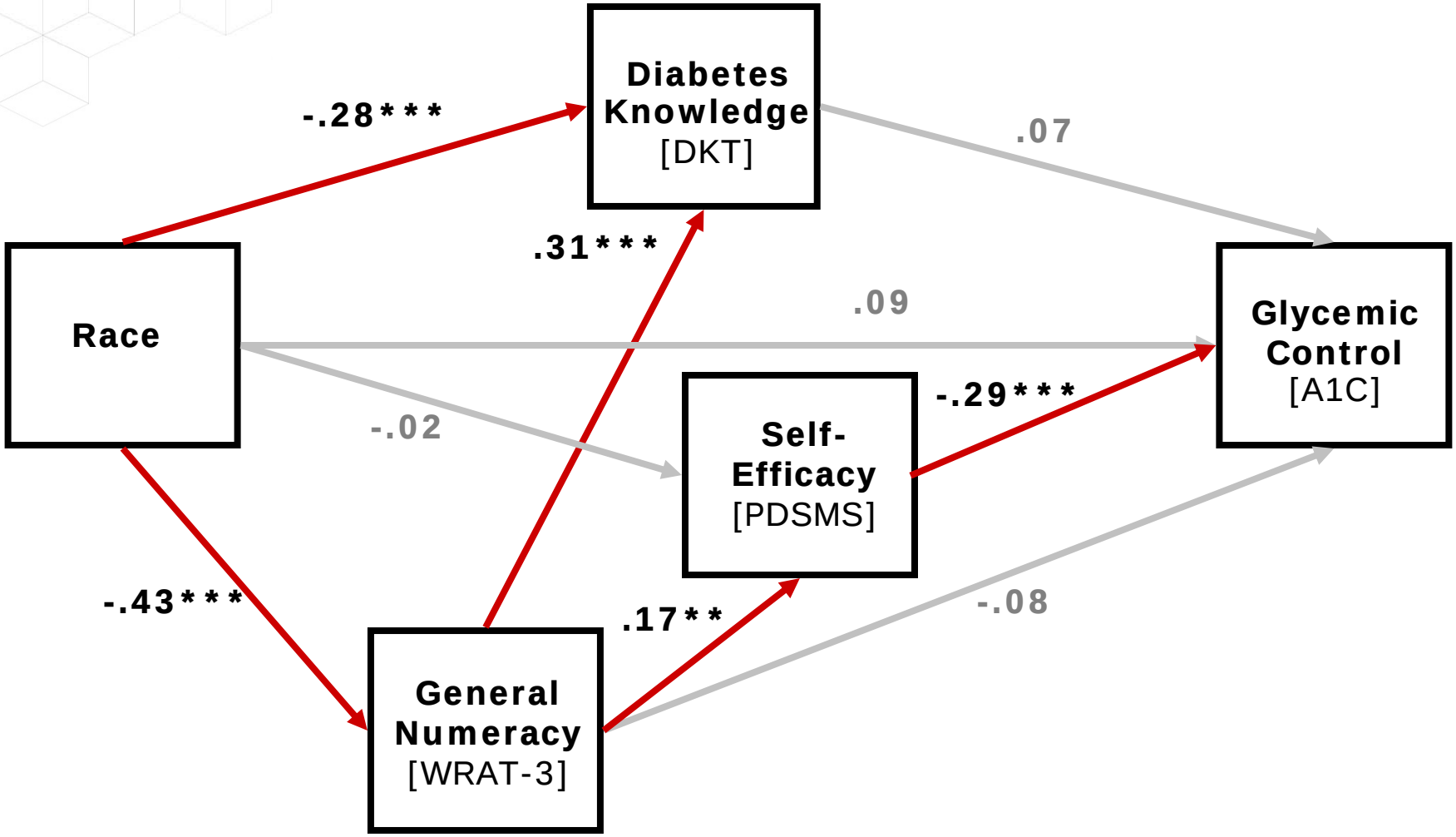
*p < .05 **p < .01 ***p < .001



Self-Efficacy Explains Numeracy to A1C

$\chi 2(1)=.04$, $p=.84$; CFI=1.00; RMSEA=.00 (90% CI:.00-.08)

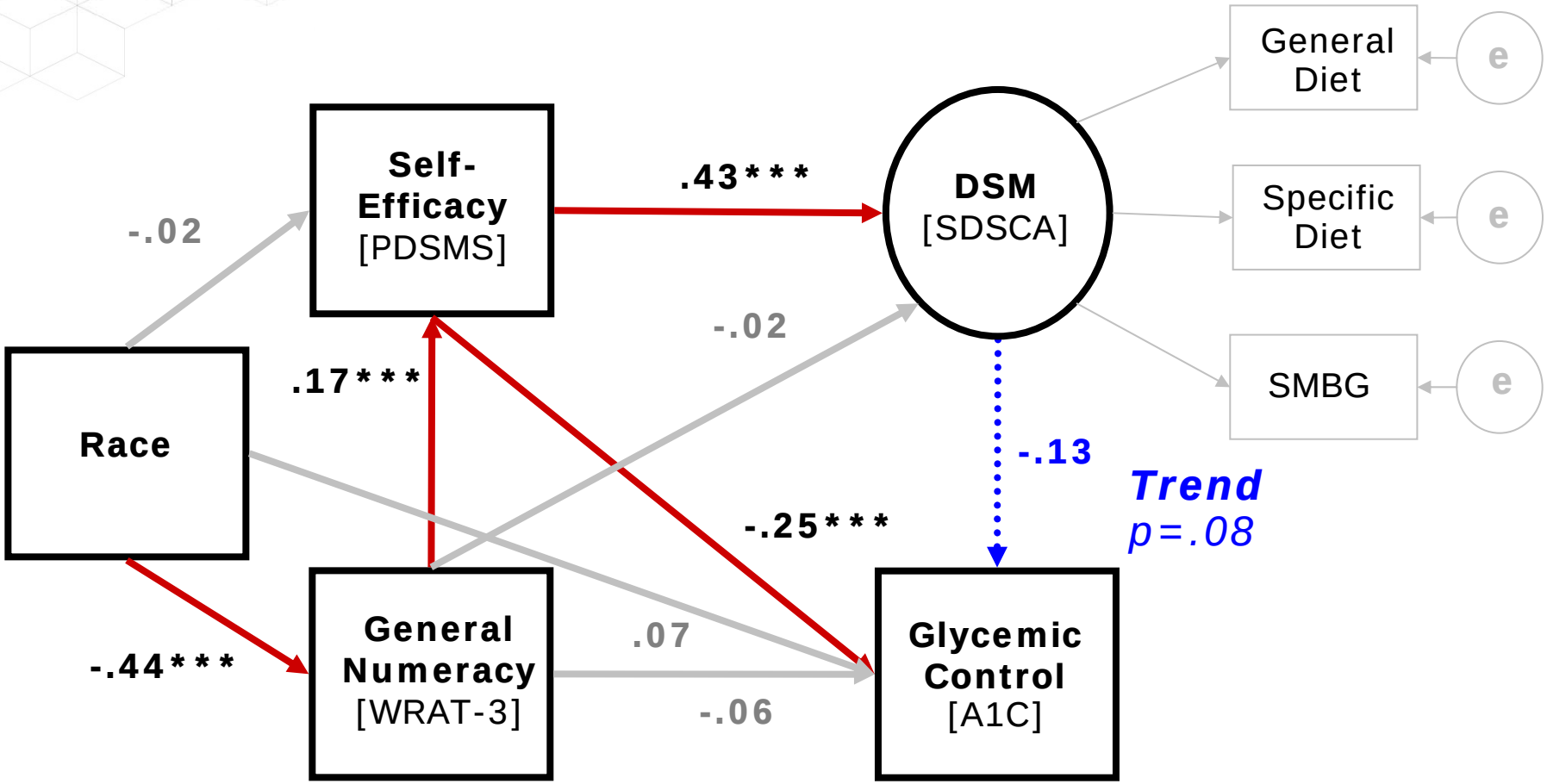
*p < .05 **p < .01 ***p < .001



Self-Efficacy Predicts Diabetes Self-Management

$\chi 2(13)=14.68$, $p=.33$; CFI=.99; RMSEA=.02 (90% CI:.00-.06)

*p < .05 **p < .01 ***p < .001



SUMMARY

- African American race was a significant predictor of poor glycemic control.
- Numeracy in the model reduced the explanatory power of race. Numeracy, and not race, was predictive of glycemic control.
- Self-efficacy was both a strong predictor of self-management, and mediated the relationship between numeracy and glycemic control.

LIMITATIONS

- Limitations of self-report scales
- Measurement error was unaccounted for in the analyses.
- Structural equation modeling cannot test directionality in relationships. There may be several models that fit the data equally well.
- Longitudinal data would help rule out alternative models.

IMPLICATIONS

Our findings highlight the importance of acknowledging numeracy and self-efficacy barriers when attempting to understand health disparities in diabetes outcomes.

Numeracy and self-efficacy should be considered in the development of effective strategies to reduce these differences.

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