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Direct and indirect effects of neighborhood factors and self-care on glycemic control in adults with type 2 diabetes

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ABSTRACT

Aim: To determine whether neighborhood factors have direct or indirect effects, via self-care behaviors on glycemic control.
Methods: Adult patients with type 2 diabetes were recruited from an academic medical center and Veterans Affairs Medical Center in the southeastern United States. Confirmatory factor analysis was used to create latent variables for neighborhood factors and diabetes self-care behavior. Structural equation modeling was used to test direct and indirect effects between neighborhood factors and glycemic control as assessed by HbA1c levels.
Results: CFA yielded four latent variables for neighborhood factors (neighborhood violence, access to healthy food, social support, and neighborhood aesthetics) and one latent variable diabetes self-care. We found that social support ($\beta = 0.28$, $z = 4.86$, $p < 0.001$) and access to healthy foods ($\beta = -0.17$, $z = -2.95$, $p = 0.003$) had direct effects on self-care; self-care ($\beta = -0.15$, $z = -2.48$, $p = 0.013$) and neighborhood aesthetics ($\beta = 0.12$, $z = 2.19$, $p = 0.03$) had direct effects on glycemic control; while social support ($\beta = -0.04$, $z = -2.26$, $p = 0.02$) had an indirect effect on glycemic control via self-care.
Conclusion: This study showed that self-care behaviors and neighborhood aesthetics have direct effects on glycemic control, social support and access to health foods had direct effects on self-care, and social support had an indirect effect on glycemic control via self-care.

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1. Introduction

Over 25 million people in the United States (US) have type 2 diabetes (T2DM) (National Institute for Diabetes, Digestion, & Kidney Disease (NIDDK), 2011). Key clinical measures, such as poor glycemic control, hypertension, and high low-density lipoprotein (LDL) cholesterol, have been shown to increase the risk of health complications (Adler et al., 2000; Stratton et al., 2000; Lu, Resnick, Joblanski, Jones, et al., 2003). Specifically, glycemic control has been directly associated with patients' adherence to self-care behaviors (Rosal et al., 2005; Shrivastava, Shrivastava, & Ramasamy, 2013), including medication adherence (Bailey & Kodack, 2011), diet (Azadbakht, Surkan, Esmaillzaheh, & Willett, 2011; Jenkins et al., 2011), exercise (Umpierre et al., 2011), self-monitoring blood glucose (Guerci et al., 2003; John, Davis, Price, & Davis, 2010; Karter et al., 2001; Virdi, Daskiran, Nigam, Kozma, & Raja, 2012), and foot care (Anonymous, 2010). However, patients struggle with adherence to self-care behaviors (Khattab, Khader, Al-Ahawaldeh, & Ajloui, 2010). Several barriers to attaining and maintaining glycemic control have been noted, including socio-environmental factors (Brown et al., 2004).

Neighborhood factors are socio-environmental factors that also impact health outcomes (Pickett & Pearl, 2001). Poor neighborhood qualities, such as violence, lack of quality resources, lack of social support and reduced access to healthy foods have been shown to be barriers to performing self-care behaviors and attaining better health outcomes (Berkowitz, Baggett, Wexler, Huskey, & Wee, 2013; Billimek & Sorkin, 2011; Brown et al., 2004; Gary et al., 2008; Horowitz, Colson,

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Hebert, & Lancaster, 2004; Hosler, Gallant, Riley-Jacome, & Rajulu, 2014; Kollannoor-Samuel et al., 2012; Renalds, Smith, & Hale, 2010; Vaccaro, Exebio, Zarini, & Huffman, 2014). However, little is known about the mechanism by which neighborhood characteristics influence glycemic control. A theoretical framework by Brown and colleagues (Brown et al., 2004) suggest that self-care behaviors mediate the relationship between neighborhood factors and health outcomes in individuals with T2DM. Additionally, Cosansu and Erdogan (2014) and Osborn and Egede (2010) found that self-care behaviors mediate the relationship between psychosocial factors and health outcomes in individuals with T2DM. However, little is known about the direct and indirect effects of neighborhood factors on glycemic control (Fig. 1). Specifically, it is unclear whether neighborhood factors have direct effects on glycemic control or indirectly via self-care.

The purpose of this study was to add to the current body of research on social determinants of health by examining the direct and indirect effects of neighborhood factors and self-care on glycemic control in adults with T2DM. For this study we adapted the theoretical framework by Brown and colleagues (Brown et al., 2004) to test the effect of neighborhood factors on HbA1c. We modified the framework to emphasize the role of neighborhood factors based on new evidence on the role of neighborhood factors that has emerged since the publication of the theoretical framework by Brown and colleagues (Brown et al., 2004). We hypothesized that neighborhood factors would influence glycemic control indirectly via self-care behaviors.

2. Subjects, materials, and methods

2.1. Sample selection and setting

Individuals with T2DM (N = 615) were recruited from an academic medical center (n = 315) and a Veterans Affairs Medical Center (n = 300) in the southeastern United States. Approvals were obtained from the institutional review board and research and development committee for both institutions prior to study enrollment. Eligible patients had to be 18 years of age or older, a patient at either facility with a diagnosis of T2DM in their medical record, and able to communicate in English. Subjects were ineligible if they exhibited mental confusion during the screening interview or reported alcohol or drug abuse/dependency or active psychosis or acute mental disorder using validated screening instruments.

2.2. Data collection

Program coordinators reviewed the electronic clinic roster to identify eligible patients. Eligible patients were approached in the clinic waiting room and provided a description of the study. For those interested and eligible, informed consent was obtained, and they were given the questionnaire to complete. Patients were able to complete the assessment before or after their scheduled clinic appointments, depending on clinic flow. Six hundred and fifteen participants were consented and completed the study. Study personnel who had direct contact with patients were required to conduct mock study visits with fellow study personnel to insure that the consent process and administration of the study assessment were standardized.

2.3. Outcome measure

The primary outcome measure, glycemic control, was assessed by hemoglobin A1c (HbA1c) level. The most recent HbA1c value within 6 months of the date the questionnaire was completed was used. HbA1c values were abstracted from the electronic medical records.

2.4. Self-care behaviors

2.4.1. Self-reported medication adherence

This was measured with the 8-item self-report Morisky Medication Adherence Scale (MMAS) (Morisky, Green, & Levine, 1986). Each of the 8 items measures a specific medication-taking behavior. The new scale has higher reliability compared with the older 4-item scale ($\alpha = 0.83$ vs. $\alpha = 0.61$). The MMAS scores can range from 0 to 8 and was categorized as high adherence (score, 8), medium adherence (score, 6 to <8), and low adherence (score, <6).

2.4.2. Self-care behaviors

This was assessed with the Summary of Diabetes Self-Care Activities (SDSCA) scale (Toobert, Hampson, & Glasgow, 2000). SCDCA is a brief, validated self-report questionnaire of diabetes self-management that includes items assessing diet, exercise, medication adherence, and self-monitoring blood glucose testing. The average inter-item correlations within scales are high; test–retest correlations are moderate; and correlations with other measures of diet and exercise generally support the validity of the SDSCA subscales.

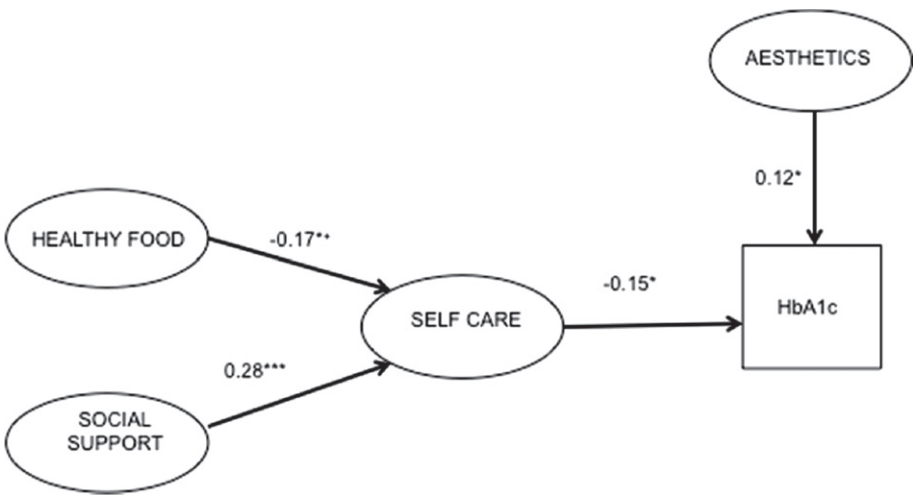

Fig. 1. Direct and indirect effects of neighborhood factors and self-care on glycemic control. Note: Overall model fit, χ^2 (197) = 240, p = 0.02; RSMEA = 0.02 and CFI = 0.996; significance levels are for standardized solutions: *p < 0.05, **p = 0.01, ***p < 0.001.

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