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Does Personality Matter in Diabetes Adherence?: Exploring the pathways between neuroticism and patient adherence in couples with Type 2 diabetes

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Abstract

Background—Personality has received some attention in the Type 2 diabetes literature, however research has not linked personality and diabetes adherence behaviors (diet and exercise), identified pathways through which they are associated, nor taken into consideration important contextual factors that influence behavior (the patient's partner).

Methods—Dyadic data from 117 married, heterosexual couples in which one member is diagnosed with Type 2 diabetes was used to explore associations between each partner's neuroticism and patient dietary and exercise adherence through the pathways of negative affect, depression symptoms, and couple-level diabetes efficacy (both patient and spouse report of confidence in the patient's ability to adhere to diabetes management regimens).

Results—Results revealed that higher levels of neuroticism were associated with lower patient dietary and exercise adherence through (1) higher levels of depression symptoms (for patients' neuroticism) and negative affect (for spouses' neuroticism), and (2) lower levels of couple-level diabetes efficacy.

Conclusions—The results from this study provide evidence that both patient and spouse personality traits are associated with patient dietary and exercise adherence through increased emotional distress—albeit different emotional pathways for patients and spouses—and lower couple confidence in the patients' ability to manage their diabetes.

Keywords

neuroticism; diabetes adherence; negative affect; depression symptoms; couple diabetes efficacy; dyadic data

Type 2 diabetes has become a global epidemic that affects over 377 million people worldwide, with estimated prevalence rates rising to an alarming 642 million people by 2040 (International Diabetes Federation, 2015). The negative effects of Type 2 diabetes can often be lessened by proper adherence to diet, exercise, and medication regimens (Gonder-Frederick, Cox, & Ritterband, 2002). Despite this, there is considerable variability in patient adherence to physician prescribed health routines (Lane et al., 2000). A variable that has received considerable attention in relation to adherence—depression—is both directly linked with poor adherence (Gonzalez et al., 2008) and indirectly linked through lower levels of patient and spouse diabetes self-efficacy, or the belief that consistent adherence by the patient is possible (Anderson et al., 2016).

Despite these important findings, researchers have yet to broaden the construct of emotional distress beyond depression (such as negative affect—nervousness, irritability, etc.) and identify the factors that may predispose patients to experience greater levels of emotional distress—such as personality—that may influence their ability to maintain adherence. Previous research that has attempted to link personality traits, such as neuroticism—a predisposition to experience higher levels of anger, anxiety, and moodiness (Costa & McCrae, 1992)—to adherence have failed to find strong or direct associations (Christensen & Smith, 1995; Brickman et al., 1996). We believe there is cause to study the link between personality traits and adherence indirectly (through emotional distress and diabetes efficacy), as well as accounting for spousal factors—personality traits, emotional distress, and diabetes self-efficacy—which are associated with patient adherence. As such, using data from 117 married, heterosexual couples in which one person has been diagnosed with Type 2 diabetes (patients), the purpose of this study is to explore how both patient's and spouse's neuroticism is associated with patient dietary and exercise adherence via patient and spouse negative affect and depression symptoms, and couple-level diabetes efficacy (the couples' joint belief that the patient can manage the disease).

Personality and Adherence in Chronic Illness Patients

Health psychologists have long been studying the association between underlying stable personality traits and health behaviors in an effort to understand why some patients respond to treatment while others do not (Smith & Williams, 1992). Patient adherence—or active, voluntary behaviors in which an individual engages in to prevent, maintain, or improve health status (Pidgeon, 1989)—is no exception, as researchers have searched for personality factors that may help to understand the variability in patient adherence.

Neuroticism, defined as “a general tendency to experience negative affect” (Costa & McCrae, 1992, p. 14), has been one of the most studied personality traits in the health literature. Research specifically on neuroticism and patient adherence in chronic illness have yielded inconsistent findings, with some finding that neuroticism was not a predictor of medication or dietary adherence in renal dialysis patients (Christensen & Smith, 1995), and others finding that moderate levels of neuroticism in Type 1 diabetes patients was associated with a higher probability to adhere to physician guidelines (Brickman et al., 1996). In another study of adolescents with Type 1 diabetes, higher neuroticism was linked with lower insulin administration (Wheeler, Wagaman, & McCord, 2012). Taylor and colleagues (2003)

found that neuroticism at diagnosis of Type 1 diabetes was consistently associated with poorer self-reported diabetes quality of life at four and twelve months after diagnosis. Looking specifically at those with Type 2 diabetes, Lane et al. (2000) found that higher levels of neuroticism were related to better glycemic control and lower HbA1c levels, but was not specifically related to diabetes management behaviors such as diet and exercise. Thus, to date, the direct link between neuroticism and diabetes adherence (i.e., diet and exercise) has not yielded consistent results.

Why might there be inconsistent associations between neuroticism and diabetes adherence? Research attempting to link neuroticism to diabetes outcomes have shown inconsistent results thus far—we believe—because studies have attempted to link them directly, and have not identified significant mediators or pathways through which they are related. We believe there is evidence for the association through several important constructs identified in the Type 2 diabetes literature, including emotional distress (e.g., depression symptoms and negative affect) and disease specific cognitions (e.g., diabetes self-efficacy).

Important Mediators between Neuroticism and Diabetes Adherence

Depression

Diabetes patients are at an increased risk for higher emotional distress, as research has shown higher rates of depression exist in diabetes patients than the general population (Anderson et al., 2001). Indeed, research has found a direct link between depression and dietary non-adherence (see Gonzalez and colleagues' 2008 meta-analysis). There also is a considerable amount of research on how personality traits are associated with depression symptoms. Although some scholars have argued that measures of personality traits are influenced by current mood states (e.g., depressed people are likely to score high on measures of neuroticism; Farmer et al., 2002), longitudinal research has found preexisting neuroticism is positively associated with the development of depression (McWilliams, 2003). Thus, personality (trait-like) seems to predict the onset of depression (state-like; see Klein et al., 2011 for an extensive review). Although these findings have been confirmed in primary care patients, (Steunenbergh, Beekman, Deeg, & Kerkhof, 2006), research has yet to link these in patients with Type 2 diabetes. Additionally, depression symptoms are just one facet of emotional distress and there is evidence to suggest that the broader concept of negative affect might provide an important, unique link between personality (neuroticism) and diabetes adherence.

Negative affect

Although research has identified a strong negative association between depression and adherence in the Type 2 diabetes literature, a paucity of research has included other measures of emotional well-being that may capture a wider range of the patient's emotional experience. Although negative affect and depression are similar (both measure some degree of sadness), the measurement of negative affect captures broader emotional experiences that are not included in diagnostic measures of depression (e.g., irritability, nervousness, anger, etc. Watson & Clark, 1988), and reflect subjective feelings in reaction to environmental stimuli (Ormel, Rosmalen, & Farmer, 2004). In contrast, neuroticism refers more to a stable

steady trait that represent a person's average level of distress over time (Miller, Vachon, & Lynam, 2009). Although negative affect and neuroticism are related, studies have shown that they are distinct constructs (Kamen, Pryor, Gaughan, & Miller, 2010), and thus more neurotic individuals may experience more negative affect at any one given point in time.

Negative affect has received some attention in the diabetes literature, albeit very few studies exist. For example, negative affect has been related to higher levels of reported health problems and poorer marital quality among adults with Type 1 and Type 2 diabetes (Trief, Himes, Orendorff, and Weinstock, 2001). Research has also found a positive link between negative affect and glucose levels (Skaff, Mullan, Hoffman, Mohr, Almeida, Masharani, & Fisher, 2009), such that higher levels of negative affect were associated with higher glycosylated hemoglobin levels. Despite this, associations between negative affect and diabetes management behaviors such as diet and exercise have not been tested and to our knowledge, negative affect has not been included in models with depression symptoms to determine the unique relationships between these different facets of emotional distress and diabetes adherence. Additionally, we believe that evidence exists for these associations through another important variable in the diabetes literature—diabetes self-efficacy—or the confidence in one's ability to manage their diabetes.

Diabetes self-efficacy

Theorists have long postulated that efficacy expectations are influenced by mood states (Bandura, 1997), suggesting that when individuals experience negative mood states they feel less confident in their ability to accomplish a specific behavior. Evidence for this ordering (mood states → diabetes self-efficacy → adherence) has been found in the Type 2 diabetes literature, although only with depression symptoms being associated with diabetes self-efficacy (Anderson et al., 2016). The present study extends such research by testing a wider range of emotional experience (including both negative affect and depression symptoms) on diabetes self-efficacy—such that higher levels of negative affect and depression symptoms will be associated with poorer dietary and exercise adherence through lower diabetes self-efficacy.

The Couple Context

Another reason—we believe—for the inconsistent or weak associations between neuroticism and diabetes adherence is that research has not included contextual factors that may be implicated in the personality/adherence process. Scholars have argued that in order to fully understand chronic illness management, the role of the patient's partner must be considered (Berg & Upchurch, 2007). We believe this is an important consideration, specifically in relation to diabetes management behaviors (diet and exercise), as spouses have been shown to be a major factor in patient adherence including both dietary and exercise adherence (August et al., 2013; Beverly & Wray, 2010). Several studies within the Type 2 diabetes literature have linked spousal factors, such as stress and depression symptoms (Anderson et al., 2016), and spouse's diabetes distress (Franks et al., 2012) to adherence—with these associations again being mediated by the spouses' diabetes self-efficacy (Anderson et al., 2016; Johnson et al., 2013)—yet no studies have identified the spouse's personality as an

important factor. Just as a patient's engagement (or not) in health behaviors may be lower because of higher emotional distress which stem from personality traits, there is cause to claim that the spouse's personality traits may be associated with the patient's dietary and exercise adherence through the same pathways discussed above. In favor of the theoretical linkage spouse personality and patient behavior, scholars have proposed that one's behavior is determined by the interface between one's own personality and their context—with research showing that one's partner's personality as an important contextual variable that can influence behavior (Zayas et al., 2002).

Finally, recent efforts have investigated spousal diabetes self-efficacy as an important variable related to patient adherence, in addition to the patient's own diabetes self-efficacy (Johnson et al., 2013), thus accounting for the unique associations of patient and spouse perspectives of patient diabetes self-efficacy and patient adherence. This approach, though, does not get at the *shared* or couple-level diabetes self-efficacy and how it relates to patient adherence. This couple-level perspective is important because it goes beyond within-person associations by accounting for the interdependence of couples' thoughts, feelings, and behaviors in order to understand the influence of relationships on health behavior change (see Lewis and colleagues' 2006 model of Interdependence and Communal Coping). Therefore, measuring individual-level diabetes self-efficacy lacks the influence of the partner's perspective. Only one known study, to our knowledge, has investigated couples' collective efficacy (the couples' shared perception of the capability to successfully perform a behavior). In a qualitative interview on couples' experience of Type 2 diabetes, Beverly and Wray (2010) found an association between couples' collective efficacy and higher patient exercise adherence. Therefore, the present study focuses on the couples' shared diabetes self-efficacy as the pathway through which neuroticism and emotional distress will be associated with patient dietary and exercise adherence.

The Present Study

The current study will test a model linking patient and spouse neuroticism to patient dietary and exercise adherence through patient and spouse negative affect and depression symptoms and couple-level diabetes self-efficacy. Although neuroticism, depression symptoms, and negative affect are similar constructs of emotional distress/negativity, the above review of research lays the theoretical and empirical foundation for including them in the same model, as: 1) neuroticism represents average levels of emotional instability over time (trait-like) that may influence the development of depression and negative affect (state-like) at any given point; 2) The subjective experiences of the state-like depression and negative affect tap into different facets of emotional distress—depression refers more to sadness whereas negative affect includes measures of anxiety, nervousness, and irritability. As such, we believe that including them together in a model will help to (1) establish how states of negative affect and depression are related to diabetes adherence behaviors by uncovering predisposing personality traits, and (2) if/how the personality traits manifest themselves differently (for patients and spouses) and are associated with diabetes adherence behaviors in the context of heterosexual couples dealing with type 2 diabetes.

We hypothesize that higher levels of neuroticism will be indirectly associated with worse patient dietary and exercise adherence via the pathways of negative affect and depression symptoms, and couple-level diabetes self-efficacy (full mediation: neuroticism → negative affect & depression symptoms → couple-level diabetes self-efficacy → patient dietary and exercise adherence). These indirect effects will be tested using bootstrapping procedures. Finally, to increase confidence in the hypothesized model, several control variables will be included in the analyses—patient and spouse age and gender, and number of years since the patient was diagnosed with Type 2 diabetes—and we will compare our hypothesized model to four alternative models. First, past research has found direct associations between neuroticism and adherence (albeit weak), so we will test whether the inclusion of direct pathways from neuroticism to patient dietary and exercise adherence improves model fit. Second, research has found that neuroticism is directly related to efficacy (Judge & Ilies, 2002), so we will test whether the inclusion of direct pathways from neuroticism to couple-level diabetes self-efficacy is necessary. Third, previous studies have found direct links from emotional well-being to dietary non-adherence (Gonzalez et al., 2008). Therefore, direct paths will be included from depression symptoms and negative affect to patient dietary and exercise adherence. Finally, research has reversed the ordering of diabetes self-efficacy and emotional distress such that lower self-efficacy was associated with higher depression (Sacco et al., 2005), therefore, we will compare our hypothesized model to this alternative model.

Method

Procedures

Participants were enlisted from a large medical center patient registry in the Midwestern United States. We only selected those patients who were diagnosed with Type 2 diabetes mellitus, between the ages of 18–74, and had not experienced severe negative effects of their diabetes (kidney disease or renal failure, amputation, or blindness). Of the several thousand patients in the registry, only 525 patients met these criteria. Next, participants were further screened to include those who were currently married with a partner (heterosexual couples) who was not diagnosed with Type 2 diabetes, and were both willing to participate in the study. This left 240 eligible patients after 180 did not qualify and 105 could not be reached after multiple attempts, and of these 240, only 155 consented to participate (85 declined). A research assistant then obtained unique e-mail addresses for the patient and partner and each was sent a separate link to complete the online survey. If requested, paper copies of the survey were sent to the patients and partners with a self-addressed and stamped envelope. Of the 155 who consented, only 117 patients and partners completed the survey (a response rate of 49% of the total 240 eligible participants). These couples received \$30 as appreciation for their participation. Data was collected and managed using REDCap electronic data capture tools hosted at University of Kansas Medical Center (Harris, Taylor, Thielke, Payne, Gonzalez, & Conde, 2009).

Participants

The present sample consisted of 67 couples (57.3%) in which the male was diabetic and 50 couples (42.7%) in which the female was diabetic. On average, patients were 57.4 years old

($SD = 9.8$) and had been diagnosed with Type 2 diabetes for 10.98 years ($SD = 9.19$), and spouses were 57.38 years old ($SD = 10.15$). Eighty-seven percent of patients and 83.3% of spouses were of European-American descent, 7.0% of patients and 5.3% of spouses were African American, 3.5% of patients and 4.4% of spouses were Latino/a, and 2.6% of patients and 7% of spouses did not specify their race. Sixty-one and a half percent of participants were in their first marriage, 27.4% had been married twice, and 11.1% of participants had been married three or more times. The average relationship length was 29.40 years ($SD = 13.88$). In terms of education, .9% of patients had less than a high school diploma, 12.1% of patients and 19.1% of spouses had graduated high school, 43.1% of patients and 31.3% of spouses had completed some college or received an associate's degree or technical training, 21.6% of patients and 28.7% of spouses held a bachelor's degree, and finally, 22.4% of patients and 20.9% of spouses had a postgraduate degree. For annual household reported income, 18.5% indicated an income below \$50,000, 24.1% reported between \$50K and \$70K, 31.5% reported between \$70K and \$100K, and 25.9% made \$100K or more per year. Finally, about 75% of patients and 80% of spouses reported minor depression symptoms.

Measures

Neuroticism—Neuroticism was assessed with the eight-item neuroticism subscale of the Big Five Inventory (John & Srivastava, 1999). Participants indicated their level of agreement on eight statements (e.g., “depressed, blue,” “relaxed, handles stress well,” “tense,” “worries a lot,” “emotionally stable, not easily upset,” “moody,” “remains calm in tense situations”, and “gets nervous easily”) ranging from 1 = *disagree strongly* to 5 = *agree strongly*. Cronbach's alpha indicated good reliability for both patients, ($\alpha = .85$) and spouses ($\alpha = .81$).

Negative affect—Negative affect was measured with the ten-item negative affect subscale of the positive and negative affect schedule (PANAS; Watson, Clark, & Tellegen, 1988). A list of feelings and emotions were presented and respondents indicated how often, on average, they felt that way (e.g., “irritable,” “distressed,” “ashamed,” “upset,” “nervous,” “guilty,” “scared,” “hostile,” “jittery,” and “afraid”). Responses range from 1 = *very slightly or not at all* to 5 = *extremely* and mean scores were computed. Cronbach's alpha indicated good reliability for both patients, ($\alpha = .90$) and spouses ($\alpha = .91$).

Depression symptoms—Depression symptoms were measured with the nine-item Patient Health Questionnaire (PHQ-9) (Kroenke, Spitzer, & Williams, 2001), a self-report assessment of depressive symptoms based on American Psychiatric Association's DSM-IV diagnostic criteria for major depressive disorder. Respondents indicated how often they have been bothered by nine depressive symptoms in the last two weeks (e.g., “little interest or pleasure in doing things,” and “feeling down, depressed, or hopeless”). Responses range from 1 = *not at all* to 4 = *nearly every day* and mean scores were computed. Cronbach's alpha indicated good reliability for both patients ($\alpha = .89$) and spouses ($\alpha = .85$).

Couple-level diabetes self-efficacy—Couple-level diabetes self-efficacy was measured via the seven-item self-efficacy subscale of the Multidimensional Diabetes Questionnaire

(MDQ; Talbot, Nouwen, Gingras, Gosselin, & Audet, 1997). This scale assessed both patient and spouse's confidence in the patient's ability to adhere to various aspects of the diabetic treatment regimen. Examples of questions included, for patients: "How confident are you in your ability to follow your diet?" and for spouses: "How confident are you in your spouse's ability to follow their exercise regimen?" Responses ranged from 0 = *not at all confident* to 5 = *completely confident* and mean scores were computed. Both patient ($\alpha = .87$) and spouse's diabetes efficacy ($\alpha = .91$) were used as indicators of a latent variable, couple-level diabetes self-efficacy, and factor loadings were set equal between patients and spouses as suggested by Newsom (2012). Standardized factor loadings were .87 for patients and .78 for spouses.

Dietary and exercise adherence—Patient dietary and exercise adherence were measured using the Summary of Diabetes Self-Care Activities measure (SDSCA; Toobert, Hampson, & Glasgow, 2000). The psychometric properties of the SDSCA have been extensively evaluated (for a review of seven studies, see Toobert et al., 2000). This scale assessed the diabetic patient's level of adherence with two items assessing the diet regimen and two items assessing the exercise regimen over the last seven days. The diet items were, "How many of the last seven days have you followed a healthful eating plan?" and "On average, over the past month, how many days per week have you followed your eating plan?". The exercise items were "How many of the last seven days did you participate in at least 30 minutes of exercise" and "On how many of the last seven days did you participate in a specific exercise session?". Responses ranged from 0 = *0 days* to 7 = *7 days*. The inter-correlation of these items was $r = .70$ ($p < .001$). Scores were averaged with higher scores indicating higher patient dietary and exercise adherence.

Covariates—Potential covariates that were explored in the model included number of years diagnosed with Type 2 diabetes, patient and spouse gender, patient and spouse age, and patient and spouse comorbidities (as measured by the Charlson comorbidity index; Charlson, Pompei, Ales, & MacKenzie, 1987). Berg & Upchurch's (2007) developmental-contextual model of chronic illness suggests that illness related distress and management may differ according to age, gender, and length of time diagnosed, underscoring the importance of including these variables in the analyses.

Analytic Plan—The data were first explored with descriptive statistics and correlations. Missing data were low, ranging from 1.7% for patient dietary adherence to 6.8% for patient report of neuroticism, and was handled through the full-information maximum likelihood procedure. Path analysis in Mplus 7.0 (Muthén & Muthén, 2012) with maximum likelihood estimation was used to answer the research questions following dyadic data analysis procedures (Kenny, Kashy, & Cook, 2006). Model fit was evaluated with the model chi-square (χ^2), the comparative fit index (CFI), Tucker-Lewis Index (TLI), the root mean square error approximation (RMSEA), and the standardized root mean square residual (SRMR) with a non-significant chi-square, values greater than .95 for CFI and TLI and smaller than .06 and .08 for RMSEA and SRMR suggesting good fit (Hu & Bentler, 1999). The alternative models were tested using appropriate procedures in regard to nested model comparison (chi-square difference test) and non-nested model comparison (Akaike

Information Criterion (AIC) and Bayesian Information Criterion (BIC), where smaller values of the AIC and BIC indicate less discrepancy between the hypothesized model and the true model (West, Taylor, & Wu, 2012)). Finally, the indirect paths were tested with bootstrapping procedures at the 95% confidence interval and 2,000 samples (Preacher & Hayes, 2008).

Results

Correlation Analysis

The correlation results revealed important information about the bivariate relationships among the variables in the study (see Table 1). Higher patient dietary and exercise adherence were associated with greater patient and spouse diabetes self-efficacy and lower patient depression symptoms, patient neuroticism, and patient negative affect. Greater patient and spouse diabetes self-efficacy were associated with lower patient depression symptoms, patient and spouse negative affect, and patient neuroticism; Greater spouse diabetes self-efficacy was associated with lower levels of spouse neuroticism. Higher patient depression symptoms were associated with higher patient neuroticism and negative affect, and higher spouse depression symptoms were associated with higher spouse neuroticism and negative affect and patient depression symptoms.

Model Comparison

We compared our hypothesized, most parsimonious model to four theoretically plausible models, the first three of which were nested (same ordering of the variables but differences in direct/indirect paths) and the last was an alternative model (different ordering of the variables). A series of nested model comparisons were conducted in order to determine if the hypothesized, parsimonious model better represented the data: (1) whether patient and spouse neuroticism were directly related to patient dietary and exercise adherence, rather than fully mediated through negative affect and depression symptoms, as well as couple-level diabetes self-efficacy (proposed model); (2) whether the indirect link between neuroticism and couple-level efficacy was best represented as fully mediated by depression symptoms and negative affect (the proposed model) or partially mediated (direct paths from neuroticism to couple-level diabetes efficacy); (3) whether patient and spouse negative affect and depression symptoms were directly related to patient dietary and exercise adherence, rather than fully mediated through couple-level diabetes efficacy (the proposed model). Each nested model was estimated and the chi-square difference tests indicated that the addition of direct pathways did not significantly improve model fit (the chi-square difference between each of the nested models was below the critical value for the respected degrees of freedom at the alpha 0.05 level). Thus our proposed, fully mediated model (neuroticism → depression symptoms and negative affect → couple-level diabetes efficacy → patient dietary and exercise adherence) represented a good fit to the data. Finally, (4) we tested an alternative (non-nested) model in which couple-level diabetes efficacy was modeled to predict patient and spouse negative affect and depression symptoms, rather than the reverse ordering (proposed model). Results revealed that our ordering of the variables was a better fit to the data. See Table 2 for full model comparison results.

Path Analysis Results

The results for the final path model can be viewed in Figure 2. The covariates were included in the model—patient and spouse gender, number of years diagnosed with Type 2 diabetes, patient and spouse age, and patient and spouse comorbidities—and care was taken to address issues of multicollinearity (testing patient and spouse gender separately as they are perfectly correlated at -1.0). None of the covariates were associated with dietary and exercise adherence, so they were trimmed from the model to increase statistical power. The pattern of results was consistent with and without the covariates. The final model proved to fit the data well: $\chi^2(22) = 22.473$, $p = .432$; RMSEA = .014 (C.I. = .000, .083); CFI = .999; TLI = .998; SRMR = .037, and accounted for 54% of the variance in dietary adherence and 27% of the variance in exercise adherence.

Higher patient neuroticism was associated with greater patient negative affect, and a higher number of patient and spouse depression symptoms. Higher spouse neuroticism was associated with greater spouse negative affect and higher number of spouse depression symptoms. More patient depression symptoms and spouse negative affect were negatively associated with couple-level diabetes self-efficacy. Finally, greater couple-level diabetes efficacy was associated with higher patient dietary and exercise adherence.

Test of Indirect Paths

Patient neuroticism was indirectly related to both patient dietary and exercise adherence. For patient dietary adherence: patient neuroticism $\rightarrow$ patient depression symptoms $\rightarrow$ couple-level diabetes self-efficacy $\rightarrow$ patient dietary adherence ($B = -.17$, $p = .003$, 95% confidence interval [CI] = $-.264, -.092$). This can be interpreted as follows: a one standard deviation unit increase in patient neuroticism is associated with a .17 standard deviation unit decrease in patient dietary adherence via the prior effect of patient neuroticism on patient depression symptoms and patient depression symptoms on couple-level diabetes self-efficacy. For patient exercise adherence: patient neuroticism $\rightarrow$ patient depression symptoms $\rightarrow$ couple-level diabetes self-efficacy $\rightarrow$ patient exercise adherence ($B = -.12$, $p = .001$, 95% confidence interval [CI] = $-.209, -.064$). Turning to the indirect effects for spouses, there was a significant indirect effect from spouse neuroticism to patient dietary adherence: spouse neuroticism $\rightarrow$ spouse negative affect $\rightarrow$ couple-level diabetes self-efficacy $\rightarrow$ patient dietary adherence ($B = -.12$, $p = .024$, 95% confidence interval [CI] = $-.241, -.022$) and from spouse neuroticism to patient exercise adherence: spouse neuroticism $\rightarrow$ spouse negative affect $\rightarrow$ couple-level self-diabetes efficacy $\rightarrow$ patient exercise adherence ($B = -.09$, $p = .039$, 95% confidence interval [CI] = $-.194, -.016$).

Discussion

This study examined the associations between patient and spouse neuroticism and patient dietary and exercise adherence via patient and spouse negative affect and depression symptoms and couple-level diabetes self-efficacy. This investigation revealed several important findings. Higher patient neuroticism was associated with lower patient dietary and exercise adherence via higher patient depression symptoms and lower couple-level diabetes efficacy. Higher spouse neuroticism was associated with lower patient dietary and exercise

adherence via higher spouse negative affect and lower couple-level diabetes self-efficacy. These findings were robust, as we included several important covariates as well as empirically compared our model with four plausible alternative models.

The most notable finding from this study was the indirect associations between neuroticism (reported by patients and spouses) and patient dietary and exercise adherence. Whereas previous research failed to find associations between personality traits, specifically neuroticism, and adherence (Lane et al., 2000), the present study uncovered important indirect pathways through which they are related. Additionally, our study shows that including spousal characteristics—personality and negative affect—are related to the patient's ability to follow diet and exercise guidelines (Berg & Upchurch, 2007; Zayas, Shoda, & Ayduk, 2002). These findings shed additional light into why diabetes adherence proves to be more difficult for some patients, and why intervention efforts aimed at improving adherence may, at times, fall short—the personality and emotional well-being of both the patient *and* a healthy spouse are associated with patient dietary and exercise adherence.

Second, the pathways through which patient and spouse neuroticism were associated with patient dietary and exercise adherence were different between patient and spouses. For patients, higher neuroticism was associated with less couple-level diabetes efficacy and lower patient dietary and exercise adherence via their own *depression symptoms*. This finding supports previous literature on the association between higher depressive symptoms and worse diabetes management (Gonzalez et al., 2008)—particularly with this association occurring through diabetes self-efficacy (Anderson et al., 2016)—yet extends the literature because it identifies patient neuroticism as an important personality trait associated with both patient dietary and exercise adherence through depression symptoms. Thus, patient neuroticism is associated with lower patient diabetes management behaviors through higher patient depression symptoms and less patient and spouse confidence that the patient can successfully manage his or her disease.

In contrast for spouses, higher neuroticism was associated with lower couple-level diabetes self-efficacy and lower patient dietary and exercise adherence via their own (the spouse's) *negative affect*. Why might the spouse's negative affect, and not depression symptoms, be the pathway through which the spouse's neuroticism is associated with patient adherence (via couple-level diabetes efficacy)? This finding may be interpreted in a number of ways. First, it could be that the patient's adherence is more sensitive to the spouse's negative affect—including anger, nervousness, moodiness—because those emotional states may be more outwardly displayed; depression symptoms may be more internally experienced (e.g., feelings of worthlessness)—further investigation revealed a significant paired samples t-test between patient and spouse report of depression (higher for patients). As such, the spouses' underlying personality traits are associated with both higher depression symptoms and negative affect (as demonstrated in this study), but the spouse's negative affect is a more salient construct related to patient adherence as it captures a broader emotional experience, is more sensitive to environmental stimuli (whereas depression may reflect more stable mood states), and decreases both partners' confidence in the patient's ability to manage their diabetes. Indeed, research has shown the influence of negative mood states on

health efficacy (Bandura, 1997). Second, although not directly studied, the spouse's negative affect may be present, at least in part, *because of* the patient's diabetes. This is supported by previous research that has identified an association between spouse's negative mood related to the experience of diabetes (i.e., diabetes-specific distress) and patient adherence (Franks et al., 2012)—the patient's management behaviors are associated with the spouse's response to the patient's disease (in this case the spouse's negative affect). Regardless of the reason, our study adds the delineation of a more nuanced pathway for spouses' emotional well-being and patient adherence. Previous research only including the spouses' depression symptoms as the measure of emotional well-being has not found an association with patient variables (Anderson et al., 2016).

Implications and Clinical Recommendations

The findings from this study have important implications for intervention in couples with Type 2 diabetes. Whereas prior research on personality and diabetes adherence has yielded inconsistent and weak associations (Lane et al., 2000), this study found important pathways through which they are related. Additionally, past literature has identified that spouses play an integral role in both dietary and exercise adherence (e.g., Beverly & Wray, 2010), yet thus far, have largely focused on the two main ways that relationships influence health—social support and control (August et al., 2013). Our study highlights that the spouse's personality (neuroticism) is an important variable to consider in the context of the patient's diabetes adherence, specifically as it relates to the experience of the spouse's negative affect. These findings can influence diabetes intervention and care in a number of ways.

First, formal diabetes education should consider the addition of both a brief personality assessment as well as an assessment for negative affect/mood for both patient and spouse—in addition to the more common depression screener. This will help provide information about personality traits and negativity that could influence adherence to diabetes regimens. Our results show that higher levels of neuroticism are associated with higher levels of patient depression and spouse negative affect, which are associated with poorer diabetes management behaviors. Second, because of the association between negative mood states and couple diabetes efficacy, intervention efforts should consider targeting negative affect directly (in addition to depression symptoms), as our study demonstrates it may undermine diabetes adherence. Including the spouse in conversations about diabetes management, and specifically targeting the spouse's emotional state and/or capacity for support is likely to influence patient outcomes. This is in line with previous research calling for assessment and treatment of the larger systemic context of patients with chronic disease (Vassilev et al., 2011). Finally, the results from this study may suggest that intervention programs targeted at couple-level diabetes self-efficacy may be useful, with specific discussion about both partners' shared confidence in the patient's ability to adhere to diet and exercise guidelines. This may be particularly helpful if the spouse's self-efficacy is related to the patient's depression symptoms, or if the patient's self-efficacy is related to the spouse's negative affect. Intervention studies are needed to help identify if this would be an effective approach.

Limitations and Directions for Future Research

While our findings have important implications, they must be considered in light of several limitations. First, the cross-sectional nature of our data limits the ability to conclude causal or sequential relationships among all the variables. Although our alternative model testing revealed that our hypothesized model was plausible, the alternative models fit similarly to the data (additions of direct paths did not significantly improve model fit). Considering theory on personality, relationships, and health, our study raises interesting questions about how personality and relationships interact and influence each other across time that could influence health outcomes in the diabetes population. Future research should include data that follows these associations across time that establishes temporal ordering. Second, the homogeneity of the sample limit the generalizability of the results to more diverse samples. Future research should replicate these findings in samples more heterogeneous in regard to socioeconomic status, geographic location, race/ethnicity, and relationship types or statuses. Third, all of the constructs were measured via self-report, so future research could include observational methods—specifically on negative affect and adherence to diet and exercise regimens—to eliminate self-report bias.

Finally, although previous research has found that neuroticism, depression, and negative affect are separate, distinct constructs (Kamen et al., 2010), they are highly correlated and may very well overlap in terms of the negativity identified. As such, future research would do well to use different measures of each construct with less overlap or tease out which individual items from each construct are separate and not as highly related to the others. Additionally, future research should test the associations with clinically significant levels of depression symptoms as the majority of our sample consisted of lower levels (about three-fourths of patients and four-fifths of spouses were in the minor depression range of the PHQ-9); the pattern of results may be different in samples with higher levels of depression symptoms.

Conclusion

In conclusion, this study is important because it identifies specific pathways in which both patient and spouse neuroticism is associated with patient dietary and exercise adherence. For patients, this link was depression symptoms, whereas for spouses it was through negative affect. Our findings go beyond traditional social support and control literature and demonstrate a more nuanced understanding of how personality and spousal factors can interfere with diabetes management. We argue for a more systemic approach to diabetes intervention and care, with specific consideration of the unique contribution of each partner—including personality and mood states—in relation to overall patient diabetes adherence.

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References

- Anderson RJ, Freedland KE, Clouse RE, Lustman PJ. The prevalence of comorbid depression in adults with diabetes a meta-analysis. *Diabetes care*. 2001; 24(6):1069–1078. DOI: 10.2337/diacare.24.6.1069 [PubMed: 11375373]
- Anderson JR, Novak JR, Johnson MD, Deitz SL, Walker A, Wilcox A, Lewis VL, Robbins DC. A dyadic multiple mediation model of patient and spouse stressors predicting patient dietary and exercise adherence via depression symptoms and diabetes efficacy. *Journal of Behavioral Medicine*. 2016; 39(6):1020–1032. DOI: 10.1007/s10865-016-9796-9 [PubMed: 27696127]
- August KJ, Rook KS, Franks MM, Parris Stephens MA. Spouses' involvement in their partners' diabetes management: Associations with spouse stress and perceived marital quality. *Journal of Family Psychology*. 2013; 27:712–721. DOI: 10.1037/a0034181 [PubMed: 24040902]
- Bandura, A. *Self-efficacy: The exercise of control*. New York: Freeman; 1997.
- Berg CA, Upchurch R. A developmental contextual model of couples coping with chronic illness across the adult life span. *Psychological Bulletin*. 2007; 133:920–954. [PubMed: 17967089]
- Beverly EA, Wray LA. The role of collective efficacy in exercise adherence: a qualitative study of spousal support and type 2 diabetes management. *Health Education Research*. 2010; 25:211–223. [PubMed: 18559399]
- Brickman AL, Yount SE, Blaney NT, Rothberg ST, De-Nour AK. Personality traits and long-term health status: The influence of neuroticism and conscientiousness on renal deterioration in Type-1 diabetes. *Psychosomatics*. 1996; 37:459–468. [PubMed: 8824126]
- Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *Journal of Chronic Diseases*. 1987; 40(5):373–383. [PubMed: 3558716]
- Christensen AJ, Smith TW. Personality and patient adherence: Correlates of the Five-Factor Model in renal dialysis. *Journal of Behavioral Medicine*. 1995; 18:305–313. [PubMed: 7674294]
- Costa PT, McCrae RR. Four ways five factors are basic. *Personality and individual differences*. 1992; 13(6):653–665.
- Farmer A, Redman K, Harris T, Mahmood A, Sadler S, Pickering A, McGuffin P. Neuroticism, extraversion, life events and depression. *The British Journal of Psychiatry*. 2002; 181(2):118–122. DOI: 10.1192/bjp.181.2.118 [PubMed: 12151281]
- Franks MM, Sahin ZS, Seidel AJ, Shields CG, Oates SK, Boushey CJ. Table for two: Diabetes distress and diet-related interactions of married patients with diabetes and their spouses. *Families, Systems, & Health*. 2012; 30(2):154–164. DOI: 10.1037/a0028614
- Gonder-Frederick LA, Cox DJ, Ritterband LM. Diabetes and behavioral medicine: The second decade. *Journal of Consulting and clinical Psychology*. 2002; 70(3):611–625. [PubMed: 12090372]
- Gonzalez JS, Peyrot M, McCarl LA, Collins EM, Serpa L, Mimiaga MJ, Safren SA. Depression and diabetes treatment nonadherence: a meta-analysis. *Diabetes care*. 2008; 31(12):2398–2403. [PubMed: 19033420]
- Hu L, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*. 1999; 6:1–55. DOI: 10.1080/10705519909540118
- International Diabetes Federation. *Diabetes Atlas*. 7th. International Diabetes Federation; 2015. Retrieved from <http://www.diabetesatlas.org/resources/2015-atlas.html>
- John OP, Srivastava S. The Big Five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of personality: Theory and research*. 1999; 2:102–138.
- Johnson MD, Anderson JR, Walker A, Wilcox A, Lewis VL, Robbins DC. Common dyadic coping is indirectly related to dietary and exercise adherence via patient and partner diabetes efficacy. *Journal of Family Psychology*. 2013; 27:722.doi: 10.1037/a0034006 [PubMed: 24015707]
- Judge TA, Ilies R. Relationship of personality to performance motivation: A meta-analytic review. *Journal of Applied Psychology*. 2002; 87:797–807. [PubMed: 12184582]
- Kamen C, Pryor LR, Gaughan ET, Miller JD. Affective lability: Separable from neuroticism and the other big four? *Psychiatry Research*. 2010; 176(2):202–207. DOI: 10.1016/j.psychres.2008.08.002 [PubMed: 20188424]

- Kenny, DA., Kashy, DA., Cook, WC. Dyadic data analysis. New York: The Guilford Press; 2006.
- Klein DN, Kotov R, Bufferd SJ. Personality and depression: explanatory models and review of the evidence. *Annual review of clinical psychology*. 2011; 7:269.doi: 10.1146/annurev-clinpsy-032210-104540
- Kroenke K, Spitzer RL, Williams JB. The PHQ-9: Validity of a brief depression severity measure. *Journal of General Internal Medicine*. 2001; 16:606–613. [PubMed: 11556941]
- Lane JD, McCaskill CC, Williams PG, Parekh PI, Feinglos MN, Surwit RS. Personality correlates of glycemic control in type 2 diabetes. *Diabetes care*. 2000; 23(9):1321–1325. [PubMed: 10977026]
- Lewis MA, McBride CM, Pollak KI, Puleo E, Butterfield RM, Emmons KM. Understanding health behavior change among couples: An interdependence and communal coping approach. *Social Science & Medicine*. 2006; 62(6):1369–1380. DOI: 10.1016/j.socscimed.2005.08.006 [PubMed: 16146666]
- McWilliams L. Neuroticism and depression. *The British Journal of Psychiatry*. 2003; 182(1):80–80. DOI: 10.1192/bjp.182.1.80 [PubMed: 12509326]
- Miller DJ, Vachon DD, Lynam DR. Neuroticism, negative affect, and negative affect instability: Establishing convergent and discriminant validity using ecological momentary assessment. *Personality and Individual Differences*. 2009; 47(8):873–877. DOI: 10.1016/j.paid.2009.07.007 [PubMed: 20160976]
- Muthén, L.K., Muthén, B.O. *Mplus User's Guide*. Seventh. Los Angeles, CA: Muthén & Muthén; 1998–2012.
- Newsom JT. Some clarifications and recommendations on fit indices. *USP*. 2012; 655:123–133.
- Ormel J, Rosmalen J, Farmer A. Neuroticism: a non-informative marker of vulnerability to psychopathology. *Social Psychiatry and Psychiatric Epidemiology*. 2004; 39(11):906–912. DOI: 10.1007/s00127-004-0873-y [PubMed: 15549243]
- Pidgeon V. Compliance with chronic illness regimens: School-aged children and adolescents. *Journal of Pediatric Nursing*. 1989; 4:36–47. [PubMed: 2921719]
- Preacher KJ, Hayes AF. Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*. 2008; 40:879–891. DOI: 10.3758/BRM.40.3.879 [PubMed: 18697684]
- Sacco WP, Wells KJ, Vaughan CA, Friedman A, Perez S, Morales R. Depression in adults with Type 2 diabetes: The role of adherence, body mass index, and self-efficacy. *Health Psychology*. 2005; 24:630–634. DOI: 10.1037/0278-6133.24.6.630 [PubMed: 16287410]
- Skaff MM, Mullan JT, Hoffman L, Mohr D, Almeida DM, Masharani U, Fisher L. Daily negative mood affects fasting glucose in type 2 diabetes. *Health Psychology*. 2009; 28(3):265–272. DOI: 10.1037/a0014429 [PubMed: 19450031]
- Smith TW, Williams PG. Personality and health: Advantages and limitations of the five-factor model. *Journal of Personality*. 1992; 60:335–423.
- Steunenberg B, Beekman AT, Deeg DJ, Kerkhof AJ. Personality and the onset of depression in late life. *Journal of Affective Disorders*. 2006; 92(2):243–251. [PubMed: 16545466]
- Talbot F, Nouwen A, Gingras J, Gosselin M, Audet J. The assessment of diabetes-related cognitive and social factors: the Multidimensional Diabetes Questionnaire. *Journal of Behavioral Medicine*. 1997; 20:291–312. [PubMed: 9212382]
- Taylor MD, Frier BM, Gold AE, Deary IJ. Psychosocial factors and diabetes-related outcomes following diagnosis of type 1 diabetes in adults: the Edinburgh prospective diabetes study. *Diabetes Medicine*. 2003; 20:135–146.
- Toobert DJ, Hampson SE, Glasgow AR. The summary of diabetes self-care activities measure: results from 7 studies and a revised scale. *Diabetes care*. 2000; 23(7):943–950. [PubMed: 10895844]
- Trief PM, Himes CL, Orendorff R, Weinstock RS. The marital relationship and psychosocial adaptation and glycemic control of individuals with diabetes. *Diabetes Care*. 2001; 24(8):1384–1389. [PubMed: 11473074]
- Vassilev I, Rogers A, Sanders C, Kennedy A, Blickem C, Protheroe J, Morris R. Social networks, social capital and chronic illness self-management: A realist review. *Chronic Illness*. 2011; 7:60–86. DOI: 10.1177/1742395310383338 [PubMed: 20921033]

- Watson D, Clark LA, Tellegin A. Development and validation of brief measures of positive and negative affect: The PANAS Scales. *Journal of Personality and Social Psychology*. 1988; 47:1063–1070.
- Wheeler K, Wagaman A, McCord D. Personality traits as predictors of adherence in adolescents with type I diabetes. *Journal of child and adolescent psychiatric nursing*. 2012; 25(2):66–74. [PubMed: 22512523]
- Zayas V, Shoda Y, Ayduk ON. Personality in context: An interpersonal systems perspective. *Journal of Personality*. 2002; 70:851–900. [PubMed: 12498358]

Final Model **Figure 1. Final Model**

Note: Unstandardized coefficients shown. Dashed lines represent non-significance. All patient and spouse variables were modeled to covary and account for non-independence (as shown with double-headed arrows). Model fit indices: $\chi^2(22) = 22.473$, $p = .432$; RMSEA = .014 (C.I. = .000, .083); CFI = .999; TLI = .998; SRMR = .037. $^*p < .05$. $^{**}p < .01$. $^{***}p < .001$ (two-tailed).

Table 1

Correlations and Descriptive Statistics for Study Variables (N = 117 couples)

Variables	1	2	3	4	5	6	7	8	9	10
1. P Neuroticism	–									
2. S Neuroticism	.02	–								
3. P Negative Affect	.72**	.05	–							
4. S Negative Affect	.06	.64**	.13	–						
5. P Depression	.59**	.09	.68**	.14	–					
6. S Depression	.19	.57**	.16	.69**	.20*	–				
7. P Diabetes Efficacy	–.35**	–.16	–.44**	–.25*	–.48**	–.15	–			
8. S Diabetes Efficacy	–.36**	–.28**	–.36**	–.32**	–.46**	–.32**	.63**	–		
9. P Dietary Adherence	–.23*	–.07	–.38**	–.15	–.43**	–.16	.63**	.54**	–	
10. P Exercise Adherence	–.13	–.04	–.15	–.09	–.29*	–.10	.43**	.45**	.41**	–
Mean	2.81	2.68	1.76	1.69	.73	.46	2.52	2.71	4.50	2.85
SD	.83	.76	.66	.64	.67	.46	1.10	1.20	1.90	2.30

Note:

*
 $p < .05$.**
 $p < .01$.***
 $p < .001$ (two-tailed). P = Patient, S = Spouse.

Table 2

Tests of Model Comparison

	Model Pathways		Model Fit		Model Comparison
	Alternative model	Hypothesized	Alternative model	Hypothesized	
Alternative Model #1 (nested)	N → PDA & PEA (direct paths)	N → DS & NA → CLDE → PDA & PEA (indirect paths; full mediation)	$\chi^2(18) = 17.625, p = .481$; CFI = 1.000, TLI = 1.002; RMSEA = .000, SRMR = .030	$\chi^2(22) = 22.473, p = .432$; CFI = .999, TLI = .998; RMSEA = .014, SRMR = .037	χ^2 diff (4) = 4.848, $p = .303$.
Alternative Model #2 (nested)	N → DS & NA → CLDE (Partial Mediation; direct paths from N → CLDE)	N → DS & NA → CLDE (Full mediation)	$\chi^2(20) = 22.240, p = .3276$; CFI = .995, TLI = .989; RMSEA = .033, SRMR = .036	$\chi^2(22) = 22.473, p = .432$; CFI = .999, TLI = .998; RMSEA = .014, SRMR = .037	χ^2 diff (2) = .233, $p = .890$.
Alternative Model #3 (nested)	DS & NA → PDA & PEA (direct paths)	DS & NA → CLDE → PDA & PEA (indirect paths)	$\chi^2(14) = 17.324, p = .239$; CFI = .992, TLI = .976; RMSEA = .048, SRMR = .028	$\chi^2(22) = 22.473, p = .432$; CFI = .999, TLI = .998; RMSEA = .014, SRMR = .037	χ^2 diff (8) = 5.159, $p = .740$.
Alternative Model #4 (non-nested)	N → CLDE → DS & NA → PDA & PEA	N → DS & NA → CLDE → PDA & PEA	$\chi^2(22) = 162.33, p = .000$; CFI = .681, TLI = .362; RMSEA = .248, SRMR = .138	$\chi^2(22) = 22.473, p = .432$; CFI = .999, TLI = .998; RMSEA = .014, SRMR = .037	Proposed Model vs. Alternative Model (AIC = 1838.688; BIC = 1939.175 versus AIC = 1978.545; BIC = 2079.032)

Note:

* $p < .05$.** $p < .01$.*** $p < .001$ (two-tailed).

N= Neuroticism; DS = Depression Symptoms; NA = Negative Affect; CLDE= Couple-Level Diabetes Efficacy; PDA = Patient Dietary Adherence; PEA = Patient Exercise Adherence.