



# The influence of emotion regulation and family involvement on diabetes distress among adults with type 2 diabetes

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Received: 14 September 2021 / Accepted: 13 July 2022

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**Abstract** Adults with diabetes frequently experience diabetes related distress, which is associated with negative health outcomes. Family members are commonly involved in patients' diabetes self-management. However, family involvement can have helpful and/or harmful effects on patients' diabetes outcomes. Use of interpersonal strategies to regulate negative emotions may play a role in patients' interactions with family members and experience of diabetes distress. This study examined the influences of interpersonal emotion regulation and family and friend involvement on diabetes distress among 373 adults with type 2 diabetes. Two separate three-step sequential linear regression models were used to test the main and interactive effects of harmful and helpful family involvement and interpersonal emotion regulation on diabetes distress. Greater use of interpersonal strategies to regulate negative emotions ( $p = .006$ ) and greater harmful family involvement ( $p < .001$ ) were significantly associated with greater diabetes distress. Interpersonal emotion regulation moderated the relationship of helpful ( $p = .007$ ), but not harmful ( $p = .171$ ) family involvement on diabetes distress. Specifically, greater helpful family involvement was associated with lower diabetes distress among adults with low ( $p = .017$ ) but not high ( $p = .419$ ) use of interpersonal strategies to regulate negative emotions. Helpful family involvement appears to be associated with lower diabetes distress, but only among patients with low levels of interpersonal emotion regulation.

**Keywords** Diabetes distress · Emotion regulation · Family involvement · Social support · Chronic disease self-management

Adults with diabetes commonly experience psychological distress stemming from threat of long-term complications, concerns associated with functional impairment, coordination of complex medical care, and adherence to onerous daily self-management regimens (Dennick et al., 2017; Fisher et al., 2014, 2019). Prior studies have demonstrated that diabetes related distress (hereafter, diabetes distress) is an important predictor of diabetes self-management (Fisher et al., 2008; Gonzalez et al., 2014; Jannoo et al., 2017) and cardiometabolic outcomes (e.g., glycemic control, blood pressure, and cholesterol; Aikens, 2012; Chew et al., 2018; Fisher et al., 2008, 2010; Lee et al., 2018; Ogbera & Adeyemi-Doro, 2011; Tsujii et al., 2012; Winchester et al., 2016) among patients with type 2 diabetes. Additionally, studies suggest that diabetes distress is associated with more missed workdays, higher risk of mortality, and lower quality of life among individuals with type 2 diabetes (Adriaanse et al., 2008; Carper et al., 2014; Fisher et al., 2008).

Unfortunately, existing research suggests that high diabetes distress is common and relatively persistent over time. For example, prior studies have found that approximately one-third of adults with type 2 diabetes have clinically significant levels of diabetes distress (Fisher et al., 2008, 2012). A large multinational survey of adults with diabetes living in 17 different countries found that approximately 45% of participants reported high levels of diabetes distress (Funnel et al., 2015). A longitudinal study found that approximately half of adults with high levels of diabetes distress at baseline maintained high levels of diabetes distress over an 18-month period (Fisher et al., 2008). Current standards

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of medical care recommend routine monitoring of patients' diabetes distress (American Diabetes Association, 2019). These findings and clinical recommendations highlight the importance of diabetes distress.

Adults with diabetes frequently receive disease-related support from informal health supporters such as family members or friends (Lee et al., 2017; Rosland et al., 2010). For example, one recent study found that 76 percent of adults with type 2 diabetes had at least one family member or friend who provided regular assistance with their diabetes self-management (Lee et al., 2019). These support persons often help patients with self-management activities, such as checking blood sugar, taking medications, making healthy dietary choices, and with coordination of medical care (e.g., filling prescriptions and remembering medical appointments; Lee et al., 2017; Mayberry & Osborn, 2012; Rosland et al., 2014).

Studies suggest that social support from family and friends is generally associated with positive health outcomes for adults with diabetes (Strom & Egede, 2012). However, the type of assistance or involvement from family and friends may be a particularly important determinant of diabetes-related outcomes (Baig et al., 2015; Mayberry & Osborn, 2012; Mayberry et al., 2019; Torenholt et al., 2014). Among patients with diabetes, supportive family behaviors are linked with greater adherence to self-care behaviors (e.g., self-monitoring of blood glucose and taking diabetes medication), whereas obstructive family behaviors are associated with lower adherence to diabetes self-care activities (Mayberry et al., 2014). Harmful family involvement (e.g., mis-carried helping, threats, and coercion) in patients' diabetes self-care, is associated with negative consequences including worse self-management (e.g., lower medication adherence, less frequent self-monitoring of blood glucose, poorer diet and exercise) and greater interpersonal conflict between patients and their family members (Mayberry et al., 2019). One prior study demonstrated that diabetes related tension in patient-supporter relationships is associated with greater diabetes distress among patients (Iida et al., 2013). Another recent study found that social support which emphasizes patient autonomy in managing their diabetes is associated with lower diabetes distress (Lee et al., 2019). Yet, no studies to date have examined the associations of harmful or helpful family and friend involvement with diabetes distress.

Like their social environment, individuals' dispositional characteristics may contribute to diabetes distress. For example, emotion regulation is a multidimensional construct which reflects dispositional skills and abilities which individuals use to modulate negative affective experiences. Existing literature distinguishes between *intrapersonal* or *interpersonal* regulation of emotions (Gratz & Roemer, 2004; Zaki & Williams, 2013). *Intrapersonal* emotion regulation refers to within person processes by which individuals

manage their own emotions. In contrast, *interpersonal* emotion regulation refers to the process by which individuals use interactions with others to manage their emotional experiences.

Deficits in intrapersonal emotion regulation (i.e., the ability to regulate the intensity and duration of emotions) are a major risk factor for the development of several mental health conditions, such as depression and anxiety (Hu et al., 2014; Sloan et al., 2017) and may play an important role in health outcomes among adults with chronic medical conditions (Cooper et al., 2015; Phillips et al., 2009; van Middendorp et al., 2005; Wierenga et al., 2017). Recent studies provide evidence linking specific types of *intrapersonal* emotion regulation strategies with diabetes distress. For example, one prior study found that patients' tendency to use cognitive strategies to regulate negative emotions was associated with higher diabetes distress (Kane et al., 2018). Another study found that diabetes distress was significantly associated with more negative emotionality and lower ability to regulate negative emotions (Coccaro et al., 2020). These findings suggest that individuals' use of intrapersonal strategies to effectively regulate their emotions may play a critical role in helping to mitigate diabetes distress.

A developing body of literature has identified *interpersonal* emotion regulation as a uniquely important driver of psychological distress (Hofmann, 2014; Williams et al., 2018). Interpersonal emotion regulation strategies involve using social interactions to modulate positive and negative emotional experiences (Zaki & Williams, 2013). Interpersonal emotion regulation strategies may be either adaptive or maladaptive, depending on social and emotional contexts (Dixon-Gordon et al., 2015). For example, seeking emotional support from others may be an effective strategy for coping with environmental stressors and decreasing negative affect. In contrast, use of interpersonal emotion regulation strategies, such as reassurance seeking and venting, have been linked with greater interpersonal conflict and thus, may be maladaptive when used excessively (Dixon-Gordon et al., 2015, 2018). No prior studies have examined the link between interpersonal emotion regulation and important diabetes related outcomes such as diabetes distress.

Individuals' use of interpersonal emotion regulation strategies may interact with their social environment to precipitate or maintain psychological and emotional distress (Hofmann, 2014). Similarly, among adults with diabetes, use of interpersonal strategies to regulate negative emotions may impact interactions with family members and friends who are involved in their diabetes self-management. However, it is not clear how individuals' use of potentially maladaptive or adaptive interpersonal strategies to regulate negative emotions may interact with beneficial or detrimental characteristics of their social networks. For example, supportive social networks may be particularly beneficial in

mitigating emotional distress among individuals who have a greater tendency to engage others to regulate their emotions. In contrast, the impact of unsupportive or unhelpful social networks on psychological distress may be especially pronounced among individuals with a tendency to use others to regulate their emotions. Accordingly, greater harmful family involvement may be more strongly associated with higher diabetes distress among adults with greater use of interpersonal emotion regulation strategies whereas greater helpful involvement with diabetes self-management may evidence a stronger association with lower diabetes distress among individuals with greater use of interpersonal emotion regulation strategies.

The current study examines whether individuals' use of interpersonal emotion regulation strategies moderates the relationship between the type of family involvement (e.g., harmful vs. helpful involvement) and diabetes distress. First, we hypothesized that higher levels of harmful family involvement would be associated with higher diabetes distress and, conversely, higher levels of helpful family involvement would be associated with lower diabetes distress. Second, given previous findings linking greater use of intrapersonal emotion regulation (e.g., Kane et al., 2018) with greater diabetes distress, we hypothesized that greater use of interpersonal strategies to regulate negative emotions would be associated with greater diabetes distress. Third, we hypothesized that the tendency to engage others to regulate one's emotions would moderate the predicted relationships of harmful and helpful family involvement with diabetes distress. Specifically, we hypothesize that harmful and helpful family involvement will be more strongly associated with higher and lower levels of diabetes distress, respectively, among patients with greater use of interpersonal strategies to regulate negative emotions.

## Method

### Participants and procedure

Participants were recruited using Prime Panels (cloudresearch.com), a web-based survey recruitment platform that combines multiple research market panels to enable targeted sampling of large groups with one or more specific characteristics (Chandler et al., 2019). Using Prime Panels, we used convenience sampling to recruit participants from a large group of U.S. adults who had previously reported having a diagnosis of type 1 or 2 diabetes. Participants accessed and completed all study procedures online via Qualtrics. Participant recruitment and data collection occurred between June and July of 2020.

To be eligible, targeted panel members had to indicate that they were 18 years of age and use a unique IP address

located within the United States. Non-unique IP addresses were automatically blocked from participation to prevent respondents from completing the survey more than once. Eligible participants were asked to provide informed consent prior to enrolling in the study. We confirmed participants' diagnosis of type 2 diabetes by asking them to indicate (Yes or No) whether they had previously been diagnosed by healthcare providers with several chronic health conditions including: obesity, hypertension, type 1 diabetes, type 2 diabetes, or heart disease. Respondents who did not endorse having a diagnosis of type 2 diabetes were excluded from further participation. This measure was taken to ensure that all enrolled participants had diagnosis of type 2 diabetes. Enrolled participants completed a battery of survey measures. The order of presentation of survey measures was randomized. We included one multiple choice item to check participants attention (e.g., Please select "Orange" from the list of colors below"). The final survey item asked participants to indicate whether they had a current diagnosis (Yes or No) of any of the following medical conditions: type 2 diabetes, type 1 diabetes, gestational diabetes, or none of the above. We excluded data for participants who did not pass the attention check *or* did not verify their initially reported diagnosis of type 2 diabetes.

A total of 536 individuals initiated the survey of which 518 (96.6%) provided informed consent. Of those who provided informed consent, 428 reported having type 2 diabetes (82.6%). One participant did not pass the attention check and 14 indicated not having type 2 diabetes. Of the remaining 413 respondents, 40 (9.7%) started but did not complete the survey. Therefore, the final sample included 373 U.S. adults with type 2 diabetes who passed three attention checks, one of which asked participants to confirm their type 2 diabetes diagnosis. Four participants (1%) completed the survey but had incomplete responses to one or more measures and were excluded from multivariable models.

### Measures

#### *Sociodemographic and medical characteristics*

Participants reported their age, race, ethnicity, highest level of education, annual household income, age when first diagnosed with type 2 diabetes, presence of health insurance and primary care provider during the past 12 months. These variables were used to characterize the sample.

#### *Diabetes distress*

The Diabetes Distress Scale-17 (DDS-17) was used to measure participants' emotional distress associated with having diabetes (Polonsky et al., 2005). The DDS is comprised of 17 items which are rated on a Likert scale from 1 ("Not a

Problem”) to 6 (“A Very Serious Problem”). The DDS-17 consists of four subscales: Emotional burden subscale, physician-related distress subscale, regimen-related distress subscale, and diabetes-related interpersonal distress subscale. In this study, we used the total scale score as a measure of participants’ overall diabetes distress. The DDS-17 has strong criterion validity with higher scores associated with poorer self-care (e.g., meal planning, exercise, self-monitoring of blood glucose), elevated lipid levels, and higher HbA1c (Fisher et al., 2014; Lee et al., 2018; Polonsky et al., 2005). The total scale has demonstrated strong internal consistency in the current sample ( $\alpha=0.93$ ).

#### *Family and friends involvement in diabetes self-care*

The Family and Friend Involvement in Adults’ Diabetes (FIAD) scale was used to measure the type of social support participants receive (Mayberry et al., 2019). The FIAD is comprised of 16 items which are rated on a Likert scale from 1 (“Never in the past month”) to 5 (“Twice or more each week”). The FIAD consists of one seven-item subscale and one nine-item subscale which measure: *harmful* family involvement and *helpful* family involvement in diabetes self-management. FIAD subscales were used as the focal independent variable in this study. The FIAD has demonstrated strong criterion validity with patient reported self-care behaviors including effectiveness of family support, satisfaction with their family support, and HbA1c (Mayberry et al., 2019). Additionally, the FIAD subscales have high test–retest reliability (*harmful*  $\rho=0.61$ , *helpful*  $\rho=0.64$ ) over a period of three-months and have shown good internal consistency in prior work (*harmful*:  $\alpha=0.72$ ; *helpful*:  $\alpha=0.87$ ) and excellent internal consistency in the present sample (*harmful*:  $\alpha=0.94$ ; *helpful*:  $\alpha=0.91$ ).

#### *Interpersonal regulation*

The Interpersonal Regulation Questionnaire (IRQ) was used to measure participants’ use of interpersonal strategies to regulate negative emotions (Williams et al., 2018). The IRQ is a 16-item self-report measure with four subscales. Two subscales measure respondents’ tendency to use interpersonal strategies to regulate *negative* and *positive* emotions. Two subscales measure perceived efficacy of using interpersonal strategies to regulate *negative* and *positive* emotions. Respondents rate their agreement to statements of interpersonal emotion regulation (e.g., “I manage my emotions by expressing them to others,” “When things are going well, I feel compelled to seek out other people”) on a Likert scale from 1 (“Strongly disagree”) to 7 (“Strongly agree”). Item responses are summed to generate each subscale score with higher scores indicating greater tendency or perceived efficacy of using interpersonal strategies to regulate negative

or positive emotions. The negative tendency and efficacy subscales have demonstrated convergent validity with other measures of interpersonal emotion regulation strategies including venting and use of emotional and instrumental support (Williams et al., 2018). In this study, we calculated the average of the negative tendency and negative efficacy subscale scores to generate a single measure reflecting respondents’ perceived efficacy and use of interpersonal strategies to regulate negative emotions. This scale had excellent internal consistency ( $\alpha=0.90$ ) in the present study.

#### *Control variables*

The Short Form Perceived Stress Scale (PSS-4) is a four-item instrument used to measure perceived general life stress (Cohen et al., 1983). In the present study, the PSS-4 demonstrated acceptable internal consistency ( $\alpha=0.69$ ). We also measured and controlled for reported insulin use (do not use insulin = 0, use insulin = 1), age, sex (male = 0, female = 1), and race (White = 0, Other race = 1).

#### **Data analysis**

Descriptive statistics were used to characterize the sample. We examined univariate distributions of each study variable to assess normality. FIAD helpful and harmful scales and the DDS-17 demonstrated positive skew. Univariate distributions and Tukey’s outlier labeling rule did not identify any univariate outliers (Hoaglin & Iglewicz, 1987). Given the skewed distribution of several variables, we used Spearman’s rank order correlations (Spearman’s  $\rho$ ) to examine the bivariate associations between predictors and control variables.

We used two separate three-step sequential linear regression models to test the main and interactive effects of both the harmful and helpful family involvement subscales of the FIAD with Interpersonal Emotion Regulation (IRQ) total scores on Diabetes Distress Scale scores. All predictors were mean centered. Prior studies have linked insulin use with higher diabetes distress (Baek et al., 2014; Polonsky et al., 2005). Consequently, we controlled for participants’ insulin use in all statistical models. Further, both models controlled for PSS-4 scores to help isolate the unique relationship between harmful or helpful family involvement and use of interpersonal strategies to regulate negative emotions with *diabetes distress*—above and beyond general life stress. Harmful and helpful family involvement were simultaneously included in the model to control for the overlap in harmful and helpful family involvement in previous studies and in the present study ( $r=0.80$ ,  $p<0.001$ ; Mayberry et al., 2019). Variance Inflation Factors for variables in main effect and interaction models were not indicative of multicollinearity (VIF: 1.03 to 3.27).

Both main effect and interaction models met all assumptions of ordinary least square regression (i.e., normally distributed residuals, homoskedasticity, independence of observations). Cook’s distances did not reveal any multivariate outliers. All analyses were performed using SPSS version 26 (IBM Corp, 2019). All statistical tests were two-tailed with alpha = 0.05.

**Results**

**Participant characteristics**

Table 1 includes descriptive statistics for the sample. The sample was approximately half male and predominantly White. The average age of the sample was 55 years. Most participants were high school graduates with more than three quarters having at least some college experience. Participants were roughly equally distributed across income levels.

**Table 1** Sample characteristics, *N* = 373

|  | % ( <i>n</i> ) |
|--|----------------|
| Age <sup>a</sup>                                 | 54.9 (15.67)   |
| Sex—female                                       | 56.8 (212)     |
| Race   |                |
| White  | 78.6 (293)     |
| Black  | 12.6 (47)      |
| Asian  | 3.5 (13)       |
| American Indian                                  | 1.1 (4)        |
| Ethnicity  |                |
| Hispanic/Latino                                  | 9.9 (37)       |
| Education  |                |
| Some high school, but did not graduate           | 2.1 (8)        |
| High school graduate or GED                      | 20.1 (75)      |
| Some college or 2-year college degree            | 35.1 (131)     |
| 4-year college graduate                          | 25.5 (95)      |
| More than 4-year college degree                  | 17.2 (64)      |
| Current income                                   |                |
| < \$15,000                                       | 9.4 (35)       |
| \$15,000–30,000                                  | 20.1 (75)      |
| \$30,000–50,000                                  | 19.8 (74)      |
| \$50,000–75,000                                  | 20.9 (78)      |
| > \$75,000                                       | 29.8 (111)     |
| Insulin use                                      | 38.9 (144)     |
| Primary care provider                            | 97.1 (362)     |
| Health insurance                                 | 95.2 (355)     |
| Other adults living in home <sup>a</sup>         | 1.70 (1.43)    |
| Diabetes supporters inside of home <sup>a</sup>  | 0.74 (1.23)    |
| Diabetes supporters outside of home <sup>a</sup> | 0.78 (1.65)    |
| DDS-17 <sup>a</sup>                              | 2.40 (1.33)    |

<sup>a</sup>Mean (SD)

More than 95% of participants saw a primary care provider and had health insurance over the past 12 months. More than a third of participants were prescribed insulin at the time of data collection.

**Bivariate correlations**

Table 2 includes bivariate associations among study variables. There were significant small to moderate correlations apart from a nonsignificant correlation between IRQ and PSS-4 (Spearman’s *rho* = 0.02). Harmful and helpful family involvement were strongly and positively correlated (Spearman’s *rho* = 0.72; Table 2).

**Emotion regulation and family involvement**

Table 3 depicts the results of two three-step hierarchical linear regression models examining the main and interactive associations of interpersonal strategies for regulating negative affect, type (helpful or harmful) of family involvement with diabetes distress. In the first step, diabetes distress was significantly associated with greater general life stress (*p* < 0.001), younger age (*p* < 0.001), and insulin use (*p* = 0.031) but not race (*p* < 0.088) or sex (*p* = 0.296). Control variables entered in step 1 accounted for approximately 43% of the variance in diabetes distress (*R*<sup>2</sup> = 0.43, *p* < 0.001).

In the second step, greater interpersonal regulation of negative emotions (*p* = 0.015) and greater harmful family involvement (*p* < 0.001) were significantly associated with greater diabetes distress, whereas helpful family involvement was not significantly associated with diabetes distress (*p* = 0.767). Together, the variables entered in step 2 accounted for a 9% increase in explained variance in diabetes distress ( $\Delta R^2 = 0.09$ , *p* < 0.001).

Interaction terms were added in the third step of each model. The interaction between use of interpersonal strategies to regulate negative emotions with harmful family

**Table 2** Bivariate correlations of independent variables, *N* = 373

|                   | 1     | 2     | 3     | 4     | 5     |
|-------------------|-------|-------|-------|-------|-------|
| 1. DDS            | –     |       |       |       |       |
| 2. Insulin        | .27** | –     |       |       |       |
| 3. PSS-4          | .51** | .18** | –     |       |       |
| 4. IRQ            | .22** | .12*  | .02   | –     |       |
| 5. FIAD (Harmful) | .59** | .30** | .34** | .28** | –     |
| 6. FIAD (Helpful) | .45** | .29** | .23** | .33** | .73** |

DDS Diabetes Distress Scale, PSS-4 Perceived Stress Scale 4, IRQ Interpersonal Regulation Questionnaire, FIAD Family and Friend Involvement in Adults’ Diabetes

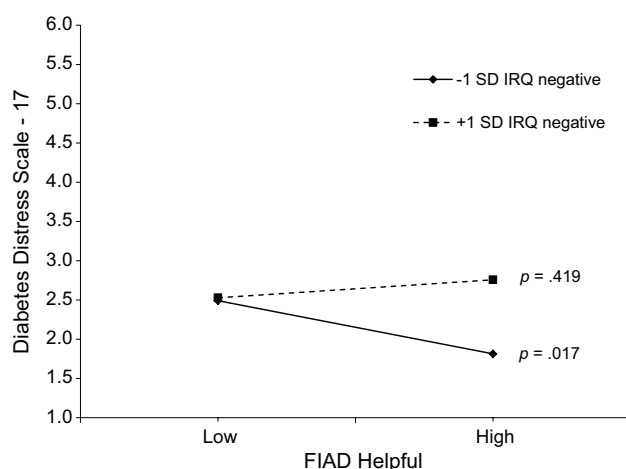
\**p* < .05, \*\**p* < .001

**Table 3** Results of hierarchical linear regression models examining the main and interactive effects of interpersonal strategies negative emotions and type of family involvement with diabetes distress ( $N=369$ )

|                        | Diabetes Distress Scale |      |          |        | $\Delta R^2$ |
|------------------------|-------------------------|------|----------|--------|--------------|
|                        | <i>B</i>                | SE   | <i>p</i> | 95% CI |              |
| Step 1                 |                         |      | <.001    |        | .43          |
| PSS-4                  | 0.50                    | 0.08 | <.001    | 0.36   | 0.65         |
| Insulin use            | 0.28                    | 0.11 | .013     | 0.06   | 0.50         |
| Age                    | -0.04                   | .004 | <.001    | -0.05  | -0.03        |
| Race (White vs. Other) | -0.22                   | 0.13 | .088     | -0.47  | 0.03         |
| Sex                    | -0.07                   | 0.11 | .483     | -0.28  | 0.13         |
| Step 2                 |                         |      | <.001    |        | .09          |
| IRQ Negative           | 0.02                    | 0.01 | .013     | 0.01   | 0.04         |
| FIAD Harmful           | 0.56                    | 0.08 | <.001    | 0.40   | 0.72         |
| FIAD Helpful           | -0.09                   | 0.07 | .224     | -0.23  | 0.05         |
| Step 3 <sup>a</sup>    |                         |      |          |        |              |
| IRQ×FIAD Harmful       | 0.01                    | 0.01 | .172     | -0.01  | 0.03         |
| IRQ×FIAD Helpful       | 0.02                    | 0.01 | .004     | 0.01   | 0.04         |

PSS-4 Perceived Stress Scale 4, IRQ Interpersonal Regulation Questionnaire, FIAD Family and Friend Involvement in Adults' Diabetes

<sup>a</sup>Interactions added in separate models



**Fig. 1** Simple slopes of helpful family involvement (FIAD Helpful) with diabetes distress (DDS-17) among individuals with high and low use of interpersonal strategies for regulating negative emotions (IRQ negative), controlling for age, sex, race (white vs. other), insulin use, and general life stress (PSS-4)

involvement was not significant ( $p=0.171$ ). However, the interaction of use of interpersonal strategies to regulate negative emotions with helpful family involvement was significant ( $p=0.004$ ). Tests of simple slopes showed a significant negative association between greater helpful family involvement and lower diabetes distress among individuals with low ( $-1$  SD) use of interpersonal emotion regulation strategies ( $B = -0.17$ ,  $t = -2.34$ ,  $p=0.017$ ; Fig. 1). However, the simple slope of helpful family involvement with diabetes distress was not significant at high ( $+1$  SD) use

of interpersonal emotion regulation strategies ( $B=0.06$ ,  $t=0.87$ ,  $p=0.419$ ).

## Discussion

This study is the first to examine the direct and interactive associations between interpersonal regulation of negative emotions, type of family involvement, and diabetes distress. Our results suggest that the use of interpersonal strategies to regulate negative emotions is a strong predictor for diabetes distress. As predicted, greater harmful family involvement was significantly associated with greater diabetes distress. However, unexpectedly, helpful family involvement was not associated with lower diabetes distress after controlling for harmful family involvement. Consistent with expectations, our finding also suggests that greater use of interpersonal strategies to regulate negative emotions may moderate the relationship between the type of family involvement (i.e., harmful or helpful) and diabetes distress. Greater helpful family involvement was associated with lower diabetes distress among adults with low use of interpersonal strategies to regulate negative emotions. However, the association between harmful family involvement and diabetes distress did not differ across levels of interpersonal emotion regulation.

### Interpersonal emotion regulation and diabetes distress

As hypothesized, greater use of interpersonal strategies to regulate negative emotions was significantly associated

with greater diabetes distress. Our findings are parallel to those of previous studies showing that negative emotionality and limited ability to regulate such emotions are associated with greater diabetes distress (Coccaro et al., 2020). A prior study found that greater use of strategies to regulate negative emotions was associated with higher diabetes distress (Kane et al., 2018). These findings suggest that individuals who experience more diabetes distress also use more emotion regulation strategies—possibly as an attempt to mitigate negative emotional experiences. Another study found that the use of maladaptive strategies for regulating negative emotions (i.e., lack of emotional awareness, more judgment of emotions, and greater reactivity to emotions) was associated with greater development of diabetes distress, poorer diabetes management, and worse metabolic control among adults with type 1 diabetes (Fisher et al., 2018). The results of the present study add to these existing studies by showing that the tendency to use family members and friends who provide support for diabetes self-management to regulate negative emotions may have a counterproductive effect on diabetes distress. Together, these results suggest that emotion regulation may play an important role in patients' experience of diabetes distress.

### Family involvement and diabetes distress

Harmful and helpful family involvement were strongly and positively correlated with each other and with diabetes distress. Contrary to hypothesis, helpful family involvement was not significantly associated with diabetes distress when controlling for harmful family involvement. A previous study found a consistent suppression effect whereby the relationship of each FIAD subscale with diabetes related outcomes was strengthened when adjusting for the variance shared between both FIAD subscales (Mayberry et al., 2019). In contrast, in this study, the bivariate relationship between helpful family involvement and diabetes distress was completely attenuated when controlling for harmful family involvement indicating that the observed bivariate association between helpful family involvement and diabetes distress is driven by the strong positive correlation between harmful and helpful involvement. This discrepancy may be due to differences in the way harmful and helpful family involvement impact diabetes distress compared to other diabetes outcomes such as self-management behaviors and glycemic control. For example, controlling for shared variance between types of family involvement (harmful vs. helpful) could elucidate the unique positive or negative association of each type of family involvement with patients' diabetes self-management behaviors and/or glycemic control. In contrast, in the context of the present study, controlling for harmful family involvement may eliminate a potentially artefactual positive correlation between helpful family involvement and

greater diabetes distress resulting from the high positive correlation between both types of family involvement. Overall, this pattern of findings suggests that helpful family involvement is not associated with greater diabetes distress, however, harmful family involvement is robustly associated with higher levels of diabetes distress. Interestingly, these findings suggest that the negative relationship of harmful types of family involvement (e.g., arguing about food choices or health; criticizing for not testing blood sugar) with diabetes distress may outweigh beneficial effects of family involvement on diabetes distress. However, the directional nature of this relationship remains unclear. Harmful family involvement may lead to greater negative emotions (e.g., anger, frustration, hopelessness) which in turn may contribute to heightened diabetes distress. Alternatively, individuals who have suboptimal diabetes self-management or exhibit higher levels of diabetes distress may garner more attention and assistance from concerned family members. Although well intentioned, these supporters' efforts to help may be perceived by support recipients as unhelpful or unsupportive and may interfere with support recipients' diabetes self-management. It is also plausible that harmful family involvement may function as an antecedent of diabetes distress whereas helpful family involvement may be a consequence of high diabetes distress. That is, harmful involvement may contribute to heightened diabetes distress. However, patients with higher diabetes distress may elicit greater types of helpful family involvement from family and friends. The possibility that family members provide more helpful support to individuals expressing high levels of diabetes distress is supported by findings from a recent study of patient-supporter dyads which found that patients with higher diabetes distress reported more frequent assistance from their supporters with self-management activities and coordination of medical care (Lee et al., 2020). Overall, these findings suggest that decreasing harmful family involvement may be a comparatively more potent target of interventions aimed at reducing diabetes distress than increasing the amount of helpful family involvement.

### Moderating role of interpersonal emotion regulation

Use of interpersonal strategies to regulate negative emotions moderated the relationship between helpful family involvement and diabetes distress. More specifically, for adults with low levels of interpersonal regulation of negative emotions, helpful family involvement was associated with greater diabetes distress. However, the relationship between helpful family involvement and diabetes distress among adults with high use of interpersonal strategies to regulate negative emotions was not significant. Further studies are needed to corroborate and clarify the processes underlying the moderating role of interpersonal emotion regulation on the relationship

between helpful family involvement and diabetes distress. However, it is possible that use of interpersonal behaviors (e.g., managing emotions by expressing them to others) to regulate negative emotions may interfere with the mitigating effects of helpful family involvement on diabetes distress.

### Limitations

Findings from this study should be interpreted in the context of several notable limitations. First, this study used a validated measure of family involvement in adults' diabetes which was based on participants' retrospective self-report and therefore may be susceptible to recall bias. Second, the FIAD focuses on family and friend involvement in diabetes care over the past month and thus, prior impactful harmful or helpful family involvement may not be considered. Third, this study used a cross-sectional design which does not permit inferences about the directionality of the relationships among study variables. For example, it is unclear whether family members help more with diabetes care when they perceive the patient to be distressed about their diabetes or whether greater involvement in diabetes care contributes to greater diabetes distress (Lee et al., 2020). It is also possible that diabetes distress directly contributes to greater familial conflict around diabetes self-management. Fourth, it is unclear how the COVID-19 pandemic influenced the results of this study. Fifth, due to the demographic makeup of the sample, findings from this study may not generalize to racial and ethnic minorities with type 2 diabetes. Sixth, although we used targeted sampling of adults with diabetes and asked participants to indicate and then reconfirm their diagnosis of type 2 diabetes at the beginning and end of the survey, we were not able to verify diagnoses of type 2 diabetes. Previous studies indicate that patients' self-report is a reliable and reasonably accurate method of determining diabetes status (Schneider et al., 2012; Yuan et al., 2015). Finally, we were not able to compare characteristics of the sample with panel members who did not participate.

### Clinical implications

These preliminary findings indicate that harmful family involvement in type 2 diabetes self-management may be an important target of interventions aimed at reducing diabetes distress. However, the relationship of helpful family involvement to diabetes distress is more complex. Specifically, results from the present study suggest that the beneficial role of helpful family involvement in mitigating diabetes distress maybe undermined by frequent use interpersonal emotion regulation strategies. Finally, our results suggests that high levels of interpersonal emotion regulation maybe an independent risk factor for diabetes distress.

**Author contributions** Conceptualization: PL, AL. Data curation: PL, AL. Methodology: PJJ, AL. Writing—original draft: PL. Writing—review and editing: PL, SK, BL, AL.

**Funding** No funding was received for conducting this study.

**Data availability** Data from the current study will be made available to individuals upon request.

**Code availability** Code from the current study will be made available to individuals upon request.

### Declarations

**Conflict of interest** The authors have no relevant financial or non-financial interests to disclose.

**Ethical approval** This study has received IRB Exempt Approval by the University of Mississippi Institutional Review Board. Protocol #20x-312.

**Consent to participate** Informed consent was acquired from all study participants.

### References

- Adriaanse, M., Dekker, J., Heine, R., Snoek, F. J., Beekman, A., Stehouwer, C., Bouter, L., Nijpels, G., & Pouwer, F. (2008). Symptoms of depression in people with impaired glucose metabolism or Type 2 diabetes mellitus: The Hoorn Study. *Diabetic Medicine*, 25, 843–849.
- Aikens, J. E. (2012). Prospective associations between emotional distress and poor outcomes in type 2 diabetes. *Diabetes Care*, 35, 2472–2478.
- American Diabetes Association. (2019). 5. Lifestyle management: Standards of medical care in diabetes—2019. *Diabetes Care*, 42(Supplement 1), S46–S60.
- Baek, R. N., Tanenbaum, M. L., & Gonzalez, J. S. (2014). Diabetes burden and diabetes distress: The buffering effect of social support. *Annals of Behavioral Medicine*, 48, 145–155.
- Baig, A. A., Benitez, A., Quinn, M. T., & Burnet, D. L. (2015). Family interventions to improve diabetes outcomes for adults. *Annals of the New York Academy of Sciences*, 1353, 89–112.
- Carper, M. M., Traeger, L., Gonzalez, J. S., Wexler, D. J., Psaros, C., & Safren, S. A. (2014). The differential associations of depression and diabetes distress with quality of life domains in type 2 diabetes. *Journal of Behavioral Medicine*, 37, 501–510.
- Chandler, J., Rosenzweig, C., Moss, A. J., Robinson, J., & Litman, L. (2019). Online panels in social science research: Expanding sampling methods beyond Mechanical Turk. *Behavior Research Methods*, 51, 2022–2038.
- Chew, B.-H., Vos, R. C., Pouwer, F., & Rutten, G. E. (2018). The associations between diabetes distress and self-efficacy, medication adherence, self-care activities and disease control depend on the way diabetes distress is measured: Comparing the DDS-17, DDS-2 and the PAID-5. *Diabetes Research and Clinical Practice*, 142, 74–84.
- Coccaro, E. F., Lazarus, S., Joseph, J., Wyne, K., Drossos, T., Philipson, L., & de Groot, M. (2020). Emotional regulation and



- diabetes distress in adults With Type 1 and Type 2 diabetes. *Diabetes Care*, 44, 20–25.
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 385–396.
- Cooper, C. L., Phillips, L. H., Johnston, M., Whyte, M., & MacLeod, M. J. (2015). The role of emotion regulation on social participation following stroke. *British Journal of Clinical Psychology*, 54, 181–199.
- Corp, I. (2019). *IBM SPSS Statistics for Windows* (Version 26.0) IBM Corp.
- Dennick, K., Sturt, J., & Speight, J. (2017). What is diabetes distress and how can we measure it? A narrative review and conceptual model. *Journal of Diabetes and Its Complications*, 31, 898–911.
- Dixon-Gordon, K. L., Bernecker, S. L., & Christensen, K. (2015). Recent innovations in the field of interpersonal emotion regulation. *Current Opinion in Psychology*, 3, 36–42.
- Dixon-Gordon, K. L., Haliczler, L. A., Conkey, L. C., & Whalen, D. J. (2018). Difficulties in interpersonal emotion regulation: Initial development and validation of a self-report measure. *Journal of Psychopathology and Behavioral Assessment*, 40, 528–549.
- Fisher, L., Gonzalez, J., & Polonsky, W. (2014). The confusing tale of depression and distress in patients with diabetes: A call for greater clarity and precision. *Diabetic Medicine*, 31, 764–772.
- Fisher, L., Hessler, D., Glasgow, R. E., Arean, P. A., Masharani, U., Naranjo, D., & Strycker, L. A. (2013). REDEEM: A pragmatic trial to reduce diabetes distress. *Diabetes Care*, 36, 2551–2558.
- Fisher, L., Hessler, D. M., Polonsky, W. H., & Mullan, J. (2012). When is diabetes distress clinically meaningful?: Establishing cut points for the Diabetes Distress Scale. *Diabetes Care*, 35, 259–264.
- Fisher, L., Hessler, D., Polonsky, W., Strycker, L., Guzman, S., Bowyer, V., Blumer, I., & Masharani, U. (2018). Emotion regulation contributes to the development of diabetes distress among adults with type 1 diabetes. *Patient Education and Counseling*, 101, 124–131.
- Fisher, L., Mullan, J. T., Arean, P., Glasgow, R. E., Hessler, D., & Masharani, U. (2010). Diabetes distress but not clinical depression or depressive symptoms is associated with glycemic control in both cross-sectional and longitudinal analyses. *Diabetes Care*, 33, 23–28.
- Fisher, L., Polonsky, W., & Hessler, D. (2019). Addressing diabetes distress in clinical care: A practical guide. *Diabetic Medicine*, 36, 803–812.
- Fisher, L., Skaff, M., Mullan, J., Arean, P., Glasgow, R., & Masharani, U. (2008). A longitudinal study of affective and anxiety disorders, depressive affect and diabetes distress in adults with type 2 diabetes. *Diabetic Medicine*, 25, 1096–1101.
- Funnell, M. M., Bootle, S., & Stuckey, H. L. (2015). The diabetes attitudes, wishes and needs second study. *Clinical Diabetes*, 33, 32–36.
- Gonzalez, J. S., Shreck, E., Psaros, C., & Safren, S. (2014). Distress and Diabetes Treatment Adherence: A Mediating Role for Perceived Control in Adults with Type 2 Diabetes (822-P). *Netherlands Tijdschrift Voor Diabetologie*, 12, 26–27.
- Gratz, K. L., & Roemer, L. (2004). Multidimensional assessment of emotion regulation and dysregulation: Development, factor structure, and initial validation of the difficulties in emotion regulation scale. *Journal of Psychopathology and Behavioral Assessment*, 26(1), 41–54.
- Hoaglin, D. C., & Iglewicz, B. (1987). Fine-tuning some resistant rules for outlier labeling. *Journal of the American Statistical Association*, 82(400), 1147–1149.
- Hofmann, S. G. (2014). Interpersonal emotion regulation model of mood and anxiety disorders. *Cognitive Therapy and Research*, 38, 483–492.
- Hu, T., Zhang, D., Wang, J., Mistry, R., Ran, G., & Wang, X. (2014). Relation between emotion regulation and mental health: A meta-analysis review. *Psychological Reports*, 114, 341–362.
- Iida, M., Stephens, M. A. P., Franks, M. M., & Rook, K. S. (2013). Daily symptoms, distress and interaction quality among couples coping with type 2 diabetes. *Journal of Social and Personal Relationships*, 30, 293–300.
- Jannoo, Z., Wah, Y. B., Lazim, A. M., & Hassali, M. A. (2017). Examining diabetes distress, medication adherence, diabetes self-care activities, diabetes-specific quality of life and health-related quality of life among type 2 diabetes mellitus patients. *Journal of Clinical & Translational Endocrinology*, 9, 48–54.
- Kane, N., Hoogendoorn, C., Tanenbaum, M., & Gonzalez, J. (2018). Physical symptom complaints, cognitive emotion regulation strategies, self-compassion and diabetes distress among adults with Type 2 diabetes. *Diabetic Medicine*, 35, 1671–1677.
- Langa, K. M., Vijan, S., Hayward, R. A., Chernew, M. E., Blaum, C. S., Kabeto, M. U., Weir, D. R., Katz, S. J., Willis, R. J., & Fendrick, A. M. (2002). Informal caregiving for diabetes and diabetic complications among elderly Americans. *The Journals of Gerontology Series b: Psychological Sciences and Social Sciences*, 57, S177–S186.
- Lee, A. A., Heisler, M., Trivedi, R., Obrosky, D. S., Mor, M. K., Piette, J. D., & Rosland, A.-M. (2020). Diabetes distress among dyads of patients and their health supporters: Links with functional support, metabolic outcomes, and cardiac risk. *Annals of Behavioral Medicine*.
- Lee, A. A., Piette, J. D., Heisler, M., Janevic, M. R., Langa, K. M., & Rosland, A.-M. (2017). Family members' experiences supporting adults with chronic illness: A national survey. *Families, Systems, & Health*, 35, 463.
- Lee, A. A., Piette, J. D., Heisler, M., Janevic, M. R., & Rosland, A.-M. (2019). Diabetes self-management and glycemic control: The role of autonomy support from informal health supporters. *Health Psychology*, 38, 122.
- Lee, A. A., Piette, J. D., Heisler, M., & Rosland, A. M. (2018). Diabetes distress and glycemic control: The buffering effect of autonomy support from important family members and friends. *Diabetes Care*, 41, 1157–1163.
- Mayberry, L. S., Berg, C. A., Greevy, R. A., Jr., & Wallston, K. A. (2019). Assessing helpful and harmful family and friend involvement in adults' type 2 diabetes self-management. *Patient Education and Counseling*, 102, 1380–1388.
- Mayberry, L. S., & Osborn, C. Y. (2012). Family support, medication adherence, and glycemic control among adults with type 2 diabetes. *Diabetes Care*, 35, 1239–1245.
- Mayberry, L. S., Rothman, R. L., & Osborn, C. Y. (2014). Family members' obstructive behaviors appear to be more harmful among adults with type 2 diabetes and limited health literacy. *Journal of Health Communication*, 19(sup2), 132–143.
- Ogbera, A., & Adeyemi-Doro, A. (2011). Emotional distress is associated with poor self care in type 2 diabetes mellitus. *Journal of Diabetes*, 3, 348–352.
- Phillips, L. H., Saldias, A., McCarrey, A., Henry, J. D., Scott, C., Summers, F., & Whyte, M. (2009). Attentional lapses, emotional regulation and quality of life in multiple sclerosis. *British Journal of Clinical Psychology*, 48, 101–106.
- Polonsky, W. H., Fisher, L., Earles, J., Dudl, R. J., Lees, J., Mullan, J., & Jackson, R. A. (2005). Assessing psychosocial distress in diabetes: Development of the diabetes distress scale. *Diabetes Care*, 28, 626–631.
- Rosland, A.-M., Heisler, M., Choi, H.-J., Silveira, M. J., & Piette, J. D. (2010). Family influences on self-management among functionally independent adults with diabetes or heart failure: Do family members hinder as much as they help? *Chronic Illness*, 6, 22–33.

- Rosland, A. M., Piette, J. D., Lyles, C. R., Parker, M. M., Moffet, H. H., Adler, N. E., Schillinger, D., & Karter, A. J. (2014). Social support and lifestyle vs. medical diabetes self-management in the Diabetes Study of Northern California (DISTANCE). *Annals of Behavioral Medicine, 48*, 438–447.
- Schneider, A. L., Pankow, J. S., Heiss, G., & Selvin, E. (2012). Validity and reliability of self-reported diabetes in the atherosclerosis risk in communities study. *American Journal of Epidemiology, 176*, 738–743.
- Sloan, E., Hall, K., Moulding, R., Bryce, S., Mildred, H., & Staiger, P. K. (2017). Emotion regulation as a transdiagnostic treatment construct across anxiety, depression, substance, eating and borderline personality disorders: A systematic review. *Clinical Psychology Review, 57*, 141–163.
- Strom, J. L., & Egede, L. E. (2012). The impact of social support on outcomes in adult patients with type 2 diabetes: A systematic review. *Current Diabetes Reports, 12*, 769–781.
- Torenholt, R., Schwennesen, N., & Willaing, I. (2014). Lost in translation—The role of family in interventions among adults with diabetes: A systematic review. *Diabetic Medicine, 31*, 15–23.
- Tsujii, S., Hayashino, Y., & Ishii, H. (2012). Diabetes distress, but not depressive symptoms, is associated with glycaemic control among Japanese patients with type 2 diabetes: Diabetes Distress and Care Registry at Tenri (DDCRT 1). *Diabetic Medicine, 29*, 1451–1455.
- van Middendorp, H., Geenen, R., Sorbi, M. J., Hox, J. J., Vingerhoets, A. J., van Doornen, L. J., & Bijlsma, J. W. (2005). Styles of emotion regulation and their associations with perceived health in patients with rheumatoid arthritis. *Annals of Behavioral Medicine, 30*, 44–53.
- Wierenga, K. L., Lehto, R. H., & Given, B. (2017). Emotion regulation in chronic disease populations: An integrative review. *Research and Theory for Nursing Practice, 31*, 247–271.
- Williams, W. C., Morelli, S. A., Ong, D. C., & Zaki, J. (2018). Interpersonal emotion regulation: Implications for affiliation, perceived support, relationships, and well-being. *Journal of Personality and Social Psychology, 115*, 224.
- Winchester, R. J., Williams, J. S., Wolfman, T. E., & Egede, L. E. (2016). Depressive symptoms, serious psychological distress, diabetes distress and cardiovascular risk factor control in patients with type 2 diabetes. *Journal of Diabetes and Its Complications, 30*, 312–317.
- Yuan, X., Liu, T., Wu, L., Zou, Z. Y., & Li, C. (2015). Validity of self-reported diabetes among middle-aged and older Chinese adults: The China Health and Retirement Longitudinal Study. *British Medical Journal Open, 5*, e006633.
- Zaki, J., & Williams, W. C. (2013). Interpersonal emotion regulation. *Emotion, 13*, 803.

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