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# Association of depressive symptomology and psychological trauma with diabetes control among older American Indian women: Does social support matter?

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## Abstract

**Aims**—Among older American Indian women with type 2 diabetes (T2DM), we examined the association between mental health and T2DM control and if social support modifies the association.

**Methods**—Survey data were linked to T2DM medical record information. Mental health measures were the Center for Epidemiologic Studies – Depression Scale and the National Anxiety Disorders Screening Day instrument. T2DM control was all HbA1c values taken post mental health measures.

**Results**—There was not a significant association between depressive symptomatology and higher HbA1c although increased depressive symptomatology was associated with higher HbA1c values among participants with low social support. There was a significant association between psychological trauma and higher HbA1c values 12 months [mean 7.5, 95% CI 7.0–8.0 for no trauma vs. mean 7.0, 95% CI 6.3–7.6 for trauma with no symptoms vs. mean 8.4, 95% CI 7.7–9.1 for trauma with =1 symptom(s)] and 6 months later [mean 7.2, 95% CI 6.7–7.7 for no trauma vs. mean HbA1c 6.8, 95% CI 6.2–7.4 for trauma with no symptoms vs. mean 8.4, 95% CI 7.6–9.2 for trauma with 1 symptom(s)]. High social support attenuated the association between psychological trauma and HbA1c values.

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Correspondence to: R. Turner Goins.

Conflict of interest: There is no Conflict of interest.

**Conclusions**—T2DM programs may consider activities that would strengthen participants' social support and thereby building on an intrinsic community strength.

### Keywords

American Indians; Older adults; Depression; Psychological trauma; Mental health; Social support

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## 1. Introduction

American Indians are twice as likely to have type 2 diabetes (T2DM) (Blackwell, Lucas, & Clarke, 2014) and twice as likely to die from T2DM compared to their non-Hispanic White counterparts (Heron, 2016). T2DM is the most common form of diabetes and is more common in older adults (Blackwell et al., 2014). Since T2DM is one of the leading causes of morbidity and mortality among American Indians, its prevention and control are a major focus of the Indian Health Service. In addition, the cost for treating T2DM is tremendous. Treating T2DM consumes over one-third (37%) of all medical costs for the Indian Health Service and age-adjusted total health expenditures for persons with T2DM is over three times higher than for persons without T2DM (O'Connell, Wilson, Manson, & Acton, 2012). When T2DM is poorly controlled, there can be many catastrophic health complications, which often occurs with greater frequency in American Indians compared to their non-Indian counterparts. For instance, American Indians have a 3.5 times higher rate of T2DM-related kidney failure compared to the general U.S. population (Indian Health Services, 2008). Thus, given the high prevalence of T2DM, poor control, and diabetes-related complications among American Indians, identifying factors that affect management is an important public health issue in Indian Country.

To address the high prevalence of T2DM and the increased likelihood of negative T2DM outcomes among American Indians, it may be clinically relevant to identify mental health conditions related to poor T2DM control. Research with other race and ethnic groups have found that poor mental health, such as depression and its associated symptoms, constitute a risk factor in the development of T2DM (Anderson, Freedland, Clouse, & Lustman, 2001) and subsequent poor T2DM control (Lustman et al., 2000; Molife, 2010) and accelerate the onset of T2DM complications (De Groot, Anderson, Freedland, Clouse, & Lustman, 2001; Molife, 2010). Also, among patients with T2DM, minor and major depression have been shown to be strongly associated with increased mortality (Katon et al., 2005). Other research findings indicate that there is a relationship between psychological trauma and T2DM (Boyko et al., 2010; Goodwin & Davidson, 2005; Grigsby, Anderson, Freedland, Clouse, & Lustman, 2002). Yet, substantially less research has examined psychological trauma with T2DM outcomes, which has not detected an association between psychological trauma and hemoglobin (Hb) A1c values (Trief, Ouimette, Wade, Shanahan, & Weinstock, 2006).

Data indicate that American Indians experience disproportionately high rates of mental illness (Beals, Novins, et al., 2005; Henry J. Kaiser Family Foundation, 2016; National Center for Health Statistics, 2014; Substance Abuse and Mental Health Services Administration, 2007). However, published studies that have examined the association between poor mental health and HbA1c values in this population, collectively, present a

mixed picture. Specifically, a few of these studies have not found a significant association between emotional well-being, depression, and psychological trauma symptoms with higher HbA1c values (Jacob et al., 2013; Johnson, Nowatzki, & Coons, 1996; Knaster, Fretts, & Phillips, 2015). Yet, other studies have observed a significant association between depression, anxiety, and psychological distress with higher HbA1c values (Calhoun et al., 2010; Huyser et al., 2015; Sahota, Knowler, & Looker, 2008; Singh et al., 2004; Walls, Aronson, Soper, & Johnson-Jennings, 2014).

Given the research to date, there continues to be a need to examine the association between poor mental health and T2DM control among American Indians. It is also important that research not only seeks to identify health disparities but to identify individual strengths that may attenuate the likely association between these two conditions such as social support. A growing body of research demonstrates the robust positive effect social support has on health (Holt-Lunstad, Smith, & Layton, 2010; Nyqvist, Pape, Pellfolk, Forsman, & Wahlbeck, 2014). Understanding how social support influences health-related behaviors and outcomes is a growing and important area of public health research. Greater amounts of positive social support is beneficial for T2DM management (Bardach, Tarasenko, & Schoenberg, 2011; Nicklett, Heisler, Spencer, & Rosland, 2013). While negative social support can result in a decrease in T2DM management behaviors (Grzywacz et al., 2012; Helgeson, Mascatelli, Seltman, Korytkowski, & Hausmann, 2016; Kahn, Stephens, Franks, Rook, & Salem, 2013; Mayberry, Egede, Wagner, & Osborn, 2015; Mayberry & Osborn, 2012). Leveraging social support to improve health can be particularly relevant for Native communities where the supportive role of the family and the larger community is valued (Kelley & Small, 2016). Thus, among older American Indian women with T2DM, the purpose of our study was to examine the association between depressive symptomatology and psychological trauma with HbA1c values and if that association differs by level of social support.

## **2. Subjects, materials and methods**

### **2.1. Data source**

We used survey data from the Native Elder Care Study which was linked to T2DM-related information from the participant's corresponding electronic health records at the local tribal hospital. The Native Elder Care Study was a cross-sectional study of 505 community-dwelling members of a federally-recognized American Indian tribe in the southeast. The tribe has over 16,000 enrolled members where the majority reside on or near tribally owned tracts of land that span across multiple adjacent rural counties. The study gathered in-depth information using in-person interviewer-administered surveys from 2006 to 2008 on demographics, physical functioning, personal care needs, mental and physical health, health-related behaviors, psychosocial characteristics, and health care use. Inclusion criteria for the Native Elder Care Study included being an enrolled tribal member, aged 55 years, residing in the tribe's service area, noninstitutionalized, and having passed a cognitive screen. More detail regarding the Native Elder Care Study and its methodology is described elsewhere (Goins, Garrouette, Leading Fox, Geiger, & Manson, 2011).

For this study, we examined those Native Elder Care Study participants who had a medical diagnosis in their electronic records of T2DM with the ICD code of 250.00. Although there

are other codes for a T2DM diagnosis, we determined that everyone with T2DM had the code of 250.00 regardless of what other codes were present or not. Of these participants, we linked their specified T2DM-related information from their electronic health records and laboratory data housed at the local tribal hospital using first name, last name, and date of birth to their Native Elder Care Study survey data. Although the data do not exist, the CEO of the hospital estimates that around 98% of tribal members use this facility for their primary care (C. Cooper, personal communication, June 2, 2016). Of the 505 Native Elder Care Study participants, electronic health records were not obtained for 44 participants (9%): 30 participants (6%) could not be found in the tribal hospital records and 14 participants (3%) had not been seen at the hospital in the past 3 years and their electronic health records were unavailable. The tribe's institutional review board, tribe's health board, tribal council, and [blinded for review] institutional review board approved this project.

## 2.2. Measures

Our dependent variable, T2DM control was measured with the participant's HbA1c laboratory data from the local tribal hospital. We used all HbA1c measurements that were collected within 6 and 12 months after the Native Elder Care Study interview was conducted.

Mental health was collected as part of the Native Elder Care Study interview and included depressive symptomatology and psychological trauma and associated symptoms. Depressive symptomatology was measured with the 20-item Centers for Epidemiological Studies—Depression (CES-D) scale (Radloff, 1977). The CES-D assesses depressive symptomatology and its reliability and validity has been demonstrated among older adults across different racial and ethnic groups (Kim, DeCoster, Huang, & Chiriboga, 2011), including older American Indians (Chapleski, Lamphere, Kaczynski, Lichtenberg, & Dwyer, 1997). The 20-item CES-D scale is comprised of four domains, including depressed affect, positive affect, somatic symptoms, and perceptions regarding interpersonal relationships (Radloff, 1977). The CES-D asks respondents how often they felt each symptom in the past week, with a response scale of 0 to 3 (0 = rarely or none of the time, 1 = some or a little of the time, 2 = occasionally or a moderate amount of time, 3 = most or all of the time). Positive affect items are reverse coded with the full scale total sum score ranging from 0 to 60. Cronbach's alpha for the CES-D in the Native Elder Care Study sample was 0.87.

Psychological trauma and associated symptoms was measured with the National Anxiety Disorders Screening Day Instrument (Ritsher, Struening, Hellman, & Guardino, 2002). Respondents were first asked "Have you ever had an extremely frightening, traumatic, or horrible experience? Examples of such experiences include being a victim of a violent crime or domestic violence, being in a disaster like a flood or fire, being in a combat, being seriously injured in an accident or witnessing a serious accident, and being sexually assaulted." The response options were "yes" or "no." If the respondent answered "yes," then they were asked whether they experienced five different kinds of symptoms in the past 30 days. The validity of this instrument has been demonstrated across different ethnic groups, including American Indians (Ritsher et al., 2002). We categorized participants into 3 groups: no trauma, trauma with no symptoms, and trauma with 1 symptom(s) in the past 30 days.

Social support was collected as part of the Native Elder Care Study interview with the Medical Outcomes Study Social Support (MOSSS) survey (Sherbourne & Stewart, 1991). Social support refers to the receipt of emotional support, tangible assistance, affection, and positive social interactions by persons in one's social network. The MOSSS is a 19-item scale gauging the frequency of the availability of social support with response items ranging from 1 (*none of the time*) to 5 (*all of the time*). We calculated the overall MOSSS by averaging the score for all 19 items; possible scores ranged from 1 to 5. Participants who were missing 11 items were excluded from analyses. Cronbach's alpha for the MOSSS in the Native Elder Care study sample was 0.96. We dichotomized the overall score at the median (4.3, interquartile range = 3.9–4.7) to create two groups representing low and high social support.

With respect to other characteristics of our participants, age, education, and health care use were also collected as part of the Native Elder Care Study interview. Age was measured in years. Education was measured with the following categories: 1–11 years (less than a high school degree), 12 years (high school graduate or passed the General Educational Development tests), 13–15 years (some college or an associate's degree), 16 years (college graduate), and 17 years (post college education). We collapsed education into a binary variable as less than high school graduate or high school graduate or greater. Health care use was measured with the question "Have you seen a doctor within the last 6 months?" Response options were "yes" or "no" and participants who indicated "yes," also provided number of doctor visits. We grouped responses into categories including 0, 1, 2, 3–5, and 6 times. T2DM duration was captured through the hospital's electronic medical records and was measured in years with whole years and then fractional years for any remaining months.

### 2.3. Statistical analyses

T-tests and chi-square tests were used to compare participants with and without available HbA1c data. We used linear regression to examine the association of depressive symptomatology and psychological trauma with T2DM control. Depressive symptomatology and psychological trauma and associated symptoms were our independent variables of interest and were examined in separate models. T2DM control was the dependent variable for all models and measured via HbA1c within a specified timeframe following the Native Elder Care Study interview. Our primary analysis examined HbA1c measured within 12 months of the interview and a sensitivity analysis examined HbA1c measured within 6 months of the interview. Our sensitivity analysis was performed on a smaller sample of participants but with more proximal timing between the independent and dependent variables. Models adjusted for age, education, number of doctor visits, and duration of T2DM at the time of HbA1c test. Other adjustment variables were considered, such as body mass index and elapsed time between the interview and HbA1c test, but our sample size limited the number of possible adjustment variables and we chose the most influential based on preliminary bivariate analyses. Regression models were fit using generalized estimating equations with robust standard errors to adjust for the correlation between multiple HbA1c observations within a participant. This approach allowed us to use all available data and account for non-independence due to clustered data. We examined effect modification according to social support based on a priori hypotheses that the

association between our measures of mental health and T2DM control would differ in participants with high versus low social support. We tested for effect modification by including the product term(s) between depressive symptomatology and psychological trauma with social support in the regression models. We also present results stratified by social support.

### 3. Results

Among the 461 Native Elder Care Study participants with electronic health records data, we determined that 256 or 55.5% had a diagnosis of T2DM at the time of their Native Elder Care Study interview. We excluded the remaining 205 who did not have T2DM at the time of the interview and 128 who did not have HbA1c data within 12 months after the interview. Compared to participants who did not have HbA1c data, those who had HbA1c data were younger (mean  $68 \pm 9$  years vs.  $73 \pm 10$  years;  $p < 0.01$ ), had longer duration of T2DM (mean  $12 \pm 6$  years vs. mean  $10 \pm 7$  years;  $p = 0.01$ ), and had fewer depressive symptoms (mean  $6.8 \pm 6.7$  vs. mean  $10.4 \pm 11.3$ ;  $p = 0.02$ ). Participants with and without HbA1c data were similar with respect to education, health care use, psychological trauma, and social support. Additional exclusions were made for participants missing key analytic variables. Initial analyses indicated differences between males and females for our associations of interest, and we attempted to stratify our analysis by sex. However, only 40 male participants were available for analysis, resulting in unstable model estimates. Thus, we only present results for the 81 females who remained in the sample.

Table 1 presents the demographic and health characteristics for the females. The mean age was  $67.6 \pm 8.9$  years and 63% had a high school diploma or passed the General Educational Development tests. The mean number of doctor visits in the past 6 months was  $4.5 \pm 5.2$  with the mean duration of T2DM of  $12.4 \pm 6.0$  years. The mean CES-D score was  $6.8 \pm 6.8$ . Sixty-three percent of participants reported no psychological trauma, 23% reported psychological trauma with no symptoms, and 14% reported psychological trauma with 1 symptom(s). The mean score on the MOSSS was  $4.2 \pm 0.6$ . Mean HbA1c level was  $7.5 \pm 1.8\%$  and ranged from 4.4% to 14.0%. Within 12 months of the interview, the mean number of HbA1c level observations per individual was 2.9 and ranged from 1 to 6 observations.

Table 2 presents the adjusted association between the CES-D and HbA1c overall and stratified by level of social support. We observed a trend for higher HbA1c levels with increasing CES-D scores, but the results were not statistically significant. However, the association was significant among participants with low social support. The effect modification term for CES-D and social support was statistically significant in the 12-month HbA1c model ( $p = 0.03$ ) but was not significant in the 6-month HbA1c model ( $p = 0.15$ ).

Table 3 presents the adjusted association between psychological trauma and HbA1c overall and stratified by level of social support. We found that overall, there was an association between psychological trauma and higher HbA1c levels suggesting that psychological trauma with symptom(s) is correlated with poorer T2DM control. We also found that high social support attenuated this association. The effect modification term for psychological

trauma and social support trended toward statistical significance in the 12-month HbA1c model ( $p = 0.05$ ) but was not significant in the 6-month HbA1c model ( $p = 0.24$ ).

#### 4. Discussion

We sought to examine the association between mental health and T2DM control, measured by HbA1c, among older American Indian women. We examined depressive symptomology and psychological trauma, which are prominent among American Indians. We also examined whether social support modified the association of mental health and HbA1c levels. The T2DM prevalence in our sample is similar to the prevalence estimated for all of those aged 65 years in the same Indian Health Service region, which is 60% (United South and Eastern Tribes, 2015). Also, our sample is similar to the parent study's larger sample of 505 of both men and women with respect to educational attainment (Goins, Innes, & Dong, 2012).

Although we saw a trend for higher HbA1c levels among those with higher levels of depressive symptomatology, particularly among those with low social support, these differences were not statistically significant. The trend we observed is consistent with other studies with American Indians which have found associations between measures of depression and higher HbA1c levels (Calhoun et al., 2010; Sahota et al., 2008; Singh et al., 2004; Walls et al., 2014). Our inability to detect a statistically significant association between depression and T2DM control may be due to our relatively small sample size, regional diversity, and our measurement of depressive symptomatology. Research has demonstrated a diversity in the prevalence of mental health conditions across geographic regions for American Indians and Alaska Natives. For example, the American Indian Service Utilization, Psychiatric Epidemiology, Risk and Protective Factors Project found that depressed mood among American Indian women in the Southwest was 50.4% compared to 33.5% of their Northern Plains counterparts (Beals, Manson, et al., 2005). Thirdly, a systematic review of the literature suggests that effect size between depression and T2DM control may depend on methods to assess depression; a larger effect size was found when depression was assessed via diagnostic criteria rather than through self-report questionnaires (Lustman et al., 2000).

We found a statistically significant association between psychological trauma and higher levels of HbA1c. Our findings are similar to a study that found an association of greater psychological distress, as measured by the Kessler-6, and higher HbA1c levels among American Indians (Huysen et al., 2015). However, interestingly, our findings differed from those in a recent study that demonstrated no association between the same measure of psychological trauma and T2DM control in a sample of 3776 American Indians (Jacob et al., 2013). These researchers concluded that the lack of association suggests that there are other factors unaccounted for in their analysis that affect American Indians' ability to control their blood sugar. Given that we found an association, this may indicate that there are regional geographic differences in this association. Although Jacob et al.'s study had participants from three regions, they did not examine the association of psychological trauma and HbA1c values by this characteristic nor did their sample include the southeast (2013). Clearly, more



research is needed to more fully investigate relationships between psychological trauma and T2DM control particularly in American Indians.

Lastly, we did not find a significant association between depressive symptomatology and HbA1c although increased depressive symptomatology was associated with higher HbA1c values among participants with low social support. We also found that higher levels of social support attenuated the relationship between psychological trauma and poor T2DM control. According to the broader literature, social support appears to be a powerful protective factor for health. For instance, two meta-analytic studies found that stronger social support was associated with lower mortality (Holt-Lunstad et al., 2010; Nyqvist et al., 2014). Although greater social support is beneficial for T2DM management (Bardach et al., 2011; Nicklett et al., 2013), there is currently no consensus about the role of social support on HbA1c levels (Strom & Egede, 2012).

Our findings have important implications for T2DM programs and future research. Trauma-related histories and trauma diagnosis are not routinely completed in medical care settings despite that those with trauma have more physician visits than those who do not (Greene, Neria, & Gross, 2016). Given the relationship between psychological trauma and T2DM control found in our study and others, there is need for routine screening in primary care settings. A recent study reported on the development of a screening and brief intervention for psychological trauma in primary care settings for American Indians and Alaska Natives. The authors concluded that the key to the success of this effort was the engagement of community leaders, providers, and patients. The study also determined that the nature of the traumas experienced in American Indian and Alaska Native communities, the need to develop a trusting patient-provider relationships, and the health care system's human resources are all important aspects in the development of an effective screening tool and brief intervention (Hiratsuka et al., 2016). Helpful future research and mental health treatment efforts with American Indians and/or Alaska Natives would examine the role of social support in patient outcomes. Such research should also consider the trauma type and how type intersects with social support especially if the trauma is interpersonal in nature.

Our study is the first to examine and document the buffering effect of social support in the relationship between mental health measurements and T2DM control among American Indians. Our results also suggest the importance of expanding T2DM programs to also fully explore social support beyond the typical support group mechanism. Little is known regarding the influence of social support and T2DM-related outcomes or behaviors among American Indians. An examination with Navajos with T2DM found that when the majority of the meals were cooked by family members for someone with T2DM, they were more likely to have lower HbA1c levels (Epple, Wright, Joish, & Bauer, 2003). A more recent qualitative study with American Indians and Alaska Natives with T2DM found that social support emerged as an important aspect in their T2DM management. Participants indicated that social support was a source of encouragement for dietary adherence and coping. Also, many participants reported difficulty in finding support from friends and/or family for their dietary needs, which for some would lead to social isolation since many social events centered on food (Shaw, Brown, Khan, Mau, & Dillard, 2013).

Specific social network focused interventions have been used in other race and ethnic populations for body weight reduction (Sorkin et al., 2014), to lower HbA1c and blood glucose levels (Shaya et al., 2014), and to encourage smoking cessation (Saul et al., 2007). Yet this line of inquiry remains unexplored among American Indians. Ironically, although social support – one feature of social networks – is a historical and cultural value among American Indians, we know almost nothing about it today, either generally or relative to the prevention or treatment of T2DM. To advance our understanding and to improve the impact of existing public health T2DM efforts, there is a critical need for research to identify one's social network attributes that can facilitate desired therapeutic goals for T2DM management and control.

Our findings should be interpreted in the context of its limitations. First, while we introduced a prospective component to the study by focusing on HbA1c levels measured after the mental health assessment, conclusions about causality and temporality between mental health and T2DM control factors should be interpreted with caution because mental health was only assessed at a single time point. Second, our sample consisted of older American Indian women drawn from a community of reservation-dwelling individuals enrolled in a particular federally recognized tribe. Thus, our sample limits the generalizability of our findings to American Indians from other tribes and geographic regions, younger individuals, and men. Living on tribal lands or a reservation compared to an urban setting may have important implications in the prevalence of psychological trauma exposure and social support. Future research needs to examine these associations among American Indian men as mental health prevalence and conditions differs by sex (Beals, Novins, et al., 2005; Brave Heart et al., 2016) as does social support (Conte, Schure, & Goins, 2015).

Third, our analyses were based on data that were linked from multiple, unrelated sources which resulted in the exclusion of participants who did not have HbA1c measured in our designated timeframe. The included participants were younger, had longer duration of T2DM, and had fewer depressive symptoms than excluded participants, but it is uncertain what effect that may have had on our results. Lastly, we measured psychological trauma with the National Anxiety Disorders Screening Day Instrument. Although the validity of this instrument has been demonstrated with American Indians (Ritsher et al., 2002), there are numerous instruments to choose from with acceptable psychometric properties (Elhai, Gray, Kashdan, & Franklin, 2005). The gold standard of assessing psychological trauma and associated symptoms would be measured by mental health professionals in a clinical interview. However, there is a surprising lack of studies demonstrating that diagnostic prevalence estimates generated by clinicians is more reliable or valid than diagnostic prevalence estimates generated by lay interviewers using highly structured interviews as our study did.

Our findings show that social support may have a positive influence on T2DM control in older American Indian women, particularly among those with psychological trauma. In recognition of this evidence, efforts to improve T2DM control among American Indians should include understanding an individual's social support that may explain adoption and maintenance of behaviors for T2DM control. Future research is needed to fully characterize

the mechanisms through which social support effects T2DM control and examines types of social support and aspects in that person's life that are influencing their social support. Such information will help in the creation of interventions that would be best suited for older American Indians and promote wellness in this population as well as other groups that experience a disproportionate burden of poor T2DM outcomes. Such public health efforts would benefit from adopting an assets model approach for American Indians with T2DM by leveraging intrinsic community strengths such social support.

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**Table 1**Participant characteristics ( $n = 81$ ).

	Mean (SD)	%
Age, years	67.6 (8.9)	
55–64		41
65–74		40
75		20
High school graduate/GED or more		63
Doctor visit in past 6 months	4.5 (5.2)	
0		4
1		17
2		28
3–5		25
6		26
T2DM duration, years	12.4 (6.0)	
CES-D*	6.8 (6.8)	
Psychological trauma		
No trauma		63
Trauma but no symptoms		23
Trauma with 1 symptom(s)		14
MOSSS	4.2 (0.6)	

T2DM = type 2 diabetes; SD = standard deviation; CES-D = Center for Epidemiological Studies - Depression Scale;

\*  
n = 75;

MOSSS = Medical Outcomes Study Social Support survey.

**Table 2**

Adjusted association between depressive symptoms and HbA1c, overall and stratified by level of social support.

	N	n	B (95% CI)	p-value
HbA1c in 12 months post CES-D assessment				
Overall	222	75	0.05 (-0.01, 0.10)	0.09
Low social support	130	44	0.08 (0.03, 0.12)	<0.01
High social support	92	31	-0.02 (-0.13, 0.08)	0.67
HbA1c in 6 months post CES-D assessment				
Overall	113	65	0.05 (-0.01, 0.10)	0.09
Low social support	64	36	0.08 (0.01, 0.14)	0.02
High social support	49	29	0.01 (-0.10, 0.11)	0.90

Adjusted for age, education, number of doctor visits in past 6 months, duration of T2DM at time of HbA1c test; B = difference in HbA1c for a 1-point increase in CES-D; Hb = hemoglobin; CES-D = Center for Epidemiological Studies - Depression Scale, N = number of observations; n = number of participants; CI = confidence interval.



**Table 3**  
Adjusted association between psychological trauma and HbA1c, overall and stratified by level of social support.

	N	n	No trauma Mean (95% CI)	Trauma, no symptoms Mean (95% CI)	Trauma, with 1 symptom(s) Mean (95% CI)	p-value
HbA1c in 12 months post psychological trauma assessment						
Overall	240	81	7.5 (7.0–8.0)	7.0 (6.3–7.6)	8.4 (7.7–9.1)	0.02
Low social support	132	45	7.3 (6.9–7.7)	7.1 (5.8–8.3)	9.0 (8.1–9.8)	<0.01
High social support	108	36	7.8 (7.0–8.6)	7.0 (6.3–7.7)	7.2 (6.2–8.2)	0.32
HbA1c in 6 months post psychological trauma assessment						
Overall	122	71	7.2 (6.7–7.7)	6.8 (6.2–7.4)	8.4 (7.6–9.2)	<0.01
Low social support	65	37	6.9 (6.6–7.3)	6.8 (5.6–7.9)	8.8 (7.9–9.7)	<0.01
High social support	57	34	7.4 (6.6–8.2)	6.9 (6.2–7.6)	7.4 (6.1–8.8)	0.50

Adjusted for age, education, number of doctor visits in past 6 months, duration of T2DM at time of HbA1c test; Hb = hemoglobin; N = number of observations; n = number of participants; CI = confidence interval.