Psychosocial Moderators of the Impact of Diabetes Stigma: Results From the Second Diabetes MILES – Australia (MILES-2) Study

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OBJECTIVE

To examine the association of diabetes stigma with psychological, behavioral, and HbA_{1c} outcomes and to investigate moderation effects of self-esteem, self-efficacy, and/or social support.

RESEARCH DESIGN AND METHODS

The national Second Diabetes MILES – Australia (MILES-2) survey included adults with type 1 diabetes ($n = 959$, 41% of whom were male, with mean ± SD age 44 ± 15 years), insulin-treated type 2 diabetes ($n = 487$, 60% male, age 61 ± 9 years), and non–insulin-treated type 2 diabetes ($n = 642$, 55% male, age 61 ± 10 years). (Un)adjusted linear regression analyses tested the association between diabetes stigma (Diabetes Stigma Assessment Scale [DSAS]) and psychological outcomes (depressive symptoms [eight-item version of the Patient Health Questionnaire (PHQ-8)], anxiety symptoms [Generalized Anxiety Disorder 7-item (GAD-7) questionnaire], and diabetes-specific distress [20-item Problem Areas In Diabetes (PAID) scale]), behavioral outcomes (healthy diet and physical activity [Summary of Diabetes Self-Care Activities (SDSCA)]), and self-reported HbA_{1c}. Interaction effects tested whether associations varied by self-esteem (Rosenberg Self-Esteem Scale [RSES]), self-efficacy (Confidence in Diabetes Self-Care [CIDS] scale), or diabetes-specific social support (Diabetes Support Scale [DSS]).

RESULTS

Significant positive associations were observed between DSAS and PHQ-8, GAD-7, and PAID across diabetes type/treatment groups (all $P < 0.001$), whereby each SD increase in DSAS scores was associated with approximately one-half SD deterioration in emotional well-being. Associations between DSAS and SDSCA and HbA_{1c} were nonmeaningful. Self-esteem moderated psychological outcomes among participants with type 1 and non–insulin-treated type 2 diabetes and diabetes distress among those with insulin-treated type 2 diabetes. Interaction effects were partially observed for social support but not for self-efficacy.

CONCLUSIONS

This study provides evidence of the association between diabetes stigma and depressive/anxiety symptoms and diabetes distress and for the moderating effects of self-esteem and social support among adults with type 1 and type 2 diabetes. Further research is needed to examine associations with objectively measured behavioral and clinical outcomes.

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Evidence of the extent and potential impact of diabetes-related stigma is increasing (1–7). Notably, the international second Diabetes Attitudes, Wishes and Needs (DAWN2) study found that one in five adults with type 1 diabetes or type 2 diabetes have experienced discrimination because of their diabetes (4) and that discrimination is associated with impaired quality of life and increased diabetes-specific distress (8). However, discrimination is just one, albeit extreme, form of stigma. Diabetes-related stigma includes perceived or experienced exclusion, discrimination, status loss, rejection, blame, or stereotyping based on the diagnosis or management of diabetes (9–11), e.g., being or feeling blamed by others for causing the condition (2,3).

In 2013, Schabert et al. (11) reviewed the limited, at that time, diabetes-related stigma research in the field of diabetes and proposed a framework for understanding diabetes stigma, which was further refined (3) following qualitative studies examining the sources, experiences, and impact of stigma among adults with type 1 or type 2 diabetes (2,3). Sources of diabetes stigma may be external (e.g., media, health professionals, family, public) or internal (i.e., self-stigma) (2,3). The specific features of diabetes and its management contributing to diabetes stigma (e.g., needle use, overweight/obesity), and the experiences of diabetes stigma, differ qualitatively and quantitatively (1–3,6). This is currently most notable by diabetes type (e.g., type 1 vs. type 2) and treatment (e.g., insulin-treated vs. non–insulin-treated) (1–3,6), though there is also evidence for an association between age and diabetes duration with diabetes stigma (1). However, similar psychosocial impacts and mitigating strategies have been hypothesized across groups (3,11). The framework proposes that diabetes stigma impacts upon psychological, behavioral, and clinical outcomes. For example, secondary analyses of two interview studies revealed the impact of public responses on self-care practices among adults with type 2 diabetes (i.e., omission of insulin injections and blood glucose monitoring in public) and, therefore, the potential negative impact on glucose levels (12). These consequences may be mitigated by various factors (e.g., social support, mass media campaigns) (3,11,12). However, there has been little quantitative research to date investigating the association between diabetes stigma and those proposed "consequences" and potential moderators.

In a large ($N = 5,422$) U.S. survey using single-item measures of diabetes stigma and its perceived impact, at least one-half (52% of those with type 2 and 76% with type 1 diabetes) of those surveyed reported experiencing diabetes-related stigma, with up to 38% reporting that this had impacted on their "emotional life" (i.e., symptoms of distress) and "social life" (i.e., having a full and satisfying social and work life) (6). A Swiss survey of >3,000 adults with diabetes identified an association between diabetes stigma and quality of life, diabetes-specific distress, depressive symptoms, and social support (1). However, the novel tool to assess diabetes-related stigma, informed by an associated qualitative study, used a binary count assessment of stigma in various situations, which may under- or overstate the strength of the experienced stigma. An association has previously been reported between the Self-Stigma Scale (adapted version) with lower self-care engagement and out-of-target HbA_{1c} among Japanese adults with type 2 diabetes (5,7). The recent development and validation of the Type 1 Diabetes Stigma Assessment Scale (DSAS-1) and Type 2 Diabetes Stigma Assessment Scale (DSAS-2) (13,14) enables psychometrically robust quantification of diabetes-related stigma, including both "self" and external or public, and the assessment of correlates and moderating variables.

The mitigating strategies proposed by Schabert et al. (11) focus on *1*) countering stigma at a social level (e.g., through education, social marketing, health promotion campaigns), or *2*) the capacity of the individual with diabetes to be resilient to stigma (i.e., access to counseling services and social support, diabetes self-management) (3). Little research has been conducted investigating either approach in the diabetes population to date. However, given the demonstrated negative association between social support and diabetes stigma (1), it may be expected that social support is an important moderator of the impact of diabetes stigma on psychological, social, behavior, and clinical outcomes. In addition, diabetes self-efficacy (confidence in one's ability to self-manage diabetes) may be a reasonable proxy measure of the potential role of diabetes education and self-management skills in moderating diabetes stigma. Finally, in other health conditions and populations, evidence for the moderating effect of individual-level factors on the impact of stigma has been demonstrated (15). Specifically, self-esteem has been highlighted as a potential protective factor in reducing the impact of stigma on emotional well-being, though there is conflicting evidence for the moderating effect of self-esteem on the impact of diabetes stigma (1,5,12,14).

Further research is urgently needed to examine the hypothesized moderators and consequences of diabetes-related stigma using validated measures in large-scale studies (16). The comprehensive, large-scale, cross-sectional Second Diabetes MILES (Management and Impact for Long-term Empowerment and Success) – Australia (MILES-2) study data set provides opportunity to examine some of the proposed correlates and moderators of diabetes stigma, as measured using the DSAS-1 and DSAS-2 (17). Thus, the aims of the current study were to: *1*) examine the associations between diabetes-related stigma and psychological, behavioral, and clinical outcomes among Australian adults with type 1 diabetes, insulin-treated type 2 diabetes, and non–insulin-treated type 2 diabetes and *2*) investigate whether any identified associations are moderated by self-esteem, diabetes-specific self-efficacy, and/or social support. It was hypothesized that diabetes stigma is associated with psychological, behavioral, and clinical outcomes and that these effects would be moderated by self-esteem, self-efficacy, and social support.

RESEARCH DESIGN AND METHODS

The Diabetes MILES study is an international collaborative exploring the psychosocial aspects of living with diabetes (18,19). This study uses cross-sectional data from the MILES-2 study, a national online survey of adults with type 1 and type 2 diabetes (conducted in 2015). A detailed description of the methods, sample characteristics, and response rates have previously been published (17). Ethics approval for MILES-2 was granted from the Deakin University Human Research Ethics Committee (2011-046).

Participants and Procedure

MILES-2 eligibility criteria included a self-reported diagnosis of type 1 or type 2 diabetes, age 18–75 years, ability to read

and write in English, and current residence in Australia. Study invitations were sent to a random sample ($N = 20,000$) of National Diabetes Services Scheme registrants, stratified by state and diabetes types, and to all ($N = 2,065$) original Diabetes MILES – Australia 2011 participants who had consented to being contacted about future surveys. The online survey was also advertised nationwide in diabetes-related media (e.g., websites, e-newsletters, and social media). Recruitment materials directed potential participants to the study website, securely hosted by Qualtrics (Provo, UT). Following receipt of a plain language description of the study, indication of consent, and completion of screening questions, eligible participants were directed to the survey. Responses were saved automatically throughout survey completion, such that partial participant data are available for those who exited prior to full completion. Question completion was not compulsory (with the exception of eligibility screening items); thus, participants were free to skip single items or whole questionnaires.

In total, 2,342 eligible respondents took part in MILES-2 (17), of whom 2,088 are included in the current study. A subsample of 254 (10.8%) participants are excluded from this study, as they had access to a modified MILES-2 survey, which did not include the Diabetes Stigma Assessment Scale (DSAS), the primary measure of interest in this study. This subsample was part of the longitudinal Diabetes MILES cohort, who completed a MILES-2 survey consistent with the Diabetes MILES survey they completed in 2011.

Measures

Measures relevant to the current study are described below, and a full list of measures included in MILES-2 has previously been published (17).

Diabetes Stigma

Perceived and experienced diabetes stigma was assessed using the DSAS-1 (13) or the DSAS-2 (14), corresponding with self-reported diabetes type. Each scale includes 19 statements, and respondents are asked to rate their agreement with each item on a 5-point scale (1, "strongly disagree," to 5, "strongly agree"). Statements relate to being (or feeling) blamed, judged, or subject to negating stereotyping by others including, for example, family, colleagues, and health professionals, as well as feelings of self-blame and shame. Item scores are summed to create a total score (range 19–95), where higher scores indicate greater perceived/experienced diabetes stigma. Three subscale scores can also be calculated for each version of the DSAS, where higher scores indicate greater endorsement of that concept. The DSAS-1 and DSAS-2 both include subscales assessing "blame and judgment" and "concerns about being treated differently." The DSAS-1 includes a subscale assessing "identity concerns," while the DSAS-2 includes a subscale assessing "self-stigma."

Hypothesized Correlates of Diabetes-Related Stigma

Psychological Outcomes. Depressive symptoms were assessed using an eight-item version of the Patient Health Questionnaire (PHQ-8) (20). Anxiety symptoms were assessed with the Generalized Anxiety Disorder 7-item (GAD-7) questionnaire (21). For each measure, respondents rate symptom frequency over the past 2 weeks on a 4-point scale (0, "not at all," to 3, "nearly every day"). Item scores are summed to form a total score (PHQ-8 range 0–24 and GAD-7 range 0–21) with higher scores indicating greater experience of depressive/anxiety symptoms.

Diabetes-specific distress was assessed using the 20-item Problem Areas In Diabetes (PAID) scale (22). Respondents rate the extent to which each issue is a problem for them on a 5-point scale (0, "not a problem," to 4, "serious problem"). A PAID total score is calculated as the standardized sum of item scores (range 0–100) with higher scores indicating greater diabetes-specific distress (23).

Behavioral Outcomes. Diabetes self-care behaviors of relevance to the current study include following a healthy diet and participation in physical activity, as measured using relevant subscales of the Summary of Diabetes Self-Care Activities (SDSCA) (24). The two-item general diet SDSCA subscale assesses how many days in the last week, and in an average week in the last month, participants recall following a "healthy eating plan." No further definition of a "healthy eating plan" is provided, with participants required to interpret this instruction as related to them. The two-item physical activity SDSCA subscale measures how many days in the last week participants recall completing at least 30 min of continuous activity and on how many days they participated in a dedicated exercise session (e.g., swimming, exercise class). For both subscales, a mean of the two items is taken to provide a score from 0 to 7, with higher scores indicating more days engaging in recommended diet and physical activity behaviors.

Clinical Outcomes. Participants were asked to report how many months had passed since their most recent HbA_{1c} check (<4, 4–6, 7–12, or >12 months or do not know) and most recent HbA_{1c} level (mmol/mol or %). Participants who reported that their last check was >6 months ago, or that they did not know, were coded as having missing HbA_{1c} data.

Hypothesized Moderating Factors

General self-esteem was assessed using the Rosenberg Self-Esteem Scale (RSES) (25). Respondents rate their agreement with 10 positively or negatively worded statements about their feelings toward themselves on a 4-point scale (0, "strongly disagree," to 3, "strongly agree"). A total score (range 0–30) is calculated by summing of responses to individual items after reverse scoring of negatively worded items. Higher scores indicate higher self-esteem.

Diabetes self-efficacy was assessed using two versions of the Confidence in Diabetes Self-Care (CIDS) scale: participants with type 1 diabetes or insulin-treated type 2 diabetes received the CIDS1, designed for insulin-treated diabetes (26); participants with non–insulin-treated type 2 diabetes completed the CIDS2 (27). For both 20-item scales, respondents indicate the extent to which they believe they can perform diabetes self-care activities on a 5-point scale (1, "no, I am sure I cannot," to 5, "yes, I am sure I can"). For both scales, a CIDS total score is calculated as the standardized sum of item scores (range 0–100). Higher scores indicate greater diabetes self-efficacy.

Diabetes-specific social support was assessed using the Diabetes Support Scale (DSS) (28). The DSS includes 12 items, assessing support from peers with diabetes and those without diabetes. Participants rate the support they had received over the preceding 3 months on a 7-point scale (1, "strongly disagree," to 7, "strongly agree"). A composite score is calculated by reversing the scores of negatively worded items and taking

the mean of all items. Higher scores indicate greater perceived diabetes social support.

The following self-reported demographic and clinical characteristics were also extracted from the data set: age, gender, relationship status (in relationship/not in relationship), employment status (in paid work: yes/no), education level (university education/no university education), diabetes duration, primary diabetes treatment (insulin pump/insulin injections/noninsulin injectables/oral medication/lifestyle modifications), diabetes-related complications (total count out of seven, including kidney disease, retinopathy, neuropathy, heart disease, stroke, vascular disease, and sexual dysfunction).

Statistical Analyses

Analyses were performed using Stata SE version 15.0 (StataCorp) and IBM SPSS Statistics 23 (Chicago, IL).

Descriptive Statistics

Participant characteristics were summarized according to diabetes type: type 1, type 2 with insulin use, and type 2 noninsulin. Data were summarized using counts and percentages (categorical/binary data) or mean and SD (continuous data). The median and interquartile range are provided for skewed distributions.

Statistical Methods

Univariable and multivariable linear regression analyses were conducted to estimate the mean difference in a given outcome for every 1-point increase in diabetes stigma total score. The model was adjusted by age, gender, duration of diabetes, and number of diabetes complications. This analysis was conducted for all outcome measures: depressive symptoms (PHQ-8), anxiety (GAD-7), diabetes distress (PAID), diet (SDSCA diet subscale), physical activity (SDSCA exercise subscale), and HbA_{1c} (%). Unadjusted and adjusted regression estimates, 95% CIs, and *P* values were reported, with the latter adjusted using Bonferroni corrections to account for multiple testing. The regression results were interpreted in the context of clinical significance using the effect estimates, CIs of the effect estimates, and adjusted *P* values. Associations with $P < 0.001$ were considered to be statistically significant. Where evidence of associations was found between diabetes stigma total score and outcome measures, interaction effects were added to the model to test whether the association varied by self-esteem (RSES), self-efficacy (CIDS), and/or social support (DSS). These analyses were conducted for each type of diabetes: type 1, insulin-treated type 2, and non–insulin-treated type 2. Transformations of variables with skewed distributions were trialed in regression models, and preference was given to high parsimony models with high levels of goodness of fit.

Missing Data and Sensitivity Analyses

Only participants with complete data were included in relevant linear regression models. For variables with >20% missing data, sensitivity analyses using pattern-mixture models were carried out to test whether regression results would differ if the missing data were not missing at random. To simulate this scenario, we considered plausible values for differences in the mean of the missing data and the mean of the observed data (δ). The regression analyses were repeated for each value of δ to determine whether study conclusions would change in the presence of nonrandom missing data.

RESULTS

This study includes a total sample of $N = 2{,}088$ participants, including 959 (46%) with type 1 diabetes, 487 (23%) with insulin-treated type 2 diabetes, and 642 (31%) with non–insulin-treated type 2 diabetes. Table 1 displays the demographic and clinical characteristics and DSAS total and subscale scores, as well as summary statistics for the hypothesized correlates and moderating factors, for all participants by diabetes type/treatment group.

Associations With Psychological, Behavioral, and Clinical Outcomes

Table 2 displays the unadjusted and adjusted associations between DSAS total scores and the hypothesized psychological, behavioral, and clinical outcomes of interest for each group. Across diabetes types and treatments, after adjustment for age, gender, diabetes duration, and number of complications, significant positive associations were observed between diabetes stigma and depressive symptoms, anxiety symptoms, and diabetes-specific distress. Each SD increase in diabetes stigma is associated with approximately one-half SD increase in psychological impairment. Thus, those who report greater perceived or experienced diabetes stigma also report worse depressive, anxiety, and diabetes-specific distress symptoms. Across groups, statistically significant associations ($P < 0.001$) between DSAS total scores and behavioral and clinical outcomes were not clinically meaningful (Table 2).

Approximately 35% of participants had missing data for HbA_{1c}. Sensitivity analysis was carried out to determine whether regression results would change should these missing data be missing not at random (see Supplementary Fig. 1*A*–*C*). Various values for differences in the mean of the missing data and the mean of the observed data were considered. Results remained unchanged when the missing data were considered to be missing not at random. When analyses were conducted using DSAS subscales, the findings were consistent with those for the total scale (data not shown).

Moderating Effects of Self-esteem, Self-Efficacy, and Social Support

The interactions between the moderator variables (self-esteem, self-efficacy, and social support) and diabetes stigma in relation to associated psychological outcomes, by diabetes type/treatment, are detailed in Table 3 (and graphically represented in Supplementary Tables 1– 3). Significant ($P < 0.001$) interaction effects were observed for self-esteem across psychological outcomes. Specifically, with increasing self-esteem, the effect of diabetes stigma on psychological outcomes decreased slightly among those with type 1 and non–insulin-treated type 2 diabetes. Among those with insulin-treated type 2 diabetes, with increasing self-esteem, there was a small decrease in the association between diabetes stigma and diabetes distress, but this was not evident for depressive or anxious symptoms.

Across groups, diabetes self-efficacy scores had no impact on the association between diabetes stigma and psychological outcomes. With increasing levels of diabetes-specific social support, there were small decreases in the association between diabetes stigma and diabetes-specific distress among those with type 1 and non–insulin-treated type 2 diabetes and small decreases in anxiety symptoms among those with type 1 diabetes.

CONCLUSIONS

This large-scale cross-sectional study has demonstrated an association between

Table 1—Sample characteristics by diabetes type/treatment (N = 2,088)

	Type 1 diabetes		Type 2 diabetes (insulin)		Type 2 diabetes (noninsulin)	
	N = 959	Missing	N = 487	Missing	N = 642	Missing
Demographics						
Age, years	43.5 ± 15.4	—	61.3 ± 9.0	—	61.0 ± 9.7	—
Male gender	389 (41)	3 (0)	290 (60)	—	350 (55)	3 (0)
Born in Australia	734 (77)	—	356 (73)	—	437 (68)	1 (0)
Employed	681 (71)	2 (0)	158 (32)	—	259 (40)	—
Highest level of education		4 (0)		1 (0)		3 (1)
≤10 years	120 (13)		153 (32)		155 (24)	
Completed year 12	170 (18)		54 (11)		73 (11)	
Trade training or diploma(s)	228 (24)		151 (31)		187 (29)	
Tertiary	437 (46)		128 (26)		224 (35)	
Clinical characteristics						
Diabetes duration, years	18.7 ± 14.41, 5 (8–27)	1 (0)	14.7 ± 7.6, 14 (10–19)	3 (0)	8.4 ± 6.4, 7 (3–12)	4 (0.6)
Diabetes treatment		—		—		
Insulin injections	631 (66)		485 (100)		—	
Insulin pump	328 (34)		2 (0.4)		—	
Noninsulin injectable	—		—		40 (6)	
Glucose-lowering tablets	—		—		448 (70)	
Lifestyle only	—		—		154 (24)	
Diabetes complications		73 (8)		25 (5)		44 (7)
None	584 (66)		144 (31)		340 (57)	
One to two	245 (28)		217 (47)		206 (35)	
Three or more	57 (6)		101 (22)		52 (9)	
BMI, kg/m^2	26.4 ± 5.5, 25.3 (22.9–28.7)	177 (18)	30.6 ± 6.4, 29.4 (26.0–33.3)	142 (29)	32.7 ± 6.5, 31.9 (28.3–36.3)	116 (18)
Diabetes stigma						
DSAS total	52.9 ± 15.6	74 (8)	43.5 ± 16.2	45 (9)	39.0 ± 15.5	70 (11)
Treated differently	13.6 ± 5.4, 13 (10–17)		12.0 ± 5.1, 12 (8–15)		10.2 ± 4.3, 9 (6–13)	
Blame and judgment	19.9 ± 6.0, 21 (16–24)		19.2 ± 7.2, 20 (14–25)		17.2 ± 7.2, 17 (11–23)	
Identity concerns	19.4 ± 7.1, 19 (14–25)		—		—	
Self-stigma	—		12.3 ± 5.9, 11 (7–16)		11.6 ± 5.7, 10 (6.5–14)	
Psychological outcomes						
Depressive symptoms (PHQ-8)	6.3 ± 5.5, 5 (2–9)	21 (2)	7.8 ± 6.2, 7 (3–12)	12 (3)	5.7 ± 5.2, 4 (1–9)	7 (1)
Anxiety symptoms (GAD-7)	5.0 ± 5.1, 4 (1–7)	20 (2)	5.5 ± 5.5, 4 (1–8)	12 (3)	4.2 ± 4.6, 3 (0–6)	4 (1)
Diabetes distress (PAID)	25.1 ± 21.1, 18.8 (7.5–38.8)	76 (8)	23.0 ± 20.7, 17.5 (6.3–35)	40 (8)	15.8 ± 17.7, 10 (3.8–21.3)	53 (8)
Behavioral outcomes						
Diet (SDSCA subscale)	4.9 ± 2.0	121 (13)	4.8 ± 2.0	54 (11)	4.9 ± 1.9	87 (14)
Exercise (SDSCA subscale)	3.5 ± 2.1	119 (12)	2.9 ± 2.3	53 (11)	3.5 ± 2.2	88 (14)
Clinical outcomes						
Self-reported HbA_{1c} in last 6 months		257 (27)		169 (35)		302 (47)
%	7.4 ± 1.3		7.5 ± 1.6		6.7 ± 1.7	
mmol/mol	56.9 ± 14.4		58.5 ± 17.3		50.2 ± 18.4	
Hypothesized moderating factors						
Self-esteem (RSES)	20.2 ± 6.1, 20 (16–25)	146 (15)	19.9 ± 5.9, 20 (16–24)	73 (15)	21.1 ± 5.5, 21 (18–25)	96 (15)
Diabetes-specific self-efficacy (CIDS)	82.6 ± 13.985 (73.8–95)	127 (13)	81.4 ± 15.2, 84 (72.5–93.8)	58 (12)	82.4 ± 15.1, 84 (72.5–96.3)	120 (19)
Diabetes-specific social support (DSS)	4.3 ± 1.2	112 (12)	4.6 ± 1.1	55 (11)	4.7 ± 1.1	82 (13)

Data are n (%) or mean ± SD. Where continuous variables are nonnormally distributed, mean ± SD and median (interquartile range) are reported. For CIDS, the CIDS1 was completed by participants using insulin and CIDS2 by those not using insulin. For DSAS, the DSAS-1 was completed by participants with type 1 diabetes and DSAS-2 by those with type 2 diabetes.

perceived/experienced diabetes stigma and impaired psychological outcomes (anxiety symptoms, depressive symptoms, and diabetes distress) among Australian adults with type 1 or type 2 diabetes. Our results are consistent with both the hypothesized consequences of diabetes stigma (3,11) and previous cross-sectional research (1,6,8). Furthermore, this study extends our limited understanding of the association between diabetes stigma and behavioral and clinical outcomes, as well as the potential moderating effect on all three outcomes of self-esteem, diabetes-specific self-efficacy, and diabetes-specific social support.

In contrast to existing diabetes, and health-related, stigma research, which has established an association between stigma and various self-care behaviors (7,29,30), the current study identified a small (adjusted) association between diabetes stigma and suboptimal dietary behaviors but not physical activity.

Table 2—Unadjusted and adjusted linear regression exploring associations between diabetes stigma and psychological, behavioral, and clinical outcomes by diabetes type/treatment (N = 2,088)

	Unadjusted			Adjusted*		
	N	Mean difference in outcome for every 1-point increase in diabetes stigma (95% CI)	P	N	Mean difference in outcome for every 1-point increase in diabetes stigma (95% CI)	P
Type 1 diabetes, N = 959						
Psychological outcomes						
Anxiety symptoms (GAD-7)	883	0.14 (0.12–0.16)	<0.001	867	0.12 (0.10–0.14)	<0.001
Depressive symptoms (PHQ-8)	883	0.16 (0.14–0.18)	<0.001	867	0.13 (0.11–0.16)	<0.001
Diabetes-specific distress (PAID)	871	0.83 (0.75–0.90)	<0.001	856	0.76 (0.69–0.84)	<0.001
Behavioral outcomes						
Diet (SDSCA)	825	−0.02 (−0.03 to −0.02)	<0.001	815	−0.01 (−0.02 to −0.005)	0.002
Physical activity (SDSCA)	827	−0.01 (−0.02 to −0.001)	0.02	817	−0.002 (−0.01 to 0.008)	0.74
Clinical outcome: HbA_{1c} (%)	691	0.02 (0.009–0.02)	<0.001	686	0.01 (0.006–0.02)	<0.001
Type 2 diabetes (insulin), N = 487						
Psychological outcomes						
Anxiety symptoms (GAD-7)	441	0.17 (0.14–0.20)	<0.001	440	0.15 (0.12–0.18)	<0.001
Depressive symptoms (PHQ-8)	441	0.18 (0.15–0.21)	<0.001	440	0.15 (0.12–0.19)	<0.001
Diabetes-specific distress (PAID)	433	0.87 (0.78–0.96)	<0.001	432	0.82 (0.72–0.91)	<0.001
Behavioral outcomes						
Diet (SDSCA)	415	−0.03 (−0.05 to −0.02)	<0.001	415	−0.03 (−0.04 to −0.01)	<0.001
Physical activity (SDSCA)	415	−0.02 (−0.03 to −0.005)	0.008	415	−0.02 (−0.03 to −0.001)	0.04
Clinical outcome: HbA_{1c} (%)	304	0.02 (0.007–0.03)	0.002	304	0.009 (−0.002 to 0.02)	0.12
Type 2 diabetes (noninsulin), N = 642						
Psychological outcomes						
Anxiety symptoms (GAD-7)	572	0.12 (0.10–0.14)	<0.001	565	0.10 (0.08–0.12)	<0.001
Depressive symptoms (PHQ-8)	570	0.14 (0.11–0.16)	<0.001	563	0.11 (0.08–0.14)	<0.001
Diabetes-specific distress (PAID)	561	0.72 (0.64–0.79)	<0.001	554	0.64 (0.56–0.71)	<0.001
Behavioral outcomes						
Diet (SDSCA)	530	−0.03 (−0.04 to −0.02)	<0.001	527	−0.02 (−0.03 to −0.01)	<0.001
Physical activity (SDSCA)	529	−0.01 (−0.03 to −0.003)	0.02	525	−0.004 (−0.02 to 0.008)	0.48
Clinical outcome: HbA_{1c} (%)	330	0.02 (0.004–0.03)	0.008	328	0.01 (−0.001 to 0.02)	0.07

For CIDS, the CIDS1 was completed by participants using insulin and CIDS2 by those not using insulin. *Models adjusted for age, gender, duration of diabetes, and number of diabetes-related complications.

However, the current study used only brief self-report SDSCA subscales to assess diet and physical activities levels (24). Thus, it may be that more comprehensive and sensitive measures of self-care behaviors are needed to detect such associations.

The limited self-care behaviors assessed here may not reflect those most relevant across diabetes types/treatments. For example, concerns about others' reactions and concealment of diabetes may lead to delays in insulin administration or glucose monitoring among those with insulin-treated diabetes (12,31–33). Further research is needed to quantitatively examine the association between diabetes stigma and medication-taking or glucose-monitoring behaviors. Regardless, it is likely that suboptimal self-care, whether this be dietary, medication-taking, or glucose-monitoring behaviors, occurs only in specific situations (e.g., in public). Many instances of these behaviors may occur in private settings where diabetes stigma is unlikely to impact on performance of the behavior. Diabetes self-care assessment tools may not be sensitive to any context-specific changes in behaviors and, therefore, may not be suitable for capturing the potential effect of diabetes stigma. This highlights the strength of an approach taken by Liu et al. (6), whereby participants directly reported the extent to which they felt that others' perceptions of diabetes cause difficulties for their emotional life, social life, or diabetes management (including "successful management, adherence, and good choices").

It has been proposed, and supported elsewhere (6,7), that diabetes stigma may lead, via impaired self-care behaviors, to suboptimal HbA_{1c} and, in the very long-term, development of diabetes-related complications (11). This association was observed, though not clinically meaningful, in the current study only among adults with type 1 diabetes, and results remained following sensitivity analyses. The lack of a clinically meaningful relationship between diabetes stigma and HbA_{1c} may be due to the cross-sectional nature of the study. Prospective research is needed to examine the potential association between diabetes stigma and HbA_{1c}, including changes over time. Multiyear cohort studies are needed to determine whether diabetes stigma affects the onset or progression of diabetes-related complications.

There is limited published evidence regarding the proposed moderators of the impact of diabetes stigma, and the current study provides preliminary evidence in relation to general and diabetes-specific emotional well-being. Consistent with health-related stigma research in other populations (e.g., 15,34), we found evidence, across all three groups, for the potential moderating effects of general self-esteem on the relationship between diabetes stigma and psychological outcomes. The current study also suggests that diabetes-specific social support has a potential moderating effect on the relationship between diabetes stigma and diabetes-specific distress among adults with type 1 and non–insulin-treated type 2 diabetes and on the relationship between

Table 3—Interactions between diabetes stigma and associated outcomes by diabetes type/treatment and moderator variables (self-esteem, diabetes-specific self-efficacy, and diabetes-specific social support) (N = 2,088)*

	Self-esteem (RSES)					Diabetes-specific self-efficacy (CIDS)					Diabetes-specific social support (DSS)				
Psychological outcomes	*N*	Mean diff in outcome for every one-point increase in RSES (95% CI)	*P*	Interaction between DSAS and RSE	*P*	*N*	Mean diff in outcome for every 1-point increase in CIDS (95% CI)	*P*	Interaction between DSAS and CIDS	*P*	*N*	Mean diff in outcome for every 1-point increase in DSS (95% CI)	*P*	Interaction between DSAS and DSS	*P*
Type 1 diabetes, $N = 959$: diabetes stigma (DSAS-1)															
Anxiety symptoms (GAD-7)	790	−0.36 (−0.42 to −0.31)	<0.001	−0.006 (−0.008 to −0.003)	<0.001	808	−0.08 (−0.11 to −0.05)	<0.001	−0.001 (−0.003 to 0.0003)	0.12	822	−0.65 (−0.91 to −0.38)	<0.001	−0.03 (−0.04 to −0.01)	<0.001
Depressive symptoms (PHQ-8)	789	−0.43 (−0.49 to −0.38)	<0.001	−0.008 (−0.01 to −0.005)	<0.001	808	−0.12 (−0.14 to −0.09)	<0.001	−0.001 (−0.003 to 0.0001)	0.07	822	−0.73 (−1.02 to −0.45)	<0.001	−0.01 (−0.03 to 0.0008)	0.06
Diabetes-specific distress (PAID)	781	−1.15 (−1.35 to −0.95)	<0.001	−0.02 (−0.04 to −0.01)	<0.001	799	−0.58 (−0.66 to −0.49)	<0.001	−0.008 (−0.01 to −0.003)	0.001	812	−4.76 (−5.70 to −3.82)	<0.001	−0.14 (−0.19 to −0.09)	<0.001
Type 2 diabetes (insulin), $N = 487$: diabetes stigma (DSAS-2)															
Anxiety symptoms (GAD-7)	398	−0.47 (−0.55 to −0.38)	<0.001	−0.005 (−0.009 to −0.0005)	0.03	411	−0.04 (−0.08 to −0.01)	0.01	9.96e-6 (−0.002 to 0.002)	0.99	418	−0.13 (−0.56 to 0.31)	0.57	−0.01 (−0.04 to 0.01)	0.34
Depressive symptoms (PHQ-8)	532	−0.47 (−0.79 to −0.14)	0.005	−0.03 (−0.04 to −0.007)	0.007	411	−0.07 (−0.11 to −0.04)	<0.001	0.0001 (−0.002 to 0.002)	0.88	418	−0.45 (−0.94 to 0.03)	0.07	−0.009 (−0.04 to 0.02)	0.51
Diabetes-specific distress (PAID)	390	−1.02 (−1.30 to −0.74)	<0.001	−0.03 (−0.05 to −0.02)	<0.001	403	−0.35 (−0.45 to −0.24)	<0.001	−0.005 (−0.01 to 0.0004)	0.07	411	−2.05 (−3.45 to −0.66)	0.004	−0.04 (−0.12 to 0.03)	0.26
Type 2 diabetes (noninsulin), $N = 642$: diabetes stigma (DSAS-2)															
Anxiety symptoms (GAD-7)	517	−0.39 (−0.46 to −0.32)	<0.001	−0.006 (−0.009 to −0.003)	<0.001	505	−0.08 (−0.10 to −0.05)	<0.001	−0.002 (−0.003 to −0.0005)	0.006	532	−0.47 (−0.79 to −0.14)	0.005	−0.03 (−0.04 to −0.007)	0.007
Depressive symptoms (PHQ-8)	515	−0.53 (−0.60 to −0.46)	<0.001	−0.006 (−0.01 to −0.003)	<0.001	503	−0.10 (−0.13 to −0.07)	<0.001	−0.001 (−0.003 to 0.0001)	0.08	530	−0.64 (−1.00 to −0.29)	<0.001	−0.02 (−0.04 to 0.0009)	0.06
Diabetes-specific distress (PAID)	508	−0.77 (−1.01 to −0.54)	<0.001	−0.03 (−0.04 to −0.02)	<0.001	496	−0.33 (−0.42 to −0.24)	<0.001	−0.007 (−0.01 to −0.002)	0.002	523	−2.77 (−3.81 to −1.73)	<0.001	−0.14 (−0.20 to −0.08)	<0.001

For CIDS, the CIDS1 was completed by participants using insulin and CIDS2 by those not using insulin. For DSAS, the DSAS-1 was completed by participants with type 1 diabetes and DSAS-2 by those with type 2 diabetes. diff, difference. *Models adjusted for age, gender, duration of diabetes, and number of diabetes-related complications.

diabetes stigma and anxiety symptoms among adults with type 2 diabetes. Similarly, social support has been identified as a potential buffer of stigma among adults with HIV/AIDS (15,29,34). In particular, familial support is cited as a critical factor in overcoming HIV-related stigma, though this has not yet been investigated among diabetes populations (29). Further research is needed to examine the role of familial support in reducing the impact of diabetes stigma. The current study provides no evidence to suggest that diabetes-specific self-efficacy is a potential buffer of the impact of diabetes stigma on emotional well-being. However, this is perhaps unsurprising. We expect diabetes-specific self-efficacy to mitigate the association between stigma and self-care behaviors, rather than psychological outcomes, but we did not investigate this due to the lack of meaningful associations in the current study between diabetes stigma and self-care behaviors. Further research in this area is warranted.

The evidence for these moderators is suggestive that the previously hypothesized mitigating strategies of diabetes stigma, which largely focus on external intervention (e.g., education, counseling, social marketing, and social support) (3,11), may be useful in countering the impact of diabetes stigma. Diabetes-specific peer support and social support in general have been found to be associated with greater emotional well-being among adults with diabetes (35,36), and peer support interventions have been shown to have positive effects on diabetes distress (36,37). Future intervention studies may provide evidence for the role of peer support, and psychological therapies, in reducing the impact of diabetes stigma via improving social support and self-esteem.

Adults with insulin-treated type 2 diabetes report a qualitatively different and greater experience of diabetes stigma compared with those with non–insulin-treated type 2 diabetes (2,3,6). Interestingly, the hypothesized moderators examined were largely unsupported for participants with insulin-treated type 2 diabetes, with the exception of self-esteem on diabetes distress. We propose that, for this group, insulin injections are a major source of perceived and experienced external stigma and self-blame (38). Indeed, people with type 2 diabetes report self-blame and perceived failure associated with insulin initiation and feeling judged by others as "sicker" due to their insulin treatment (31,39). Furthermore, concerns about public perceptions when needing to inject are common and may lead to delayed insulin administration (2,6,12). Potential buffers of the effects of diabetes stigma for those with insulin-treated type 2 diabetes may instead include those that specifically target public perceptions of insulin use and dispel myths (e.g., social marketing, diabetes education, counseling).

A detailed description of the strengths and limitations of the MILES-2 cross-sectional survey has previously been published (17), including for the self-selected sample. While the MILES-2 sample was broadly representative in terms of gender and place of residence (metro vs. regional/rural; Australian state/territories) and included people of a broad age range and background (e.g., place of birth), it also included a greater proportion of English-speaking, employed, and highly educated Australians relative to the general population (17). The current subanalysis of the MILES-2 study offered a uniquely comprehensive assessment of the psychological, behavioral, clinical correlates, and potential moderators of diabetes stigma using validated questionnaires, split by diabetes type/treatment. However, potentially important outcome measures were not assessed. For example, MILES-2 did not include other relevant behavioral outcomes such as medication taking (3,11). Furthermore, our data on self-reported HbA_{1c} were limited in terms of timing of assessment and raise questions about accuracy of recall (40). Future research needs to further examine the behavioral and clinical correlates of diabetes stigma using valid, and potentially more relevant and sensitive, assessments, including objective data. Finally, the current study is exploratory, limited by its cross-sectional nature and the use of linear regression, which is sensitive to influential observations and outliers. While our findings offer further support for the hypothesized consequences of diabetes stigma (3,11), no firm conclusions can be drawn with regard to causality or the direction of the observed relationships. It is possible that those experiencing impaired emotional well-being, for example, are more susceptible to self-blame and perceive greater diabetes stigma due to repetitive negative thinking symptomology. Regardless, the current study provides preliminary evidence for those outcomes worthy of further investigation in prospective and interventional studies.

Consistent with the hypothesized consequences of diabetes stigma outlined in the diabetes stigma framework (3,11), this current large-scale, cross-sectional study demonstrates an association between greater perceived and/or experienced diabetes stigma and the experience of impaired general and diabetes-specific emotional well-being among adults with type 1 and type 2 diabetes. Notwithstanding the limitations of cross-sectional research, it is suggestive of the potential negative psychological impact of diabetes stigma, corroborating previous qualitative research and studies that have been limited by single-item assessment (1–6). This study also provides novel preliminary evidence for the moderating effect of self-esteem and, to a lesser extent, social support on the psychological impact of diabetes stigma. Therefore, while efforts need to be made to reduce the occurrence of diabetes stigma in the future (e.g., via social marketing campaigns that dispel myths about diabetes), the evidence presented here suggests that interventions to mitigate the effects of existing diabetes stigma may be warranted.

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