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The social context of the relationship between glycemic control and depressive symptoms in type 2 diabetes

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Abstract

Objective: Individuals with type 2 diabetes and depressive symptoms have poorer diabetes outcomes than those with diabetes alone, and there is need for improved understanding of the relationship between illness markers and depressive symptoms. The role of social support is well established; less is known about *social comparisons* (i.e. comparisons to others in the social environment), which are common and influential in chronic illness. The present study examined the mediating effects of social comparison and social support on the relationship between glycemic control and depressive symptoms.

Method and outcome measures: Participants with physician-diagnosed type 2 diabetes ($N = 185$) completed an electronic survey about recent depressive symptoms, glycemic control (Hb_{A1c}), perceived social support, and social comparison.

Results: Controlling for relevant covariates, social comparison and social support showed independent statistical mediation of the relationship between glycemic control and depressive symptoms ($ps < 0.05$). Path analysis also showed that including indirect pathways through social comparison and social support reduced the relationship between glycemic control and depressive symptoms to nonsignificance ($\beta = 0.10$, $p = 0.14$).

Conclusion: These findings demonstrate that social comparison plays a role in the relationship between diabetes regulation and depression, independent of social support. Greater attention to this aspect of the social environment may render better diabetes outcomes.

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The global burden of diabetes and depression

Type 2 diabetes currently afflicts over 334 million people worldwide,[1] and moderate to severe depressive symptoms are present in up to half of patients assessed.[2] Patients with depressive symptoms tend to exhibit poorer quality of life, worse diabetes management and medical outcomes, and greater all-cause mortality than those with diabetes alone.[3–9] Available evidence also suggests a causal relationship between diabetes symptomatology and incident depressive symptoms, or "diabetes distress." Distress may result from the diagnosis of diabetes, difficult lifestyle changes, and continuous threat to longevity, among other negative medical and psychosocial consequences of the disease.[10] Depressive symptoms that are not directly related to diabetes itself also may be exacerbated by the disease process.

Interventions for diabetes have focused on increasing patient medical knowledge and enhancing individual motivation for difficult self-care behaviors.[11,12] Although these efforts have been modestly effective, millions of individuals with type 2 diabetes continue to struggle with depressive symptoms.[10,13] Emerging evidence demonstrates that the social environment exerts powerful effects on health behaviors, such as food consumption[14,15] and physical activity,[16,17] health status (e.g. obesity[18]), and overall affect.[19] As a result, increasing attention is directed to features of the social environment associated with depressive symptoms among individuals with type 2 diabetes.

The social context of diabetes

Much of the existing empirical work relevant to social influences in diabetes has focused on the role of social support. For instance, assistance with food shopping, meal planning, or medication adherence can facilitate self-care, and positive emotional support can reduce barriers to engagement in healthy behaviors.[20] Lack of support, in contrast, is associated with poor self-care.[21] Social support also has been shown to mediate the relationship between diabetes-related impairment and depressive symptoms.[22,23]

Although social support is known to affect the diabetes–depression relationship, there is more to understand about the broader social context of diabetes.[24] *Social comparisons,* or self-evaluations relative to others, represent a key source of information about one's health status and potential self-care behaviors.[25] For example, patients with chronic illnesses encounter others in the social environment (e.g. peers, family members, media figures[26,27]) and may perceive these others as "doing better" or "doing worse" than themselves.

In chronic illness groups, a greater tendency toward social comparison has been associated with more severe depressive symptoms and worse self-rated health.[28] However, these conclusions have been drawn mainly from studies of cancer, cardiovascular disease, and rheumatoid arthritis.[29] Type 2 diabetes is unique in its intensive—and often, long-term—self-management burden,[30] and few studies of social comparison have focused specifically on the experiences of patients with diabetes. Existing findings suggest that comparisons are common among

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individuals with diabetes[31] and can influence motivation for diabetes self-care.[32,33]

Study aims and hypotheses

The presence of an illness such as diabetes may increase social comparison activity, which is associated with depressive symptoms in illness groups. Consequently, an improved understanding of the role of comparisons—independent of the role of social support—may elucidate processes that maintain depression among individuals with diabetes. To our knowledge, these relationships have not been explored in previous research. The present study was designed as a preliminary evaluation of the mediating effect of social comparison, as separate from the known mediating effect of social support, on the relationship between glycemic control and depressive symptoms.

Both social comparison and social support were expected to mediate the relationship between glycemic control and depressive symptoms, representing two distinct pathways from illness severity to depression (see Figure 1). We tested the direct pathway from glycemic control (Hb_{A1c}) to depressive symptoms (represented as path A) and the independent explanatory value of social support (path B and C) and social comparison (path D and E). We expected that the direct relationship between Hb_{A1c} and depressive symptoms (path A) would be weakened by the inclusion of social support and social comparison as indirect paths. In exploratory analyses, we also examined the relationship between social support and social comparison, and contrasted the mediational effects of social support and social comparison.

Method

Participants and procedure

Individuals with type 2 diabetes were recruited to participate in an online assessment of diabetes experiences, depression, and social behavior. Inclusion criteria required that participants be at least 25 years old, fluent in English, have a physician diagnosis of type 2 diabetes, and able to report their most recent Hb_{A1c} levels (i.e. assessed within the past 6 months). A total of 185 individuals met these criteria and completed the study. On average, participant age was 49 years ($SD = 10.47$), and time since diabetes diagnosis was 4.35 years ($SD = 4.59$). Mean body mass index (BMI) for the sample was 28.59 ($SD = 7.53$) kg/m^2. Most participants were male (55%), Caucasian (87%), and married (74%). Most participants (92%) also indicated that they resided in the United States at the time of participation. The remainder

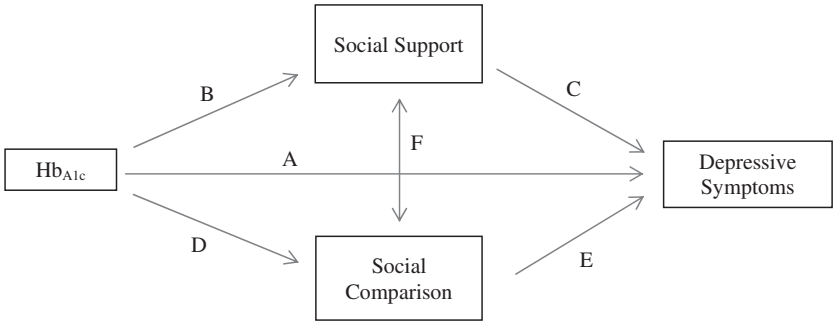

Figure 1. Path model demonstrating the influence of social comparison and social support on the relationship between glycemic control and depressive symptoms. Covariates included were age, BMI, income, and time since type 2 diabetes diagnosis. $t < 0.10$, $*p < 0.05$, $**p < 0.01$.

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(8%) comprised English-speaking individuals from other geographic regions, including Canada, Europe, Southeast Asia, and the Middle East.

All procedures were approved by the Institutional Review Board at the supporting university. Recruitment posts appeared on diabetes-specific websites and directed interested individuals to a web-based, electronic portal to complete a one-time assessment of their illness characteristics, mood, and social experiences. Those who visited the portal were asked to provide informed consent before completing the validated self-report measures (detailed below). Participants received a $5 discount coupon to Amazon.com as compensation. All recruitment and data collection procedures were conducted between June 2010 and September 2011.

Measures

Demographics and illness characteristics. Participants reported demographic information (e.g. age, gender, ethnicity), time since type 2 diagnosis, and their most recent Hb_{A1c} level. Hb_{A1c} reflects the average level of blood glucose over a period of 2–4 months. Hb_{A1c} is widely considered a good indicator of glycemic control and is routinely assessed every 3–6 months.[34] Higher Hb_{A1c} denotes worse glycemic control; standard treatment recommendations include the reduction of Hb_{A1c} to 7% (8.6 mmol/l) or lower.

Iowa-Netherlands Comparison Orientation Measure (IN-COM). A 23-item questionnaire that evaluates engagement in social comparison activity. Items related to one's tendency to make comparisons are rated on a scale ranging from 1 (strongly disagree) to 5 (strongly agree). Test–retest reliability of the IN-COM declines from 0.71 over 3–4 weeks to 0.60 over 1 year, reflecting that one's tendency to make comparisons changes with context.[35] Thus, this measure best captures comparisons made over the past month. Cronbach's alphas for this measure have ranged from 0.78 to 0.85 across two previous samples, indicating good internal consistency. Alpha for the present sample was 0.80.

Social Support Appraisals Scale. This 23-item inventory assesses perceived social support from close others. Items are rated on a scale of 1 (strongly disagree) to 4 (strongly agree); summary scores are computed for total perceived social support, perceived support from family, and perceived support from friends. Previous validation studies have shown high internal consistency for all three scales ($\alpha = 0.90$ for total score; $\alpha = 0.81$ for family; $\alpha = 0.84$ for friends).[36] Cronbach's alphas in the present study were 0.93 (total score), 0.85 (family), and 0.86 (friends). Although test–retest coefficients are not available for this scale, similar scales have shown modest stability over 2 months (e.g. 0.75–0.80[37]), are known to be influenced by recent mood,[38] and have been used as mediators in various models of health.[39,40]

Center for Epidemiological Studies-Depression scale (CES-D). The CES-D is one of the most commonly used self-report inventories for depressive symptoms.[41] It includes 20 items related to individual depressive symptoms, as experienced over the past 4 weeks. Items are rated on a scale of 0 (not at all) to 4 (very much), with higher scores indicating more severe symptoms. This measure has shown excellent psychometric properties in both healthy and chronic illness samples.[42] Alpha for the present study was 0.93.

Data analysis plan

All analyses were conducted using SAS Version 9.3. Of the demographic characteristics assessed, age, BMI, income, and time

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since diabetes diagnosis were associated with at least one key variable and were therefore included in analyses as covariates.

Descriptive statistics and bivariate correlations. The frequency of social comparisons rarely has been quantified among individuals with type 2 diabetes. To provide this background information, descriptive statistics and bivariate correlations between social comparison and other key variables (i.e. depressive symptoms, glycemic control, and social support) are presented.

Multiple mediation with path analysis. Initially, support for statistical mediation effects was evaluated with separate models for social support and social comparison. Mediation was tested using Bootstrap estimates from 1000 resamples.[43] Social support and social comparison then were included in a simple path analysis. Chi-square and root mean square error of approximation (RMSEA) estimates were used to determine model fit. Bootstrap estimates from 1000 resamples were included as indicators of the indirect effects of social support and social comparison in a multiple mediator model.[43] This approach has been documented in previous studies of multiple mediation in chronic illness groups.[44]

Results

Glycemic control and depressive symptoms

Descriptive statistics for variables of interest are presented in Table 1, and bivariate correlations are presented in Table 2. On average, participants endorsed moderate to severe depressive symptoms ($M = 24.95$, $SD = 9.66$); this mean is similar to

Table 1. Descriptive statistics for covariates, diabetes characteristics, and social experiences.

	N	%		
Household income				
<$20,000 per year	19	9		
$00,000–$39,999	17	8		
$40,000–$59,999	25	12		
$60,000–$79,999	36	17		
$80,000–$99,999	25	12		
>$100,000 per year	90	42		
	M	SD	Minimum	Maximum
Age	49.08	11.04	25	78
Time since diabetes diagnosis (years)	4.35	4.59	<1	39
BMI	28.59	7.53	18.54	50.29
Hb_{A1c}	7.89	1.69	4.90	14.70
Depressive symptoms	24.95	9.66	7.00	52.00
Perceived social support total	68.70	9.29	97.00	92.00
Perceived social support—family	24.35	3.96	11.00	32.00
Perceived social support—friends	20.66	3.35	8.00	28.00
Social comparison	35.08	6.28	15.00	52.00

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Table 2. Correlation coefficients for relationships between diabetes characteristics, mood, and social experiences.

	DS	PSS total	PSS family	PSS friends	SC
Hb_{A1c}	0.19*	−0.23**	−0.25**	−0.17*	0.09^{t}
Depressive symptoms	–	−0.46***	−0.45***	−0.34***	0.28**
Perceived social support total		–	0.89***	0.87***	−0.18*
Perceived social support—family			–	0.63***	−0.19**
Perceived social support—friends				–	−0.10

$^{t}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$
DS: depressive symptoms; PSS: perceived social support; SC: social comparison.

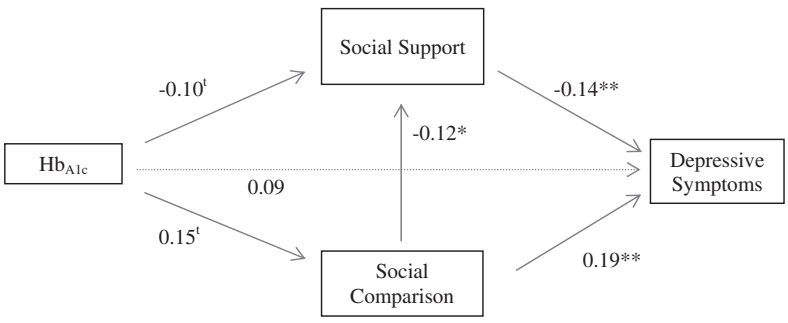

Figure 2. Proposed model describing the paths from glycemic control to depressive symptoms through social comparison and social support.

published scores in diabetes samples.[45] In contrast, mean Hb_{A1c} level was 7.89% ($SD = 1.75$; 11 mmol/l), suggesting moderately good glycemic control. Hb_{A1c} was positively associated with depressive symptoms ($r = 0.19$, $p = 0.02$). Participants perceived relatively high social support (overall $M = 68.70$ out of 92, $SD = 9.29$). Mean scores for social support were somewhat higher than estimates in other patient samples[46] and comparable to those from samples of individuals in recovery from major depressive disorder.[47] Participants also endorsed moderate levels of social comparison ($M = 35.08$ out of 55, $SD = 6.28$) that were slightly higher than estimates in samples of individuals with cancer.[35] To our knowledge, estimates for social comparison norms from diabetes samples are not available.

Simple mediation

A Sobel test confirmed that social support significantly statistically mediated the relationship between Hb_{A1c} and depressive symptoms ($p = 0.04$). A second Sobel test demonstrated that social comparison also significantly statistically mediated the relationship between Hb_{A1c} and depressive symptoms ($p = 0.03$).

Multiple mediation

The proposed model demonstrated optimal fit ($\chi^2 = 0.00$, $p < 0.001$;

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$RMSEA = 0.01$; see Figure 2). Participants with higher Hb_{A1c} levels showed trends toward less social support (path B: $\beta = -0.11$, $p = 0.09$) and more frequent comparisons (path D: $\beta = 0.15$, $p = 0.06$) than those with less severe depressive symptoms. Participants with higher Hb_{A1c} levels and more frequent comparisons also reported more severe depressive symptoms (path E: $\beta = 0.24$, $p = 0.001$). Similarly, participants with higher Hb_{A1c} levels and less social support also reported more severe depressive symptoms (path C: $\beta = -0.37$, $p < 0.001$). The relationship between social influences was unidirectional (from social comparison to social support; path F $\beta = -0.12$, $p = 0.02$).

Both social support and social comparison emerged as statistically significant mediational pathways ($ps = 0.04$). A direct contrast between the mediating effects of social support and social comparison resulted in a 95% confidence interval that included 0 (CI = −0.08 to 0.07), indicating no significant difference between these effects. Although the overall model was statistically significant ($\beta = 0.18$, $p = 0.0$, $R^2 = 0.36$), the direct path from Hb_{A1c} to depression was no longer significant when both mediators were included in the model (path A: $\beta = 0.09$, $p = 0.14$).

Discussion

Individuals with type 2 diabetes often experience depressive symptoms that can impede their illness management and quality of life.[48] Previous work has documented the relationship between glucose dysregulation and depressive symptoms,[49] as well as the role of perceived social support in both diabetes outcomes[20,24] and depressive symptoms.[50] In contrast, little is known about the influence of related aspects of social dynamics, including social comparison. In the present study, we expected that social comparison would play a key role in the relationship between glycemic control and depression for individuals with type 2 diabetes, such that adding this construct to explanatory models would provide a more complete understanding of the relationships among glycemic control, social support, and depression.

Findings from the present study are consistent with this hypothesis and provide a framework for future research to extend these novel findings. Of note, these findings are based on reports from a subset of the broader population of individuals with diabetes (i.e. primarily affluent Caucasians who use the internet). As predicted, the extent to which individuals in the present study compared themselves with others was associated with both glycemic control (Hb_{A1c}) and depressive symptoms. These findings align with evidence from samples of patients with cancer (i.e. greater comparison associated with worse depression and medical markers[28,51]). The present findings also augment previous work by demonstrating that comparisons statistically mediate the relationship between Hb_{A1c} and depressive symptoms. Thus, regardless of perceived social support, more (vs. less) engagement in social comparison is associated with increased depression among type 2 diabetes patients. The relationship between social comparison and poor health outcomes has been shown in other illnesses[52,53]; the present study extends this relationship to a sample of individuals with type 2 diabetes and suggests that social comparisons may serve to maintain depressive symptoms in this patient group.

The observed inverse (and unidirectional) association between social comparison and perceived social support raises several possibilities. For example, comparisons to others (with or without diabetes) may be made on the basis of social support. Thus, some patients may perceive others as having relatively greater support, leading them to rate their own social support as low.

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This explanation is consistent with previous work in both the general population (e.g. Mussweiler et al.[54]) and patients with chronic illness.[27] Another potential explanation for the finding is that the frequency with which some individuals engage in social comparisons negatively affects their social behaviors and is correlated with a loss in social support.

Social support figures also may serve as primary comparison targets. Patients with rheumatoid arthritis report using close others who are healthy as models for desired levels of functioning[55]; similar processes may be operating in patients with diabetes. *Identification* with healthy social support figures (i.e. individuals perceived as "better off" than the self, or upward targets) may provide inspiration or instruction, whereas *contrast* against these individuals could increase patient awareness of the limitations or burden of their illness (e.g. "my sister can eat whatever she wants, but I have to be so restrictive"[56]). To our knowledge, there has been little direct investigation of social comparisons with social support figures among patients with type 2 diabetes. The present findings suggest that such work could improve upon our current understanding of barriers to chronic illness self-management.

Practice implications

Opportunities to engage in social comparison are ubiquitous (e.g. friends and family members, other patients in clinics or doctors' offices), and comparisons serve as a key source of information for individuals with type 2 diabetes.[31,57] Comparisons that result in negative self-perceptions (and consequent negative affect) could intensify or maintain overall depressed mood.[58] The present findings serve as preliminary evidence to suggest that, for some patients, modifying one's response to comparisons might positively influence affect, social functioning, and thereby, physical health status. Existing intervention techniques, such as encouragement to focus on contrasting oneself against "worse off" others[59] and challenges to one's negative interpretations of a comparison (e.g., cognitive restructuring[60]), may be particularly useful for diabetes educators, nurses, psychologists, and others who provide psychosocial intervention. Future work that applies such approaches to type 2 diabetes and other chronic illnesses could improve the effectiveness of existing interventions.

Strengths, limitations, and future directions

Primary strengths of this study include the use of path and multiple mediation models and a substantial sample size. The ratio of cases to path model parameters was 24:1, including covariates, which exceeds recommended thresholds for simple models.[61] Path analysis allows for tests of directional relationships; in the present study, this advantage allowed for specification of the relationships of interest. The use of validated instruments to assess primary psychosocial constructs, including social comparison, social support, and depression, represents an additional strength. These methods may be easily replicated in future research. Finally, the geographic heterogeneity of the sample (participants were from eight different countries and numerous locations within the United States) enhances the generalizability of the present findings.

The present study is limited by self-selection and self-report biases. As noted, participants were primarily Caucasian and affluent, and thus do not represent the broader population of individuals with type 2 diabetes.[1] For example, the prevalence and incidence of diabetes,[62] as well as the clinical presentation of depression,[63] differ among racial and ethnic groups. Accordingly, it is possible that relationships

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among glycemic control, social perceptions, and depressive symptoms function differently in minority groups (or other samples not captured in this study). This work thus presents only the first step in extending our understanding of the role of social factors in type 2 diabetes. Future work should examine the generalizability of these findings to minority and other samples, and explore the potential role of social factors and/or processes in understanding health disparities.

In addition, as all data were collected at a single point in time, it is not possible to make confident temporal nor causal inferences, although the data are consistent with some such interpretations. Alternative explanations for the observed statistical patterns cannot be ruled out. For instance, it is possible that social comparison confounds the relationship between glycemic control and depressive symptoms, rather than mediates it. The primary predictor (Hb_{A1c}) also was patient reported and not corroborated in the lab/clinic. Although efforts were made to capture Hb_{A1c} within the past 6 months, there was heterogeneity in the timing of participants' most recent Hb_{A1c} tests. As a result, these data must, of course, be interpreted with caution, and there is need to replicate the present findings using objective and longitudinal methods. Finally, reports of recent diabetes self-care behaviors (e.g. frequency of self-monitoring, exercise, diet) were not collected. Reports of these behaviors may be a useful addition to the proposed model. These limitations notwithstanding, findings from this study provide evidence to support future work that could employ objective, temporally sensitive assessment of glycemic control.

Conclusions

Individuals with type 2 diabetes respond to various aspects of their social environments. This study demonstrates that, in addition to the potential adverse influence of low perceived social support, frequent engagement in social comparison represents an important pathway between glycemic control and depressive symptoms. In addition, this study found evidence of a significant pathway between social comparison and perceived social support, providing further justification for the inclusion of social comparison in frameworks for understanding the social context of diabetes. Future research should replicate and extend these findings, with the ultimate goal of improving future treatment efforts for those with type 2 diabetes.

Declaration of Conflicting Interests

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