Diabetes Distress, Intentional Hyperglycemia at Work, and Glycemic Control Among Workers With Type 1 Diabetes

Ulla M. Hansen,[1,2] Timothy Skinner,[3] Kasper Olesen,[1] and Ingrid Willaing[1]

Diabetes Care 2019;42:797–803 | https://doi.org/10.2337/dc18-1426

OBJECTIVE

The aim was to explore relationships between work-related factors, work-related diabetes distress (WRDD), diabetes distress (measured by Problem Areas in Diabetes [PAID]-5 scale), intentional hyperglycemia at work (IHW), and glycemic control.

RESEARCH DESIGN AND METHODS

A cross-sectional survey was conducted with 1,030 working adults with type 1 diabetes and linked with electronic health record data from a specialist diabetes clinic in Denmark. With use of structural equation modeling, two alternative models were compared, based on fit indices, statistical significance, and theoretical meaningfulness.

RESULTS

A combined model provided the best fit to the data. WRDD was more strongly affected by work ability, opportunity to self-manage at work, being treated differently, and job demands. PAID-5 was more strongly affected by identity concern and blame and judgment. Both PAID-5 and WRDD were associated with more frequent IHW, which was associated in turn with worse glycemic control.

CONCLUSIONS

Work-related factors are associated with WRDD and PAID-5. Distress increases the frequency of IHW, which is, in turn, associated with worse glycemic control. Future studies should investigate ways to balance diabetes management and work life without compromising diabetes care.

For individuals with type 1 diabetes, work life, in general, unfolds differently compared with work life for the general population; diabetes negatively affects employment status and earnings (1) and is associated with more sick leave and decreased health-related quality of life (2). Although no clear link has been demonstrated, it has been hypothesized that the daily burden of disease management negatively affects work life opportunities and choices (1). Considerable evidence from qualitative studies highlights contextual factors influencing the illness perceptions and self-care practices of people with type 1 diabetes in work life (3,4), but evidence from population-based studies is sparse (5).

Diabetes distress is considered one of the most important psychosocial concerns among adults with type 1 diabetes (6–8). Diabetes distress reflects an emotional response to specific stressors in the context of a demanding health-related condition

[1]Diabetes Management Research, Steno Diabetes Center Copenhagen, Gentofte, Denmark
[2]National Institute of Public Health, University of Southern Denmark, Copenhagen, Denmark
[3]Department of Psychology, University of Copenhagen, Copenhagen, Denmark

Corresponding author: Ingrid Willaing, ingrid.willaing.tapager@regionh.dk

Received 4 July 2018 and accepted 21 January 2019

This article contains Supplementary Data online at http://care.diabetesjournals.org/lookup/suppl/doi:10.2337/dc18-1426/-/DC1.

(9). Distress symptoms should not be considered separately from the diabetes-relevant issues prompting them; context is crucial for explaining the link between disease and emotional distress (10). It has been suggested that the stress associated with reconciling work and diabetes management is a significant potential source of diabetes distress that has not yet been accounted for (11).

In 2016, a study introduced the concept of work-related diabetes distress (WRDD), reporting its association with glycemic control in Finnish workers with type 1 diabetes (5). Unfortunately, the construct used to measure WRDD did not allow direct comparison with any validated measures of diabetes distress. Consequently, Hansen et al. (12) adapted WRDD to the format of the widely used Problem Areas in Diabetes (PAID)-5 scale (13) and established the relevance of WRDD, as distinct from diabetes distress, for assessing the perceived burden of reconciling work life and type 1 diabetes (12). Diabetes distress attributable to work life reflects the burden of managing a demanding self-care regimen in the context of issues of work identity and deviance, as well as more mundane concerns about when, where, and how to self-manage at work, job demands, and work ability.

Managing blood glucose levels at medically recommended targets is known to prevent or postpone complications (14,15) but may increase the risk of hypoglycemia (16). Managing blood glucose is a delicate balancing act for people with type 1 diabetes; it fluctuates in response to both well-known sources of variation—insulin, exercise, and diet—and less direct and measurable stimuli such as emotional and hormonal conditions and work patterns (17). Intentionally running blood glucose levels higher than recommended is a coping strategy used by patients with diabetes to avoid hypoglycemia or fear of hypoglycemia (3,16). This "strategic non-compliance" (18) may be particularly relevant in work life, where job-related stress and demands may compete with diabetes self-management tasks. The need to avoid letting diabetes interfere with workplace productivity may lead to management choices aimed at preventing hypoglycemia (9,19). The choice to maintain higher-than-recommended blood glucose levels while working may be critical to understanding the link between distress and glycemic control among working people with type 1 diabetes (5).

This study aimed to clarify patterns of relationships between work-related factors and diabetes outcomes. More specifically, we hypothesized that experiences and perceptions of diabetes stigma, challenges in self-managing diabetes at work, poor work ability, and high job demands would constitute sources of diabetes distress affecting self-care and, in turn, glycemic control. The hypothesis was based on *1*) a theoretical framework presenting a tension between the logic of the worker and the logic of the patient that may lead to emotional distress and problematic self-care behaviors in work life (20) and *2*) the extensive diabetes distress literature, where diabetes distress reflects an emotional response to specific stressors in the context of a demanding health-related condition (11,21).

Informed by previous analyses (12), we distinguished between generic diabetes distress, as measured with PAID-5 (22), and WRDD (5) to clarify whether and how WRDD adds to the psychosocial burden of type 1 diabetes experienced by working adults.

RESEARCH DESIGN AND METHODS

We conducted a cross-sectional survey using self-report measures linked with electronic health record data. The study was registered with the Danish Data Protection Agency (j.nr. SDC-2015–033 DiA/I-Suite nr. 03813).

Participant Recruitment and Data Collection

A population consisting of 3,053 adults with type 1 diabetes was identified through the electronic health records at a specialist diabetes clinic in Denmark. Individuals were included if they had a diagnosis of type 1 diabetes, were 18–70 years of age, and were receiving treatment at the clinic at the time of the study. Informed by the literature, a questionnaire was designed to inquire broadly about diabetes and work life. The draft questionnaire was reviewed by multidisciplinary experts in diabetology, diabetes psychology, patient advocacy, and public health and tested for clarity and relevance by 13 adults with type 1 diabetes from the target group. Data collection via online survey occurred over a 12-week period in the last quarter of 2016. Two reminders were sent to nonrespondents after ~3 and 6 weeks. The last reminder included a paper version of the questionnaire and a prepaid return envelope. Participants provided consent by responding to the questionnaire.

Measures

The following measures were included in the survey (for item details see Supplementary Table 1).

Diabetes Distress

Diabetes distress was measured with the PAID-5 scale, a validated and reliable short form of the full 20-item PAID scale, with which it correlates ($r = 0.92$) (13,22). A sum score was calculated. PAID-5 demonstrated good internal consistency in this study (Cronbach α = 0.91). Higher scores indicated higher diabetes distress.

WRDD

WRDD was measured by two validated questions about worry and exhaustion related to reconciling diabetes and work life (5,12). A sum score was calculated. WRDD demonstrated good internal consistency in this study (Cronbach $\alpha = 0.81$). Higher scores indicated higher WRDD.

Intentional Hyperglycemia at Work

We assessed intentional hyperglycemia at work (IHW) with a single item. Respondents were asked to rate how often they intentionally maintained a high blood glucose level at work, using a 5-point Likert scale from "never" to "always." This measure has been validated in a previous survey among the adult working population with type 1 diabetes (5) and through qualitative research (3). Higher scores indicate more frequent IHW.

Opportunity to Self-Manage Type 1 Diabetes at Work

To account for the extent to which respondents' work environments accommodated diabetes management, we included a four-item scale of opportunities to self-manage. Using a 4-point Likert scale from "very easy" to "very difficult" (no midpoint), respondents were asked to rate how easy it was to perform the following self-management tasks in their workplace: blood glucose monitoring, eating snacks, insulin injections, and eating meals (23,24). A sum score was calculated, with higher scores

indicating more difficulty self-managing diabetes at work. The scale demonstrated good internal consistency (Cronbach α = 0.88).

Work Ability

The Work Ability Score (WAS) asks respondents to compare their current work ability with their lifetime best on a scale of 0 ("completely unable to work") to 10 ("work ability at its best"). WAS is the first item of the widely used Work Ability Index (25,26). WAS and Work Ability Index both predict stress, general and mental health, and sick leaves (27), and WAS is associated with WRDD (5). Higher scores indicate better work ability.

Job Demands

Job demands were assessed with four questions from the validated Job Content Questionnaire (JCQ) (28). Respondents were asked to rate specific job requirements using a 5-point Likert scale from "fully agree" to "fully disagree." The full scale with 49 questions was out of scope for our study, and we therefore opted to use five items from JCQ, in line with Hakkarainen et al. (5), to measure psychological job demands. When pilot testing the Danish questionnaire, consistently perceived redundancy made us omit one of the items. A sum score was calculated, with higher scores indicating greater job demands. The scale demonstrated good internal consistency (Cronbach α = 0.74). Job demands are a risk factor for psychological distress and are moderately associated with WRDD and poor work ability (5,29).

Diabetes Stigma

Diabetes stigma was measured with the newly translated and validated Danish version of the Type 1 Diabetes Stigma Assessment Scale (30,31). It consists of 19 items in three subscales assessing distinct aspects of diabetes stigma: being treated differently (e.g., "Some people see me as a lesser person because I have type 1 diabetes"); blame and judgment (e.g., "Because I have type 1 diabetes, some people judge me if I eat sugary food or drinks [e.g., cakes, lollies, soft drinks]"); and identity concerns (e.g., "To avoid negative reactions, I don't tell people I have type 1 diabetes"). Each item was scored on a 5-point Likert scale, from "strongly disagree" to "strongly agree." We used the subscale scores, with higher scores indicating more perceived or experienced diabetes stigma. All subscales demonstrated good internal consistency (Cronbach α = 0.85 for all). Diabetes stigma is relevant in the context of work life and may result in emotional distress (30–32).

Glycemic Control

Glycemic control was assessed by glycosylated hemoglobin (HbA_{1c}). Higher values are associated with increased risk of micro- and macrovascular complications (33). The most recent HbA_{1c} recorded before data collection ended in December 2016 was obtained from electronic health records at the specialist diabetes clinic. The mean (SD) number of months between the most recent HbA_{1c} test and survey invitation was 2.8 (3.7). Most people (92%) had a maximum of 6 months between the most recent HbA_{1c} test and survey invitation.

Data on age, albumin-to-creatinine ratio (ACR), diabetes duration, complication status, and sex were also obtained from clinic electronic health records.

Cases with any missing or invalid data were excluded prior to analyses.

Statistical Analysis

Structural equation modeling is a general statistical modeling technique that allows for representing, estimating, and testing a network of relationships between variables (34). In structural equation modeling, unlike regression analysis, no clear distinction between dependent and independent variables exists; a dependent variable in one part of the model can become an independent variable in another part.

We used structural equation modeling because it provides an appropriate inference framework for mediation analyses, in which the effect of one variable on another is transmitted via an intervening variable (35). In full mediation, the direct effect of predictors on dependent variables will not be significant in the presence of a mediator, but the indirect effect through the mediator will be significant.

Using path analysis, a special case of structural equation modeling, we modeled hypothesized relationships among work-related factors WRDD, PAID-5, IHW, and glycemic control, comparing a mediation model with a direct model to avoid confirmation bias (36). Informed by the diabetes distress literature (7,10,11) and the qualitative insights (3,4), the mediation model posits that the effect of work-related factors on IHW is mediated through WRDD and diabetes distress; the direct model posits that work-related factors, WRDD, and diabetes distress exert a direct influence on IHW. The directional specifications are not tested in structural equation modeling but, rather, are assumed. The overall fit of the models to the data is evaluated under this assumption (34).

The data conformed to a multivariate normal distribution, and we used maximum likelihood estimates to predict paths. Modification indices values of $<$10 were considered of little value to overall model fit (37). Path coefficients were evaluated based on direction and magnitude and interpreted as weak ($<$0.10), moderate (0.10–0.50), or strong ($>$0.50) (37). We removed nonsignificant paths from the model and allowed minor theoretically justifiable modifications in pathways. Model fit was evaluated with GFI (goodness-of-fit index), CFI (comparative fit index), and RMSEA (root mean square error of approximation). A GFI of $>$0.90 and $>$0.95, respectively, indicated good and excellent fit; a CFI of 0.9–0.95 and $>$0.95 indicated acceptable and good fit; and an RMSEA of $<$0.05 and $<$0.08 indicated excellent and good model fit (38). In addition to the model being a good fit to the data, individual paths in the model must be statistically significant and theoretically meaningful. We adhered to the parsimony principle in which the simplest of similar models is the better choice (34). In the final model, we reported standardized path coefficients (β) and the proportion of explained variance (R^2). Covariates were included in the model based on significant associations with the endogenous variables as assessed with Spearman correlation coefficients and Student *t* tests. Besides sex, age, and diabetes duration, we included ACR, which measures the amount of albumin escaping from the kidneys into the urine as a marker of disease severity.

All analyses were performed with SAS 9.4 and IBM SPSS AMOS 23.

RESULTS

Characteristics of the Population

A total of 1,594 individuals completed the survey, corresponding to a response rate of 52%. Of these, 1,126 were currently working. After exclusion of cases with missing data, the final population

consisted of 1,030 working adults with type 1 diabetes. Of these, 492 (48%) were women, the mean (SD) age was 46 (12) years, mean (SD) diabetes duration was 23 (14) years, and mean (SD) HbA_{1c} was 7.7% (3%) (60.8 [11] mmol/mol). A total of 485 (47.1%) participants had at least one complication of diabetes, and 190 (18.5%) used an insulin pump to manage their diabetes. Nearly a third of the population reported IHW, sometimes (230 [22.3%]), often (99 [9.6%]), or always (14 [1.4%]) maintaining high blood glucose levels at work. Another third reported doing so a few times (326 [31.7%]), and 351 (35.1%) reported never maintaining high blood glucose levels at work. Complete participant characteristics are available in Supplementary Table 2.

Bivariate Associations Among Key Variables

Work ability and opportunity to self-manage were associated with HbA_{1c} ($P < 0.001$), as were blame and judgment and being treated differently ($P < 0.05$). PAID-5 and WRDD were significantly associated, at $P < 0.001$, with IHW (0.34 and 0.33, respectively) and with HbA_{1c} (0.14 and 0.08, respectively), and IHW was associated with HbA_{1c} (0.28, $P < 0.001$). All pairwise correlations among key variables in the path model are available in Supplementary Table 3.

Test of Structural Models

Mediation Model

In the mediation model, the effect of work-related factors on IHW was transmitted through PAID-5 and WRDD. The effects of PAID-5 and WRDD on HbA_{1c} were transmitted, in turn, through IHW. Figure 1 depicts path coefficients. All paths from work-related factors to WRDD and PAID-5 were significant except the paths from being treated differently to PAID-5, blame and judgment to WRDD, and identity concern to WRDD.

Modification indices suggested that additional direct paths from opportunity to self-manage at work and identity concern to IHW would improve model fit.

Direct Model

We tested an alternative model with direct pathways from work-related factors, PAID-5, and WRDD to IHW. Figure 2 depicts path coefficients. Only opportunity to self-manage at work, identity concern, WRDD, and PAID-5 were directly linked with IHW, whereas the effects of job demands, blame and judgment, being treated differently, and work ability on IHW were transmitted through PAID-5 and WRDD.

The fit indices were marginally superior to those of the mediation model (Table 1). However, an additional consideration is theoretical meaning. Diabetes distress is an emotional reaction to specific stressors (9); it makes theoretical sense that WRDD and PAID-5 sit as mediators between work-related stressors and IHW.

Combined Model

We tested a third model by combining the mediation and direct models (Fig. 3).

Three paths from opportunity to self-manage at work, job demands, and being treated differently to PAID-5 were insignificant and deleted. Fit indices for the combined model were excellent and superior to the direct model on three of four indices (Table 1). In keeping with the conceptual model of diabetes distress, the effect of work-related factors on self-care, as measured by IHW, was primarily transmitted by PAID-5 and WRDD. In turn, IHW transmitted the effect of PAID-5 and WRDD to glycemic control.

In this final model, the effects of blame and judgment and work ability on IHW were mediated by both PAID-5 and WRDD (Fig. 3). The latter was more strongly affected by low work ability, whereas PAID-5 was more strongly affected by blame and judgment. Thus, people who experienced blame and judgment ($\beta = 0.14$ and $\beta = 0.11$) and had low work ability ($\beta = -0.09$ and $\beta = -0.38$) reported more diabetes distress and more WRDD, respectively. The effects of job demands and being treated differently on IHW were fully mediated by WRDD; people who

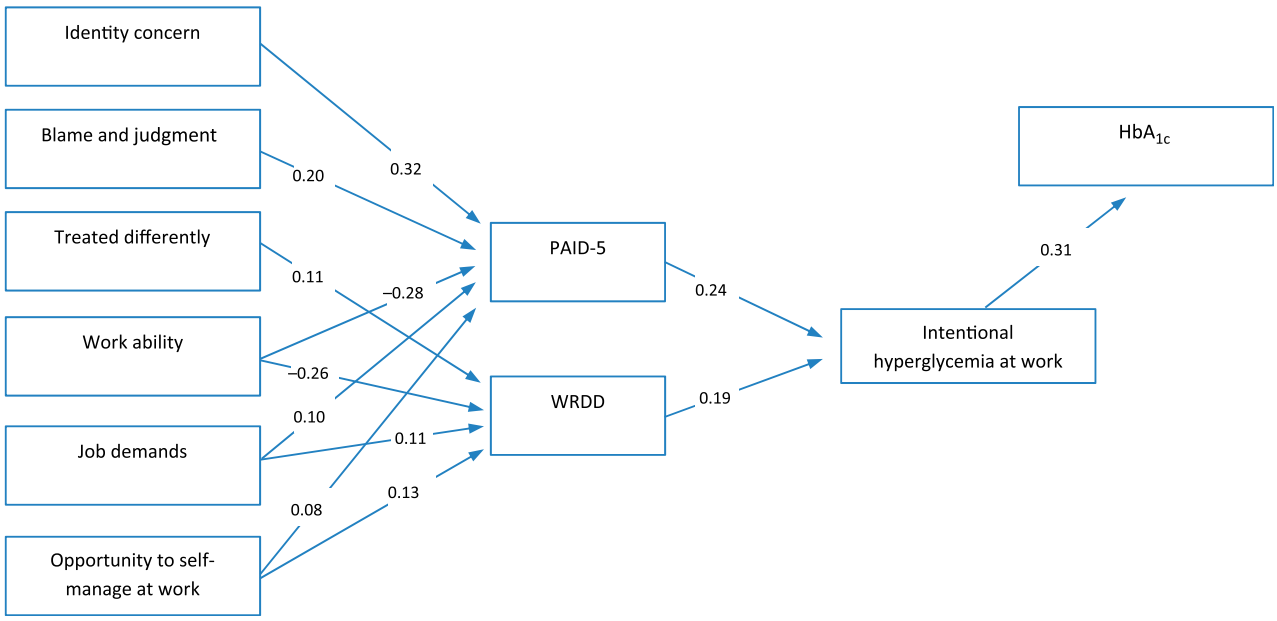

Figure 1—Test of mediation model.

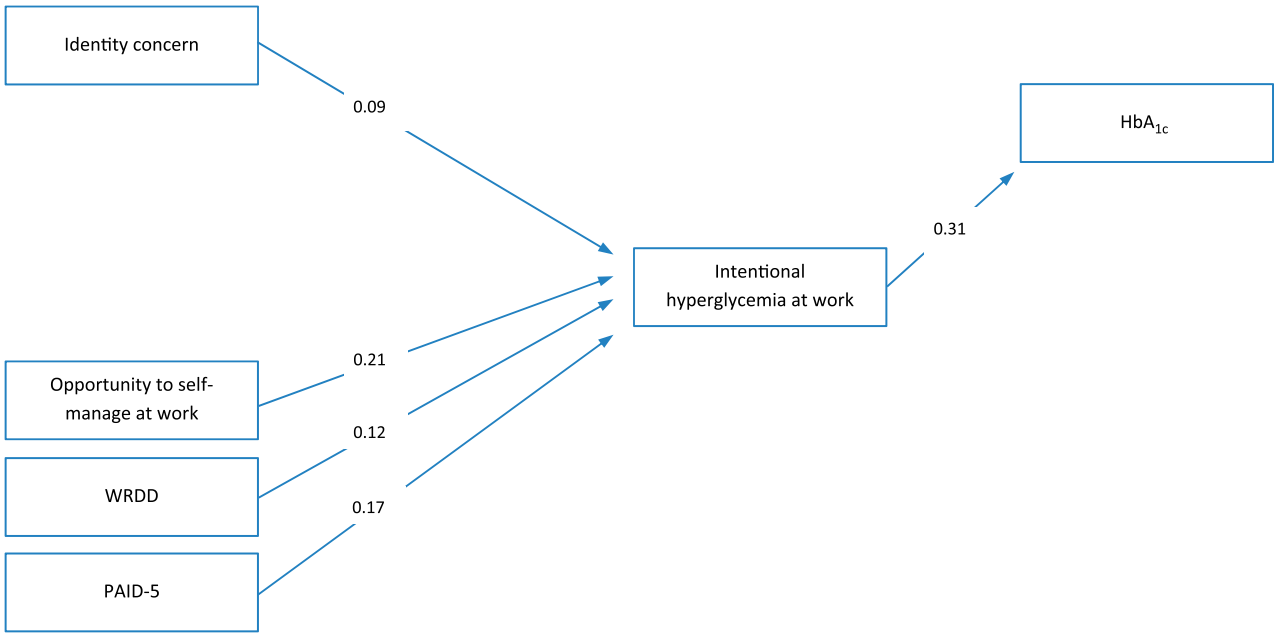

Figure 2—Test of direct model.

reported higher job demands (β = 0.15) and experienced being treated differently (β = 0.17) reported more WRDD.

The effect of identity concern on IHW was partly mediated by PAID-5 (β = 0.25), but a direct effect on IHW was also observed (β = 0.09). The effect of opportunity to self-manage at work was partly mediated by WRDD (β = 0.21), but a direct effect on IHW was also observed (β = 0.21). Both WRDD (β = 0.12) and PAID-5 (β = 0.17) were associated with more frequent IHW, which, in turn, was associated with worse glycemic control (β = 0.31). The final model accounted for 40% of the variance in WRDD, 50% of the variance in PAID-5, 20% of the variance in IHW, and 10% of the variance in glycemic control.

This model was adjusted for sex, age, diabetes duration, and ACR. Sex was associated with PAID-5 (β = 0.08), diabetes duration with PAID-5 (β = −0.05) and IHW (β = −0.10), and ACR with HbA_{1c} (β = 0.08) and PAID-5 (β = 0.07).

CONCLUSIONS

The final model showed that WRDD was the most significant pathway through which work ability, job demands, being treated differently, and opportunity to self-manage at work negatively

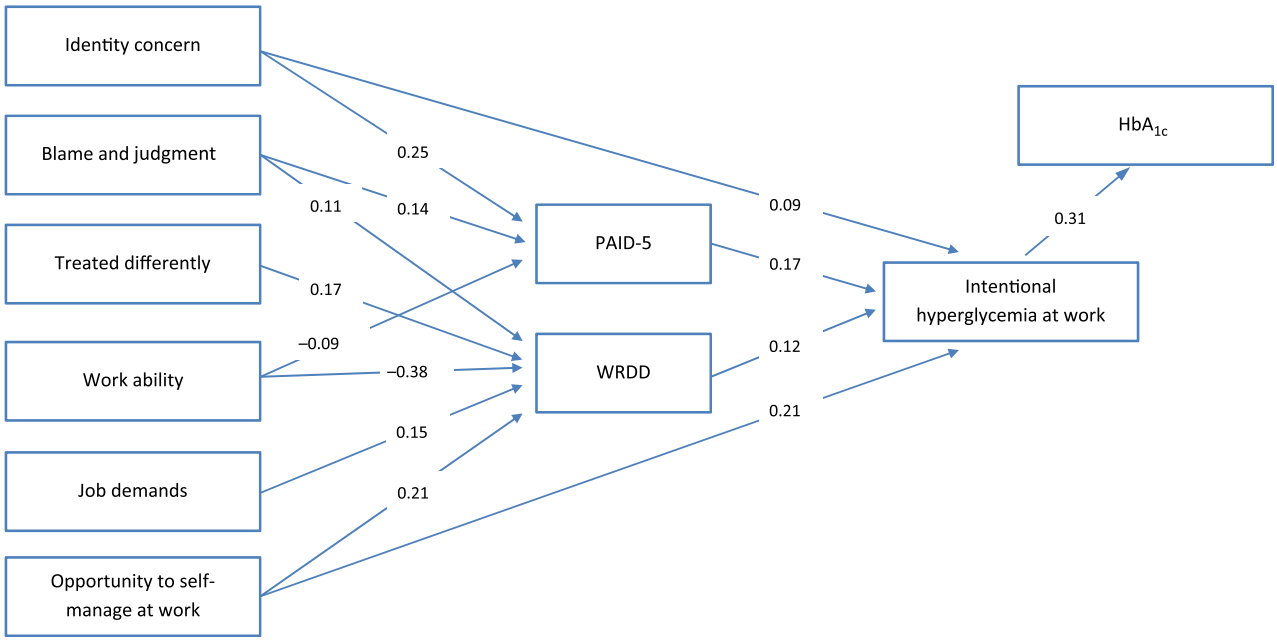

Figure 3—Test of combined model. All paths are significant at $P < 0.001$.

Table 1—Model fit indices

	χ^2/df	GFI	CFI	RMSEA
Mediation model	5.926	0.981	0.968	0.069 (0.056–0.083)
Direct model	5.590	0.993	0.987	0.067 (0.041–0.095)
Combined model	2.916	0.991	0.988	0.043 (0.029–0.058)
Adjusted final model*	2.778	0.994	0.991	0.042 (0.027–0.056)

*Adjusted for sex, age, diabetes duration, and ACR.

influenced IHW (Fig. 3). Diabetes distress, as measured by PAID-5, was the most significant pathway through which identity concern and blame and judgment negatively influenced IHW. The pathways from WRDD and PAID-5 to IHW were moderately strong and IHW was, in turn, moderately associated with glycemic control. The fact that work-related variables, including being treated differently, were all more strongly correlated with WRDD than with PAID-5 makes intuitive sense and suggests that these work-related factors cause work-related diabetes distress as well as add to overall diabetes distress.

Our findings are consistent with findings from a previous study modeling WRDD as a mediator of the association between selected work-related, diabetes-related, and health-related variables (5). The path model in that study was an excellent fit for the data, although no alternative model was compared, raising a risk of confirmation bias (5). As in our study, work ability and job demands were associated with WRDD. Interestingly, in the study by Hakkarainen et al. (5), no path was found between psychosocial work conditions and WRDD, whereas we saw associations between the novel construct of diabetes stigma and WRDD and PAID-5.

In contrast to other studies, e.g., (7), we found no direct significant relationship between diabetes distress and glycemic control over and above the indirect effect through IHW when investigating the pattern of relationship in a path model, albeit small, significant bivariate associations were seen between PAID-5 and WRDD, respectively, and glycemic control (0.14 and 0.08, both $P < 0.001$). This diverging finding is likely attributable to our choice of path analysis, which enables one to display both direct and indirect effects of a variable on another. The direct relationship between diabetes distress and glycemic control found in other studies may be caused by unmeasured mediating factors, e.g., self-management behaviors, but this warrants more research. The final model accounted for 10% of the variance in glycemic control, highlighting the importance of other determinants of suboptimal diabetes outcomes such as educational, medical, and social factors.

Our study focused on intentionally maintaining high blood glucose levels at work because we hypothesized that this behavior was important in understanding the link between work-related factors, diabetes distress, work-related diabetes distress, and glycemic control. Future studies should also assess other self-management behaviors with the Summary of Diabetes Self-Care Activities (SDSCA) (39) or the Diabetes Self-Management Questionnaire (DSMQ) (40).

Study strengths include a large population, the use of validated scales, and the combination of self-report measures and clinical data in a novel area of research. However, the novelty also constitutes a limitation of the study in terms of few studies for comparison and the use of novel constructs in need of further consolidation, e.g., WRDD. Structural equation modeling is a multivariate statistical analysis technique that can reject suggested models with poor fit to the data, but it cannot confirm a model (34). Confirmation bias can arise from testing a single model without considering other explanations for the data (34,36); to avoid this risk, we tested plausible near-equivalent models for comparison. Path models, unlike regression analyses, allow investigating multiple pathways for glycemic control in combination. Although the method is useful for elucidating pathways and mechanisms of action, our cross-sectional design in which all variables were concurrently measured was a limitation; our results should be corroborated by longitudinal studies to allow investigation of causal pathways and mediation (34).

In conclusion, work-related factors influence self-care and glycemic control among working people with type 1 diabetes mainly through WRDD and PAID-5 acting as separate intermediate pathways to IHW, which, in turn, transmits the effect of diabetes distress to glycemic control. The model also included direct paths from opportunity to self-manage at work and identity concern to IHW. A sound understanding of the mechanisms of actions linking work-related diabetes distress to suboptimal glycemic control among working people with type 1 diabetes can inform intervention development. The current study speaks to the possible value of interventions targeting issues and problems specific to work life, such as WRDD, IHW, job demands, and opportunity to self-manage at work, as well as broader psychosocial issues, such as diabetes stigma and diabetes distress, for ameliorating the quality of both work life and diabetes care among workers with type 1 diabetes.

Acknowledgments. The authors acknowledge Amra Ciric Alibegovic from Steno Diabetes Center Copenhagen for valuable advice regarding data collection. The authors acknowledge Jennifer Green from Caduceus Strategies for proofreading the manuscript.

Funding. This study was partly funded by an unrestricted grant from Innovation Fund Denmark.

Duality of Interest. No potential conflicts of interest relevant to this article were reported.

Author Contributions. U.M.H. performed all analyses and wrote the manuscript. T.S. reviewed the analyses and edited the manuscript. K.O. reviewed the analyses and edited the manuscript. I.W. reviewed and edited the manuscript. U.M.H. is the guarantor of this work and, as such, had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

Prior Presentation. Parts of this study were presented in abstract form at the 78th Scientific Sessions of the American Diabetes Association, Orlando, FL, 22–26 June 2018.

References

1. Persson S, Dahlquist G, Gerdtham UG, Steen Carlsson K; Swedish Childhood Diabetes Study Group. Why childhood-onset type 1 diabetes impacts labour market outcomes: a mediation analysis. Diabetologia 2018;61:342–353

2. Nielsen HB, Ovesen LL, Mortensen LH, Lau CJ, Joensen LE. Type 1 diabetes, quality of life, occupational status and education level - a comparative population-based study. Diabetes Res Clin Pract 2016;121:62–68

3. Ruston A, Smith A, Fernando B. Diabetes in the workplace - diabetic's perceptions and experiences of managing their disease at work: a qualitative study. BMC Public Health 2013;13:386

4. Balfe M, Brugha R, Smith D, Sreenan S, Doyle F, Conroy R. Why do young adults with type 1 diabetes find it difficult to manage diabetes in the workplace? Health Place 2014;26:180–187
5. Hakkarainen P, Moilanen L, Hänninen V, Heikkinen J, Räsänen K. Work-related diabetes distress among Finnish workers with type 1 diabetes: a national cross-sectional survey. J Occup Med Toxicol 2016;11:11
6. Fisher L, Gonzalez JS, Polonsky WH. The confusing tale of depression and distress in patients with diabetes: a call for greater clarity and precision. Diabet Med 2014;31:764–772
7. Hessler DM, Fisher L, Polonsky WH, et al. Diabetes distress is linked with worsening diabetes management over time in adults with type 1 diabetes. Diabet Med 2017;34:1228–1234
8. Young-Hyman D, de Groot M, Hill-Briggs F, Gonzalez JS, Hood K, Peyrot M. Psychosocial care for people with diabetes: a position statement of the American Diabetes Association. Diabetes Care 2016;39:2126–2140
9. Fisher L, Polonsky WH, Hessler DM, et al. Understanding the sources of diabetes distress in adults with type 1 diabetes. J Diabetes Complications 2015;29:572–577
10. Gonzalez JS, Fisher L, Polonsky WH. Depression in diabetes: have we been missing something important? [published correction appears in Diabetes Care 2011;34:2488]. Diabetes Care 2011;34:236–239
11. Sturt J, Dennick K, Due-Christensen M, McCarthy K. The detection and management of diabetes distress in people with type 1 diabetes. Curr Diab Rep 2015;15:101
12. Hansen UM, Olesen K, Browne JL, Skinner TC, Willaing I. A call for inclusion of work-related diabetes distress in the spectrum of diabetes management: results from a cross-sectional survey among working people with type 1 diabetes. Diabetes Res Clin Pract 2018;140:139–147
13. Polonsky WH, Anderson BJ, Lohrer PA, et al. Assessment of diabetes-related distress. Diabetes Care 1995;18:754–760
14. Fullerton B, Jeitler K, Seitz M, Horvath K, Berghold A, Siebenhofer A. Intensive glucose control versus conventional glucose control for type 1 diabetes mellitus. Cochrane Database Syst Rev 2014:CD009122
15. Stettler C, Allemann S, Juni P, et al. Glycemic control and macrovascular disease in types 1 and 2 diabetes mellitus: meta-analysis of randomized trials. Am Heart J 2006;152:27–38
16. Perlmuter LC, Flanagan BP, Shah PH, Singh SP. Glycemic control and hypoglycemia: is the loser the winner? Diabetes Care 2008;31:2072–2076
17. Reddy M, Rilstone S, Cooper P, Oliver NS. Type 1 diabetes in adults: supporting self management. BMJ 2016;352:i998
18. Campbell R, Pound P, Pope C, et al. Evaluating meta-ethnography: a synthesis of qualitative research on lay experiences of diabetes and diabetes care. Soc Sci Med 2003;56:671–684
19. Weijman I, Ros WJ, Rutten GE, Schaufeli WB, Schabracq MJ, Winnubst JA. The role of work-related and personal factors in diabetes self-management. Patient Educ Couns 2005;59:87–96
20. Hansen UM, Cleal B, Willaing I, Tjørnhøj-Thomsen T. Managing type 1 diabetes in the context of work life: a matter of containment. Soc Sci Med 2018;219:70–77
21. Fisher L, Hessler D, Polonsky W, Strycker L, Masharani U, Peters A. Diabetes distress in adults with type 1 diabetes: prevalence, incidence and change over time. J Diabetes Complications 2016;30:1123–1128
22. McGuire BE, Morrison TG, Hermanns N, et al. Short-form measures of diabetes-related emotional distress: the Problem Areas in Diabetes Scale (PAID)-5 and PAID-1. Diabetologia 2010;53:66–69
23. Hakkarainen P, Moilanen L, Hanninen V, Rasanen K, Munir F. Disclosure of type 1 diabetes at work among Finnish workers. Diabet Med 2017;34:115–119
24. Detaille SI, Haafkens JA, Hoekstra JB, van Dijk FJH. What employees with diabetes mellitus need to cope at work: views of employees and health professionals. Patient Educ Couns 2006;64:183–190
25. Tuomi K, Ilmarinen J, Jahkola A, Katajarinne L, Tulkki A. *Work Ability Index*. Helsinki, Finland, Finnish Institute of Occupational Health, 1998
26. El Fassi M, Bocquet V, Majery N, Lair ML, Couffignal S, Mairiaux P. Work ability assessment in a worker population: comparison and determinants of Work Ability Index and Work Ability score. BMC Public Health 2013;13:305
27. Ahlstrom L, Grimby-Ekman A, Hagberg M, Dellve L. The work ability index and single-item question: associations with sick leave, symptoms, and health–a prospective study of women on long-term sick leave. Scand J Work Environ Health 2010;36:404–412
28. Karasek R, Brisson C, Kawakami N, Houtman I, Bongers P, Amick B. The Job Content Questionnaire (JCQ): an instrument for internationally comparative assessments of psychosocial job characteristics. J Occup Health Psychol 1998;3:322–355
29. Hakkarainen P, Moilanen L, Hanninen V, Heikkinen J, Rasanen K. Work ability among Finnish workers with type 1 diabetes. Occup Med (Lond) 2016;66:446–453
30. Browne JL, Ventura AD, Mosely K, Speight J. Measuring type 1 diabetes stigma: development and validation of the Type 1 Diabetes Stigma Assessment Scale (DSAS-1). Diabet Med 2017;34:1773–1782
31. Hansen UM, Willaing I, Ventura AD, Olesen K, Speight J, Browne JL. Stigma perceived and experienced by adults with type 1 diabetes: linguistic adaptation and psychometric validation of the Danish version of the Type 1 Diabetes Stigma Assessment Scale (DSAS-1 DK). Patient 2018;11:403–412
32. Browne JL, Ventura A, Mosely K, Speight J. 'I'm not a druggie, I'm just a diabetic': a qualitative study of stigma from the perspective of adults with type 1 diabetes. BMJ Open 2014;4:e005625
33. American Diabetes Association. 6. Glycemic targets: *Standards of Medical Care in Diabetes—2017* [published correction appears in Diabetes Care 2017;40:985]. Diabetes Care 2017;40(Suppl. 1):S48–S56
34. Kline RB. *Principles and Practice of Structural Equation Modeling*. New York, The Guilford Press, 2016
35. Little TD. *Longitudinal Structural Equation Modeling*. New York, The Guilford Press, 2013
36. Shah R, Goldstein SM. Use of structural equation modeling in operations management research: looking back and forward. J Oper Manage 2006;24:148–169
37. Byrne BM. *Structural Equation Modeling With AMOS: Basic Concepts, Programming, and Application*. 2nd ed. New York, Routledge, 2016
38. Hu LT, Bentler PM. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. Struct Equ Modeling 1999;6:1–55
39. Toobert DJ, Hampson SE, Glasgow RE. The Summary of Diabetes Self-Care Activities measure: results from 7 studies and a revised scale. Diabetes Care 2000;23:943–950
40. Schmitt A, Reimer A, Hermanns N, et al. Assessing diabetes self-management with the Diabetes Self-Management Questionnaire (DSMQ) can help analyse behavioural problems related to reduced glycaemic control. PLoS One 2016;11:e0150774