




# Research: Educational and Psychological Aspects

## Diabetes and COVID-19: psychosocial consequences of the COVID-19 pandemic in people with diabetes in Denmark—what characterizes people with high levels of COVID-19-related worries?

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### Abstract

**Aim** To map COVID-19-specific worries and overall psychosocial health among people with diabetes in the initial phase of the COVID-19 pandemic in Denmark, and to explore characteristics of people with diabetes and high levels of worries related to the COVID-19 pandemic.

**Methods** A cross-sectional survey was conducted by distributing online questionnaires to 2430 adult members (> 18 years) of two user panels consisting of people with diabetes who have volunteered to share information about their life with diabetes. The questionnaire included items on COVID-19-specific worries as well as such worries related to diabetes, sociodemographic and health status, social relations, diabetes-specific social support, diabetes distress and changes in diabetes-specific behaviours. Responses were analysed with descriptive statistics and logistic regressions.

**Results** People with diabetes have COVID-19-specific worries related to their diabetes. More than half were worried about being overly affected due to diabetes if infected with COVID-19, about one-third about being characterized as a risk group due to diabetes and not being able to manage diabetes if infected. Logistic regressions showed that being female, having type 1 diabetes, diabetes complications and diabetes distress, feeling isolated and lonely, and having changed diabetes behaviours were associated with being more worried about COVID-19 and diabetes.

**Conclusion** People with diabetes have COVID-19-specific worries related to their diabetes which is associated with poorer psychosocial health. These worries should be addressed through support targeting specific questions and needs of individuals with diabetes as well as frequent updates on new knowledge regarding COVID-19 and diabetes.

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### Introduction

Spread of coronavirus disease 2019 (COVID-19) was declared a global pandemic by the World Health Organization (WHO) on 11 March 2020 [1]. For most people, COVID-19 will cause only mild symptoms similar to a common cold, but it can also cause severe respiratory infections and multi-organ failure [2]. The COVID-19 outbreak started in the Hubei Province, China in December 2019. Since then, the virus has spread rapidly to multiple countries across the globe within a very short space of time.

In Denmark, all schools and childcare services were closed on 12 March, employees in the public sector with non-

critical roles were sent home and a ban on gatherings of more than 10 people was issued. Care services were adapted to handle the COVID-19 pandemic not only by increasing capacity to treat people with COVID-19, but also by avoiding spread of the virus between healthcare professionals and patients [3].

The COVID-19 outbreak and associated mass media coverage about the course of the pandemic worldwide and the frightening mortality levels in some countries are expected to increase the prevalence and change the character of psychological problems, including anxiety, depression and stress among citizens in affected countries [4–6]. Previous studies have highlighted the psychological impact of quarantine, which can cause post-traumatic stress symptoms,

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**What's new?**

- Little is known about how worldwide pandemics affect the psychosocial health of people with diabetes.
- This study showed a high prevalence of diabetes-specific worries related to COVID-19, especially fear of being overly affected by the virus, labelling of people with diabetes as a high-risk group, and inability to manage diabetes if infected.
- Female gender, type 1 diabetes, diabetes complications, isolation, loneliness, high diabetes distress and behaviour changes were associated with being more worried about COVID-19 and diabetes.
- When providing information and support to people with diabetes in time of crisis, attention should be paid to crisis-specific worries in specific groups.

confusion and anger [6,7]. Stressors related to quarantine include fear of infection, frustration, boredom, inadequate supplies, inadequate information, financial loss and stigma [7]. During the COVID-19 outbreak in China, a survey of 1210 respondents found that half rated the psychological impact of the outbreak as moderate or severe; 17% reported moderate to severe depressive symptoms; 29% reported moderate to severe anxiety symptoms; and 8% reported moderate to severe stress levels [8,9]. The study showed that people with chronic illness experienced greater stress, anxiety and depression compared with people without chronic illness [9]. An increase in generalized fear has also been documented during other outbreaks such as SARS in 2003 and spread of the Ebola virus in 2014 [10]. The psychological responses were particularly high among high-risk persons [10].

It is well-established that diabetes under 'normal' conditions can have a significant and negative effect on quality of life. Around 40% of people with diabetes experience diabetes distress as well as an increased prevalence of a range of psychosocial problems, including depression, anxiety, eating disorders and general stress compared with the general population [11,12]. The psychosocial consequences of the COVID-19 pandemic may add to the burden of psychosocial problems of people with diabetes.

The aim of this paper is: (1) to map overall psychosocial health and COVID-19-specific worries among people with diabetes in the initial phase of the COVID-19 pandemic in Denmark; and (2) to explore characteristics of people with high levels of worries related to the COVID-19 pandemic.

## Participants and methods

### Design and study participants

A cross-sectional survey was conducted by distributing online questionnaires to 2430 adult (> 18 years) members

of two user panels at Steno Diabetes Center Copenhagen and The Danish Diabetes Association, respectively. The user panels consist of people with diabetes, who have volunteered to share information about their lives with diabetes. Panels comprise people from all parts of Denmark with type 1 and type 2 diabetes, latent autoimmune diabetes of adulthood (LADA), gestational diabetes (GDM) and other rarer types of diabetes. Thus, the panels represent people with diabetes who are treated in different primary and/or secondary care settings across Denmark.

### Recruitment methodology

Invitations containing a link to the online questionnaire and written informed consent were sent to all members of the user panels via e-mail. The questionnaire was open for response seven days from the distribution date and a reminder was sent out if a response had not been recorded within the first three days. The study was approved by the Danish Data Protection Agency (P-2020-271).

### Questionnaire content

The questionnaire was developed in close collaboration with a person with diabetes and professional communication people working with patient involvement in diabetes care. This was done to ensure appropriate wording of normative items in the questionnaire to avoid inducing unnecessary worry or anxiety in the surveyed population. Alongside with items on COVID-19-specific worries, the questionnaire included items on sociodemographic and health status, social relations, diabetes-specific social support, diabetes distress as well as changes in diabetes-specific behaviours. The generic mental health questions were developed as part of a larger Danish data collection initiative 'Standing together—at a distance: How Danes are living with the Corona Crisis' (<https://coronaminds.ku.dk/>). The specific questions used in this study are listed in Table S1.

Items on COVID-19-specific worries included one question measuring general worries due to the COVID-19 pandemic: 'How worried are you about the Corona-crisis on a scale from 1 to 10?', and a yes/no list of ten potential diabetes-related worries due to the COVID-19 pandemic.

Sociodemographic and health status items included age, gender, type of diabetes, complication status and latest HbA<sub>1c</sub> measurement as well as questions about whether the respondent had other chronic or mental illnesses. Items regarding whether relatives or respondents themselves had experienced COVID-19 symptoms or been diagnosed with COVID-19 with or without hospitalization were also included.

Measures of social relations included general and diabetes-specific loneliness and diabetes-specific social support. General loneliness was measured with the three-item UCLA Loneliness Scale [13,14] with response categories 'never/rarely', 'sometimes'

and 'often', providing a total score from 0 to 9. Diabetes-related loneliness was measured with two questions developed for a previous qualitative pilot study [15] and took the same format as the UCLA Loneliness Scale. The questions measured: (1) if the respondents missed someone to talk to about diabetes; and (2) whether they felt alone with diabetes. The questions on loneliness were accompanied by a 1- to 10-point scale about the degree of feelings of isolation. Diabetes-related social support from family, friends, people at work, healthcare professionals, other people in the community and people on social media was measured with questions inspired by the Diabetes Attitudes, Wishes and Needs (DAWN) Support for Diabetes Self-Management Profile [16]. The original scale measures how supportive potential support providers are, with the response categories 'not supportive', 'somewhat supportive' and 'very supportive'. We also included social media as potential support which is not included in the original scale. The social support questions were analysed separately as single items in this study and not as a total score.

Diabetes distress was measured by the brief two-item diabetes distress scale (DDS2) [17]: 'Feeling overwhelmed by the demands of living with diabetes' and 'Feeling that I am often failing with my diabetes routine'. Possible scores on each item range from 1 (not a problem) to 6 (a very serious problem). The DDS2 score is derived as the average of the two items. A score > 2 indicates moderate to high diabetes distress.

Changes in diabetes-related behaviours as a result of the COVID-19 pandemic were measured with a yes/no list of potential behaviour changes related to diet, physical activity, medication taking and measurement of blood glucose.

### Statistical methods

Multivariate logistic regression models were used to examine the likelihood of experiencing: (1) diabetes-related worries related to the COVID-19 pandemic by sociodemographic factors and health status; and (2) diabetes-related worries related to the COVID-19 pandemic by sociodemographic factors, health status and psychosocial and behavioural factors. For each diabetes-related worry, the same base model consisting of age, gender, education, diabetes type and number of diabetes complications was used. In each regression, a specific explanatory psychosocial variable of interest was included. All coefficients were estimated using maximum likelihood and all coefficients are reported as odds ratios (or) with 95% confidence intervals (CI) and standard errors (SE). *P*-values ≤ 0.05 were considered statistically significant. All analyses were performed in Stata 15.1 (StataCorp, College Station, TX, USA)

## Results

### Participant characteristics

Table 1 shows sociodemographic and health status characteristics of the study population. Half of the participants

**Table 1** Study population characteristics (N = 1396)

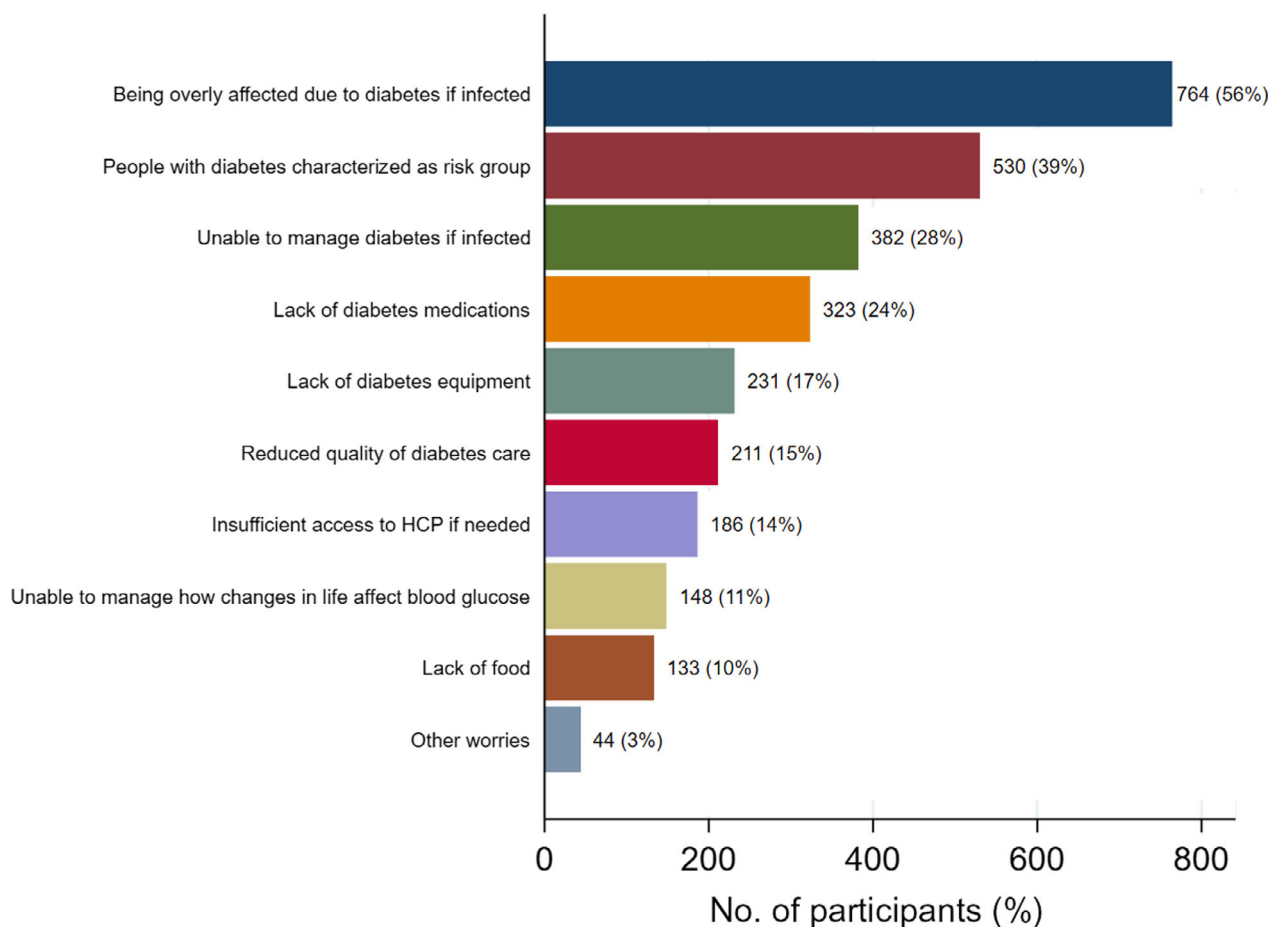
Variable	Descriptive statistics	No. of missing observations
Age; years [range]	61.6 (12.9), [18-99]	165
Gender, female	685 (55.7)	167
Education		165
Primary school	83 (6.7)	
Secondary education (high school)	49 (4)	
Secondary education (vocational)	347 (28.2)	
Lower tertiary education	177 (14.4)	
Medium tertiary education	513 (41.7)	
Higher tertiary education	57 (4.6)	
Other	5 (0.4)	
Employment status		165
Employed	439 (35.7)	
Retired	679 (55.2)	
Other*	113 (9.2)	
Diabetes type		34
Type 1	471 (34.6)	
Type 2	839 (61.6)	
LADA	52 (3.8)	
Diabetes complications		34
Retinopathy	93 (6.8)	
Nephropathy	41 (3)	
Neuropathy	178 (13.1)	
Foot ulcer	28 (2.1)	
Heart disease	150 (11.1)	
Amount of complications [range]	0.4 (0.7) [0-5]	34
0 complications	999 (73.4)	
1 complication	271 (19.9)	
2 complications	65 (4.8)	
3 complications	21 (1.5)	
4 complications	4 (0.3)	
5 complications	2 (0.2)	
HbA <sub>1c</sub> (mmol/mol) [Q25, median, Q75]	56 (13.7) [48, 54, 61.8]	653
HbA <sub>1c</sub> (%) [Q25, median, Q75]	7.3 (1.8) [6.5, 7.1, 7.8]	
At least one other chronic illness	760 (55.8)	34
Mental illness	116 (8.5)	34
COVID-19 symptoms	59 (4.2)	1
COVID-19 tested positive		
Participant	2 (0.1)	
Relatives	12 (0.7)	
COVID-19 hospitalisation		
Participant	0 (0)	
Relatives	6 (0.4)	

Descriptive statistics are given as *n* (%) or mean (SD) as appropriate.

\*Other category includes 'under education', 'sick leave' and 'unemployed'.

LADA, latent autoimmune diabetes of adulthood; Q25/Q75, 25th/75th percentiles.

were women; age ranged from 18 to 99 years with a mean of 62 years; almost half of the population had medium to higher tertiary education; 36% were employed; around one-third had type 1 diabetes; 27% had diabetes complications; over



**FIGURE 1** COVID-19-specific worries experienced by people with diabetes

half of the participants had another chronic illness and 8% had a mental illness.

### COVID-19-specific diabetes worries

Figure 1 shows that participants were most frequently worried about 'being overly affected due to diabetes if infected with COVID-19' (56%), about 'people with diabetes being characterized as a risk group' (39%) and 'not being able to manage diabetes if infected with COVID-19' (28%). In all, 24% were worried about 'possible lack of diabetes medications' and 14–17% were worried about 'possible lack of diabetes equipment', 'reduced quality of professional health care during the COVID-19 crisis' and 'insufficient access to health care professionals if needed'. In the later analyses, we focus on the three most prevalent worries.

### Psychosocial health

Table 2 presents levels of different psychosocial factors. Mean rating of overall COVID-19-specific worries was 5.9 and mean rating of feeling socially isolated was 5.5. One-

quarter of participants had moderate to high diabetes distress (DDS2 score > 2). Around 57%, 29% and 61% often or sometimes felt lonely, isolated from others and starved for company, respectively. The average loneliness score was 4.8. Roughly 33% often or sometimes felt alone with their diabetes, while 23% felt that they often or sometimes missed someone to talk to about diabetes. Regarding diabetes-specific social support, most respondents (80%) received moderate to high levels of support from family, friends and people close to them. Moderate to high support from people at work or school, diabetes care team, other people in the community and other people with diabetes, and people on social media ranged from ~ 35% (people at work or school) to 50% (diabetes care team).

### Characteristics of people with worries related to the COVID-19 pandemic

#### Sociodemographic and health status

Table 3 shows associations between COVID-19-specific worries and sociodemographic and health status. Women more often than men experienced worries about being overly affected due to diabetes if infected with COVID-19 (OR 1.6,

**Table 2** Psychosocial and behavioural factors (N = 1396)

Variable	Descriptive statistics	No. of missing observations
COVID-19-specific worry, scale from 1 (low) to 10 (high)	5.9 (2.5)	147
Isolation, scale from 1 (low) to 10 (high)	5.5 (2.7)	164
Loneliness		
UCLA score	4.8 (1.6)	162
Loneliness		
Often or sometimes feel left out	703 (56.8)	162
Often or sometimes feel isolated from others	355 (28.8)	162
Often or sometimes feel starved for company	754 (61.1)	162
Often or sometimes miss someone to talk to about diabetes	285 (23.1)	162
Often or sometimes feel lonely with diabetes	402 (32.6)	162
Diabetes distress		
DDS2 score	1.8 (1)	162
Moderate to high diabetes distress (DDS2 score > 2)	346 (25.4)	162
Social support*		
Moderate to high social support		
Family, friends and people close to you	713 (80.2)	507
People at work or school	150 (35.4)	972
Diabetes care team	323 (52.2)	777
Other people in your community	201 (37.2)	856
Other people with diabetes	195 (39.8)	906
Social media	179 (40)	948
Behaviour change		
Check blood glucose more often than usual	120 (9.6)	147
More careful about taking medications than usual	77 (6.2)	147
Less exercise than usual	501 (40.1)	147
More exercise than usual	138 (11.1)	147
Eat less than usual	98 (7.9)	147
Eat more than usual	233 (18.7)	147
No change	567 (45.5)	147
Other changes	70 (5.6)	147

Descriptive statistics are given as *n* (%) or mean (SD) as appropriate.

\*If respondents indicated 'Not relevant' or 'Too supportive' to a given support category, the response is treated as missing. DSDSP, Diabetes Attitudes, Wishes and Needs (DAWN) Support for Diabetes Self-Management Profile.

95% CI 1.3 to 2.1). Women were also more worried than men about not being able to manage diabetes if infected with COVID-19 (OR 1.7, 95% CI 1.3 to 2.1). People with type 2 diabetes were less likely to worry about being overly affected due to diabetes and not being able to manage diabetes if infected with COVID-19 compared to people with type 1 diabetes (OR 0.6, 95% CI 0.5 to 0.8 and OR 0.4, 95% CI 0.3 to 0.5). People with diabetes complications were more likely to have worries about being overly affected by COVID-19 compared with people with no complications (OR 1.4, 95% CI 1.2 to 1.8) and were more likely to be

worried about being able to manage diabetes if infected with COVID-19 (OR 1.2, 95% CI 1.0 to 1.5).

### Psychosocial health status

People who reported moderate to high levels of distress were more likely to be worried about being overly affected (OR 4.9, 95% CI 3.2 to 7.5), about people with diabetes being characterized as a risk group (OR 2.4, 95% CI 1.8 to 3.3) and about not being able to manage diabetes if infected (OR 3.2, 95% CI 2.3 to 4.4) compared with people with low/no distress (Table 4). Likewise, participants who felt left out (OR 1.5 to 1.9, 95% CI 1.2 to 2.5), isolated from others (OR 1.7 to 2.2, 95% CI 1.7 to 2.9) and starved from company (OR 1.6 to 2.0, 95% CI 1.2 to 2.5) were more likely to experience worries compared with people who did not experience these elements of loneliness. Participants who missed someone to talk to about diabetes (OR 1.6 to 2.7, 95% CI 1.2 to 3.8) and felt lonely with diabetes (OR 1.8 to 2.6, 95% CI 1.4 to 3.5) were also more likely to be worried than those participants who did not experience diabetes loneliness.

Feelings of isolation also predicted being worried. Participants who felt a stronger sense of isolation were more likely to experience worries (OR 1.1 to 1.1, 95% CI 1.0 to 1.2).

### Changes in diabetes management due to the COVID-19 pandemic

Participants who were more likely to have diabetes-related worries about the COVID-19 pandemic were more likely to check blood glucose more often (OR 1.6 to 1.7, 95% CI 1.0 to 2.6), were more aware of medication taking (OR 2.3 to 3.0, 95% CI 1.3 to 4.9) and exercised more than usual (OR 1.3 to 1.7, 95% CI 1.0 to 2.2) (Table 4). Eating more or less than usual were both associated with being worried about people with diabetes being characterized as a risk group compared with people eating as usual (OR 1.4, 95% CI 1.1 to 1.9 and 2.1, 1.4 to 3.2).

### Discussion

This study of 1396 people with diabetes showed that worries related to the COVID-19 pandemic were highly prevalent. Participants most frequently worried about 'being overly affected due to diabetes if infected with COVID-19' (56%), that 'people with diabetes are characterized as a risk group' (39%) and 'not being able to manage diabetes if infected with COVID-19' (28%). People with diabetes have been informed of the necessity to be acutely aware of the advice and restrictions imposed by the health authorities [12] because they are expected to be at higher risk of being infected and to experience more severe symptoms of COVID-19 if infected. The information from, for example, the Danish health authorities varied in the initial phase of the pandemic: At first, people with diabetes were said to be at

**Table 3** Odds ratios of experiencing COVID-19 worries by sociodemographic and health variables

	Worried about being overly affected due to diabetes COVID-19		Worried about people with diabetes being characterized as a risk group		Worried about not being able to manage diabetes if infected with corona virus	
	OR [95% CI]	SE	OR [95% CI]	SE	OR [95% CI]	SE
Age, years (reference 18 years)	1 [0.99–1.01]	0.01	1 [0.98–1.01]	0.01	0.99 [0.98–1.01]	0.01
Gender, female vs. male	1.64*** [1.28–2.1]	0.21	1.04 [0.82–1.32]	0.12	1.65*** [1.27–2.144]	0.22
Education† (reference primary school)						
Secondary education (high school)	1.15 [0.54–2.46]	0.45	0.78 [0.37–1.62]	0.29	0.53 [0.23–1.21]	0.22
Secondary education (vocational)	1.2 [0.73–1.96]	0.3	1.2 [0.72–1.92]	0.29	0.91 [0.53–1.56]	0.25
Lower tertiary education	1.22 [0.71–2.11]	0.34	0.73 [0.43–1.25]	0.2	0.81 [0.45–1.45]	0.24
Medium tertiary education	1.17 [0.72–1.9]	0.29	1.02 [0.63–1.64]	0.25	0.69 [0.41–1.17]	0.19
Higher tertiary education	0.92 [0.4–1.87]	0.33	1 [0.5–1.99]	0.35	0.64 [0.29–1.39]	0.25
Retired vs. employed†	0.9 [0.7–1.24]	0.14	0.89 [0.66–1.2]	0.14	0.89 [0.64–1.24]	0.15
Type 2 diabetes vs. type 1 diabetes†	0.61*** [0.46–0.81]	0.09	0.97 [0.74–1.3]	0.13	0.35*** [0.26–0.47]	0.05
Diabetes complications, continuous (reference 0)	1.44*** [1.18–1.76]	0.15	1.1 [0.93–1.3]	0.01	1.23** [1.02–1.49]	0.12
Diabetes complications, categorical (reference 0)						
1	1.49** [1.11–2.03]	0.23	1.41** [1.06–1.89]	0.21	1.29 [0.93–1.78]	0.21
≥ 2	2.65*** [1.52–4.63]	0.75	1.11 [0.69–1.78]	0.27	1.78** [1.08–2.93]	0.45
Mental illness vs. no mental illness	1.2 [0.75–1.9]	0.28	1.37 [0.89–2.09]	0.3	1.2 [0.76–1.89]	0.28
Other chronic illness vs. no chronic illness	1.23 [0.95–1.6]	0.16	0.99 [0.77–1.26]	0.12	1.3 [0.98–1.72]	0.19
Observations	1,225		1,225		1,225	

OR, odds ratio; CI, confidence interval; SE, standard error.

Coefficients are adjusted for each other. Reported OR for age, gender, education, employment status, diabetes type and chronic illness are from regressions with number of complications included as a continuous variable. Using amount of complications as a continuous or categorical variable has no significant influence on coefficients for the included variables.

†The following variable categories have been dropped from the regressions due to low frequencies: ‘Other education’, ‘other employment’ and ‘LADA’.

\*\* $P < 0.05$ , \*\*\* $P < 0.01$ .

risk only if their diabetes was not well regulated. However, later all people with diabetes were categorized as being at high risk irrespective of diabetes type, regulation and complications [18]. The high morbidity and mortality in people with diabetes was made clear as well as the lack of knowledge about reasons for this. This information may potentially increase worries among people with diabetes and is likely to create a demand for more information. The question regarding worries about being labelled as a risk group was intended to measure experiences of stigma associated with this labelling. However, respondents may have interpreted this as being worried about the actual risk associated with diabetes.

Living with diabetes and managing the condition on a day-to-day basis are associated with heightened levels of anxiety and distress [11,12]. Likewise, a range of different factors, such as sex, diabetes type and presence of complications, moderate the levels at which distress and anxiety are experienced [12,19].

In our population, 25% experienced diabetes distress at the beginning of the COVID pandemic, which corresponds to what is found under normal circumstances [20–22]. Our findings also showed that experiencing high diabetes distress and feeling lonely were related to experiencing COVID-19-specific worries. Women, people with type 1 diabetes and people with diabetes complications were more likely to

express COVID-19 worries than men, people with type 2 diabetes and people without complications, respectively. This corresponds to previous findings of predictors for diabetes distress. [14,16]. We did not find an association between level of social support and COVID-19-specific worries, although previous studies have shown that a lack of social network and social support was associated with higher diabetes distress [23,24]. Thus ‘corona worries’ seem to have resemblances to as well as differences from worries under normal circumstances.

In 2016, a survey of ~1000 members of the Danish Diabetes Association showed that loneliness is more frequent among people with diabetes and their relatives compared with the general Danish population [25]. In this population, 28% often or sometimes felt left out, 39% often or sometimes felt isolated from others, and 40% often or sometimes felt starved for company [25]. In our study, the corresponding figures were, respectively, 57%, 29% and 61%. This indicates that a larger proportion of people with diabetes feel left out and starved for company during the COVID-19 pandemic than during normal circumstances, but the proportion of people feeling isolated does not differ. People with diabetes are supposedly even more alone at home than the general population, which may lead to feelings of being left out and starved for company. The feeling of being left out may refer to not being able to, for

**Table 4** Odds ratios of experiencing COVID-19 worries by psychosocial and behavioural variables

	Worried about being overly affected if infected with corona virus due to diabetes		Worried about people with diabetes being characterized as a risk group		Worried about not being able to manage diabetes if infected with corona virus	
	OR [95% CI]	SE	OR [95% CI]	SE	OR [95% CI]	SE
Isolation, scale from 1 (low) to 10 (high)	1.14*** [1.1–1.19]	0.03	1.08*** [1.04–1.13]	0.02	1.13*** [1.08–1.19]	0.03
Moderate/high vs. none/low diabetes distress	4.9*** [3.2–7.5]	1.07	2.4*** [1.76–3.31]	0.39	3.16*** [2.28–4.39]	0.5
Loneliness, often/sometimes vs. rarely						
Feel left out	1.55*** [1.226–1.96]	0.19	1.51*** [1.19–1.9]	0.18	1.94*** [1.48–2.54]	0.27
Feel isolated from others	2.22*** [1.68–2.95]	0.32	1.66*** [1.29–2.13]	0.21	1.84*** [1.4–2.42]	0.26
Feel starved for company	1.98*** [1.55–2.52]	0.24	1.57*** [1.24–2]	0.19	1.9*** [0.34–1.57]	0.27
Miss someone to talk to about diabetes	2.72*** [1.97–3.76]	0.45	1.6*** [1.22–2.1]	0.22	2.48*** [1.85–3.32]	0.37
Feel lonely with diabetes	2.62*** [1.98–3.47]	0.38	1.77*** [1.38–2.28]	0.23	2.5*** [1.91–3.27]	0.34
Social support, moderate/high vs. no support						
Family	1.2 [0.84–1.71]	0.22	1.03 [0.73–1.44]	0.18	1.35 [0.92–1.99]	0.27
Friends and people close to you	1.08 [0.68–1.71]	0.25	1.07 [0.69–1.64]	0.23	1.22 [0.78–1.91]	0.28
People at work or school	0.72 [0.51–1.02]	0.13	0.79 [0.57–1.09]	0.13	0.85 [0.6–1.22]	0.15
Healthcare team	1.09 [0.74–1.61]	0.22	0.99 [0.69–1.4]	0.18	1.08 [0.74–1.58]	0.21
Other people in your community	1.18 [0.79–1.77]	0.24	1 [0.68–1.45]	0.19	1.16 [0.77–1.74]	0.24
Social media	0.99 [0.64–1.52]	0.22	1.29 [0.86–1.92]	0.26	1.4 [0.92–2.14]	0.3
Diabetes-related behavioural changes						
Check blood sugar more often	1.69** [1.08–2.62]	0.38	1.57** [1.06–2.3]	0.31	1.56** [1.03–2.35]	0.33
More aware of medication taking	2.32*** [1.32–4.06]	0.67	2.35*** [1.45–3.82]	0.58	2.96*** [1.8–4.86]	0.75
More exercise than usual	1.31** [1.02–1.66]	0.16	1.36*** [1.08–1.71]	0.16	1.69*** [1.31–2.19]	0.22
Less exercise than usual	1.22 [0.83–1.8]	0.24	0.97 [0.67–1.4]	0.18	1.26 [0.84–1.87]	0.25
Eat more than usual	1.1 [0.78–1.45]	0.17	1.44** [1.07–1.93]	0.22	1.19 [0.86–1.64]	0.2
Eat less than usual	1.3 [0.82–2.1]	0.31	2.11*** [1.38–3.24]	0.46	1.68** [1.06–2.64]	0.39
I do the same as I have always done	0.72*** [0.56–0.91]	0.09	0.66*** [0.53–0.84]	0.08	0.6*** [0.46–0.78]	0.08
Other	1.97** [1.08–3.58]	0.6	1.37 [0.83–2.24]	0.35	1.52 [0.9–2.29]	0.41

Models are adjusted for age, gender, educational, diabetes type and number of diabetes complications as a continuous variable.

OR, odds ratio; CI, confidence interval; SE, standard error.

\*\* $P < 0.05$ , \*\*\* $P < 0.01$ .

example, take up what is allowed for the general population such as gathering up to 10 people, which might not seem appropriate for people with diabetes, either by themselves or their friends and relatives. People feeling alone with or having no one to talk to about their diabetes were more than twice as likely to worry about COVID-19. Qualitative studies show that people with diabetes under usual conditions experience a burden of feeling lonely with their diabetes [26]. The present study showed that 33% often or sometimes felt alone with their diabetes, while 23% felt that they often or sometimes missed someone to talk to about diabetes. These are high numbers per se, and although we have not found valid information about usual conditions related to feeling lonely with diabetes, the frequency is expected to be higher under the COVID-19 pandemic and the related isolation.

Our study indicates that people who report being more worried are more likely to check their blood glucose levels, are more aware of taking their medication and exercise more. This appears to be an upside and may be an adaptive response to the current situation. This behaviour may even relieve feelings of worry as exercise is associated with lower levels of, for example, stress, anxiety and depression [27].

Our results emphasize the need to communicate all new information regarding diabetes and COVID-19, as well as to

provide support and guidance associated with specific and individual worries related to diabetes and COVID-19. More knowledge about how to provide this support systematically is needed. Even under normal circumstances, it is often not possible for people with diabetes to get access to emotional support, but in the case of the COVID-19 pandemic this might be even more important [28]. Peer support, social media and telephone support may be part of the solution [26,29,30].

Strengths of our study include the timeliness of the survey, which was initiated very shortly after substantial lockdown in Denmark due to the COVID-19 pandemic. The response rate of > 50% is considered relatively large under the circumstances, with a relatively short response time and only one reminder. Also, the study included both people with type 1 diabetes (35%) and type 2 diabetes (62%). Limitations include the convenience sample of participants, who may generally be healthier than the average person with diabetes. This is evinced by the relatively low prevalence of diabetes complications, for example retinopathy, with 7% in our study population reporting retinopathy compared with 18% in the Danish Diabetes Registry [31]. However, one could argue that our estimates are conservative given the fact that psychosocial issues are less pronounced in healthier individuals with diabetes, further emphasizing the gravity of the

situation. Furthermore, more than half of the population has at least one comorbid condition. All measures are self-reported, which may introduce uncertainties about prevalence of diabetes complications, comorbidity and glycaemic levels. Validation of the questionnaire was somewhat compromised by time constraints imposed by the need to administer the survey as and when concerns about COVID-19 were emerging. However, relevant actors from the Danish Diabetes Association, the user-involvement programme at Steno Diabetes Center Copenhagen and a person with type 1 diabetes contributed to and piloted the questionnaire through several iterations. Very few respondents commented negatively about the questionnaire.

### Conclusion

This study highlights a high prevalence of worry among people with diabetes during the COVID-19 pandemic related to being part of a high-risk group, as well as several other significant worries due to diabetes.

Further studies are needed to explore if and how COVID-19 worries change during the pandemic. Our study will be continued, and the future longitudinal study will contribute to this understanding. Our findings are expected to be relevant in settings other than the Danish, depending on the local course of the COVID-19 pandemic and local restrictions. Thus, our findings could be helpful in the effort to improve support for people with diabetes to manage their anxieties, particularly for those at greater risk of worries. Providing peer support and support help lines may be helpful in mediating feelings of loneliness.

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### Competing interests

None declared.

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## Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article.

### Table S1. Questionnaire content

**Doc. S1.** English translation of the online article ‘Sundhedsstyrelsen: Alle med diabetes er i risikogruppen’ published on the website of the Danish Diabetes Association, 7 April 2020.