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The impact of the covid-19 pandemic on perceived diabetes care and regulation, with a focus on ethnic minorities: a mixed-methods study

Saskia E. van Grondelle[1*], Bilal Güzel[1], Manon D. Mijnsbergen[1], Paul Uitewaal[2], Janet M. Kist[1], Sytske van Bruggen[1], Hedwig M. M. Vos[1], Mattijs E. Numans[1] and Rimke C. Vos[1]

Abstract

Background This study aimed to explore the impact of the COVID-19 pandemic and resulting changes to diabetes care, especially concerning disease control, the use of (tele)consultation and lessons worth implementing to improve diabetes care, with a specific focus on ethnic minority groups.

Methods A mixed-methods prospective cohort study among people with type 2 Diabetes Mellitus (T2DM) treated in primary care during the COVID-19 pandemic. A survey was sent regionally, including items related to teleconsultation and amount of contact with the healthcare professional. We conducted interviews based on the chronic care model with individuals from various ethnic backgrounds living in a deprived neighbourhood. Change in diabetes control (HbA1c, fasting glucose, LDL, systolic BP, BMI, eGFR) was evaluated based on routine care data. Latent class analysis was performed to identify groups who were more at risk for decreased glycaemic control.

Results Most people maintained face-to-face (59%) or telephone (44%) contact with their healthcare provider. A decrease in consultations was observed. Based on the interviews, factors important for maintaining good glycaemic control were the use of medical devices, religion, routines and social support from family and friends. We did not find a clinically relevant change in diabetes control and no specific group was identified as at risk for worse diabetes regulation.

Conclusions In the context of proactive care, remote healthcare and self-regulation have a crucial role for people with T2DM. It is important to identify barriers and facilitators for maintaining good glycaemic control among vulnerable groups, such as ethnic minority groups.

Keywords Covid-19, Type 2 diabetes mellitus, Care delivery, Ethnic minority groups

Introduction

The COVID-19 pandemic placed a heavy burden on healthcare systems, negatively affecting care delivery in general and diabetes care in particular. Approximately 85% of Dutch adults with Type 2 Diabetes Mellitus (T2DM) are treated in primary care, and the many restrictions imposed during the COVID-19 pandemic resulted in major changes to the delivery of this

*Correspondence:
Saskia E. van Grondelle
s.e.van_grondelle@lumc.nl
[1] Health Campus The Hague/Department of Public Health and Primary Care, Leiden University Medical Center, The Hague, The Netherlands
[2] GGD Haaglanden and Rubenshoek, The Hague, The Netherlands

care. Face-to-face contact was restricted and, where possible, replaced by teleconsultations [1, 2], which is defined as remote communication for the purpose of diagnosis or treatment of a patient [3], such as consultation by telephone or video-consultation. This resulted in an overall decrease in the number of T2DM-related consultations [4–6] as diabetes care was deferred due to its presumed low urgency.

Ethnic minority groups were disproportionately affected during the COVID-19 pandemic, with a higher risk of infection, hospitalization and mortality [7, 8], an outcome possibly influenced by deprivation, as well as underlying health conditions such as T2DM [9, 10]. Numerous factors such as social distancing, quarantine measures, calls to stay at home, difficulty getting a routine check-up and limited options for adjusting therapy based on symptoms and test results may have had a negative effect on glycaemic control in diabetes patients in general. However, due to poor health literacy, language problems and difficulties with teleconsultation, those with T2DM from an ethnic minority group may have been disproportionally affected compared to the wider Dutch population, although only limited data currently supports this conjecture.

The Dutch diabetes guideline advises T2DM check-ups every three to six months, and studies have shown that structured diabetes care is important for good glycaemic control independent of socio-demographic factors [11, 12]. Disruption of care due to COVID-19 may offer a unique opportunity to determine whether certain individuals or groups derive greater benefit from face-to-face care or from teleconsultations.

We explored the impact of the COVID-19 pandemic and resulting changes to diabetes care in people with T2DM, especially concerning disease control, the use of (tele)consultation and possible lessons worth implementing to improve diabetes care among diverse ethnicities in a highly urbanized multi-ethnic context.

Methods

Ethical considerations

This study conformed to the principles of the Declaration of Helsinki and Dutch law, and was approved by the Institutional Review Board of the Leiden University Medical Centre (LUMC) for observational Covid-19 studies (reference 'CoCo 2020–062'). The Medical Research Involving Human Subjects Act (WMO) was not applicable.

Setting and study design

This mixed-methods observational cohort study was performed between September 2020 and January 2022 amongst adults with T2DM. We developed a survey to explore the impact of the COVID-19 pandemic and changes to diabetes care. Adults with T2DM of diverse socio-economic status registered with ELAN (Extramural LUMC Academic Network)-affiliated GP practices were invited in writing to participate in the survey by their own GP. Participants received validated questionnaires together with a set of non-validated questions addressing COVID-19-related subjects. T2DM glycaemic control, patient characteristics, medical determinants and participant disease characteristics were extracted from the ELAN datawarehouse, a collection of pseudonymised healthcare data derived from the electronic medical records (EMR) of all affiliated physicians.

To gain more in-depth information on the association between the COVID-19 pandemic and diabetes regulation in people from various ethnic minority backgrounds, this was studied qualitatively based on semi-structured interviews of adults with T2DM from a primary healthcare centre in a deprived neighbourhood. To select an appropriate neighbourhood, the local 'deprivation score' [13] was used. The deprivation score indicates the average socio-economic position of the population in an area relative to the entire city. These deprivation scores are based on five indicators: 1. the percentage of individuals with a migration background from non-Western countries, 2. the percentage of individuals receiving social assistance, 3. the average household income, 4. the average property value and 5. the percentage of residents who have moved in the past three years in or out of the neighbourhood. A negative score (-) indicates less or no disadvantage, while a positive score indicates more disadvantage. For the Hague, the average score is set at 0. Therefore, a negative or positive score signifies a deviation from the average score of The Hague. In the neighbourhood with the highest score (13.9) – so most deprived -, we selected a primary healthcare centre where people were recruited for an interview. Our quantitative analysis used ELAN data from adults with T2DM participating in an integrated diabetes primary care program in the same primary healthcare centre. The different methods described were used to ensure comprehensiveness and triangulation of results. Results were integrated at the interpretation and reporting level through narrative in the contiguous approach [14].

According to the Dutch government, the first confirmed COVID-19 case in the Netherlands was identified on 27th of February, 2020, and the first government measures were instituted in March 2020. For the purposes of this study, we considered 1st March, 2020 as the beginning of the COVID-19 pandemic in the Netherlands.

Data collection

We developed a survey to explore the impact of the COVID-19 pandemic and the ensuing changes to diabetes care for people of different socio-economic status. Semi-structured interviews were performed with people registered at a primary care practice in a deprived neighbourhood from a Turkish, Moroccan or Surinamese background, which are the largest non-western ethnic minority groups in the Netherlands [15]. In the selected neighbourhood (25.2%) of the population is Turkish, (20.1%) Moroccan, and (14.2%) or Surinamese, much higher than the average in the Netherlands (Turkish 2.4%, Moroccan 2.4%, Surinamese 2.1%) [13, 15]. This was then broadened to include a quantitative analysis of routine care data concerning diabetes regulation (Hba1C, fasting glucose, BMI, systolic blood pressure, LDL and eGFR) from people with T2DM registered at the same primary care practice to get a complete overview of the impact of the COVID-19 pandemic on diabetes care and regulation.

Survey

Eligible individuals were selected and invited by ELAN-affiliated GPs in neighbourhoods of different socio-economic status. After receiving informed consent, participants were sent a link that would allow them to fill in the survey (see appendix 1 for the complete survey). Covid-related questions focused on the following topics: the general impact of COVID-19, impact on the delivery of diabetes care and experience with video consultation.

Treatment satisfaction was assessed by the *Diabetes Treatment Satisfaction Questionnaire* (DTSQ, range 1–36). A higher score indicates a higher treatment satisfaction [16, 17].

Well-being was assessed using the World Health Organisation-5 *Well-Being Index* (WHO-5). This questionnaire consists of five statements (range 0–5) and the sum of the answers is multiplied by four, in which zero is the worst wellbeing imaginable and 100 the best wellbeing imaginable [18]. Resilience was tested using the *Brief Resilience Scale* (BRS), which consists of six factors, three items negatively worded and three positively. The resilience of the participant is assessed by the reverse coding of the negatively worded questions, followed by finding the mean of all the factors. According to Smith et al., the score can be divided into low (1.00 – 2.99), normal (3.00 – 3.50) and high resilience (3.51 – 5.00) [19].

Empathy of the healthcare provider was assessed by the *Consultation and Relational Empathy* (CARE) measure; this questionnaire consists of ten questions (range 1–5) and is focused on the ability of the practitioner to understand the patients feelings, perspectives and situation, and how they communicate and act on this understanding [20]. The skills of the practitioner can be assessed by the sum of the answers.

Disease and demographic characteristics

Disease and demographic characteristics of survey participants were extracted from ELAN, if available, as well as for all people with T2DM from a primary healthcare centre in a deprived neighbourhood. Extracted ELAN data included: HbA1c (mmol/mol), fasting glucose (mmol/L), LDL (mmol/L), SBP (mmHg), BMI (kg/m^2), diabetes duration (in years), age, sex, eGFR (ml/min/1.7), T2DM medication (no medication, only oral medication, or insulin-dependent) and COVID-19 infection.

Interviews

In addition to the survey, we conducted interviews based on the chronic care model (CCM), a guide to higher-quality chronic illness management within primary care. This model predicts that improvement in its interrelated components—including self-management support, decision support, healthcare organization, and community resources—may contribute to better patient outcomes. This framework has previously been applied to primary diabetes care [21].

The interview guide was based on the CCM domains: 'resources and policies', 'process of care', 'decision making' and 'self-management'. Based on these themes, a more detailed topic list was developed by an interdisciplinary team consisting of a bachelor student in medicine (BG), a GP (JK), a psychologist with expertise in qualitative research (SvB), and an epidemiologist (RV).

During the periodic diabetes consultation, the nurse practitioner (NP) from the selected GP practice in a deprived neighbourhood invited people with T2DM and from an ethnic minority background to participate in the study. Oral and written information about participation was provided. The interviewer (BG) spoke both Dutch and Turkish fluently, so participants needed to have sufficient oral proficiency in either language; otherwise, this was a reason for exclusion.After their consultation with the NP, semi-structured interviews with participants were held face-to-face at the primary care practice and enrolment continued until thematic saturation was reached.

All interviews were recorded, with the permission of the participants, and were transcribed verbatim. All transcriptions were pseudonymized before analysis to protect privacy.

Data analysis

Survey

Data analyses were performed in R studio version 22.07.1. Descriptive statistics were expressed as n (%) or for the validated questionnaires as means (sd).

Disease and demographic characteristics

The primary endpoint was HbA1c change over time, with a change of 5.5 mmol/mol considered clinically relevant [22]. The secondary endpoints were difference in FG, LDL, SBP, weight, BMI and eGFR. Differences between means in the year preceding and the first year of the pandemic were used as outcomes. Complete case analysis was chosen and missing data were excluded. Normal distribution of continuous variables was assessed with Q-Q plots.

Paired t-tests (normally distributed) or Wilcoxon signed rank tests (non-normal distribution) were used to test if the results were clinically relevant.

To identify individuals with T2DM most likely to benefit from regular face-to-face consultations, based on increased HbA1c during the pandemic, we carried out Latent Class Analysis (LCA) to identify classes of participants based on their sociodemographic characteristics. We used R (poLCA package) to estimate LCA models using the following variables: sex, age, having had Covid, physical activity, medication use and diabetes duration at the start of the pandemic. To conduct LCA a sample size of at least 300 cases is desirable, with a minimum of 50 cases per class [23, 24]. The number of latent classes was determined using Bayesian Information Criteria (BIC), with lower values indicating a better fit of the model [24]. Once the optimal number of latent classes was determined, the classes were first described in terms of sociodemographic characteristics. Next, we studied the association between class membership and HbA1C using linear regression analysis to identify any differences in HbA1c outcome between classes.

Interviews

Transcripts were analysed using thematic analysis. We used both an inductive and deductive approach. Relevant quotes were first highlighted independently by two researchers (BG and SvB). Both researchers then categorized the quotes independently deductively into domains of the CCM, and inductively into subcategories and clusters using the Framework Method [25]. The interpretation was discussed and rediscussed until consensus was reached. For each quote we report whether it acted as a barrier to or a facilitator of appropriate disease management.

Results

Survey

In total, 171 participants completed the survey, with disease and demographic characteristics available for 54 participants (Table 1). Regarding type of consultation (face-to-face, telephone or video consultations) before and during the COVID pandemic, most participants had face-to-face consultations (59%) or contact by telephone (44%) (Fig. 1), with a majority stating that they had the same level of contact before as during the COVID-19 pandemic (64.3%). Only 19% claimed to have less frequent contact with their healthcare provider. Nevertheless, measurement of HbA1c levels four or more times a year decreased during the pandemic, while no or only one measurement per year increased. During the COVID-19 pandemic self-reported HbA1c levels were stable for 39% of participants, increased in 25% and decreased in 24%.

The average score for treatment satisfaction (DTSQ) was 27.9 (SD 6.6), while the total score for well-being (WHO-5) was 58.7 (SD 21.9). As regards resilience scores (BRS), 37% of participants had a normal score, compared to 43% with a high score and 20% with a low score. The average score for empathy of the caregiver (CARE) was 36.7 (SD = 8.6). Questionnaire scores per question can be found in appendix 2. Disease control among survey participants did not change significantly during the COVID-19 pandemic (Table 2).

Routine medical data from a GP practice centre

We analysed data on 607 people with T2DM registered with a healthcare centre in a relatively deprived area. The mean age was 62.4 years (SD11.6), with a mean of 13.4 (SD 6.3) years since their T2DM diagnosis (Table 1). The number of missed laboratory check-ups increased after the first year of the pandemic, especially for BMI, GFR and LDL (Table 3). HbA1c increased from 56.5 (13.2 sd) to 57.0 (13.5 sd)mmol/mol; $p < 0.003$). Glucose increased from 8.2(2.0 sd) to 8.3(2.0 sd) ($p < 0.001$) and systolic blood pressure from 132.3(15.2 sd) to 136.0(16.2 sd) mmHg ($p < 0.001$). The eGFR decreased from 89.8(19.3 sd) to 88.5(20.1 sd) ($p < 0.001$). LDL and BMI did not change during the pandemic.

We then performed LCA and chose the model with the lowest BIC, which was the model with two classes. Comparing class 1 ($n = 169$) with class 2 ($n = 317$), class 1 was characterized by a younger age, fewer years since their T2DM diagnosis and greater use of oral medication only or lifestyle advice only (Fig. 2). The two classes were comparable regarding sex distribution, numbers with Covid-19 and physical activity. To identify possible differences in HbA1c between the different groups we performed linear regression. However, with a beta coefficient of 0.02, there were no significant differences ($p = 0.106$).

Table 1 Characteristics of the population that completed the survey and the population from a GP practice in a deprived neighbourhood

	Survey (*N* = 171)	**People with T2DM from a GP practice in a deprived neighbourhood (*N* = 607)**
	N (%)	**N(%)**
Age (mean, SD)	69 (9)	62 (12)
Female	63 (37)	316 (52)
Years of diabetes		
< 1 year	9 (0.1)	13 (6)
1–10 years	84 (49)	
> 10 years	78 (46)	
Used treatment		
Lifestyle	83 (49)	136 (22)
Oral medication	134 (78)	360 (59)
Insulin	27 (16)	111 (18)
Comorbidity		
Hypertension	66 (39)	442 (73)
Hypercholesterolemia	29 (17)	271 (45)
Heart disease	32 (19)	261 (43)
Obesity	76 (44)	265 (44)
Kidney disease	15 (9)	115 (19)
Pulmonary disease	20 (12)	168 (28)
Covid-19		
Yes	12 (7)	91 (15)
No	159 (93)	516 (85)

Interviews

Inclusion of 10 individuals with T2DM was sufficient to reach interview data saturation. All interviewees received structured primary diabetes care from a healthcare centre located in a deprived neighbourhood. The interviewees (5 females, 5 males) consisted of four from Suriname, four Turkish and two Moroccan participants, which all are important ethnic minorities in the Netherlands (Table 4).

In each domain, subcategories emerged in which different clusters were determined.

Resources and policies

Resources and policies during the pandemic affected the lives of most participants in various ways. Two subcategories emerged: 'Impact on the individual level' and 'Media influence'. The subcategories, clusters and illustrative quotes are presented in Table 5. In the subcategory 'impact on the individual level' participants described their general experiences, which consisted mainly of barriers, in a society under COVID-19 measures. One participant, with a daughter in her final year of primary school, struggled with the fact that social activities like the school camp and musical were cancelled (Q1). Participants also reported being lonely during the pandemic, with one participant comparing lockdown with wartime, while another missed her children and a third stated that contact via the telephone is not the same as face-to-face contact (Q2-Q4). Participants missed their social life, which was felt most by housewives because their partners could still go to work (Q5). One participant experienced little change, as she could still go to work by bicycle (Q6). As regards their understanding of COVID-19 measures at the GP practice, most participants expressed support because they had lost close family to COVID-19 (Q7-Q9). One participant expressed concerns about making an appointment by phone. While she had no trouble herself, she was worried that her non-Dutch speaking neighbours might find it difficult to schedule a GP appointment over the phone, since visiting the practice in person was not permitted (Q10). Participants reported that pharmacy accessibility was good (Q11). As concerns compliance to COVID-19 measures, one participant felt this should be dependent on infection rates, while another found it easier to comply as rules in the Netherlands were less strict than in her country of origin (Q12 and Q13).

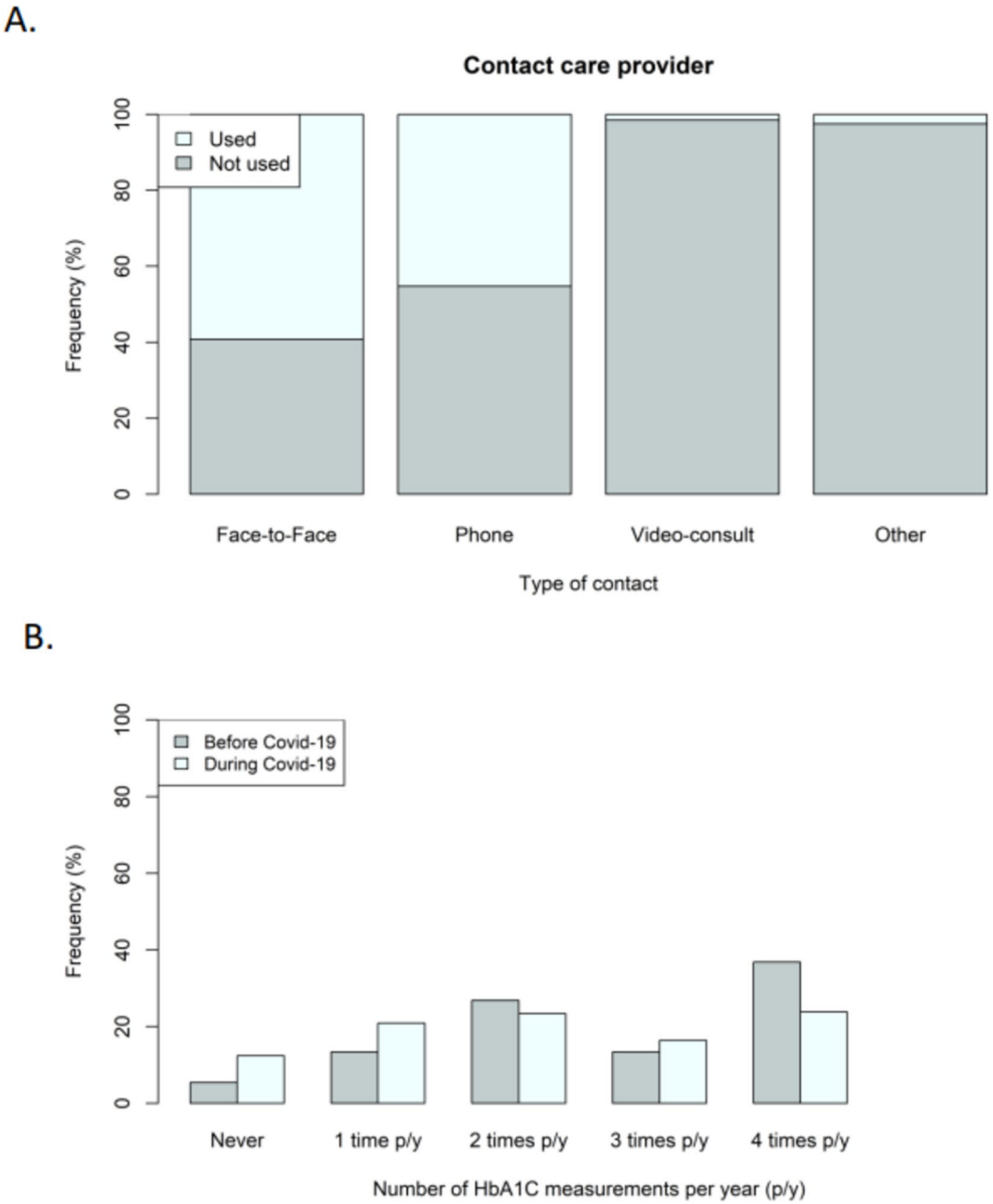

Fig. 1 Contact with healthcare provider. **A** Type of contact with healthcare provider during the COVID-19 pandemic. **B** Number of HbA1c measurements per year

Table 2 Changes in disease control in survey participants

	Baseline[a]	After Covid[a]	*P*-value
HbA1c (*n* = 54)	55.6 (10.6)	56.4 (10.7)	0.109
Fasting glucose (*n* = 72)	8.5 (2.2)	8.3 (2.0)	0.443
BMI (*n* = 44)	29.9 (4.9)	29.6 (5.1)	0.405
Systolic blood pressure (*n* = 46)	135.4 (15.7)	133.6 (11.7)	0.056

HbA1c was measured in mmol/mol, fasting glucose was measured in mmol/L, BMI was measured in kg/m^2, systolic blood pressure was measured in mmHg. [a]mean (SD)

Table 3 Number of missings before and after the first year of the covid pandemic

	Before Covid	After Covid
HbA1c	32 (5.3%)	75 (12.4%)
FG	25 (4.1%)	76 (12.5%)
SBP	37 (6.1%)	117 (19.3%)
LDL	67 (11.0%)	145 (23.9%)
eGFR	59 (9.7%)	132 (21.7%)
BMI	55 (9.1%)	152 (25.0%)

Table 4 Characteristics of interview participants

Speaker	Sex	Age	Country of origin	Reference
1	Female	59	Suriname	1_F_59_Sur
2	Male	66	Morocco	2_M_66_Mor
3	Male	42	Morocco	3_M_42_Mor
4	Male	54	Suriname	4_M_54_Sur
5	Male	50	Turkey	5_M_50_Tur
6	Female	53	Turkey	6_F_53_Tur
7	Male	50	Turkey	7_M_50_Tur
8	Female	60	Suriname	8_F_60_Sur
9	Female	44	Turkey	9_F_44_Tur
10	Female	40	Suriname	10_F_40_Sur

In the second subcategory 'media influence', participants reported that they found the available information reliable, although one participant felt that information in the Netherlands was more chaotic than in his country of origin (Q14 and Q15). For the domain of 'resources and policies' there was a variety of experiences during the COVID-19 pandemic, marked by a wish for social connections, support of health measures, different perceptions on the accessibility of health care and varying trust in the information received by the media.

Process of care: delivery of diabetes care

All participants indicated that the COVID-19 pandemic had a significant impact on the delivery of diabetes care in primary care. Two subcategories emerged: 'disease insight' and 'remote care'. An overview of these subcategories, clusters and illustrative quotes is presented in Table 6.

Concerning 'disease insight', most participants considered the monitoring of their diabetes-related health outcomes important (Q16). One participant, who admitted to sometimes being reluctant to go to consultations because he knew his blood values would be high, nevertheless recognized the added value of periodic diabetes check-ups (Q17).

As a result of the COVID-19 restrictions, diabetes care was often delivered remotely. In the subcategory 'Remote care', most participants reported that they could reach the GP practice if necessary and that they received sufficient support during the pandemic (Q18).

One participant mentioned that remote care hindered open communication with the practice nurse. He measured his blood values at home, but hid the–worsened –outcomes due to fear of the consequences (Q19). By contrast, contact by phone was a good alternative

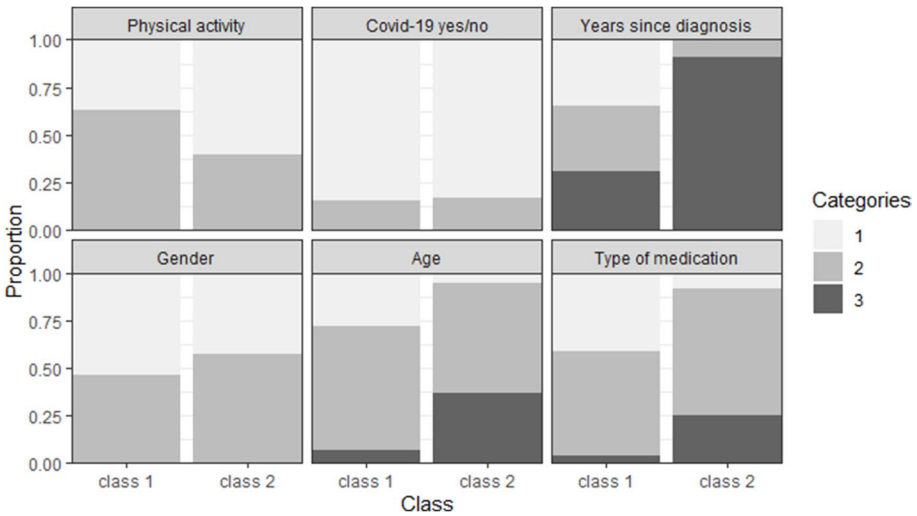

Fig. 2 Latent class analysis. Description of categories: 'Physical activity': 1 = not enough physical activity, 2 = enough physical activity, 'Tested positive for Covid-19': 1 = no, 2 = yes, 'Years since diagnosis': 1 = < 5 years, 2 = 5–10 years, 3 = > 10 years, 'Sex': 1 = male, 2 = female, 'Age': 1 = < 50 years, 2 = 50–70 years, 3 = > 70 years, 'Type of medication': 1 = no medication, 2 = oral medication, 3 = insulin

Table 5 Resources and policies: overview of each subcategory including underlying clusters and quotes of people's experiences

Subcategory	Cluster	Quotes
Impact on individual	Experiences in society in general with regard to COVID-19 measures	Q1. (Barrier) "My daughter was in her final year (group 8) of primary school. She couldn't go to camp, take part in the musical or any other activities. I also couldn't thank her teachers personally. That was a real pity." (6_F_53_Tur)
	Loneliness during the pandemic	Q2. "I felt very lonely during the lockdown period. You weren't allowed to go outside after 9:00 PM. We had to race home when it was close to 9:00 PM. And the police kept driving around. Very scary, it was like wartime. It was a relief when the lockdowns ended." (6_F_53_Tur)
		Q3."Yes, at certain times I felt lonely. Especially at weekends as I was used to being with my kids. We did video calls and sometimes my kids brought groceries for me, but they kept their distance; they were afraid because I have diabetes." (8_F_60_Sur)
		Q4. "Real life is different from the telephone. If you see someone, you can give them a hug. I couldn't hug anyone, even my own sister. So yeah, that was really tough." (4_M_54_Sur)
	Social life	Q5. (Barrier) "As women we love meeting up, going to nice places together and going out. Sitting together with friends and talking about things is very different from sitting at home alone. It was even more difficult for housewives, because men still went to work." (9_F_44_Tur)
		Q6. "The pandemic wasn't a disaster for me because I was still cycling to and from work, so I was mobile. I didn't really have a social life, and I don't really have social contacts because I just live here in the Netherlands, so it didn't really affect my life." (10_F_40_Sur)
	Understanding for measures at GP practice	Q7. (Facilitator) "Yeah sure, because a lot of people have died. Many people died, particularly in the beginning, and people are still dying. That's why it's good that they have taken measures." (9_F_44_Tur)
		Q8. "I have seen the consequences of COVID-19 in my close family. One family member, a taxi driver, died. That does something to you. Another thing, in the past I had an allergic reaction and stopped breathing. I don't want to experience that again, it was very frightening." (1_F_59_Sur)
		Q9. "I have lost 4 relatives to COVID-19. Imagine, I am on my way to my brother-in-law's funeral, and I get off a plane and then I suddenly hear that my mother has also died. That is very difficult. That's why I think it's good that they took measures." (9_F_44_Tur)
		Q10. (Barrier) "I found it very difficult in the beginning, because normally you could walk in to make an appointment. But now it all has to be done by phone, which is a real pity. Not for myself but for immigrants living in this area who don't speak the language. That really bothered me. I was worried that people who don't speak Dutch wouldn't be able to make an appointment. I think there should be other options for those people." (6_F_53_Tur)
	Pharmacy accessibility	Q11. "Yes, I always went in the morning because there are usually not that many people. Or when it was raining or whatever. To avoid crowds during COVID-19, it's best to go during horrible weather." (1_F_59_Sur)
	Compliance	Q12. "When there are fewer cases you're more willing (to do things). But when you know that cases are increasing again…—I actually left home with a face mask when I saw masses of people. I am extra careful now." (3_M_42_Mor)
		Q13. "Yes, in Turkey they are much stricter. I don't think it's good that it's even mandatory to wear a face mask outside. I followed the measures most closely here in the Netherlands, because it was less strict than in Turkey." (9_F_44_Tur)
Media influence	Information given	Q14. (Facilitator) "Information is first-hand, straight from the health minister. So both are reliable. Look, Hugo de Jonge is also a minister. They are both ministers, so why would they lie?" (5_M_50_Tur)
		Q15. "The Turkish health minister provides daily updates. It's a bit of a disaster scenario here in the Netherlands, it's just chaotic. If you compare the two, I think the Turkish approach and information is much better. " (5_M_50_Tur)

according to one participant, and sometimes even better than a face-to-face consultation because you don't need to leave the house (Q20). For the domain 'delivery of diabetes care', while participants recognized the importance of monitoring their diabetes and generally found remote care during the COVID-19 pandemic to be effective, they also highlighted challenges such as fear of reporting worsened health outcomes when these were measured at home.

Table 6 Delivery system design: overview of each subcategory including underlying clusters and illustrative quotes

Subcategory	Cluster	Quote
Disease insight	Added value of periodic check-ups	Q16. (facilitator) "My blood sugar is stable. It's not like it's varying wildly. I receive timely warnings from my healthcare provider." (1_F_59_Sur)
		Q17. (Barrier) "Yes, because you stay sharp. Then you know: hey, listen, this isn't going well. You can at least still switch. It may get you down for a few days, but then you say to yourself: 'Okay, now I have to do something about it'. During the summer I had treated myself to too many sweets, so you just know it isn't okay. So I felt real reluctance to come to the practice." (3_M_42_Mor)
Remote healthcare	Support from GP	Q18. (Facilitator) "Yes, [the GP was] always available of course. I mean, you call them and they help you. Sometimes things are not going so well, so when you call the GP you're on the phone for half an hour. Yes, that's normal." (5_M_50_Tur)
	Teleconsultation	Q19. (Barrier) "No [I didn't let my nurse practitioner know about my blood values], definitely not. If I had, that would have meant that something had to be done. I didn't feel like talking about my health. It was fear, a bit afraid of bad news. Where would it end? Would I have to go back to hospital for more tests? I might hear that it's even worse or they might tell me I needed more medication. Like this you can avoid it and hold on to a little hope that maybe one day you can resolve it by improving your lifestyle." (3_M_42_Mor)
		Q20.(Facilitator) "It's basically the same, although you can't weigh yourself you do discuss everything else. On the phone is almost the same as being there. I usually do the measurements myself. Periodic appointments for blood tests were cancelled in the early pandemic. We received a letter telling us that we were not allowed to take a blood test, so we just had to wait. I could check my values because I have my own blood glucose meter, that's how I kept checking myself. Personally, a telephone consultation was not a problem for me. It is actually better because you don't have to leave the house in the cold. Look, in the beginning you really have to get used to it, but once you're used to it, it's okay. For example, I think talking about results is better by phone. This could be continued in the future." (10_F_40_Sur)

Self-management (CCM)

The impact of the pandemic on diabetes self-management fell into two subcategories: 'disease insight' and 'lifestyle'. Clusters of detailed themes and descriptive quotes are presented in Table 7. Regarding 'disease insight', some participants indicated they purchased medical devices to keep an eye on their disease when physical consultations were not possible (Q21, Q22). The presence of other family members with diabetes also stimulated self-management (Q23). One participant reported active attempts to improve her diabetes regulation with dried fruits, which unfortunately contain high levels of sugar. As she couldn't measure blood sugar levels she didn't know whether it helped (Q24). One participant mentioned he sometimes forgot to take his medication (Q25). In the second subcategory 'lifestyle', participants who stayed at home found it more difficult to maintain a healthy lifestyle. Some participants felt that their diabetes health had worsened during the pandemic due to little physical exercise and a high consumption of sweets (Q26, Q27). Others thought their glucose levels were stable (Q28). Some participants tried to maintain a healthy lifestyle by keeping busy, while others received social support from family or colleagues that helped them to stay healthy (Q29-Q32). Most participants were Muslims, and in Islam, Ramadan – a month in which people fast from sunrise to sunset – is celebrated each year. This contributed to self-management according to some participants, as did perceived support from their faith (Q33). The COVID-19 pandemic influenced diabetes self-management among participants, revealing both adaptive strategies, such as purchasing medical devices and getting social support, as well as challenges like difficulties in maintaining a healthy lifestyle; this highlights the complexity of health management and lifestyle changes experienced during this period.

Discussion

In this mixed-methods study, our survey showed that most people maintained face-to-face or telephone contact with their healthcare provider, with very few participants using video consultation. However, as the frequency of four HbA1c measurements per year decreased, a reduction in the frequency of diabetes check-ups is likely despite claims to the contrary. This decrease also aligns with findings from other studies [26, 27]. At 27.8, treatment satisfaction among participants was high and comparable to a pre-pandemic Dutch study (28.5) [16]. Well-being seemed comparable or even slightly improved compared to before the pandemic (58.7 vs. 55.0), as found by another Dutch study of people with T2DM [28].

Further evidence supporting a decrease in check-ups was the near doubling of missing laboratory measures after the first year of the pandemic. Together with a modest but statistically significant increase in HbA1c levels and FG, this suggests that regular check-ups are important for diabetes control. However, differences were small (0.5 mmol/mol) and not clinically relevant over this time frame. How regular check-ups should be to maintain

Table 7 Self-management: overview of each subcategory including underlying clusters and illustrative quotes

Subcategory	Cluster	Quotes
Disease insight	The use of medical devices	Q21. (Facilitator) "Yes, I have [medical devices]. I bought a blood pressure monitor during the pandemic to keep track of my own blood pressure. Because now and then you feel a bit odd and I thought this was a way to keep checking myself." (8_F_60_Sur)
		Q22. "Periodic appointments for blood tests were cancelled (…). I've got my own blood glucose meter; that's how I kept checking my values. For me it wasn't a problem." (10_F_40_Sur)
	Diseases in the family	Q23. (Facilitator) "Yes, many of our relatives have diabetes. That's why I'm conscious of the dangers of diabetes and the reason why I do my best to keep my sugar levels under control." (9_F_44_Tur)
	The use of alternative medicine	Q24. (Barrier) "[Yes, I tried some alternative medicine during the pandemic.] A type of dried fruit from Turkey. You have to cook it and then drink half a glass every day. I tried it but I don't know if it helped because I can't check myself. I haven't got a device to measure blood sugar. I've tried various things. Yes, grapefruit, there's no sugar in that either." (6_F_53_Tur)
	Medication adherence	Q25. (Barrier) "Being at home I do have periods when I forget. Every day is almost the same, so you can't remember and start to wonder: Did I or didn't I take it? There were actually days when I thought, 'I'm not going to take another one because of side effects.'" (3_M_42_Mor)
Lifestyle	Diabetes regulation	Q26. (Barrier) "Guaranteed my sugar has gone up. You're not getting any exercise. [You had] nowhere to go because everything was closed. I am also a stress eater, so I ate sugary things. It made me feel bad, no exercise, unhealthy food and a lot of stress. You don't get out of the house. I was tired all the time." (3_M_42_Mor)
		Q27. (Barrier) "I didn't go out for quite a while, at least three or four months. You just lie on the bed, eat, sometimes eat sugary things and hardly move." (5_M_50_Tur)
		Q28. (Facilitator) "My blood sugar is stable. It's not like it's varying wildly. I receive timely warnings from my healthcare provider." (1_F_59_Sur)
	Physical activity and diet	Q29. (Facilitator) "Yes, when I had to work I went out every day. Or I was busy in my garden. I like to keep busy. Or I'm doing some painting. I'm always busy with something. No, every day was not the same for me during the COVID-19 period." (4_M_54_Sur)
	Social support	Q30. (Facilitator) "I tried to exercise, also because of my kids. They think a lot about me. They said to me, 'Dad, please don't get, you know, like, Dad, please don't have soft drinks, don't have sugar, et cetera. We also bought fewer crisps during the pandemic. My kids said, 'Dad, just stop for a while'. It's also important that your kids are in on it, because if your children participate the whole family does too." (7_M_50_Tur)
		Q31. (Facilitator) "My two sisters-in-law in particular are really trying to help me. If I eat something unhealthy, they tell me. They also call me to ask how I am doing. Sometimes when I tell them I have a headache, they tell me to pay more attention to my disease. I am grateful. They are good people." (9_F_44_Tur)
	Self-confidence to control diabetes	Q32. (Facilitator) "Yeah, just believe in yourself. I have my family, my friends, and very good colleagues. And I walk a lot at work. Okay, they say that's not the same as exercising, but I walk 18,000 steps at work." (4_M_54_Sur)
	Religion	Q33. (Facilitator) "For example, when fasting during Ramadan I can stop myself eating until 11 o'clock in the evening, no real problem. But outside of Ramadan, if I'm not fasting I can't stop myself if I haven't eaten for a few hours. Faith gives me strength." (9_F_44_Tur)

an acceptable level of care will require follow-up over a longer period of time.

Concerning glycaemic control during the pandemic, existing literature is inconsistent, with two studies finding no significant changes in HbA1c [29, 30], whereas a systematic review reported changes in HbA1c [31]. In an attempt to identify specific groups at greater risk of poor glycaemic control we conducted latent class analysis. However, no differences were found between the classes, although this could be due to missing values after the first year of the pandemic. It might also suggest that other unmeasured factors influenced risk of uncontrolled diabetes.

This assumption was confirmed by interviews of people with T2DM, as factors in the domain of self-management such as use of medical devices, religion, routines and social support from family, friends and neighbours all emerged as important facilitators of a healthy lifestyle. A meta-analysis has previously shown that social support can improve the self-management of people with T2DM [32]. Participants who spent a lot of time at home found it more difficult to regulate their diabetes, and other barriers to good diabetes regulation included poor dietary choices (such as dried fruit) and depressive feelings, which were cited by participants as important and are known to affect diabetes regulation [33, 34].

Strengths of the study included the range of methods used, which provided a better understanding of the personal impact of COVID-19 on individuals. The social and personal factors that emerged from the qualitative study supported the objective routine care data. Another strong point of the study was the inclusion of non-Dutch speaking participants with a Turkish background as our interviewer also spoke fluently Turkish, providing a window on a group rarely represented in research studies.

Several limitations should also be mentioned. First, the survey focused on the way diabetes care was delivered during the pandemic, rather than the approach of comparing situations before and during the pandemic. Second, by using ELAN data we were bound to the values registered in the medical records and our dataset had numerous missing clinical values. By performing complete case analysis we might have induced selection bias. Data might be missing 'not at random' as we noticed that the percentage of missing data increased after the first year of the COVID-19 pandemic. This pattern of missing data suggested that fewer people visited the health centre during the first year of the pandemic compared with the preceding year, which on the other hand provided additional valuable insight.

Numerous missing values one year into the COVID-19 pandemic preclude a clear view of HbA1c levels for many individuals, but diabetes regulation may have worsened in this group, as inadequate registration of target indicators is associated with poorer HbA1c levels [11]. Risk stratification of adults who benefit more or less from regular face-to-face consultations might also be useful.

We found that factors such as social support and use of medical devices may be helpful and could be usefully included in any risk stratification. Interviewees supported the use of teleconsultation, suggesting that this may be a valuable healthcare tool when face-to-face contact is not possible. However, healthcare providers should be mindful that teleconsultation may hinder open communication as it seems to encourage people to avoid negative factors.

Conclusions

Our study showed that less diabetes care was delivered during the first year of the COVID-19 pandemic. Available healthcare was nevertheless still mostly provided face-to-face or by telephone consultations. Clinically-relevant changes to average HbA1c levels were not seen, and no specific group was identified as at risk for worse diabetes regulation.

However, in view of the increasing burden of healthcare for chronic conditions such as T2DM, it may be worth exploring who benefits the most from regular face-to-face check-ups, as groups may exist that require different levels of care in order to maintain good levels of health.

Supplementary Information

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Supplementary Material 1.

Supplementary Material 2.

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Not applicable.

Authors' contributions
SG, RV, HV, SB, JK and PU contributed to the design of the study. SG, RV, HV and SB developed the survey. PU facilitated data collection. SG and MM did the quantitative analyses. RV, SB, JK and BG developed the topic list for the interviews. BG conducted the interviews. BG and SB analysed the qualitative data. SG drafted the manuscript. RV, HV, SB, JK, PU and MN helped drafting and revising the manuscript. All authors read and approved the final manuscript.

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Data availability
The data that support the findings of this study are available from ELAN but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are however available from the authors upon reasonable request and with permission of ELAN.

Declarations

Ethics approval and consent to participate
This study conformed to the principles of the Declaration of Helsinki and Dutch law, and was approved by the Institutional Review Board of the Leiden University Medical Center (LUMC) for observational Covid-19 studies (reference 'CoCo 2020–062'). The Medical Research Involving Human Subjects Act (WMO) was not applicable. Consent to Participate declaration: Informed consent was obtained from participants of the survey and the interviews. In accordance to Dutch legislation, individuals from the participating GP practice were informed by the GP about use of their anonymized data for research purposes and could withdraw via an informed opt-out procedure.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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