Contents available at ScienceDirect

Diabetes Research and Clinical Practice

journal homepage: www.elsevier.com/locate/diabres

International Diabetes Federation

Experiences of people with type 1 diabetes fasting Ramadan following structured education: A qualitative study

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ARTICLE INFO

Article history:
Received 14 February 2019
Received in revised form
16 April 2019
Accepted 20 May 2019
Available online 28 May 2019

Keywords:
Ramadan
Type 1 diabetes
Structured education
DAFNE
Fasting

ABSTRACT

Background and Aims: Although people with type 1 diabetes are exempt from fasting the month of Ramadan due to the risk to their health, many wish to fast nonetheless. Little is known about the impact of structured education on the fasting experiences of people with type 1 diabetes. This study aimed to explore how the Dose Adjustment for Normal Eating (DAFNE) course affected people with type 1 diabetes' fasting experiences to provide insight into the benefits of structured education for people wishing to fast while managing their diabetes.

Methods: Semi-structured interviews were conducted with 40 DAFNE graduates who fasted Ramadan. The purposive sample was selected from the DAFNE registry at Dasman Diabetes Institute in Kuwait. The interviews were transcribed verbatim and analysed thematically in an iterative process. Topics discussed included fasting experiences prior to attending the DAFNE course, fasting experiences this year, and how DAFNE affected their fasting.

Results: Five themes emerged; (1) Reduction in fluctuations and complications, (2) Improvement in confidence and self-reliance, (3) Tailored support for dose and pump programming adjustments, (4) Positive effect on wellbeing, and (5) Encouraging informed-decision making about fasting.

Conclusions: The findings have provided insight into the impact of DAFNE structured education on the fasting experiences of people with type 1 diabetes and has shown how overall, DAFNE had enhanced the quality of fasting. In addition, by assisting them in fulfilling their fasting wishes, DAFNE has had a positive effect on their wellbeing.

1. Introduction

In 2017, there were approximately 1.1 million young people living with type 1 diabetes worldwide [1]. In Kuwait, there were 441,000 cases of diabetes in 2017, with a prevalence of 15% [2]. The incidence of type 1 diabetes in Kuwait has risen dramatically, with numbers moving it from the fourth to the second highest country worldwide [1,3]. In addition, the past

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https://doi.org/10.1016/j.diabres.2019.05.021
0168-8227/

two decades have seen an increase in the incidence of type 1 diabetes in Kuwaiti children, with the numbers doubling [4,5].

People with type 1 diabetes can develop microvascular complications with uncontrolled blood glucose; these include nephropathy, retinopathy and neuropathy [6]. Controlling blood glucose levels assists in reducing the risk of developing complications. The use of insulin therapy whilst applying certain principles can effectively control blood glucose levels. These principles were used by a group of German diabetologists at the Diabetes Centre in Dusseldorf in the 1980s; they developed a 5-day structured training programme to promote self-efficacy and management [7].

In the UK, the programme was reworked and introduced as an educational programme called Dose Adjustment for Normal Eating (DAFNE). It utilises problem-based learning and goal-setting activities to encourage self-efficacy and self-management, as well as empowering patients [8,9]. The central theme revolves around flexible intensive insulin therapy, in which basal and meal-time insulin are separated. This allows the basal insulin doses to maintain the blood glucose within range. DAFNE participants are taught how to anticipate altering their doses to correct their blood glucose accordingly. Counting carbohydrates and adjusting their fast-acting insulin dose based on their calculation is another skill taught in the DAFNE programme.

Initial results from the DAFNE programme at 3 UK centres demonstrated significant improvement in blood glucose levels with a decrease in hypoglycaemia, as well as increased patient satisfaction and better quality of life [10]. The success of the programme has allowed it to receive funding from the Department of Health and is now running in 71 centres around the UK [9]. Furthermore, it is now recognized internationally and is active in Ireland, Australia, New Zealand, Kuwait and Singapore.

The DAFNE programme has been active at Dasman Diabetes Institute (DDI) for 10 years in Kuwait, in collaboration with the Ministry of Health (MOH) and is a licensed centre in the Middle East. The 5-day course is run by 2 trained DAFNE educators, with a group consisting of 6–8 adults with type 1 diabetes. The participants must attend the full 5 days from 4:30 pm till 9.30 pm. There are approximately 483 graduates of the program who are being followed-up by the DAFNE team, and many more being included.

People with type 1 diabetes have been known to fast the month of Ramadan. During the month of Ramadan, Muslims abstain from food and drink during the daylight hours. Ramadan is the ninth month in the Muslim lunar calendar, and it commences approximately 10 days earlier every year. Adult Muslims who are able and well are required to fast. During the summer and depending on the geographical location, fasting during daylight hours can be as long as 20 h. In Kuwait, fasting was approximately 16 h during Ramadan in 2018, and was 29 days.

People with type 1 diabetes are considered exempt from fasting due to the risk to their health, although many people wish to fast nonetheless [11]. Recommendations and advice for diabetes patients when fasting have been published previously and updated to ensure patients and their health care professionals (HCPs) are informed about safe fasting practices [12–15,11]. The main complications resulting from fasting include severe hypoglycaemia, hyperglycaemia, dehydration and diabetic ketoacidosis (DKA).

A few studies have been conducted that explore diabetes patients' beliefs and experiences with fasting Ramadan [16–20], although they were not conducted in the Middle East and therefore results may not be generalisable due to location and culture differences. Furthermore, they were not all specifically about type 1 diabetes; the management of type 1 diabetes and the fasting experience differ greatly from type 2 diabetes. In addition, they do not consider the effect of structured education on fasting. Ramadan-specific structured education has been shown to reduce hypoglycaemic episodes in patients with type 2 diabetes [21]. People with type 1 diabetes self-manage their diabetes, and managing type 1 diabetes is very complex, especially in Ramadan with the change in eating habits. The DAFNE course offers an important opportunity to allow those who wish to fast to do so safely. The current study is novel as it gained in-depth experiences of people with type 1 diabetes who are part of DAFNE and decided to fast.

The aim of the current study was to identify if structured education in the form of DAFNE courses has an impact on people with type 1 diabetes' fasting experiences and explore how DAFNE has supported them.

2. Methods

2.1. Study design

In order to achieve the study's aim, a qualitative approach was implemented for the study design. Semi-structured interviews with open and structured questions and prompts were used. A topic guide was developed by reviewing the literature. In addition, a pre-Ramadan workshop was conducted for DAFNE graduates; themes emerging from group discussions informed the development of the topic guide. The interview questions were in English and translated to Arabic using a translator. Discrepancies were discussed between the researcher and translator and consensus reached on the final topic guide. The topic guide was updated twice during the interview period to reflect new topics that emerged from the interviews. Ethical approval was obtained from the Ministry of Health (2016/435).

2.2. Sampling and recruitment

Purposive sampling was employed to fulfil the research objectives by choosing those who have fasted, no matter how many days. Purposive sampling took place to ensure diversity of age, gender, days fasted, years as DAFNE graduate, and years since diagnosis in the final sample. The sample aimed to people who are either using multiple daily injections (MDI) or on insulin pumps, across all ages and nationalities, and both sexes.

Participants were recruited from the DAFNE registry in Kuwait. Those who fasted were identified and contacted via telephone for consent to be interviewed. A date and time convenient for the participants was chosen and the participants were interviewed at DDI, which is where the DAFNE courses take place. Interviews commenced the week after the Eid holiday to ensure people were free after the holidays and cel-

ebrations. The interviews were completed within the first month after Ramadan to lower the risk of recall bias. Recruitment ended when data saturation was achieved.

2.3. Data collection and analysis

The study and the participants' involvement were explained by the researcher and signed consents were taken. The principal investigator is an experienced, bilingual interviewer, fluent in both Arabic and English, is a health care professional, and is from the same culture as the participants. The interviews were conducted in Arabic or English, depending on the participants' choice. They were audio-recorded and transcribed verbatim by a member of the research team. The data was managed using the qualitative data management software MAXQDA 2018 [22]. Transcripts were kept in the source language; it was decided not to translate the transcripts to ensure no meaning is lost through translation [23]. The analysis and specific quotes were translated to English for dissemination purposes.

Analysis was conducted using principles of thematic framework analysis, and it was an iterative process. Both inductive and deductive approaches were utilised, as well as constant comparison across transcripts; this was to ensure that theories were not limited to what is already known, and that analysis was not rigid [24]. Constant comparison enabled an iterative approach whereby themes were searched and compared across participant data sets [25,26].

Before being transferred to MAXQDA, transcripts were re-read alongside listening to the audio-recording to ensure accuracy. This was also done so the researcher familiarises themselves with the data. Initial analysis and annotation of interesting text was done while transcribing before moving the qualitative data to MAXQDA. This assisted in generating broad codes and identified recurring themes and concepts by using principles of thematic framework analysis [27]. Coding was independently reviewed by another member of the research team and consensus reached to ensure validity and reliability.

3. Results

3.1. Participant demographics

A total sample size of 40 was obtained, with 23 MDI users and 17 insulin pump users. Data saturation was achieved with this sample size. The mean age was 33 years, ranging from 21 to 53 years. The average duration of disease was 17.8 years (range from 3.5 to 37 years). The average total days fasted was 25.6 days. The graduates had joined DAFNE at different time points; some participants were from the very first group of graduates, while others had joined in the previous year and were fasting for the first time. Table 1 details the participant demographics. Those on MDI either used flash glucose monitoring (FGM) or regular blood glucose monitoring devices. Insulin pump users had either FGM or continuous glucose monitoring (CGM).

Table 1 – Demographics of participants fasting during Ramadan.

Demographics	Number of participants
Gender	
Male	16
Female	24
Age range	
21–29	14
30–39	15
40–49	9
50–69	2
Nationality	
Kuwaiti	33
Egyptian	2
Jordanian	2
Iraqi	1
Palestinian	1
Kenyan	1
Duration of disease	
<5 years	2
5–10 years	7
11–15 years	8
16–20 years	11
>20 years	12
Therapy type	
MDI	23
Insulin pump	17
Time in DAFNE	
First year	13
2–4 years	9
5–7 years	12
8–9 years	6
Days fasted range	
10–15 days	2
16–20 days	2
21–25 days	7
26–28 days	17
All of Ramadan	12

3.2. Themes

Participants discussed their fasting experiences prior to enrolling in the DAFNE course and compared these with their current fasting experiences. Five main themes emerged from analysis of the data relating to the impact of DAFNE structured education on fasting experiences. These were (1) reduction in fluctuations and complications, (2) improvement in confidence and self-reliance, (3) tailored support for dose and pump programming adjustments, (4) positive effect on wellbeing, and (5) encouraging informed-decision making about fasting. The themes are detailed below with supporting quotes from participants to elucidate them. Table 2 summarises the themes, sub-themes, and quotes to support each theme.

3.2.1. Reduction in fluctuations and complications

Participants discussed how they had better fasting experiences this year as they saw a reduction in fluctuations, as well as severe hypoglycaemia and hyperglycaemia episodes. In addition, some participants recalled how they underwent recurrent hospital admissions for DKA or severe hypoglycaemia episodes, and this had stopped after enrolling in DAFNE. "*The past 2 years were filled with hyperglycaemia episodes.*

Table 2 – Themes and sub-themes with supporting quotes.

Themes	Sub-themes	Illustrative Quotes
Reduction in fluctuations and complications	• Reduction in hypoglycaemia/hyperglycaemia episode reoccurrence, diabetic ketoacidosis and hospital admission. • Adopt safer fasting practices e.g. breaking their fast and not withstanding hypoglycaemia. • Enhance quality of fasting and fast more days. • Learning to adjust doses according to meals rather than fixed dosing. • Learning about correction doses and their use in managing hyperglycaemia when fasting.	*"The past 2 years were filled with hyperglycaemia episodes. It used to reach 22. I suffered greatly. I used to go to the hospital almost on a daily basis. Intravenous fluids were a necessity." Participant 33, MDI, Female, 21 years old* *"This year's fasting was great. Best fasting experience in my life…the amount, I fasted more days, 28 days. My diabetes is controlled" Participant 6, insulin pump, Male, 31 years old*
Improvement in confidence and self-reliance	• Increase in confidence led to better and safer self-management when fasting. • Adopted self-reliance strategies, such as daily diaries to understand trends. • Depended on themselves and required minimal reassurance from educators.	*"In Ramadan, your whole routine changes, even the food changes. Some new things [food] are added and others are removed. So, I need to write this down so I remember" Participant 39, insulin pump, Female, 30 years old* *"I know how to manage [her diabetes], and I don't have to guess anymore, instead I know how to ensure my body isn't affected by diabetes. So, this makes me happy, the fact that I know how to manage diabetes in all situations" Participant 9, MDI, female, 36 years old*
Tailored support for dose and pump programming adjustments	• Teaching the graduates dose and pump programming adjustments prior to Ramadan made them feel supported and ensured they fasted safely.	*"Before I used to be on my own, so I adjusted my doses, I increase and I…this time I'm more comfortable because they [DAFNE] adjusted my doses for me and I tried fasting a day before Ramadan. So, I was sort of calmer because my doses were adjusted…it was easier than previous years" Participant 10, insulin pump, female, 28 years old*
Positive effect on wellbeing	• Better control and confidence gave graduates opportunity to fast for first time. • Alleviated previous fears of hypoglycaemia during Ramadan.	*"I told [the DAFNE educator] "it's an unbelievable feeling. Maybe you can't sense it, but I do". This is the first Eid I celebrate honestly!…Yes. it really, really, really made a difference." Participant 16, insulin pump, Female, 39 years old* *"I'm telling you, I used to be afraid, I used to worry even when praying, in the mosque, if there's something or there isn't [hypoglycaemia]. Now I'm more serene, mentally and physically. Yeah, I'm telling you I used to worry while running errands…overall it [DAFNE] gave me peace of mind" Participant 26, insulin pump, Male, 42 years old*
Encouraging informed-decision making about fasting	• DAFNE provided the right knowledge and tools to make informed decisions about fasting. • Graduates informed the DAFNE team about their fasting decisions and listened to their advice as they trusted them.	*"Yes, DAFNE affected my decision to fast, it gave me as they say the opportunity. Before, if you don't fast you feel weird or inferior, and I'm not the kind of person who wants to appear sick or different than others. After DAFNE, I saw many people who don't fast…I understood the complications that might happen if I was stubborn and fasted and did all these things." Participant 31, insulin pump, Male, 30 years old*

It used to reach 22. I suffered greatly. I used to go to the hospital almost on a daily basis. Intravenous fluids were a necessity." Participant 33, MDI, Female, 21 years old

This was achieved through knowledge and skills learned from DAFNE courses, of which carbohydrate counting and correction doses were the most important aspects. Although all people with type 1 diabetes receive one-on-one education from HCPs when they are diagnosed, the information and approach to education offered through DAFNE had more impact. Participants discussed how the knowledge gained through DAFNE changed their whole outlook; previously they would fast without checking their blood glucose levels and would withstand hypoglycaemia and hyperglycaemia in order to not break their fast, not understanding the consequences. The majority (N = 38) stated that fasting was easier, whereas before it had been exhausting, so the quality of their fasting experience was enhanced. Also, participants were able to fast more days each year with DAFNE, which gave them a sense of fulfilment.

"This year's fasting was great. Best fasting experience in my life-. . .the amount, I fasted more days, 28 days. My diabetes is controlled" Participant 6, insulin pump, Male, 31 years old
"Before DAFNE I used to fast but the amount of days that I broke my fast was much higher. I went from fasting 8 days to 23 days" Participant 23, MDI, Male, 32 years old

Furthermore, understanding when to suspend their insulin pumps to avoid hypoglycaemia also assisted some insulin pump users to fast. These all helped participants to regulate their blood glucose levels effectively to continue fasting in a safe manner.

*"When I used to fast before [DAFNE], I didn't have this knowledge about diabetes and I didn't even know how much my blood glucose levels were when I was fasting. This is the first year that I fast **knowing** what to do during hypoglycaemia and hyperglycaemia episodes, when to break my fast if it's high, when to suspend if it's low. So, this year I fasted knowing everything, thank God" Participant 22, insulin pump, Female, 25 years old*

After DAFNE, participants were able to adjust their doses according to the carbohydrate content of their food and understand the different ratios of insulin to carbohydrates for each meal, rather than the previous fixed dose regime. This played a major part in regulating their blood glucose levels during Ramadan.

"I'm fasting [before DAFNE] but I break my fast because of hypoglycaemia or hyperglycaemia, severe thirst. I rarely checked my blood glucose because I didn't have the right information before DAFNE, I didn't know how to adjust my dose and other things. I used to take what my doctor told me, 20 20 20 [fixed dose] ok? So I had hypoglycaemia, I had hyperglycaemia. After DAFNE, last year I fasted more days [safely]" Participant 23, MDI, Male, 32 years old

Learning about correction doses and that they can take them while fasting to regulate their high blood glucose levels had a great impact on many people who suffer from hyperglycaemia when fasting, and who would previously either withstand these episodes or break their fast to drink water.

*"There were no correction doses before. Because honestly when I joined DAFNE, it was the first time that I learned about correction doses and how to take them. It was the first time I learned so much information, but for me the practical information about correction doses honestly, I'd never heard of before. And it was [her blood glucose] **extremely** high. I didn't take correction doses and continued fasting and it was high, high, high" Participant 20, MDI, Female, 29 years old*

3.2.2. Improvement in confidence and self-reliance

Participants mentioned how DAFNE has increased their confidence in their ability to control their blood glucose, and this in turn helped them become more confident when fasting and encouraged them to fast safely. The following participant started fasting two years after joining DAFNE and of having the insulin pump. Whereas before he never monitored his blood glucose levels and was careless with his health and appointments, this changed after joining DAFNE.

"I learned more about the pump and managing diabetes. I know how to manage it effectively, I learned more about carbs [counting], so I could [fast]." Participant 28, insulin pump, Male, 30 years old

They also developed self-reliance and used what they learned in DAFNE to learn more about their diabetes when fasting. One participant used a diary during Ramadan where she wrote her carbohydrate intake and doses and resultant blood glucose levels to better understand her diabetes. She adopted the idea from the DAFNE course she attended.

"In Ramadan, your whole routine changes, even the food changes. Some new things [food] are added and others are removed. So, I need to write this down so I remember" Participant 39, insulin pump, Female, 30 years old

Whereas previously they would not fast, or fast while heavily relying on support from HCPs, this changed after joining DAFNE. Those fasting for the first time understandably required reaffirmation from the DAFNE educators, but the majority were happy relying on themselves to manage their diabetes based on the knowledge and skills they learned, needing reassurance for actions only in certain situations.

*"Before I joined DAFNE, I was with a dietician called E I think, from [hospital name], who taught me about carbohydrates, calculating carbohydrates, and I learned about 70–75%. With DAFNE, I learned more than 90%, I learned **many, many** things. So, after learning all this information and feeling capable, like sometimes I know more about managing myself than my doctor, so I know in this situation what to do and in this other situation what to do. And in any other situation where I need support from my doctor, but I know how to manage most situations, so I know exactly what to do, so I said I'd try fasting. I tried the first year and my fasting went well, thank God. I used to fast previously, but I couldn't fast all the days and I didn't know what to do.*

But after DAFNE I know so much more, and I think after DAFNE I fasted all of Ramadan 2 years in a row" Participant 34, insulin pump, male, 25 years old

They also learned when to break their fast to ensure they did not withstand hypoglycaemia and hyperglycaemia episodes.

"I know how to manage [her diabetes], and I don't have to guess anymore, instead I know how to ensure my body isn't affected by diabetes. So, this makes me happy, the fact that I know how to manage diabetes in all situations" Participant 9, MDI, female, 36 years old

"Last year I had hypos, but I was stubborn. It was before fitoor by an hour "no I want to stay [fasting]". By the time it's fitoor I'm exhausted. So, I had days when I had hypos where I was supposed to break my fast but I didn't, I continued. This year I said, "no it's ok", so if I have a hypo in the afternoon and fitoor is hours away, it's best I break my fast" Participant 11, MDI, male, 29 year old

3.2.3. *Tailored support for dose and pump programming adjustments*

DAFNE educators provided tailored support for DAFNE graduates on how to adjust their MDI doses (their basal insulin dose) and their insulin pump programming. They provided this assistance before Ramadan and ensured participants were aware of how to adjust the doses on their own. Participants felt they were adequately supported, and that their fasting was easier.

"Before I used to be on my own, so I adjusted my doses, I increase and I…this time I'm more comfortable because they [DAFNE] adjusted my doses for me and I tried fasting a day before Ramadan. So, I was sort of calmer because my doses were adjusted…it was easier than previous years" Participant 10, insulin pump, female, 28 years old

"They put me on a basal trial fasting, I tried fasting and she [DAFNE educator] continued adjusting the programming till we reached the perfect dose 2 days before Ramadan, and the optimal programming for the pump. I reached a point where I couldn't believe that my blood glucose levels were stable all day while I was fasting, between 5 and 7, without hypos or hyperglycaemia, without feeling dizzy, without feeling hunger." Participant 4, insulin pump, female, 42 years old

3.2.4. *Positive effect on wellbeing*

Enrolling in DAFNE has helped many graduates fast with better control over their blood glucose levels, irrespective of their therapy type. They were able to anticipate and manage their blood glucose trends.

"I told [the DAFNE educator] "it's an unbelievable feeling. Maybe you can't sense it, but I do". This is the first Eid I celebrate honestly!…Yes. it really, really, really made a difference." Participant 16, insulin pump, Female, 39 years old

"Yeah, just the fact that I can manage my diabetes, that was the epitome of happiness! (laughs) yeah how to manage during hyperglycaemia was important, also hypoglycaemia" Participant 35, MDI, Female, 24 years old

Furthermore, a few graduates were given the opportunity to fast for the first time in many years. It also helped alleviate their previous fears of hypoglycaemia episodes during Ramadan. All of this had a positive effect on their wellbeing.

"I'm telling you, I used to be afraid, I used to worry even when praying, in the mosque, if there's something or there isn't [hypoglycaemia]. Now I'm more serene, mentally and physically. Yeah, I'm telling you I used to worry while running errands…overall it [DAFNE] gave me peace of mind" Participant 26, insulin pump, Male, 42 years old

"I put henna on my hands because I fasted! No, it's unbelievable, my mental health, the feeling that I know myself, know my diabetes, and finally controlled it." Participant 14, MDI, female, 45 years old

"They [DAFNE] brought up if I wanted to fast. You don't know how happy I was. Finally! (laughs) you don't know how happy I am, every time I see a family member I tell them the good news "I fasted!" because I have never fasted before." Participant 24, MDI, female, 45 years old

3.2.5. *Encouraging informed-decision making about fasting*

Trust in the DAFNE team also affected participants; they were more willing to inform them of their fasting decisions and were happy to receive advice regarding those decisions to ensure they fast in a safe manner. It also provided them with the knowledge to make informed decisions about fasting.

*"Yes, DAFNE affected my decision to fast, it gave me as they say the opportunity. Before, if you don't fast you feel weird or inferior, and I'm not the kind of person who wants to appear sick or different than others. After DAFNE, I saw **many** people who don't fast…I understood the complications that might happen if I was stubborn and fasted and did all these things." Participant 31, insulin pump, Male, 30 years old*

"If it wasn't for DAFNE, I wouldn't even fast" Participant 27, MDI, Female, 36 years

In addition, those intending to fast had an incentive to lower their HbA1c levels and regulate their blood glucose levels to be able to fast with DAFNE.

*"My HbA1c last year was 8 after fasting. And I was **forbidden, forbidden** from fasting, orders from Dr. E that I don't fast for 6 months, and this weighed **heavily** on my heart, but I listened to her and my HbA1c levels improved" Participant 4, insulin pump, Female, 42 years old*

4. Discussion

Previous research has shown the importance of structured education on managing type 1 diabetes effectively and improving the quality of life of people with type 1 diabetes

[10,28,29]. The current findings have provided insight into the impact of structured education in the form of DAFNE on the fasting experiences of people with type 1 diabetes, and has shown how overall, DAFNE has enhanced the quality of fasting. Participants on either MDI or insulin pumps both attested to the positive impact of DAFNE on their fasting experiences and wellbeing during Ramadan, as they were able to confidently self-manage and fast safely.

People with diabetes view fasting during Ramadan as an opportunity to gain better control of their blood glucose, lose weight, and be more spiritual [16–20,30,31]. In the current study, the majority of participants had a positive outlook on fasting post-DAFNE and attributed the fulfilment of their fasting wishes to the knowledge gained through the programme. Aspects that enhanced their fasting experience included empowering self-management, improving blood glucose control, adopting safe fasting practices, and a reduction in complications requiring hospital admittance. Principles of carbohydrate counting and correction doses were two major factors that improved their experiences after DAFNE. Carbohydrate counting is even more important in Ramadan as the type and quality of foods differ than normal days and thus affect their doses. Correction doses were considered a revelation as participants could finally control their hyperglycaemia and not have to break their fast. Those with insulin pumps required complicated support in the form of changes in programming, whereas those with MDIs had a reduction in units and a change in timing. They appreciated this one-on-one support provided by DAFNE educators which helped them fast better this year. Requiring tailored support for dose adjustments was a main factor in people fasting more comfortably, and this was deemed a priority for sustaining self-management skills learned in DAFNE [32].

DAFNE is known to reduce the reoccurrence of DKA and severe hypoglycaemia episodes [33]. This was evident from the participants' experiences while fasting after attending the DAFNE course in comparison to pre-DAFNE. This is a great outcome and had a profound effect on the participants' wellbeing, as they were able to limit breaking their fast and ultimately fast more days, as well as fast more comfortably.

DAFNE has been shown to empower people [9] as their principles emphasise independence, and this was similarly seen in those fasting after DAFNE. Even so, people with type 1 diabetes in DAFNE have shown that they required reassurance or trouble-shooting advice to support their self-management skills [32], and the current participants demonstrated this. They gained confidence in their abilities to manage their diabetes and relied more on themselves during Ramadan, the amount of support they needed diminishing over the course of the month, with only the need for reassurance of actions taken to manage their diabetes. This gave them a sense of achievement and hence had a positive effect on their wellbeing. Quality of life and wellbeing are important, and this is more so in Ramadan where there are religious and spiritual aspects and people have a duty they wish to fulfil like other people in their community [16–20,31]. Enabling them to do this with DAFNE had a massive impact on them. This was more prominent in participants fasting for the very first time in years where their happiness at doing so was indescribable.

DAFNE also has a great impact on people's decision to fast, as they can make informed decisions based on the knowledge attained and by meeting other people with type 1 diabetes and hearing their experiences. The trust between the participants and the DAFNE educators was evident; this was seen when people followed advice or not. Interface with formal care has been previously linked with decisions to fast and fasting experiences, and with the need for HCPs to understand and empathise with the patient's experience [16–20,31].

Ramadan-focused education is important to ensure people with diabetes manage their blood glucose effectively and avoid severe hypoglycaemia and hyperglycaemia episodes and ultimately DKA, and this has been shown to be effective in people with type 2 diabetes [21]. For Ramadan-focused education to be effective, there should be a foundation for this, which is what DAFNE offers people with type 1 diabetes. By using the information and skills obtained in DAFNE, such as carbohydrate counting and correction doses, participants were able to adapt these to fit Ramadan conditions and their own needs.

Fasting during Ramadan is feasible for people with type 1 diabetes [34], and the current study also illustrates this. People with type 1 diabetes are capable of fasting in a safe manner with the right support, which HCPs should be able to provide to allow them to fulfil their fasting needs, which ultimately has a positive effect on their quality of life. Another way is ensuring that they can control their blood glucose levels and keep fasting, rather than withstanding hypoglycaemia and hyperglycaemia [35]. By providing them with the right knowledge and tools through DAFNE structured-education, people with type 1 diabetes will have a stable foundation on which to base future Ramadan-focused education and build on it year after year and enable them to live their lives well with diabetes, which includes fasting safely.

While the benefits of the DAFNE programme have been demonstrated in this study, a similar approach may work well for other structured education programmes. As there is a limited data on the overall fasting experiences of people with type 1 diabetes, future research should focus on this to understand the patient experience and ensure issues are identified and managed accordingly. Furthermore, the implementation of Ramadan-focused education for type 1 diabetes wishing to fast is imperative; this should be developed, and its impact studied to inform future recommendations.

4.1. *Limitations*

As the study focused on the impact of DAFNE on fasting experiences, only those enrolled in DAFNE were represented. Nevertheless, the sample was diverse across a range of ages (21 and above), backgrounds and nationalities, time in DAFNE, and not limited to a specific post-code. Furthermore, the sample included both people using MDI and insulin pumps.

5. Conclusions

The principles of DAFNE assist in enhancing the quality of patients' fasting experience and ensure their blood glucose is well managed. A reduction in blood glucose fluctuations,

severe hypoglycaemia and hyperglycaemia episodes, and the prevention of hospital admissions during Ramadan is a great outcome from DAFNE education. The principles of DAFNE underpin the factors involved in improving the fasting experiences of people with type 1 diabetes and help them to live well with their diabetes. Assisting people with type 1 diabetes to fast has a great effect on their wellbeing, which reflects on their quality of life in the long run.

Declaration of Competing Interest

The authors declare that they have no conflict of interest

Acknowledgments

The authors would like to thank all the members of the DAFNE Kuwait team (Ms Etab Taghadom, Mrs Amira Megahed, Mrs Abeer El Samad, Mrs Sahar Murad, Mrs Sumaya Al-Ibrahim and Mr Salman AlEnaizy) for the recruitment of participants and conducting the pre-Ramadan workshop. We would also like to thank all the workshop and interview participants for their time and the clinical services department at DDI. Special thanks to Prof. Simon Heller and the DAFNE Central UK.

Funding

None.

Author contributions

DA: Data collection, data analysis and manuscript writing; JA: Proposal writing and organization of the study; EA: Supervision of the study, data analysis and manuscript writing.

Appendix A. Supplementary material

Supplementary data to this article can be found online at https://doi.org/10.1016/j.diabres.2019.05.021.

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