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Original article

A qualitative study exploring patients' experiences regarding insulin pump use

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ABSTRACT

Background: Diabetes is a threat to peoples' lives around the world, particularly in the Middle East. Medicine misuse and poor glycaemic control are prevalent among patients with type 2 diabetes, especially insulin-dependent patients (Alsairafi et al., 2016). With advances in medical technology, insulin pumps became a treatment option for patients with type 1 diabetes and those with insulin-dependent type 2 diabetes. However, use of these devices is still lacking in Kuwait, particularly in patients with type 2 diabetes. Information on how patients manage these devices and their efficacy and safety from the perspectives of patients is also lacking (Alsaleh et al., 2016).
Objective: To examine the views and experiences of adults with type 2 diabetes regarding the use of insulin pumps compared to their previous insulin delivery methods, in terms of glycaemic control, quality of life, preference, convenience and adherence to doses.
Setting: The main five secondary-care hospitals in Kuwait: Mobarak Al-Kabeer, Al Amiri, Al Adan, Al Farwaniya and Al Jahra.
Method: All adults with type 2 diabetes who used an insulin pump were invited to participate. Data were collected through semi-structured interviews. Data analysis was performed using MAXQDA-11.
Results: A total of eight patients were interviewed. Interviews with patients revealed that using an insulin pump improved patients' glycaemic control and quality of life as a consequence of improved satisfaction and adherence to doses.
Conclusion: From the perspective of adults with type 2 diabetes, there are lots of benefits of using insulin pumps over other insulin delivery methods, mainly seen by the improvement of quality of life and patients' adherence to doses. Policy-makers and healthcare professionals (HCPs) must be aware of such benefits and should support the wider implementation of this technology in the country by including patients with type 2 diabetes. Results of this study will help to inform healthcare provision and guideline modifications and to provide guidance for new patients using this therapy.

1. Introduction

Type 2 diabetes accounts for around 90 per cent of all diabetes cases. It mostly affects adults and is associated with obesity, hyperlipidaemia and hypertension (Alhyas et al., 2011). The prevalence of type 2 diabetes has dramatically increased over the past decades and it is the most prevalent type of diabetes in Middle Eastern countries (IDF, 2013). A study in Kuwait concluded that type 2 diabetes is becoming an urgent health problem that expands to children and adolescents (Moussa et al., 2008). During the last five years, 13 per cent of patients with type 2 diabetes had an onset

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age of less than 10 years and 42 per cent had an onset age of 10–20 years. Family history, body mass index (BMI) and sex are established risk factors for developing type 2 diabetes (Channanath et al., 2013). For example, the higher the BMI, the lower the diabetes onset age. For the third class obesity category, diabetes onset age is lower by 8.2 years than that for normal BMI category. The increase of type 2 diabetes among children in Kuwait could be linked to the increase in childhood obesity. Increased obesity among children is attributed to a combination of genetic and lifestyle factors such as decreased physical activity and increased consumption of fast food (Elkum et al., 2015). Achieving glycaemic control is important to reduce the risk of micro- and macrovascular complications (Inzucchi et al., 2015). Nevertheless, the majority of insulin-dependent patients have difficulties achieving the recommended glycaemic targets of glycated haemoglobin A1c (HbA1c) levels of less than seven per cent (Al-Khawaldeh et al., 2012). Studies have shown that annual treatment costs for patients using insulin are higher compared to those using oral hypoglycaemic agents only (Al-Maskari et al., 2010).

Adherence is defined as "the extent to which a person's health behaviour corresponds with agreed recommendations from a healthcare provider" (WHO, 2003). Despite its importance in the management of type 2 diabetes, it is often neglected by patients (Bailey and Kodack, 2011). Researchers worldwide have reported many contributors to non-adherence in type 2 diabetes, including fear of side effects, frustration due to failure to achieve control, and cost of treatment (Vermeire et al., 2003; Aflakseir, 2012; Alsairafi et al., 2016). The World Health Organisation (WHO) identifies some other factors that affect patients' adherence to treatment, such as complexity of the treatment regimen, lack of immediate benefit of therapy, and social stigma attached to the use of some medications and devices (WHO, 2003). Adherence to insulin continues to be a challenge for optimum diabetes management (Cramer, 2004; Lee et al., 2006). International non-adherence rates to insulin reach 40 per cent among patients with type 2 diabetes (Wallia and Molitch, 2014). In the Middle East, insulin is still considered the last resort for patients with type 2 diabetes due to fear of injections and weight gain (Lakkis et al., 2013).

There is little known about interventions that improve adherence to insulin regimens (Doggrell and Chan, 2015). It has been suggested that simplifying the insulin delivery method can overcome barriers to insulin use. Insulin pumps have been introduced as an alternative insulin delivery method to help patients cope with the disease and management tasks (Shaghouli and Shah, 2009). Many improvements have been made since the introduction of the first pump 35 years ago (Alsaleh et al., 2010; Salem, 2010). Technological advances over the years have turned insulin pumps into a practical alternative to multiple daily injections (MDIs), since pager-sized pumps (e.g. OneTouch and MiniMed Paradigm) have taken the place of the brick-sized old ones (Alsaleh et al., 2010; Lepore and Tommaselli, 2015).

Insulin pumps have been shown to be cost-effective in patients with poorly controlled type 2 diabetes despite therapy optimisation (Roze et al., 2016). Furthermore, the physiological continuous delivery of insulin via a pump provides better glycaemic control with less insulin usage and thus fewer side effects (less weight gain and hypoglycaemic events), which subsequently improves patients' quality of life and wellbeing (Lepore and Tommaselli, 2015). Studies examining the use of these devices in the management of patients with type 2 diabetes are scarce. This is because their use in several countries is mostly recommended for patients with type 1 diabetes, supported by the extensive evidence on their effectiveness particularly for this type (Barnard and Dixon, 2010; Wolff-McDonagh et al., 2010; Didangelos and Iliadis, 2011; Reznik et al., 2014). The National Diabetes Information Service Insulin Pump Audit reported 35 patients with type 2 diabetes using insulin pumps in England in 2009 versus 5667 patients with type 1 diabetes. In Turkey, 99.5 per cent of pump users have type 1 diabetes. In the Middle East, the use of insulin pumps in adults has not been widely investigated. Only four studies were found in this context (Wainstein et al., 2005; Merheb et al., 2008; Reznik et al., 2014; Alsaleh et al., 2016), of which two studies were conducted among patients with type 1 diabetes (Merheb et al., 2008 Alsaleh et al., 2016). The other two studies are randomised controlled trials (RCTs) examining the efficacy of using insulin pumps.

Insulin pumps were first introduced in Kuwait in 2006, and are provided free for patients by the Ministry of Health (MOH). Due to a lack of evidence on the effectiveness of insulin pumps for type 2 diabetes, the guidelines for insulin pumps coverage have been strictly for type 1 diabetes to date (Al-Wotayan, 2011). Accordingly, patients with type 1 diabetes who fail MDIs and express a willingness to commit to the management tasks associated with the therapy are considered eligible to start insulin pump therapy. However, in some practices, adults with type 2 diabetes who had been uncontrolled with MDIs for a period of time and were willing to comply with the pump-related tasks were provided with insulin pumps. Nevertheless, patients using insulin pumps in the country are still very few. The average number of patients who use such therapy in the main five hospitals in Kuwait is 150 (including both types of diabetes). Qualitative studies exploring adults' perspectives regarding the use of insulin pumps are lacking in Kuwait (Alsaleh et al., 2016).

The aim of this study is to examine the views and experiences of adults with type 2 diabetes concerning the use of insulin pumps and to compare these with the use of other delivery methods such as injections and pens in terms of glycaemic control, general well-being, satisfaction and adherence. There was a particular concern to include patients with type 2 diabetes because, as mentioned above, this is the most prevalent type in the region, and it has been noted from a preliminary fieldwork that around 80 per cent of patients with type 2 diabetes in Kuwait are managing their disease with insulin (Alsairafi, 2016). Therefore, it was pivotal to explore how this group of patients manage their disease and what problems they encounter. In addition, there is a lack of studies exploring the use of pump therapy particularly for this type. In Kuwait, there is only one study that reported the use of insulin pump in adults (Alsaleh et al., 2016). However, that study included patients with type 1 diabetes from one hospital (one health region) only, and it depended on a questionnaire to collect data. There are few studies which have examined how insulin pumps affect patients' lives, particularly adults (Ritholz et al., 2007). Therefore, this study also aimed to investigate the impact of insulin pumps on the lives of patients and their family members. Results from this study can be used as an evidence-based guidance for new patients who wish to use this therapy and will help to inform healthcare provision of insulin pump therapy in the country and guideline modifications.

2. Ethical approval

The study was approved by the Standing Committee for Coordination of Health and Medical Research, MOH, State of Kuwait. Informed consent was obtained from all participants prior to participation. Data collection was conducted over seven months (from March 2014 to September 2014).

3. Materials and method

3.1. Study design

Cross-sectional semi-structured interviews were conducted. The face-to-face interviews allowed exploration of patients' views

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and experiences of the use of insulin pumps and identification of their advantages and disadvantages compared to the patients' previous insulin delivery methods. In addition, the most recent clinical data-e.g. HbA1c level, blood glucose level, body mass index (BMI)-were obtained from patients' medical notes by the researcher at the time of the interview.

3.2. Sampling and recruitment

All adults (age ≥18 years) with type 2 diabetes who used an insulin pump and were treated in the main five hospitals in Kuwait (Mobarak Al-Kabeer, Al Amiri, Al Adan, Al Farwaniya and Al Jahra) were eligible for this study. Accordingly, all eligible adults who visited outpatient clinics during the data collection period were invited to participate. The exclusion criteria were patients who did not consent to participate and those with type 1 diabetes. This was because the focus of this study was type 2 diabetes and it would be complicated to include patients with type 1, as they have different requirements and needs from those with type 2 diabetes, and so the results might be biased.

Patients were approached by obtaining their contact numbers from their consultants. Then, patients were contacted by the researcher and invited to participate in the study. Patients were assured that the researcher was independent from the healthcare team to ensure validity of the results. The aim of the study and what it would involve were explained verbally to the patients. With those who agreed to take a part, a time and place for conducting the interview were identified. This recruitment procedure was adopted because it was known from the preliminary fieldwork that patients with type 2 diabetes who use insulin pumps were very few and they did not regularly attend their clinical visits.

3.3. Study instrument and data collection procedures

An interview topic guide was developed specifically to achieve the study aims and objectives. The preliminary fieldwork and the literature review assisted in structuring the schedule and designing some of the questions (Peyrot and Rubin, 2005). The schedule included closed questions for obtaining demographic and clinical data. The main part of the schedule comprised open questions. To encourage the participants to provide rich information, probing techniques were adopted, where prompts were added to most of the questions. Leading questions, which may influence the participants' responses, were avoided. The questions were about the insulin pump-e.g. its efficacy in improving glycaemic control and quality of life, impact of using it on daily activities and family, its acceptance, ease/difficulty of use, satisfaction with its use and adherence to doses. The topic guide was revised many times by the research team comments regarding the contents and the structure of the guide were incorporated and the final version of the schedule was agreed by all.

Before commencing the interviews, participants were given the chance to ask questions, assured that their participation was voluntary and that they could withdraw at any time without giving an explanation. Participants were also reassured that their responses would be anonymous and would not be communicated to their HCPs. Participants were allowed to talk freely and without following the particular sequence of the questions, whereby topics could be explored according to issues raised by the participants. To capture all information that might assist in the analysis, notes on the participants' facial expressions and body language, and post-interview comments and feedback, were hand-written and added as memos in the interview transcripts. At the end of the interviews, the discussion was clearly concluded by asking this question "Finally, would you like to add anything about your therapy that we have not discussed?".

The interviews were audio-recorded after gaining the participants' permission. All recorded data were transcribed verbatim. Interviews were conducted and transcribed by the researcher alone, which ensured consistency and minimised variability in having two or more researchers involved in the process. Interviews were conducted in Arabic after translating the interview schedule. A parallel translation technique was adopted, where the schedule was translated by the researcher and another bilingual person (AA) independently (Behling and Law, 2000). Then, discrepancies were resolved through discussions.

3.4. Data analysis

Interview transcripts were typed using Microsoft Word. Files were saved with numbers, indicating the order in which the interviews were conducted. MAXQDA-11 software was used to assist the management of the textual data. It allowed collecting, organising and analysing content from interviews in Arabic in a flexible manner. Thematic analysis was conducted in three main stages: data management, data description and data interpretation. Analysis in this study was not a linear process a constant comparison was adopted. Data were revised each time a new code/sub-code was added. Therefore, all the interviews were revisited after primary coding and inspected for relevance of these codes until no additional codes could be developed. Data were analysed in Arabic the language in which they were collected. This was followed to avoid limitations, as participants used culturally bound words which, if translated, might affect the meaning (van Nes et al., 2010).

4. Results

At the time of data collection, only nine adults were identified as being eligible to participate in the study. However, when they were invited, only eight patients gave consent to take part. The duration of the interview ranged from 30 to 51 min according to patients' views and experiences. Characteristics of participants are shown in Table 1.

Thematic analysis of the interviews revealed different codes/sub-codes, as shown in Table 2.

4.1. Code 1 Impact of using insulin pump on patient's health and behaviour

4.1.1. Achieving and maintaining glycaemic control

The entire sample (n = 8) reported improved blood glucose levels when using the insulin pump compared to MDIs. Two participants added that they had negative experiences when replacing the pump with insulin pens temporarily in circumstances such as travelling:

> "Once I stopped using it [the pump] for one day, and returned to [insulin] pens. You can't imagine how my health deteriorated and my blood glucose levels fluctuated between ups and downs. It was only for one day!"
>
> [Patient 5: A 34 year old female; 12 months of pump use]

However, an improvement in blood glucose levels was noticed promptly at the onset of pump commencement, as reported by most participants (n = 6). The remaining two participants reported experiencing hypo-/hyperglycaemic episodes for approximately the first two years of starting the pump:

> "At the beginning, it [the pump] didn't help me, and my blood glucose level was always high. I've been admitted to the hospital four times to reduce blood sugar level."
>
> [Patient 1: A 47 year old female; 24 months of pump use]

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Table 1
Characteristics of participants.

	Patient	Gender	Age (years)	Education level	HbA1c (%)	Blood glucose level (before meal) (mmol/l)	BMI (kg/m^2)	Co-morbidity	Period of pump use (months)
	1	Female	47	Secondary school	12*	5	30.1	Nil	24
	2	Male	67	University	6.8	4	38	CVD	6
	3	Female	49	Diploma	7.5	6.3	46.9	CVD	72
	4	Male	28	University	7	6	35.1	Nil	72
	5	Female	34	Diploma	7.1	6.5	26.7	Nil	12
	6	Female	25	Primary school	NA^	7	24.9	Nil	1
	7	Female	28	University	5	4.2	28.1	Nil	18
	8	Female	28	Post-graduate	5.7	7	25.7	Nil	24
Mean ± SD			38.2514.8		6.43.3	5.81.2	31.97.6		28.628.0

CVD: Cardiovascular disease.
* Old data, collected two months prior to the interview.
^ No reading was available during the pump period.

Table 2
Codes/sub-codes emerging from the interviews.

Code 1	*Impact of using insulin pump on patient health and behaviour*
Sub-codes	1. Achieving and maintaining glycaemic control
	2. Frequency and awareness of hypoglycaemia
	3. Adherence to doses and overall preference
Code 2	*Daily activities with insulin pump*
Sub-codes	1. Sleeping
	2. Practising sport
	3. Wearing clothes
	4. Travelling
Code 3	*Impact of using insulin pump on family and social life*
Sub-codes	1. Initial worries
	2. Independency versus help needed
	3. Confidence versus embarrassment
Code 4	*Problems of using insulin pump*
Sub-codes	1. Carbohydrate counting and weight gain
	2. Skin reactions at cannula insertion site
	3. Mechanical problems

Regarding the overall improvement, all the participants reported occasions of uncontrolled blood glucose levels such as hyper- or hypoglycaemia when using the insulin pump. Factors contributing to such occasions, as reported by the participants, were non-adherence to diet, irregular menstruation and stress:

"When I eat large meals, especially sweets, my blood glucose level goes up."
[Patient 2: A 67 year old male; 6 months of pump use]

"When I am invited to weddings, I usually eat lots of fats and sweets. Sometimes, I forget to press the button [for bolus dose administration] at such occasions; I lose control on my blood glucose level and it becomes high."
[Patient 4: A 28 year old male; 72 months of pump use]

"I feel that because my period is irregular, my blood glucose level is not good all the time. Also, every time I have an exam, my blood glucose level becomes high, even if I don't eat anything."
[Patient 7: A 28 year old female; 18 months of pump use]

4.1.2. Frequency and awareness of hypoglycaemia

The majority of participants (n = 5) reported fewer hypoglycaemic episodes on insulin pumps compared to MDIs. Such improvement was also noted in relation to the severity of the episode, which was lessened with using the pump, as reported by three participants. The rest of the participants (n = 3) stated that the pump helped to eliminate these episodes entirely. The impact of using the insulin pump on hypoglycaemic awareness was documented by five participants who thought that they had better sensation of hypoglycaemia when they started using the insulin pump:

"Yes, now I can feel the symptoms of hypoglycaemia. It's different in the morning than at night. In the morning, I have a headache and nausea, while at night, I feel tired."
[Patient 1: A 47 year old female; 24 months of pump use]

Regarding general health, most participants (n = 6) reported that the insulin pump improved their health, where they never had incidents of hospital admission due to hypo-/hyperglycaemia or any other diabetes complications. In this regard, one participant stated:

"Before using the pump, you wouldn't believe how many times I had been admitted to the hospital, but now thank God, I don't need it [hospital admission]."
[Patient 5: A 34 year old female; 12 months of pump use]

4.1.3. Adherence to doses and overall preference

All participants in this study generally shared the opinion that the insulin pump was a better treatment option and never thought about switching back to injections or pens. Results showed that all the participants had improved adherence to dose administration when using the insulin pump. This was attributed to the technological advancements of insulin pumps (e.g. automatic doses calculation via the pump Bolus Wizard) over the other delivery methods. For example, the administration of insulin doses was easier with insulin pumps compared to needles or pens, as reported by almost all the participants (n = 7):

"Using the pump is better and easier than using injections. With the injections, I didn't know what to do if I experienced high [blood] glucose level, especially at night, when I had already taken all my doses. I didn't know how to take the correction dose or how to calculate it. The pump gives insulin over the day, and it's easy in terms of correction doses. Also, I can adjust it [basal rate] according to my activity level."
[Patient 3: A 49 year old female; 72 months of pump use]

Two participants thought that the improved adherence to doses with insulin pumps was due to the elimination of the side effects (e.g. pain, swelling and bleeding), which were always experienced with injections and pens:

"With [insulin] pens I never felt comfortable. Four injections [doses] per day-it was painful. Sometimes I got swelling, and I skipped doses to avoid pain and swelling. With the pump, there is no pain or swelling."
[Patient 6: A 25 year old female; 1 month of pump use]

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As such, most participants (n = 6) reported a more flexible life with insulin pumps than with MDIs:

"It [the pump] eases my life, unlike insulin injections; I was always worrying about administering my doses outside home as I needed to discontinue the gathering and look for a private place, while with the pump it's more comfortable."

[Patient 1: A 47 year old female; 24 months of pump use]

Using the insulin pump not only improved participants' adherence (n = 6) to dose administration but also to their self-care behaviour such as self-monitoring of blood glucose (SMBG):

"Before I used the pump, I rarely monitored my blood glucose level because I was always worrying about getting a high reading, where I needed to take a correction dose, which I hated. With the pump, I monitor my blood glucose level two or three times a day."

[Patient 1: A 47 year old female; 24 months of pump use]

On the other hand, insulin pumps impacted negatively on their adherence to SMBG, as reported by two participants. However, this was because they had improved awareness of hypo-/hyperglycaemic episodes, whereby they thought they did not need to monitor their glucose levels more frequently.

4.2. Code 2 Daily activities with insulin pump

4.2.1. Sleeping

Two participants were still not used to sleeping with the pump although they had been using it for a period of more than one year. The cause of this inconvenience was related to the pump tubing:

"For the whole day, the pump is perfect, but during sleeping it's annoying. I always find myself tangled up in the pump tube."

[Patient 4: A 28 year old male; 72 months of pump use]

Although sleeping with the insulin pump was initially bothersome, some participants found that they gradually got used to it. Others coped with it by creating positions in which they could sleep with their pumps comfortably:

"At the beginning, it was very annoying, especially because I move a lot in bed. I would find myself wrapped with the tube every day. But now, I've got used to it; I spontaneously turn right and left. Also, I tend to move the pump according to my position; all this happens while I'm sleeping [patient laughed]."

[Patient 5: A 34 year old female; 12 months of pump use]

4.2.2. Practising sport

Of the eight participants interviewed, six reported that switching to insulin pumps did not preclude them from performing their routine exercises, such as walking and swimming. Participants were either disconnecting their pumps during exercise and then reconnecting them, or suspending delivery of insulin for one hour. However, the activity most affected by use of the insulin pump was swimming:

"My favourite sport is swimming. When I was on [insulin] pens, I swam as much as I liked. There were no worries, but with the pump, I have to take care not to stay in water more than one hour. It's annoying. I've even been thinking of switching to [insulin] pens in the days when I go swimming."

[Patient 8: A 28 year old female; 24 months of pump use]

Findings of this study suggest that exercising with the insulin pump is safe. No participant reported serious complications due to practising sport with the pump. However, one participant explained that she experienced hypoglycaemia while walking with her insulin pump attached. This problem was resolved by suspending insulin delivery during her exercise.

4.2.3. Wearing clothes

Half of the participants (n = 4) neither had complaints nor were annoyed from wearing the pump. The participants mentioned that they could wear whatever they want, as before using the pump. They put it in their pockets, fastened it around their waist using its belt, or clipped it to their trousers/skirt and covered it. However, the rest of the participants (n = 4) expressed dissatisfaction with wearing the pump because it limited their wearing of particular types of clothing. For example, one participant reported that wearing the pump obliged her to wear either trousers or a skirt to clip her pump on because she felt uncomfortable when she wore *Abaya* a traditional long black gown for women.

Interestingly, one participant coped with wearing the pump by re-sewing all his clothes to a style that allowed him to pass the pump from his pocket to facilitate the administration of his doses (bolus doses):

"Since I used the pump, I have been wearing it around my thigh, using a garter to fix it in. But it was annoying at the beginning, and over time, my thigh became larger. Then, I tore all the pockets of my *Disdashas* [a traditional long white gown for men] so that I could clip it [the pump] to my underwear. I can pass it through the torn pocket easily."

[Patient 2: A 67 year old male; 6 months of pump use]

4.2.4. Travelling

Some participants (n = 4) provided information about travelling with the pump, while others did not discuss this. This could be because the activity was not mentioned in the interview schedule, or because the participant had not travelled since she/he had been using the pump. However, there were different points of view, as some participants provided positive comments, while others were bothered. The most common reasons for 'liking' the pump during travelling were the portability of the device and the availability of the required insulin:

"I travelled 16 times since I used the pump. I liked it; it's much easier for travelling than [insulin] pens. I don't need to carry too many items anymore, only the pump, which is attached, and the insulin ampoule [Actrapid^{R}], which is small. Also, with [insulin] pens, I was always worried about how to store them. When I was carrying them in my pocket, I worried if they became hot as they would lose their activity. . .I usually forget my medicines at home, when I was on [insulin pens]; I tried my best to get them abroad, but they were not available in all countries. On the other hand, the insulin used in the pump is available everywhere."

[Patient 2: A 67 year old male, 6 months of pump use]

'Disliking' the pump was attributed to the annoyance experienced from the security check in some airports and the unsuitability of the pump when wearing particular types of clothing:

"I didn't like the pump in travelling, because it made me liable to investigation a lot at the security points; they [security] always keep asking 'what is this device?' Also, in travelling, I like to wear jeans and t-shirts but with it [the pump], I couldn't; it would be visible and looks unacceptable."

[Patient 4: A 28 year old male; 72 months of pump use]

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4.3. Code 3 Impact of using insulin pump on family and social life

4.3.1. Initial worries

Since the technology of the insulin pump was different from the traditional delivery methods-e.g. injections and pens- use of such device prompted family members to worry about the patients. In this study, families responded variously; as such, some (n = 2) were anxious about using a new device while others (n = 2) were happy seeing the patients improved and satisfied on the pump.

Factors that affected families' reactions towards using insulin pump are summarised in Table 3.

4.3.2. Independency versus help needed

To perform all the pump-related tasks, the patient requires cognitive thinking for dose calculation and carbohydrate counting as well as technical skills for dose administration and changing the infusion set. All participants (n = 8) were able to perform all the tasks independently.

For dose calculation such as insulin boluses and correction doses, most of the participants (n = 6) explained that they used the Bolus Wizard a software with which the required insulin dose is calculated automatically by entering the blood glucose level and the value of carbohydrate to be ingested. All participants shared the opinion that performing this task using the pump was easy, regardless of the fact that not all of them were completely competent with calculating carbohydrates in the meals to be ingested. Of the eight participants interviewed, three were confident in performing such a step and they knew its basic information, while others misunderstood or did not perform these calculations:

> "I know how to make correction doses; I only needed them sometimes, particularly if I was invited to a wedding and had a fatty dinner, where my blood glucose level went high. So, I press the button to administer the correction dose."
>
> [Patient 4: A 28 year old male; 72 months of pump use]

Another participant reported:

> "Although I'm still not counting calories very well, it's [the pump] so simple. One only needs to calculate the calories in one's meal, and it [the pump] calculates the dose."
>
> [Patient 5: A 34 year old female; 12 months of pump use]

With regard to the pump operation, including setting and resetting basal insulin according to activities, in most cases (n = 5) participants were still dependent on their doctors when adjusting their basal insulin rates. Participants were uncertain about their ability to perform this step due to being new to the pump technology, experiencing hormonal changes-e.g. recent childbirth-or preferring to double-check doses with the doctor for special occasions (e.g. travelling).

Using the insulin pump requires patients to change the infusion set regularly (every two or three days) in order to avoid side effects such as infection, allergy or irritation. The infusion set is a tubing system that connects the pump to the patient's body; it attaches to a cannula that should be inserted subcutaneously in fatty-rich tissues such as the abdomen. In this context, all participants revealed that they could change the infusion set and checked the cannula insertion site themselves.

Table 3
Families' perceptions towards using insulin pump, reasons behind their feelings, and their frequency.

Family's perception	Reason	Frequency
Satisfied with pump use	Participant was uncontrolled on insulin injections and pens	1
	Participant achieved glycaemic control on insulin pump	2
	Participant's satisfaction improved on insulin pump	1
Worried about pump use	A new device	3
	Participant experienced irregular blood glucose levels for a period of time with using the insulin pump	2
	The pump is complicated	1
	Changes in the participant's status (e.g. pregnancy)	1

4.3.3. Confidence versus embarrassment

All the participants (n = 8) reported feelings of normalcy in living with the pump. Two participants added that, at the start of using it, they were bothered about it being attached all the time, but then they got used to it. In most cases (n = 7), the pump had no impact on participants' self-confidence:

> "At the beginning, I tried to hide it [the pump] so as not to be bothered by the questions (Why? How? What is this?) from those who saw it. But now, I don't mind showing or using it; I don't feel embarrassed at all."
>
> [Patient 8: A 28 year old female; 24 months of pump use]

The insulin pump was also found to have psychosocial benefits over other insulin delivery methods which were attracting other people's attention when administering doses in public. On the other hand, visibility to others contributed to participants' stigmatisation and feelings of self-consciousness, as reported by three participants:

> "The pump is annoying, especially if I want to go to a party and wear a tight dress, or jeans and T-shirt it is visible and looks unacceptable. One can easily recognise that there is something wrong."
>
> [Patient 5: A 34 year old female; 12 months of pump use]

4.4. Code 4 Problems of using insulin pump

4.4.1. Carbohydrate counting and weight gain

The majority of participants (n = 5) reported a considerable weight gain following initiation of the pump therapy, and some added that they tried to lose weight many times but they failed. Of the remaining participants, two noticed no changes in their body weight, while one reported weight loss:

> "I have started eating a lot since I put on the pump. It's [the pump] so simple, one only needs to enter one's blood glucose level and the calories, and it [the pump] gives the correct dose. When I was on [insulin] pens, I needed to calculate the dose that matched my blood glucose level and the calories; this is rather difficult as you have to try several times until you get it [insulin dose] right! I was avoiding eating enough because of this reason."
>
> [Patient 5: A 34 year old female; 12 months of pump use]

4.4.2. Skin reactions at cannula insertion site

Only one participant experienced inflammation at the cannula insertion site, where her skin became red, swollen and painful. Three participants reported that they experienced bruising at the cannula insertion site. However, this was resolved by rotating the site regularly:

> "It [the pump] colours my skin; it changes it to red, then green, but it [skin marks] gets back to normal when I put some ice on. I keep injecting myself in different places."
>
> [Patient 4: A 28 year old male; 72 months of pump use]

4.4.3. Mechanical problems

The use of insulin pumps was not exempted from occasions of mechanical malfunction where the pump stopped working completely, as reported by four participants. Two participants added that their problems started with experiencing bolus delivery problems (the pump was recording bolus doses incorrectly), giving false alarms (the pump gave alarms about the need to fill in the insulin reservoir while it was already filled). Then, it ended with 'frozen' buttons. However, in all cases where the pump stopped working, it was replaced with a new one from the MOH:

> "It [the pump] once stopped working when I was abroad. I called my doctor and he advised me to use injections instead. I did that until I came back to Kuwait and replaced it with a new one."
>
> [Patient 3: A 49 year old female; 72 months of pump use]

5. Discussion

Studies exploring the experiences of using insulin pumps to manage type 2 diabetes are lacking (Morera et al., 2016). To our knowledge, this is the first study in Kuwait to explore patients' views of using insulin pumps in type 2 diabetes (Alsaleh et al., 2016). Although the sample is relatively small-consistent with the current guidance in Kuwait for assigning insulin pump therapy only for patients with type 1 diabetes who fail MDI-findings of this study suggest that insulin pump can also be effective for adults with type 2 diabetes. All the participants had good glycaemic control manifested by HbA1c readings of $\leq$7.5% and/or good blood glucose levels. Achievement of the target levels was easier with the pump compared to the traditional MDIs, and control was maintained for a longer time.

Results of this study regarding the efficacy of the insulin pump in type 2 diabetes are consistent with Berthe et al. (2007) study, who also reported reduced rates of hyperglycaemia when using the insulin pump. Experiencing less hyperglycaemia could be attributed to the easier access to insulin due to being attached all the time so that doses are less likely to be omitted or forgotten. In addition, use of the insulin pump reduced hypoglycaemia, which might be predictable because the continuous delivery of insulin with the pump simulates the work of the pancreas of normal persons who do not have diabetes (Berthe et al., 2007). Traditional delivery of insulin with injections or pens cannot simulate the body in the same way, and larger doses are injected daily over periods of time, whereby probability of hypoglycaemia is increased (Barnard and Dixon, 2010; Didangelos and Iliadis, 2011). However, other researchers reported fewer hyperglycaemic episodes on the insulin pump, but no significant differences in the occurrence of hypoglycaemia between insulin pump and MDI groups (Raskin et al., 2003; Herman et al., 2005; Wainstein et al., 2005; Reznik et al., 2014).

Although use of the insulin pump requires patients to acquire many skills to operate the pump, participants in this study showed better adherence to doses compared to MDIs. This improved adherence was attributed to the improvement in participants' satisfaction as a result of the reduced burden of dose tracking and scheduling, and enhanced life flexibility. Studies exploring patients' perceptions about the advantages of the insulin pump reported more convenience and flexibility, better freedom, ease with meals, and consequently better quality of life (Ritholz et al., 2007; Brunton, 2008; Yilmaz and Oguzhan, 2008; Didangelos and Iliadis, 2011; Reznik et al., 2014). Barnard et al. (2007) also reported feelings of a more 'normal' lifestyle among insulin pump users due to freedom from interruptions of insulin injections.

The most prevalent clinical problem associated with insulin pump use in this study was weight gain. These results were consistent with Wolff-McDonagh et al.'s (2010) study, who noticed significant increase in the BMI of patients with type 2 diabetes after the initiation of pump therapy. In addition, in their retrospective analysis, Morera et al. (2016) reported increased body weight by 2.9 ± 7.6 kg from baseline among the 161 participants. The use of insulin in general leads to hyperinsulinemia and weight gain due to increased appetite and low thermogenesis (Russell-Jones and Khan, 2007). However, continuous delivery of insulin could result in better control using less insulin, thus causing less weight gain (Wainstein et al., 2005; Didangelos and Iliadis, 2011). While this was not the case in the present study, other researchers provided different results. When comparing the insulin pump and MDIs in a group of patients with type 2 diabetes, no significant changes in weight were reported for either group (Herman et al., 2005; Wainstein et al., 2005; Reznik et al., 2014). Based on those researchers' findings, weight gain reported for patients using the insulin pump may not differ from weight gain that would occur if the patient had continued to use MDIs. This means that treatment with insulin may result in weight gain regardless of the insulin delivery method.

However, examining factors that contributed to weight gain in the current study revealed that lack of nutritional awareness and lifestyle were the major reasons for gaining weight on the insulin pump. Many participants in the current study were incompetent in counting carbohydrate. Lacking awareness of carbohydrate counting or not counting carbohydrate at all could contribute to excessive consumption of carbohydrate, and consequently weight gain (Johnson, 2000). In addition, non-adherence to diet and exercise as a consequence of pump-related factors was reported in this study. Based on the participants' views, the effectiveness of the pump in reducing blood glucose levels, even if they ate large portions and a variety of food at any time without exercising, made them feel more flexible about eating without blaming themselves. The consumption of more calories than are burned increases bodyweight, while regular and moderate physical activity helps in losing weight (Lee et al., 2010).

Apart from determining the effectiveness of the insulin pump in type 2 diabetes, this study examined the medicine-taking behaviour of patients using this therapy, and how this behaviour improved compared to other insulin delivery methods. In addition, this study added to the literature the experiences of patients using the insulin pump during their daily lives and how this usage impacted on their activities. The impact of the insulin pump on family members was also investigated in this study. This issue was not discussed previously in such a group of patients in the Middle East. Last but not least, this study provided reasons behind weight gain when using the insulin pump, which allowed the suggestion of solutions for preventing such a problem.

6. Strengths and limitations

This is the first qualitative study to examine the experiences of adults with type 2 diabetes regarding use of the insulin pump in the Middle East. Data collection was undertaken using face-to-face semi-structured interviews, which provided deep understanding of the participants' perspectives compared to other tools (e.g. questionnaires). Data analysis was undertaken under the supervision of the research team; this peer review process reduced the potential of lone researcher bias.

However, there are some limitations. The sample was too small; this was because of the restriction of the guideline in Kuwait for starting insulin pump therapy, which only recommends a pump for Kuwaiti patients with type 1 diabetes who fail the MDI and

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are willing to commit to the therapy. Another factor that may have contributed to the small sample in this study is that only patients from governmental hospitals were recruited. Therefore, patients who receive treatment from the private sector were not included. The sample presented in this study was a part of a larger sample of a PhD thesis (Alsairafi, 2016) and the time restriction could also play a role in the sample size. Another limitation is that the results were mostly compared with international studies; this was due to a lack of published studies in similar populations. Therefore, differences between populations in terms of socioeconomic, cultural and lifestyle factors should be taken into consideration. In addition, other factors that could contribute to non-adherence, such as age, sex, education, duration of disease, presence of other complications and polypharmacy, were not investigated in this study.

7. Implications for practice

Despite the small sample size in the present study, results regarding the overall improvements in glycaemic control, satisfaction and adherence to doses with the insulin pump may have implications for modification of the current guideline for starting insulin pump therapy in Kuwait. Although there were cases in clinical practice who were offered insulin pumps, modifying the guideline will result in extending recruitment of the patients making insulin pumps more accessible to them. For example, patients with type 2 diabetes should be informed about the availability of an insulin pump as an option and be involved in the decision-making. In addition, the guidelines could appraise which group of patients should be offered the pump therapy based on the study findings. For example, to avoid weight gain, the most serious problem associated with the pump use, the insulin pump should be considered for patients with type 2 diabetes who are poorly controlled with MDIs and have the commitment to perform all the pump tasks (e.g. carbohydrate counting, frequent checks of blood glucose) and maintain good health behaviour (e.g. adhering to dietician visits, diet and exercise). Doctors should address patients' beliefs about the total dietary freedom before initiating the pump therapy, in order to reduce the possibility of gaining weight. Doctors should also emphasise the need for a high level of commitment from patients on the pump to maintain good health by constantly balancing mealtimes and energy consumption. Dieticians should also be involved by educating patients through a variety of learning styles such as reading food labels or using food models.

8. Suggestions for future work

As there is a scarcity of studies examining insulin pump use to manage type 2 diabetes in the Middle East, it will be interesting to conduct more studies on larger samples. In addition, research evaluating the cost-effectiveness of insulin pumps in the Middle East should be conducted. This is important to help in resource allocation, estimating future healthcare expenses and improving the quality of diabetes care.

9. Conclusion

The insulin pump played a role in improving patients' quality of life and health outcomes. The use of pump therapy had many advantages over MDIs and resulted in improving the medicine-taking behaviour of patients with type 2 diabetes. Insulin pumps were not free from side effects; however, based on the participants' views, they were much less than those caused by injections and pens-e.g. pain, swelling, bleeding and bruising. Although the use of insulin pumps introduced mechanical problems, which were not experienced with injections and pens, the occurrence of these problems was uncommon, no serious consequences were reported, and replacing the pump with a new one was easy and feasible. Causing weight gain, being worn around-the-clock and inconvenience in swimming and wearing particular clothing were counterbalanced by achieving good glycaemic control, lifestyle flexibility, and the portability of the pump. Overall, insulin pumps improved the satisfaction of the participants and their adherence to doses. Informing policy-makers about the advantages of such therapy is crucial, in order to expand their use to include this group of patients.

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