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# Management of diabetes during Ramadan fasting in children and adolescents: A survey of physicians' perceptions and practices in the Arab Society for Paediatric Endocrinology and Diabetes (ASPED) countries

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## ABSTRACT

**Aim:** To ascertain the pattern of diabetes management during Ramadan fasting in childhood and adolescence among physicians in Arab countries.

**Methods:** An online electronic survey questionnaire was distributed to physicians registered in the Arab society for Paediatric Endocrinology and Diabetes (ASPED).

**Results:** Of the 167 responders, 114 (86.0%) were paediatricians and the remaining 14.4% were adult physicians. 117 (79.6%) would allow patients to fast and 60.7% of them emphasized providing education before fasting. 69.1% of physicians thought that their patients complete >50% of fasting days. 46.9% recognized those with hypoglycemia unawareness among the very high-risk group for fasting. 62% reported that fasting should be broken if symptomatic hypoglycemia regardless of glucose level and 48.2% indicated that blood glucose above 300 mg/dl is another indication. 63.4% of respondents would decrease basal insulin by 25%, and 52.8% reported that using insulin pump during fasting reduced the frequency of hypoglycemia. 81.1% recommend several dietary adjustments and 56.4% used rapid-acting insulin analog according to carbohydrate counting.

**Conclusions:** There is a wide variation in the management of children and adolescents with diabetes during Ramadan in ASPED countries. A targeted educational program for physicians and establishing a guideline for this challenging area is needed.

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## 1. Introduction

Ramadan fasting is one of the five cardinal articles of faith in Islam. Fasting is observed by millions of adult and adolescent Muslims all over the world [1]. Muslims who fast during Ramadan abstain from eating, drinking, and use of oral medications, from predawn to after sunset. However, there are no restrictions between dusk and dawn [1,2]. During Ramadan, most people consume two meals per day commonly referred to by their Arabic names: one after sunset (*Iftar*) and other before dawn (*Suhoor*). The sick, the elderly, children and travellers are all exempted [1,2]. Notwithstanding, many patients, including those with diabetes, choose to fast, often for social and cultural belonging as well as a religious sense of fulfilment [3].

Several authors have highlighted the various potential risks of fasting during Ramadan, including hyperglycaemia, hypoglycaemia, ketoacidosis, and dehydration [4–6]. However, the risk of hypoglycaemia during the daytime is by far the most disliked complications as its treatment entails the intake of carbohydrate with resulting interruption of the fast. This may induce a sense of guilt and failure by the faithful individual [7]. Predictably, there is a general perceived fear by both patients and their healthcare providers about the use of insulin therapy during Ramadan being the agent most notoriously associated with an increased risk of hypoglycemia [8].

For those in whom fasting was deemed to be safe, many therapeutic regimens have been described detailing how to adjust the type, dose, and timing of insulin injections [9–11]. These regimens represent the collective clinical opinion and many observational and or interventional studies fully appraised elsewhere. However, some children and adolescents with diabetes may experience some untoward events from suboptimal management during Ramadan [12,13].

To the best of our knowledge no data on the patterns of clinical management in children and adolescents with type 1 diabetes mellitus (T1DM) during fasting. Therefore, we conducted this survey to gain an understanding of the patterns of practice of physicians registered in the database of the Arab Society for Paediatric Endocrinology and Diabetes (ASPED), who are likely to be taking the care of adolescents and children with T1DM. This survey should provide a baseline data set to help direct guidelines, education, and further research and monitor trends in the future.

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## 2. Subjects and methods

### 2.1. Study design

This is a cross-sectional electronic survey conducted between May and September 2017 under the auspices of ASPED and approved by its research committee. A web-based commercial software (Survey Monkey, Palo Alto, CA, USA) was used. The target population was identified from the ASPED physicians' database. Respondents were asked to describe themselves concerning specialties, age group, duration, and volume of practice. They all received an initial invitation e-mail that explained the rationale and what was required from the

respondents, followed by four reminder e-mails over 12 weeks including unique e-mail-specific electronic links to the questionnaire. The questionnaire was provided in English and French. A formal IRB approval for the study was granted by the local institution from which the surveys were dispatched (Sheikh Khalifa Medical City, Abu Dhabi, UAE). All subjects provided explicit informed consent electronically to voluntary participate before they could proceed to the survey questions. The voluntary nature and the strict confidentiality in which data will be analysed were reiterated. At the end of the study, responses were collected anonymously, stored electronically, and interpreted. Summary statistics were prepared for responses to each question with percentage adjustment to account for missing responses. Convenience sampling was used with the maximal possible sample of eligible participants was allowed.

### 2.2. The survey questionnaire

As there is no previously published survey to adopt from, the survey questions were developed by four pediatric and adult endocrinologist and validated by ASPED institutional board for scientific research. These sample questions are mainly generated from areas of controversies among physicians and discussed in adult guidelines during fasting in Ramadan. The first question requested the approval of the targeted physicians to participate in the survey, and the following two questions were aimed to define the professional profiles of the respondents and their country of practice. The remaining 16 questions constituted "Diabetes management during Ramadan fasting questionnaire" (Table 1). The questions covered the physicians' perceptions and practices including their usual advice to patients on whether to fast or not, medications and dietary adjustments during Ramadan, and on when fasting should be terminated. The final two questions were about the views and experience of insulin therapy during fasting (Table 1).

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## 3. Results

### 3.1. Respondents' professional and practice profiles

Only respondents practicing in the ASPED region were included in the analysis. A total of 167 respondents confirmed their willingness to participate in the study and met the inclusion criteria. The largest numbers of respondents came from Saudi Arabia (31), followed by United Arab Emirates (22), Egypt (19), Iraq (18), Algeria (17), Kuwait (11), Oman (11), Sudan (7), Palestine (6), and Tunisia (5). Smaller numbers (1–4) came from other countries in the region as Morocco, Libya, Bahrain, Lebanon, Qatar, and Jordan. Of the 167 participants, 101 (60.5%) were paediatric-endocrinologist/diabetologists 42 (25.5%) were pediatricians with interest in diabetes and the remaining 24 (14.4%) were adult physicians looking after adolescents. Most of the responders 114 (68.3%) were senior physicians (i.e. consultant/independent specialist) while 43 (25.8%) were middle grade (i.e. sub-consultant specialist/fellow/senior registrar) with only 10 (6%) were residents in training.

**Table 1 – Management of diabetes during Ramadan fasting questionnaire. Questions and [response options].<sup>a</sup>**

<b>Perceptions</b>	<p>1. From your experience, the percentage of completed days fasted by patients with diabetes in Ramadan is: [20%; 50%; 80%; 100%]</p> <p>2. What is the percentage of your patients with the widespread belief that subcutaneous, intramuscular, or intravenous route injection invalidates the fast? [20%; 50%; 70%; 100%]</p> <p>3. In your opinion, which is the most serious condition in a patient who is in a very high-risk group to fast during Ramadan: [Severe hypoglycemia within the 3 months prior to Ramadan; Hypoglycemia unawareness; Sustained poor glycemic control; Ketoacidosis within the 3 months prior to Ramadan]</p> <p>4. How does the use of insulin pump during Ramadan Fasting affect rate of hypoglycemia [-Does not appear to be different from multiple daily injection in the frequency of occurrence of hypoglycemia, use of insulin pump decreased the frequency of occurrence of hypoglycemia than multiple daily injection, use of insulin pump increased the frequency of occurrence of hypoglycemia than multiple daily injection and I do not follow up patients on insulin pump]</p>
<b>Practices</b>	<p>1. When do you schedule an appointment with your patient and/or his parents to discuss how to manage fasting and diabetes? [2–3 months before Ramadan; 1 month before Ramadan; Two weeks before Ramadan; The first week of Ramadan]</p> <p>2. Do you let your patients fast in Ramadan if they asked for it? [Yes, No]</p> <p>3. At what age would you allow your patients to start trying to fast during Ramadan [8 years; 10 years; 12 years; Above 14 years]</p> <p>4. Taking HbA1c in consideration, your patient can fast if his/her HbA1c level is: [Below 7.5%; Between 7.5 and 8.5%, Between 7.5%; 10%; Any level as long that the patient will cooperate and follow my instructions]</p> <p>5. Your usual dietary advices during Ramadan include the following [Ingestion of large amount of foods rich in carbohydrate and fat during Iftar should be avoided; Meal at Sohor should contain complex carbohydrate, as this will delay digestion and absorption (slow digesting foods). This should be taken as late as possible; Fluid should be taken liberally during non-fasting hours; I recommend all the above]</p> <p>6. You usually recommend to your patients to do “finger stick” blood glucose measurements around: [1–2 times/day; 3–4 times/day; 5–7 times/day; Only if he/she felt dizzy or unwell]</p> <p>7. You educate your patient that fasting must be broken if blood glucose levels fall to: [Below 70 mg/dl (3.9 mmol/L); Below 60 mg/dl (3.3 mmol/L); Below 100 mg/dl (5.5 mmol/L) -Below 80 mg/dl (4.4 mmol/L); Symptomatic hypoglycemia regardless of glucose level]</p> <p>8. The fast should be broken if blood glucose exceeds (you can choose more than one answer): -Above 240 mg/dl (12.7 mmol/L)-Above 300 mg/dl (16.6 mmol/L)-Above 180 mg/dl (10 mmol/L)-Never to break fasting during hyperglycemia, but to give corrections dose-Any blood glucose level with ketones</p> <p>9. You advise your patients that during fasting, basal insulin dose should be adjusted as follows: [Initially decreased by 25%;, Initially decreased by 50%; Initially decreased by 10%;, Kept the same]</p> <p>10. Best timing you recommend for your patients to give their basal insulin (long acting as insulin glargine) during Ramadan is [-Just before Iftar-Just before Sohor-Very late in evening-Early morning]</p>
<b>Case scenarios</b>	<p>1. During Ramadan fasting, your recommendations for adolescents with T1DM on basal– bolus insulin is/ are: [Rapid-acting analog should be taken with meals at same doses prior to Ramadan; Regular type of insulin should not be taken and shifted to rapid-acting analog; Increase dose of rapid-acting analog with meals according to carbohydrate counting; Only use a correcting dose of rapid-acting insulin, if glucose rises above 270 mg/dl (15 mmol/L)]</p> <p>2. It's just before Iftar and when your patient on insulin pump tested his blood sugar; it is 52 mg/dl, what should you advise him? [Put the 52 in your pump as your blood sugar number and enter the number of carbs you are going to eat; Treat with 15 g of fast acting glucose then skip by the blood sugar part of your bolus and only enter the amount of carb you are going to eat; Break the fast right away, stop the pump; and have some carbohydrates to elevate plasma glucose level, and recheck the readings every 15 min until it is found to be rising; Just eat Iftar and do not bolus for it.]</p>
<sup>a</sup> Responses as single response or possible multiples were set electronically.	

### 3.2. Perceptions of physicians of diabetes during Ramadan

Details of the physicians' perceptions of different aspects of diabetes care during Ramadan fasting are shown in Table 2. Considering the percentage of completed days fasted by patients with diabetes in Ramadan; 39.1%, 31.0% and 29.0% of respondents thought their patients would fast 80%, 50% and 20% of Ramadan days respectively. The percentage of patients with the widespread belief that subcutaneous, intramuscular, or intravenous route injection invalidates the fast were reported at different rates with 10% of the

physicians pointing that 100% of their patients have this belief. Hypoglycaemia unawareness sustained poor glycaemic control, severe hypoglycaemia or ketoacidosis within the three months before Ramadan was considered as the most serious condition in a patient to be counted in the high-risk group to fast during Ramadan by physicians in decreasing order. Over 52% of respondents thought the use of insulin pump reduced the frequency of occurrence of hypoglycaemia better than MDI. However, 39.6% declared that they do not follow up patients on insulin pump therapy (Table 2).

### 3.3. General management practices of diabetes care during Ramadan

The physicians' self-reported general management practices of diabetes care during Ramadan are described in Table 3. 80% of participants would allow patients fast in Ramadan if they asked for it and more than two thirds would let their patients attempt fasting at 12 years (37.5%) and above 14 years (34.8%). All physicians would schedule an appointment with patients and/or parents to discuss the management of diabetes during fasting, and 60% felt that such discussion should take place at least one month before the start of Ramadan. Taking HbA1c in consideration, 53.6% thought their patients could fast regardless of their HbA1c level if they follow the instructions, whereas 26.8% specified levels between 7.5 and 8.5% and 14.3% insisted on levels below 7.5%. Most responders (81.1%) recommended a multitude of dietary advice consisting of liberal fluid intake during non-fasting hours, consumption of *Suhoor* containing complex carbohydrate and avoid a large amount of food rich in carbs and fat during *Iftar*. Self-blood glucose monitoring by glucometer was recommended 3–4 times by 51.8% and 5–7 times by 39.3%. Fasting must be broken if blood glucose levels fall to 70 mg/dl (3.9 mmol/l) was the view of 58.0% and down to 80 mg/dl (4.4 mmol/L) by 19.6% of respondents. However, 61.6% recommended breaking the fast if symptomatic hypoglycaemia occurs regardless of glucose level. If hyperglycaemia occurs, 48.2% would support the fast should be discontinued if blood glucose exceeds 300 mg/dl (16.6 mmol/L) and 16.4% if blood glucose exceeds 240 mg/dl (12.7 mmol/L). However, 25.5% advised that patients should never break the fast during hyperglycaemia, but they should instead give the corrections dose, and 48.2% recommended breaking the fast at any blood glucose level if ketones were detected. Responses of smaller proportions of physicians to different questions are detailed in Table 3.

### 3.4. Insulin therapy during Ramadan fasting

The practical aspects of insulin therapy in fasting children and adolescents are detailed in physicians' responses to four different scenarios (Table 4). During fasting, 63.4% of physicians initially reduced basal insulin dose by 25% and 23.2% of physicians performed a 10% reduction. Physicians differed about the best timing they recommend for giving the basal insulin during Ramadan. Forty-five percent recommended administering basal insulin just before *Iftar* time, 41.1% recommended doing so very late in the evening while 12.6% recommended doing so just before *Suhoor* (12.6%). Similarly, physicians' recommendations for adolescents on basal-bolus insulin varied widely (Table 4).

For patients on an insulin pump, the practical management of hypoglycaemia (52 mg/dl) varied widely (Table 4). However, two-thirds of respondents chose to recommend breaking the fast right away, stopping the pump, and having some carbohydrates to elevate plasma glucose level and recheck the readings every 15 min until it is found to be rising.

## 4. Discussion

There have been many guides on the principles of diabetes care during Ramadan in the form of reviews, consensus statement and expert opinions. However, there are no adequate studies to guide the management of diabetes during fasting in children and adolescent [4–6,14–16]. To the best of our knowledge, no studies focused on this issue in children and adolescents. We report the first dataset on the perception, attitude, and practice of physicians from ASPED countries on the management of children and adolescents with diabetes during Ramadan fasting.

We have observed a remarkable variation among physicians in the perception, general management, and the practice of insulin therapy. This difference is expected for a survey of physicians who were trained and practicing in countries with various health care systems [17]. Almost 80% of the participating physicians would allow their patients to fast during Ramadan if they asked for it. However, there was a variation of the age at which children are allowed to try fasting from as young as eight years to 14 years old. Such a difference could reflect the impact of the culture on the decision of physicians. For example, in some countries, many children and adolescents with T1DM are very passionate about fasting during Ramadan [13]. This passion could be due to religious motive or social pressure. It is reassuring that only minority of clinicians (<4%) would agree for children to try fasting since the age of eight years as this would not have religious basis [1,2]. This is a very critical age to fast and will increase the risk of complications starting from dehydration and end up with severe hypoglycaemia [11–13]. We recommend that a consensus/guideline on the minimum age of fasting in liaising with religious experts is needed. It is also vital to have unification between physicians and religious leaders on which patients with diabetes should fast and who should seek exemption [2]. Young children should understand that fasting is incumbent upon every Muslim once puberty is attained, and after that. But, if any is ill or traveling—then he or she is exempted from fasting" [1]. It is essential to ensure that those who do not fast due to their medical condition understand that they are indeed rewarded as those who fast and should not feel guilty. Interestingly 37.5% of respondents thought that the percentage of completed days fasted by their patients was 80%. This high rate indicates that physicians in the region guide their patients properly to safely continue fasting through most of the holy month of Ramadan, which is in accordance with previous published [3–6,8].

Recent studies demonstrated that with proper education, rational adjustment of insulin, diet and daily activities, adolescents with T1DM, can fast during Ramadan, provided they do regular self-monitoring and are under close professional supervision [12,13,17–20]. Reassuringly, all physicians who participated in this survey agreed that pre-Ramadan assessment and education period is essential before fasting and reported that they would schedule an appointment with their patient and/or parents to discuss the management of diabetes during fasting. Although there was a variation on the appropriate timing of these educational appointments, more

**Table 2 – The perceptions of physicians of 4 different aspects of diabetes care using Ramadan fasting for children and adolescents.**

Aspects of diabetes care (number of responders to individual questions) <sup>a</sup>	Response options <sup>b</sup>	Physicians' perceptions [N (%)]
1. What is the percentage of completed days fasted by patients with diabetes in Ramadan? (145)	80%	57 (39.1%)
	50%	45 (31.0%)
	20%	42 (29.0%)
	100%	1 (0.7%)
2. What is the percentage of your patients with the widespread belief that subcutaneous, intramuscular, or intravenous route injection invalidates the fast? (144)	20%	78 (54.2%)
	50%	37 (25.7%)
	70%	19 (13.2%)
	100%	10 (9.6%)
3. Which is the most serious condition in a patient who is in a very high-risk group to fast during Ramadan? (147)	Hypoglycemia unawareness	69 (46.9%)
	Sustained poor glycemic control	40 (27.2%)
	Severe hypoglycemia within the 3 months before Ramadan	22 (15.0%)
	Ketoacidosis within the 3 months before Ramadan	16 (10.9%)
4. How does the use of insulin pump during Ramadan fasting affect rate of hypoglycemia? (144)	Use of insulin pump decreased the frequency of occurrence of hypoglycemia than MDI	76 (52.8%)
	Does not appear to be different from MDI in the frequency of occurrence of hypoglycemia	10 (6.9%)
	Use of insulin pump increased the frequency of occurrence of hypoglycemia than MDI	1 (0.7%)
	I do not follow up patients on insulin pump	57 (39.6%)

MDI = Multiple dose injection.  
<sup>a</sup> All data were adjusted by percentage expressions.  
<sup>b</sup> Some of the responses are reordered to serve message and conclusions.

than 60% of them felt that such discussion should take place at least a month before the start of Ramadan. The timing of the pre-fasting educational counselling depends on the local setting and the clinic case-load. Perhaps it is more beneficial to conduct them few weeks to the start of Ramadan in the form of small group sessions with an explicit curriculum. In addition to the standard education on diet and insulin management during fasting, it is essential to address the myths and misbeliefs on diabetes management during fasting. Of note, a significant number of physicians reported a misbelief among their patients that insulin therapy would invalidate fasting [21].

Around 80% of respondents followed the available adult guidelines for dietary management during Ramadan fasting [4–6]. These guidelines recommend large fluid intake during non-fasting hours, balanced diet of food containing “complex” carbohydrates whole grains, vegetables, and legumes, eaten as late as possible before the start of the daily fast (the pre-dawn meal) and avoiding the ingestion of large amounts of foods rich in carbohydrates and fats, especially at the sunset meal. This dietary advice should be extended to those who do not wish to fast as they are often exposed to the risk of hypo- and hyperglycaemia during Ramadan due to the social, dietary habits during the month. Close monitoring and careful insulin dose adjustments in this setting are essential to achieve optimal glycaemic control and avoid hypoglycaemia or hyperglycaemia during fasting. Most respondents recommended home blood glucose monitoring up to four times per day. Published guidelines stipulate that

patients on insulin or insulin secretagogues should be monitored 2–4 times daily before, during, and after the fasting period [4–6].

Given the potential high risk of fasting in individuals with diabetes, the decision to allow patients to fast Ramadan should be taken in the light of religious exemptions after careful consideration of the associated risk calculated by healthcare providers. The medical advice must be tailored to the individual patient's needs according to the potential dangers they must face if they decide to fast [1,2]. Conditions associated various levels of risk in patients with diabetes during Ramadan fasting have been described in previous consensus statements [4–6]. In this survey, hypoglycaemia unawareness was the most serious complication to categorize patient to be in a “very high-risk” group to fast during Ramadan. This was followed by sustained poor glycaemic control, severe hypoglycaemia and DKA within the three months before Ramadan respectively. However, more than 50% of our respondents felt that HbA1c level was not a factor in determining whether patients can start fasting as long as they follow instructions and perform regular blood glucose monitoring. Most often, the medical recommendation for individuals with diabetes is against fasting. However, patients who wish to fasting need to be aware of the associated risks and techniques to manage this risk, including clear instructions on when to break their fasting. Most of the respondents reported that fasting has to be interrupted if blood glucose falls to symptomatic hypoglycaemia regardless of the glucose level while others opted

**Table 3 – Physicians-self reported general management practices of diabetes care during Ramadan fasting in children and adolescents.**

Aspects of diabetes care (number of responders to individual questions) <sup>a</sup>	Response options <sup>b</sup>	Physicians' perceptions [N (%)]
1. When do you schedule an appointment with your patient and/or his parents to discuss how to manage fasting and diabetes? (145)	2–3 months before Ramadan	34 (23.5%)
	1 month before Ramadan	54 (37.2%)
	Two weeks before Ramadan	55 (37.9%)
	The first week of Ramadan	2 (1.4%)
2. Do you let your patients fast in Ramadan if they asked for it? (147)	Yes	117 (79.6%)
	No	30 (20.4%)
3. At what age would you allow your patients to start trying to fast during Ramadan (112)	12 years	42 (37.5%)
	Above 14 years	39 (34.8%)
	10 years	27 (24.1%)
	8 years	4(3.6%)
4. Taking HbA1c in consideration, your patient can fast if his/her HbA1c level is (112):	Below 7.5%	16 (14.3%)
	Between 7.5% and 8.5%	30 (26.8%)
	Between 7.5% and 10%	6(5.4%)
	Any level as long that the patient will cooperate and follow my instructions	60 (53.6%)
5. Your usual dietary advices during Ramadan include the following (111):	Meal at <i>Sohor</i> should contain complex carbohydrate, as this will delay digestion and absorption (slow digesting foods). This should be taken as late as possible	14(12.6%)
	Fluids should be taken liberally during non-fasting hours	4(3.6%)
	Ingestion of a large amount of foods rich in carbohydrate and fat during <i>Iftar</i> should be avoided	3(2.7%)
	I recommend all the above	90 (81.1%)
6. You usually recommend to your patients to do “finger stick” blood glucose measurements around (112):	3–4 times/day	58 (51.8%)
	5–7 times/day	44 (39.3%)
	1–2 times/day	8 (7.1%)
7. You educate your patient that fasting has to be broken if blood glucose levels fall to (you can choose more than one answer) (112):	Only if he/she felt dizzy or unwell	2 (1.8%)
	Symptomatic hypoglycemia regardless of glucose level	69 (61.6%)
	Below 70 mg/dl (3.9 mmol/L)	65 (58.0%)
	Below 80 mg/dl (4.4 mmol/L)	22 (19.6%)
	Below 60 mg/dl (3.3 mmol/L)	17 (15.2%)
8. The fast should be broken if blood glucose exceeds (you can choose more than one answer) (110):	Below 100 mg/dl (5.5 mmol/L)	8 (7.1%)
	Above 240 mg/dl (12.7 mmol/L)	18 (16.4%)
	Above 300 mg/dl (16.6 mmol/L)	53 (48.2%)
	Above 180 mg/dl (10 mmol/L)	3 (2.7%)
	Never break fasting during hyperglycemia, but to give corrections dose	28 (25.5%)
	Any blood glucose level with ketones	52 (48.2%)

<sup>a</sup> All data were adjusted as percentage.

<sup>b</sup> Some of the responses are reordered to serve message and conclusions.

that fast should be broken if blood glucose exceeds 300 mg/dl or below 70 mg/dl. According to all published guidelines, patients should understand that they must immediately end their fast if hypoglycaemia (blood glucose 60 mg/dl) occurs because their blood glucose may drop further if they delay [4–6]. The fasting should also be broken if blood glucose reaches 70 mg/dl in the first few hours after the start of the fast. Finally, the fast should be interrupted if blood glucose exceeds 300 mg/dl. All people with diabetes who choose to fast should be trained to monitor their blood glucose, to recognize hypoglycaemia, and to learn about the

management and risks associated with severe hypoglycaemic events [4–6].

The practical aspects of insulin therapy during Ramadan fasting were highlighted as an area of controversy among physicians taking part in this survey. Approximately two third of physicians agreed with the consensus in the adult literature to reduce the basal insulin dose during Ramadan fasting to up to 25% depending on the pre-Ramadan glycaemic control [4–6]. However, around one-third of them opted for keeping the same dose or reduce it by 10%. This may reflect the differences in findings in adults and children

**Table 4 – Insulin adjustments recommended by physicians' during Ramadan fasting in children and adolescent on multi-dose insulin therapy or insulin pump (during hypoglycemia).**

Aspects of diabetes care (Total respondents number) <sup>a</sup>	Response options <sup>b</sup>	Physicians' perceptions [N (%)]
1. During fasting, you advise your patients that basal insulin dose should be adjusted as follows:	Initially decreased by 25%	71 (63.4%)
	Initially decreased by 10%	26 (23.2%)
	Kept the same	9 (8.0%)
	Initially decreased by 50%	6 (5.4%)
2. Best timing you recommend for your patients to give their basal insulin (long acting as insulin glargine) during Ramadan (111):	Just before <i>Iftar</i>	50 (45.1%)
	Very late in the evening	46 (41.4%)
	Just before <i>Sohor</i>	14 (12.6%)
	Early morning	(0.9%)
3. During Ramadan fasting, your recommendations for adolescents with T1DM on basal-bolus insulin is/are:	Increase dose of rapid-acting analog with meals according to carbohydrate counting	62 (56.4%)
	Rapid-acting analog should be taken with meals at same doses prior to Ramadan	26 (23.6%)
	Regular type of insulin should not be taken and shifted to rapid-acting analog	13 (11.8%)
	Only use a correcting dose of rapid-acting insulin, if glucose rises above 270 mg/dl (15 mmol/L).	9 (8.2%)
4. It's just before <i>Iftar</i> and when your patient on insulin pump tested his blood sugar; it is 52 mg/dl, what should you advise him?	Break the fast right away, stop the pump, and have some carbohydrates to elevate plasma glucose level, and recheck the readings every 15 min until it is found to be rising	74 (67.3%)
	Treat with 15 g of fast acting glucose then skip by the blood sugar part of your bolus and only enter the amount of carb you are going to eat	18 (16.4%)
	Put the 52 in your pump as your blood sugar number and enter the number of carbs you are going to eat	10 (9.1%)
	Just eat <i>Iftar</i> and do not bolus for it	8 (7.3%)

<sup>a</sup> All data were adjusted by percentage expressions.  
<sup>b</sup> Some of the responses are reordered to serve message and conclusions.

on insulin pump therapy [22,23]. More differences were evident in selecting the timing of the basal insulin injection with 45% suggesting the dose to be given just before *Iftar* while 41% preferring late in the evening time. Such a wide variation emphasizes the need for more paediatric age-based studies to support a definite recommendation. The benefits and safety of insulin pump therapy in children and adolescents during Ramadan fasting has been advocated by some studies [22–26] and endorsed by several guidelines [4–6]. In this survey, nearly 40% of responders reported a lack of experience with insulin pump therapy, and hence they refrained from expressing an opinion. However, use of insulin pumps was thought to be effective in reducing the risk of hypoglycaemia during Ramadan fasting by 52.8% of physicians with two third of them agreeing on what to advise patients to do if they developed hypoglycaemia just before *Iftar* (Table 4). Although insulin pump therapy is widely available in some ASPED countries its usage, it is still limited in others. It was therefore difficult for us to assess the trends all over the region.

The use of technology as a continuous subcutaneous insulin infusion pump during Ramadan was among the list of questions in this survey with limited use in our region. However, the use of more advanced methods to monitor the blood glucose trend, such as the continuous glucose monitoring or ambulatory glucose profile which can be valuable tools to

detect and prevent, glycaemic excursions during Ramadan fasting was not discussed.

The bilingual questionnaire overcame communication barriers and allowed respondents from different ASPED countries, including the 3 North African countries where French is the language used for professional communication. However, it has some limitations: Firstly, it is a survey-based study rather than an accurate audit of the real practices and outcome. Secondly, the distribution of respondents among different ASPED countries were not homogeneous and relatively with a small number of participants not representing the whole Arab countries. This may reflect a variation in the research interest, appreciation, and confidence in the conclusions of survey-based studies.

In conclusion, the present survey revealed that most physicians in ASPED countries would allow children and adolescents with diabetes to experience fasting during Ramadan. Despite the variation in the perception, attitude, and practice among physicians in this area, all participants agreed to provide children and adolescent who choose to fast with pre-fasting education sessions. The findings of this survey provide a baseline overview of the current clinical practice the area which would be useful in informing regional interdisciplinary discussions to develop regional guidelines in collaboration with international organizations and direct continuous professional developments activities.

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## Authors' contribution

NA, AD, AMH conceived the research idea and developed the questionnaire. SAB revised the questionnaire and managed the online survey and data extraction. All authors had access to all the raw data. NA drafted the manuscript, and all authors revised it and approved its final version.

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## Conflict of interest

None of the authors has any conflict of interest.

## Compliance with ethical principles

This article does not contain any studies with human or animal experiments performed by any of the authors. However, the study was approved by the ASPED research committee, and approval was granted by the Institutional Review Board of Sheikh Khalifa Medical City, Abu Dhabi following its local regulations. All participants provided electronic informed consent before they could proceed to the survey.

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