Original article

# Comprehensive care for patients with diabetes in Ramadan: A module for pharmacy students and pharmacists

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## ARTICLE INFO

## ABSTRACT

Introduction: Prior studies show that many patients with diabetes whose health maybe impacted by fasting, choose to fast during Ramadan. This study describes the implementation and evaluation of an online module targeting bachelor of pharmacy (BPharm) and doctor of pharmacy (PharmD) students that aims to improve participants' knowledge, communication, and self-efficacy concerning proper care for patients with diabetes in Ramadan.
Methods: An online module consisting of two phases targeting both BPharm and PharmD students was implemented over two semesters in fall 2020 and spring 2021. Participants were directed to fill pre-module and post-module assessments to evaluate the change in their knowledge and self-efficacy using two scales. Pre- and post-survey data for participants' knowledge and self-efficacy were analyzed for significance using paired sample t-tests. Qualitative data analysis was performed to assess participants' responses to the open-ended question concerning what they liked and disliked about the module.
Results: All BPharm and PharmD students taking the lesson responded to both the baseline survey and the follow-up one resulting in 92 responses (participation rate of 100%). The average score for participants in the pre-module self-efficacy section was 1.5 (SD = 1) and increased post-module to 3.5 (SD = 0.7), t (91) = 20.2, p < 0.001. Further, the average score for participants in the pre-module knowledge section was 14 (SD = 3), which similarly increased to 22 (SD = 3) post-module t (91) = 19.7, p < 0.001. Qualitative analysis provided insights on how participants perceived the module design, content, and its impact on practice. Participants described the module as an informative one that addresses a much-needed issue they haven't been exposed to before. They emphasized how the module addresses the cultural needs of patients in their communities. They particularly appreciated seeing instructor videos depicting real-life scenarios and the focus on their communication skills, but some preferred learning about this topic through live sessions.
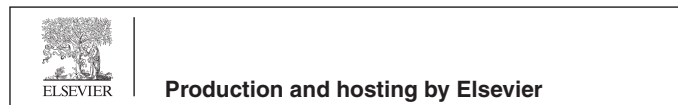Conclusion: An online module positively impacted both self-efficacy and knowledge in relation to caring for patients with diabetes considering fasting in Ramadan. Future studies should explore how different versions of this module can be integrated into educational activities for pharmacy students, pharmacists in different settings, and for other health care professionals.
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## 1. Introduction

Ramadan is the ninth month of the Muslim calendar. Fasting during that month is an obligation for capable Muslims representing the fourth Islamic pillar. For one month, Muslims abstain every day from eating, drinking, smoking, and having sexual intercourse from dawn until sunset (Al-Hilali & Khan, 2005). While fasting could promote beneficial effects on healthy individuals, it can induce harmful effects in some patients with chronic diseases (Aly, 2014; Collier, 2013). Islamic teachings provide some exemptions such that travelers, children, pregnant, breastfeeding,

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menstruating women and chronically ill patients are religiously exempt from fasting.

Literature indicates that many individuals with diabetes will chose to fast. As shown by a large population-based study, Epidemiology of Diabetes and Ramadan (EPIDIAR), among 12,243 people with diabetes, 43% of patients with type 1 diabetes and 79% of patients with type 2 diabetes chose to fast during Ramadan (Salti et al., 2004). Further, there has been an increase in the number of patients with diabetes reporting that they fasted during Ramadan from 79% in 2001 to approximately 94% and 86% in 2010 and 2016, respectively (Hassanein et al., 2021). In 2010, it was estimated that more than 50 million people with diabetes worldwide fast during Ramadan (Al-Arouj et al., 2010; Almaatouq, 2012). Recent estimates suggest that from 148 million Muslims with diabetes, 116 million may choose to fast (International Diabetes Federation, 2019). The management of fasting patients with diabetes represents an expanding public health concern (Pew Research Center, 2015).

Medication management is an essential feature in the patient's self-control of diabetes. A large number of Muslim patients may change their drug regimen, omit doses, or stop taking their medications altogether during Ramadan without consulting their health care providers (Alsunni et al., 2020; Gaborit et al., 2011; Mygind et al., 2013; Peeters et al., 2012) causing dangerous complications (Fazel, 1998; Salti et al., 2004). Patients have been shown to be missing sufficient and culturally competent education to maintain proper diabetes control and to minimize hypoglycemic risk during Ramadan (Tan et al., 2018). Thus, in this holy month, the key goal is to manage therapeutic regimens for patients and their health care providers.

Being highly accessible, community pharmacists are considered as the first place for patients seeking help in chronic disease management, including diabetes (Ali et al., 2012). Studies targeting pharmacists in Lebanon prove that according to patients, pharmacists constitute an important and trusted source of health advice (Mouhtadi et al., 2018). Unfortunately, in Muslim and non-Muslim countries alike, studies have shown that many health care providers, pharmacists included, lack knowledge of key issues related to diabetes management in Ramadan (Abdelaziz et al., 2019; Amin & Chewning, 2014; Gaborit et al., 2011; Sugiharto et al., 2021; Wilbur, 2016; Yılmaz et al., 2021).

In order to prepare Health Care Professionals (HCPs), including pharmacists, to provide the best care for patients considering fasting, the topic needs to be addressed both as a continuing education topic for practicing pharmacists and as a component in professional pharmacy programs. A number of important studies in the curriculum address the issue of training HCPs on caring for patients with diabetes observing Ramadan. The study of Wilbur et al. (2017) described a training module consisting of didactic lectures, case scenarios, and role-plays (Wilbur et al., 2017). Darko et al. (2020) described another educational program and indicated that the lack of confidence in the intervention, as well as the lack of skills and knowledge, constitute barriers for providing adequate patient education (Darko et al., 2020). Thus, there is a need for rigorous training in this area to bolster health professionals' confidence in caring for patients with diabetes considering fasting during Ramadan.

In relation to work addressing student training, the literature indicates that very little work has systematically focused on addressing the needs of patients with diabetes observing religious fasting in pharmacy curricula. An important study to highlight is one that addressed the management of patients with diabetes during Ramadan through an inter-professional educational module (Dwivedi et al., 2018). Participants including residents, physicians, dentists, midwives, nurse practitioners, and social workers stated the need for further training addressing cultural issues. One study addressing an online module on counseling patients with diabetes

considering fasting that targeted third year doctor of pharmacy students in the US as a part of their communication class (Amin et al., 2021a,b). This study focused on communication and shared decision making issues in relation to Muslim, Jewish, and Hindu patients with diabetes considering religious fasting with little emphasis on knowledge of therapeutic regimens for patients choosing to fast.

A number of important studies addressed training for pharmacists and other health professionals on caring for patients with diabetes during Ramadan (Ahmedani et al., 2016; Darko et al., 2020; Dwivedi et al., 2018; Wilbur et al., 2017; Zainudin & Hussain, 2018). Most of those studies targeted health professionals only rather than health professional students. Most studies assessed perceptions on knowledge change qualitatively while some assessed only baseline knowledge quantitatively without a post-intervention assessment. Some studies assessed confidence in relation to providing care for patients with diabetes in Ramadan (Amin et al., 2021a,b; Beshyah et al., 2021; Dwivedi et al., 2018; Zainudin & Hussain, 2018). Moreover, no studies provided details on both therapeutic as well as clinician-patient communication as intervention components concerning counseling patients about Ramadan.

This study describes an integrated and comprehensive online module that includes therapeutic and communication components. To provide a thorough evaluation of the module, this study assessed both the change in knowledge and self-efficacy quantitatively in addition to a brief qualitative assessment of the participants' experiences with the module. Finally, the population targeted by this work includes both Bachelor of Pharmacy (BPharm) as well as Doctor of Pharmacy (PharmD) students who are practicing pharmacists within the Lebanese setting.

This study aimed to evaluate a module on caring for patients with diabetes in Ramadan quantitatively by assessing participants' therapeutic knowledge and self-efficacy before and after taking the module. Further, to complement the quantitative analysis, participants' write-ups in relation to their experience in taking the module were analyzed qualitatively.

## 2. Methods

### 2.1. Participants

The study took place at the Faculty of Pharmacy, Beirut Arab University, Lebanon. Within the Lebanese context, the BPharm program is the first professional degree that allows for licensing to practice the profession of pharmacy. For a PharmD student to be enrolled in the BAU Faculty of Pharmacy, he or she would have to possess a BPharm degree. A PharmD is a post-graduate professional doctorate that includes one didactic course, four courses (seven months) of experiential clinical training, and a comprehensive thesis involving working on primary data collection. The study population consisted of fifth-year BPharm and PharmD enrolled in the academic year 2020/2021. BPharm students took the module as part of an advanced pharmacy practice experiential course, a core course that is offered twice a year while PharmD students took the module as part of several mandatory training activities that represent a graduation requirement. Both BPharm and PharmD students were not exposed to other topics addressing managing patients with diabetes considering religious fasting in the curriculum prior to this experience. The study was approved by the Beirut Arab University Institutional Review Board.

### 2.2. Module design

The design of the module was based upon the most recent therapeutic guidelines and relevant literature on the topic related to

clinical and social aspects in caring for Muslim patients with diabetes in Ramadan (Almansour et al., 2017; Amin et al., 2019; Amin & Abdelmageed, 2020; Amin & Chewning, 2016; Bajaj et al., 2019; Hassanein et al., 2017). The online module consisted of two phases. Using the lesson feature in the used learning management system, the first phase comprised a lesson addressing key topics related to diabetes management and Ramadan fasting. Those topics included addressing the following topics in relation to fasting: risk stratification for patients with diabetes in relation to fasting, medication regimen management, and non-pharmacological measures including proper dietary management and exercising. The lesson included recorded presentations accompanied by downloadable lecture slides to serve as reference points for participants. Active learning techniques were incorporated within the lesson, such as test your knowledge questions, and four pharmacist-patient role-playing videos recorded for the purpose of this study and featuring two pharmacists including the primary investigator. The first video (four minutes) addressed pharmacist-patient miscommunication and proper patient education on fasting risk levels. The pharmacist in the video provided detailed information about risk stratification for the simulated patient accompanied by the need for a proper medication adjustment if the patient chooses to fast after receiving this information. The second video (three minutes and 39 s) addressed the importance of self-monitoring blood glucose and symptoms related to hypoglycemia through a scenario depicting the pharmacist educating a patient with a history of undetected hypoglycemia who previously had a car accident during a hypoglycemic attack. The third video (two minutes and 35 s) addressed patient education about the use of diabetes medications in relation to meals and adequate timing and intensity of physical activity in Ramadan. The last video (two minutes and 18 s) highlighted the pharmacist's initiation of a conversation with the patient about his intention to fast during Ramadan along with the need for annual pre-Ramadan visits to clinicians to identify a patient's risk for fasting and necessary adjustments. A short video describing RAMadan COMmunication (RAMCOM), a tool for systematic communication between health care providers and patients in relation to Ramadan, was introduced to emphasize the role of patient autonomy, informed decision making, and empathy in caring for those patients (Amin & Abdelmageed, 2020).

Due to their high workload and restricted time to finish the module, PharmD students were only required to finish the first phase of the module. Thus, the second phase was only required to be completed by the BPharm students. This phase consisted of recording a role-playing video where participants created their own script and videotaped a patient counseling session addressing diabetes care in relation to Ramadan. Within the role-playing video, participants were instructed to address fasting risk stratification, medication regimen adjustment, counseling on non-pharmacological issues while adhering to guidance for clinician-patient communication addressed in the RAMCOM tool. Those videos were assessed according to the rubric provided in Table 1, which was shared with participants ahead of commencing the lesson. The rubric specified each component that participants needed to address through the role-playing video. Points were deducted for incorrect information or signs of lack of professionalism within the prepared video.

### 2.3. Study design

The study consisted of a diabetes management educational lesson with pre- and post-intervention assessments administered through the Learning Management System (LMS) of Beirut Arab University. Participants were directed to fill a pre-module assessment to assess their baseline self-efficacy operationalized as the

**Table 1**
Evaluation of participants' role-playing videos according to each item of the grading rubric (n = 79).

| Video Component | Participants demonstrating behavior correctly n (%)* |
|---|---|
| Ask patient on intentions with Ramadan (if he/she intends to fast) | 74 (94%) |
| Ask patient on any updates on his/her health status (other comorbidities) | 65 (82%) |
| Ask patient on any information concerning his/her risk category (risk stratification) | 60 (76%) |
| Provide patient with information on his/her risk category (risk stratification) | 49 (62%) |
| Reinforce autonomy. Example: *The decision to fast or not will always be up to you and I will work with you whatever your decision is* | 45 (57%) |
| Ask about concomitant use of other medications | 63 (80%) |
| Ask about habits during Ramadan | 74 (94%) |
| Propose alternative therapeutic regimen | 70 (89%) |
| Provide information on medications, timing, and doses to be used <u>even if some of them are not changed</u> | 75 (95%) |
| Educate patient on proper dietary management and exercise | 76 (96%) |
| Evaluate concordance. Example: *What do you think of the proposed adjusted regimen?* | 46 (58%) |
| Educate patient about hypoglycemic signs and symptoms, blood glucose level of < 70 mg/dl indicating the need to break the fast and how to break the fast in case of hypoglycemia | 67 (85%) |
| Educate patient about hyperglycemic signs and symptoms, blood glucose level of greater than 300 mg/dl indicating the need to break the fast and how to break the fast in case of hyperglycemia | 47 (59%) |
| ■ Evaluate patients' understanding of medication regimen Example: *Please tell me how you would take the medications?* | 72 (91%) |
| ■ Evaluate patients' understanding of instructions. Example: *Please tell me what do you need to keep an eye on?* | 66 (84%) |
| Show empathy to the patient (verbal and non-verbal) | 72 (91%) |
| End by wishing patient well, encouraging patient to ask if any questions come up in future | 75 (95%) |
| Video duration (no more than 10 min) | 77 (97%) |
| Video does not include jargon | 74 (94%) |
| Used appropriate voice (volume, tone, and pace) | 64 (81%) |

*All rubric components were worth one point

perceived confidence in carrying out activities related to managing therapeutic regimens for patients with diabetes in Ramadan and baseline knowledge of diabetes management in relation to Ramadan. After the completion of the two module phases, participants were instructed to fill the post-module survey and knowledge items, which included the same set of items as in the pre-module. Prior to study commencement, the entire module along with the instruments were tested on two practicing pharmacists, while monitoring their comprehension and time taken to finish the lesson.

### 2.4. Instruments

The pre-module assessment consisted of three sections. The first section of the assessment addressed self-efficacy. The format and design of this section, as well as response choices, were based on Bandura's guide for constructing self-efficacy scales (Bandura, 2006). This section consisted of five items pertaining to self-efficacy regarding diabetes management during Ramadan. Participants were asked to rate their degree of confidence on a 5 point scale ranging from "not at all confident" to "extremely confident". The second section of the assessment addressing knowledge consisted of twenty-four items that focused on diabetes and Ramadan related knowledge targeting risk stratification, medication dosage

adjustment, importance of glucose self-monitoring, blood glucose level and conditions to break the fast, healthy diet, physical activity, contraindications, and side effects of anti-diabetic medications. All knowledge questions followed a closed-ended format including multiple-choice and true/false items. The third section consisted of three items that covered the demographic information of participants. The post-module assessment consisted of two sections (self-efficacy and knowledge) that addressed the same items as the pre-module assessment. Within the post-module assessment, an item addressing what participants liked and disliked about the module was added and was analyzed qualitatively. The instrument used was subjected to face and content validity testing. A panel of three experts (two physicians and a health services researcher) with published work on the topic reviewed the face and content validity of the survey questions. In addition, cognitive interviewing was done with five clinicians to ensure the appropriateness of every single question (Willis, 2011). Minor changes were made to instrument items as needed. Additional cognitive interviewing was done with two Lebanese practicing pharmacists.

As highlighted in the introduction, an update on risk stratification for patients with diabetes considering fasting in Ramadan was published in March 2021, the period between the fall and spring semester iterations of the module were offered. Accordingly, nine questions addressing risk stratification were updated to reflect those changes. For example, one of the question items addressing risk stratification was changed from "patients with diabetes with chronic kidney disease (CKD) stage 4 are considered to be moderate to low risk for fasting during Ramadan" into "all patients with type 1 diabetes are considered to be high risk for fasting during Ramadan".

### 2.5. Analysis

Descriptive analyses generated frequencies, means, ranges, and standard deviations as relevant. Cronbach's alpha was used to analyze the internal consistency of the scale assessing the self-efficacy of participants in delivering proper diabetes education. Kuder Richardson-20 (KR-20) was used to analyze the internal consistency of the post-module scale assessing participants' knowledge of diabetes management, which included binary responses (correct/incorrect). Each item in the survey data for self-efficacy of all participants was computed before and after taking the module. The average of the numbers reported by participants was calculated to obtain an overall indicator of the participants' self-efficacy and to construct the composite score. To construct an aggregate knowledge measure, the total number of correct answers to knowledge questions was computed before and after taking the module. Pre- and post-survey data for participants' self-efficacy and knowledge were analyzed for significance using paired sample t-tests. Statistical significance was set a priori at $p < 0.05$. Data were analyzed using IBM SPSS (version 24).

Conventional qualitative content analysis was performed on the participants' narratives and comments on the open-ended question concerning what they liked and disliked about the module (Hsieh & Shannon, 2005). The first and last authors familiarized themselves with the data by reading the participants' perceptions and answers to the open-ended items in the module multiple times, reviewing quantitative results, summarizing the findings, and discussing their interpretations.

## 3. Results

### 3.1. Quantitative analysis

All BPharm and PharmD students taking the lesson filled both the baseline survey and the follow-up one resulting in 92

responses (participation rate of 100%). Seventy-three students were female (79%), and the average age was 22.5 years (range: 20–29). The median time that participants spent on taking the lesson (phase one of the module) was two hours and 36 min. See Table 2.

#### 3.1.1. Reliability and validity

The scale addressing self-efficacy in managing diabetes during Ramadan was internally consistent with Cronbach's alpha score of 0.9. Likewise, KR-20 calculations supported the reliability of the scale addressing post-module knowledge of diabetes management during Ramadan according to 2016 guidelines (fall 2020) and the updated 2021 guideline (spring 2021). The scores were 0.8 (fall 2020) and 0.7 (spring 2021) indicating acceptable internal consistency of these scales when used with pharmacy students and young pharmacists.

#### 3.1.2. Change in Participants' knowledge and Self-Efficacy

Findings indicated a significant effect of the module both on knowledge and self-efficacy of participants. Table 3 provides the pre- and post-module mean scores for each of the five items addressing participants' self-efficacy regarding diabetes management during Ramadan before and after the module. The average score for participants in the pre-module self-efficacy section was 1.5, SD = 1 (range: 0–4) and increased post module to 3.5, SD = 0.7 (range: 1–4), t (91) = 20.2, p < 0.001. Further, the average score for participants in the pre-module knowledge section was 14, SD = 3 (range: 8–22), which similarly increased to 22, SD = 3 (range: 13–24) post-module t (91) = 19.7, p < 0.001. Table 4 provides the proportion of participants selecting the correct answer for each knowledge item before and after tacking the module. As shown in the table, participants had some gaps in baseline knowledge of key issues related to diabetes management in Ramadan. Following the module, a significant increase in knowledge was evident.

Participants were asked to rate their degree of confidence based on a 0–4 scale (0: not at all confident, 1: slightly confident, 2: somewhat confident, 3: confident, 4: extremely confident)

#### 3.1.3. Participants' performance in Role-Playing videos according to the assigned rubric

According to the structured rubric, the average total score for student videos was 8, SD = 2 (range: 4–10). The percentage of participants who satisfied the requirements for each item is shown in Table 1. While the overall performance was good, there were opportunities for improvement in participants' performance. Two issues in particular that participants struggled with were reinforcing patient autonomy and evaluating concordance between the patient and the pharmacist on the therapeutic plan. As for the provision of information for risk stratification, 76% of participants asked about all the risk elements for risk stratification, but 38%

**Table 2**
Demographic characteristics of participants (n = 92).

| Participants' characteristics | n (%) |
|---|---|
| **Gender** | |
| Female | 73 (79) |
| Male | 19 (21) |
| **Age** | |
| Range | 20–29 |
| Average | 22.5 |
| **Educational Program** | |
| BPharm participants | 79 (86) |
| PharmD participants | 13 (14) |

**Table 3**
Participants' self-efficacy regarding diabetes management during Ramadan before and after the module (n = 92).

| Questions | Baseline Mean (±SD) | Post-module Mean (±SD) | Difference in Mean (±SD) |
|---|---|---|---|
| How confident do you feel in your ability to counsel patients with diabetes planning to fast on their **risk level** if they decide to fast during Ramadan? | 1.5 (±0.9) | 3.6 (±0.7) | 2.0 (±1.0) |
| How confident do you feel in your ability to counsel patients with diabetes planning to fast on **potential adjustments to their medication regimens** during Ramadan? | 1.4 (±1.0) | 3.3 (±0.8) | 1.9 (±1.1) |
| How confident do you feel in your ability to counsel patients with diabetes planning to fast on their **nutrition and exercise** during Ramadan? | 1.7 (±1.1) | 3.7 (±0.6) | 2.0 (±1.2) |
| How confident do you feel in your ability to counsel patients with diabetes planning to fast on **signs indicating that they should be breaking fasting** during Ramadan? | 1.8 (±1.2) | 3.7 (±0.6) | 1.9 (±1.3) |
| More generally, how confident do you feel in your ability to **manage patients with diabetes** during Ramadan? | 1.4 (±1.0) | 3.3 (±0.7) | 1.9 (±1.1) |
| Composite Confidence Score | 1.6 (±0.2) | 3.5 (±0.2) | 2.0 (±0.03) |

missed the risk assessment requirement (providing patient with information on his/her risk category).

*3.2. Qualitative Results/ Participants' experience with the module*

Overall, participants felt that the module shed light on a new topic they had no or little knowledge of, as it has not been previously addressed in the curriculum. Participants described the module experience as an "informative" one, which helped them feel more comfortable to approach patients with diabetes considering fasting. They appreciated seeing recorded presentations and instructor role-playing videos related to different aspects of managing diabetes in Ramadan, especially that the instructor's role-playing videos presented real-life scenarios. Participants who felt they haven't approached diabetes "from this side previously" expressed overall satisfaction with their experience. They felt that addressing the cultural needs of patients would particularly have "an impact on their relationship with patients" and that their patients, their family members, and friends would benefit from the provided information. One student describes a personal experience with diabetes in relation to Ramadan:

*[The module] gave me lots of information about pharmacological adjustment during Ramadan that I didn't know before in my 11 years of type 1 diabetes experience and my doctor never told me about when I used to intend to fast.*

*It was really beneficial because, in any textbook, they don't include a topic specific to Ramadan I don't think anyone would provide me with the information*

*It is very common; each one of us knows a patient with diabetes who insists to fast during Ramadan*

One student suggested that the topic be addressed earlier in the curriculum as previously they were not "able to guide a person hoping to fast in Ramadan." In general, participants stated that the module prepared them to better approach and take into con-

sideration the patient's needs and be more confident to handle such situations in practice. The module left some participants "eager to handle a patient with diabetes" considering fasting.

*I now know who can fast, how to manage patients with diabetes during Ramadan, when they should break their fast, how drugs should be taken, and most importantly how to counsel them.*

One student describes an experience applying what was learned in the module with patients:

*It's a new topic that I never thought about or knew about. Today, I asked three patients if they are willing to fast and gave them the appropriate advice after calling their physician.*

Participants felt that the lecture slides and instructor videos organization with ungraded "test your knowledge questions" in-between and the opportunity to revisit the instructor videos and questions when needed helped them understand the material better. Still, some participants felt there were too many instructor videos. Two PharmD students, who were not tasked with creating a role-playing video, felt the experience was "boring" and that they could not complete the lesson in one sitting.

Some participants particularly appreciated the focus on their communication skills in this area, especially the emphasis on empathy and reinforcing patient autonomy within the module. Others appreciated the information on the affordability of different medications addressed. Many participants preferred learning about this topic through live sessions accompanied by opportunities to practice their knowledge on campus or at practice sites to further enhance their understanding by interacting with real patients.

On the other hand, while improved confidence was stated by the majority of the participants, there were areas for improvement. Some participants stated that they found the pharmacotherapy part and the dosing adjustment to be a bit complex especially the insulin part. One participant felt that including more sophisticated cases on dose adjustment would have given them more experience in managing fasting patients.

Some participants found that having to create a role-playing video was helpful in getting them to "rehearse" and practice counseling patients based on the lesson information, while others found it to be complicated and onerous. Some participants did not like being tasked to create a scenario on their own rather than creating a video that addressed a specific issue and case provided by the instructors.

## 4. Discussion

This study addressed the effectiveness of an online educational module addressing providing care for patients with diabetes considering fasting during Ramadan. It is one of the few interventional studies testing a comprehensive, and easy-to-implement module addressing this topic and the first to target both professional pharmacy students and practicing pharmacists. Our findings indicated that the designed educational module resulted in an improvement both in knowledge as well as in self-efficacy regarding diabetes management during Ramadan. Participants felt that the module addressed a topic that was extremely needed by patients with diabetes in their communities.

Prior to the module, participants had a low level of self-efficacy and significant gaps in baseline knowledge of key issues related to diabetes management in Ramadan. This should not be surprising since they have not been introduced to the topic earlier. Following the module, however, a significant improvement was observed among participants both in knowledge and self-efficacy regarding diabetes management in Ramadan. This might have resulted from the comprehensive nature of the module, which provided participants with key information on risk stratification, pharmacological

**Table 4**
The proportion of participants selecting the correct answer for each knowledge item before and after taking the module (n = 92).

| Questions *, ** | Baseline percentage n (%) | Post module percentage n (%) | Differencen (%) |
|---|---|---|---|
| 1A. Which of the following patients with diabetes is considered to be at the **highest risk** for fasting during Ramadan? <br> • **History of recurrent hypoglycemia** <br> • People with diabetes performing intense physical labor <br> • Well-controlled T2DM taking mixed insulin | 38 (41%) | 40 (43%) | 2 (2%) |
| 1B. Which of the following well-controlled patients with type 2 diabetes is associated with the lowest risk for fasting during Ramadan? <br> • People suffering from hypoglycemia 2 times per week <br> • People performing intense physical labor <br> • People taking multiple daily mixed insulin <br> • **People on gliclazide** | 23 (25%) | 35 (38%) | 12 (13%) |
| 2A. Patients with diabetes with **chronic kidney disease(CKD) stage 4** are considered to be moderate to low risk for fasting during Ramadan <br> • True <br> • **False** | 32 (35%) | 41 (45%) | 9 (10%) |
| 2B. All patients with type 1 diabetes are considered to be at high risk for fasting during Ramadan <br> • True <br> • **False** | 27 (29%) | 35 (38%) | 8 (9%) |
| 3A. Patients with diabetes with acute illness are considered to be moderate to low risk for fasting during Ramadan <br> • True <br> • **False** | 19 (21%) | 40 (43%) | 21 (23%) |
| 3B. Patients with diabetes with impaired cognitive function are considered to be at moderate risk for fasting during Ramadan <br> • True <br> • **False** | 25 (27%) | 42 (46%) | 17 (18%) |
| 4. **Ideally**, for adults with type 1 or type 2 diabetes intending to fast, how long prior to Ramadan should a pre-Ramadan individualized assessment be performed? <br> • One week <br> • Two-three weeks <br> • **Six-eight weeks** | 16 (17%) | 78 (85%) | 62 (67%) |
| 5A. What is the risk stratification for type 1 diabetes with a pre-Ramadan HbA1C greater than 9%? <br> • **Very high risk** <br> • High risk <br> • Moderate/low risk | 16 (17%) | 39 (42%) | 23 (25%) |
| 5B. What is the risk stratification for type 1 diabetes with a pre-Ramadan HbA1C greater than 9% taking multiple daily mixed insulin injections with overall negative experience during previous Ramadan? <br> • Low risk <br> • Moderate risk <br> • **High risk** | 44 (48%) | 46 (50%) | 2 (2%) |
| 6A. What is the risk stratification for pregnant women with diabetes or gestational diabetes mellitus treated with insulin? <br> • **Very high risk** <br> • High risk <br> • Moderate/low risk | 18 (20%) | 38 (41%) | 20 (22%) |
| 6B. What is the risk stratification for pregnant women with type 1 diabetes within targets treated with basal-bolus insulin? <br> • Low risk <br> • Moderate risk <br> • **High risk** | 24 (26%) | 43 (47%) | 19 (21%) |
| 7A. What is the risk stratification for type 1 diabetes <br> • **High risk** <br> • Moderate risk <br> • Low risk | 12 (13%) | 39 (42%) | 27 (29%) |
| 7B. Patients with diabetes using … before Ramadan are at the lowest risk for fasting during Ramadan <br> • Basal insulin <br> • Mixed insulin <br> • **Repaglinide** | 26 (28%) | 42 (46%) | 16 (17%) |
| 8. The type of anti-diabetic medication can influence hypoglycemic risk during fasting <br> • **True** <br> • False | 88 (96%) | 91 (99%) | 3 (3%) |
| 9. Very high-risk patients choosing to fasting in Ramadan should check their blood glucose regularly <br> • **True** <br> • False | 90 (98%) | 90 (98%) | 0 (0%) |
| 10. A patient with diabetes is advised to stop the fast if the blood glucose level drops below which of these levels? <br> • **Below 70 mg/dL (3.9 mmol/L)** <br> • Below 90 mg/dL (5.6 mmol/L) <br> • Below 100 mg/dL (5.6 mmol/L) <br> • Below 240 mg/dL (13.3 mmol/L) | 65 (71%) | 91 (99%) | 26 (28%) |

**Table 4** (*continued*)

| Questions *, ** | Baseline percentage n (%) | Post module percentage n (%) | Differencen (%) |
|---|---|---|---|
| 11. Ideally, how often should self-monitored blood glucose testing be done per day during fasting in Ramadan for type 1 DM patients?<br>• One time<br>• Two times<br>• **More than three times** | 29 (32%) | 81 (88%) | 52 (57%) |
| 12. Well-controlled patients treated by lifestyle and metformin only are NOT required to carry out self-monitored blood glucose testing<br>• True<br>• **False** | 62 (67%) | 80 (87%) | 18 (20%) |
| 13. Patients with diabetes should be encouraged to take regular light-to-moderate exercise during Ramadan<br>• **True**<br>• False | 68 (74%) | 91 (99%) | 23 (25%) |
| 14. Which of the following statements describe healthy nutrition habits during Ramadan?<br>• Eating meals containing more than 1500 calories at iftar***<br>• **Ensure meals contain 45–50% carbohydrate, 20–30% protein, and < 35% fat**<br>• Consumption of large portions of high glycaemic index carbohydrates at suhoor***<br>• Eating suhoor early | 71 (77%) | 89 (97%) | 18 (20%) |
| 15. Which of the following statements about fasting for patients with diabetes during Ramadan is **FALSE**?<br>• For weight loss goals for **MEN** with type 2 DM patients in Ramadan, caloric intake should be limited to 1800 kcal/day<br>• **When breaking the fast because of hypoglycemia, patients should consume a small amount of a slow-acting carbohydrate**<br>• For patients with diabetes, Tarawih prayers are considered part of their daily exercise activities. | 41 (45%) | 78 (85%) | 37 (40%) |
| 16. Which of the following symptoms is **NOT** an indication for a patient with diabetes to break his\her fast?<br>• Palpitations and feeling faint<br>• Abdominal pain<br>• **Constipation**<br>• Extreme thirst<br>• Trembling | 77 (84%) | 88 (96%) | 11 (12%) |
| 17. Which of the following statements about the use of **Sodium-glucose co-transporter-2 (SGLT2) inhibitors (e.g. canagliflozin, dapagliflozin)** in Ramadan is **FALSE**?<br>• No dose modifications are needed<br>• Dose should be taken with iftar<br>• Extra clear fluids should be ingested during non-fasting periods<br>• **Can be used in patients with renal impairment** | 25 (27%) | 81 (88%) | 56 (61%) |
| 18A. Which of the following statements is **FALSE**?<br>■ **Extended-release formulation of metformin can not be taken once daily during Ramadan**<br>■ Patients who experienced diabetic ketoacidosis (DKA) within three months prior to Ramadan are considered at a very high risk for fasting<br>■ Well-controlled patients with diabetes treated by lifestyle and metformin can safely fast with medical advice | 32 (35%) | 41 (45%) | 9 (10%) |
| 18B. Which of the following statements is FALSE?<br>■ **Extended-release formulation of metformin can not be taken once daily during Ramadan**<br>■ Patients who experienced diabetic ketoacidosis (DKA) within three months prior to Ramadan are considered at a moderate risk for fasting<br>■ Well-controlled patients with diabetes treated by lifestyle and metformin can safely fast with medical advice | 20 (22%) | 38 (41%) | 18 (20%) |
| 19. For a patient with diabetes using only metformin three times daily and intending to fast, dose modification should be<br>• Skip morning dose<br>• **Morning dose to be taken before suhoor/combine afternoon dose with dose taken at iftar**<br>• Morning dose to be taken before iftar/combine afternoon dose with dose taken at suhoor | 63 (68%) | 90 (98%) | 27 (29%) |
| 20A. Which of the following statements about the use of **insulin secretagogues**/meglitinides e.g. repaglinide in Ramadan is **FALSE**?<br>• Consider switching to an alternative drug class with lower risk for hypoglycemia<br>• When used, Repaglinide (Novonorm) dosage should be adjusted according to mealtimes and sizes during Ramadan<br>• **Repaglinide (Novonorm) is the least safe in class for use during Ramadan** | 19 (21%) | 37 (40%) | 18 (20%) |
| 20B. Which of the following statements about the use of insulin secretagogues/meglitinides e.g. repaglinide in Ramadan is FALSE?<br>• They carry a low risk of hypoglycemia compared to glibenclamide<br>• When used, Repaglinide (Novonorm) dosage should be adjusted according to mealtimes and sizes during Ramadan<br>• **Repaglinide (Novonorm) is the least safe in class for use during Ramadan** | 15 (16%) | 38 (41%) | 23 (25%) |
| 21. Which of the following statements about using **Sulphonylureas** in fasting patients with diabetes is **FALSE**?<br>• Glibenclamide should be used with caution or avoided altogether during Ramadan<br>• For patients taking Sulphonylureas once daily, dose may be reduced in patients with good glycemic control<br>• **Compared to Sulphonylurea, the use of vildagliptin (a dipeptidyl-peptidase-4 (DPP-4) inhibitor Galvus®)is associated with a high rate of hypoglycemia during fasting in Ramadan** | 49 (53%) | 80 (87%) | 31 (34%) |
| 22A. No adjustment to pioglitazone is needed during Ramadan and doses can be taken with iftar or suhoor<br>• **True**<br>• False | 21 (23%) | 39 (42%) | 18 (20%) |
| 22B. No adjustment to pioglitazone is needed during Ramadan and doses can be taken with iftar<br>• **True**<br>• False | 29 (32%) | 43 (47%) | 14 (15%) |

**Table 4** (*continued*)

| Questions *, ** | Baseline percentage n (%) | Post module percentage n (%) | Differencen (%) |
|---|---|---|---|
| 23. Which of the following statements about using **Glucagon-like peptide-1 receptor agonists** (e.g. liraglutide) in fasting patients with diabetes in Ramadan is **FALSE**? <br> • No change if tolerating prior to Ramadan <br> • **Should be initiated within two weeks prior to or during Ramadan** <br> • Reduce dose or withhold if nausea, vomiting, or diarrhea occur | 45 (49%) | 82 (89%) | 37 (40%) |
| 24. Which of the following statements about using **short-acting insulin** in fasting patients with type 2 diabetes in Ramadan is **FALSE**? <br> • Take usual evening meal insulin dose at iftar meal <br> • **Increase suhoor meal insulin dose** <br> • Omit lunchtime insulin dose <br> • Consider switching from human regular insulin to rapid-acting insulin analogs | 43 (47%) | 83 (90%) | 40 (43%) |

*Items 1A, 2A, 3A, 5A, 6A, 7A, 18A, 20A, and 22A were revised into items 1B, 2B, 3B, 5B, 6B, 7B, 18B, 20B, and 22B as a result of the update in risk stratification section of the guidelines published in March 2021. Items 1A, 2A, 3A, 5A, 6A, 7A, 18A, 20A, and 22A were used to assess the knowledge of the fall 2020 group and items 1B, 2B, 3B, 5B, 6B, 7B, 18B, 20B, and 22B were used to assess the knowledge of the spring 2021 group.

** The correct answer for each question is shown in bold

*** Suhoor is the pre-dawn meal and iftar is the meal that breaks the fast

and non-pharmacological management of patients. In addition, the module provided the BPharm students with the chance to practice the knowledge they gained in a role-playing video, which helped participants integrate the learned materials while refining their communication about the topic bolstering their confidence as indicated in the post-module surveys. Still, there were some gaps in the participants' performance in the role-playing video they prepared that represented an area for improvement. In particular, a high percentage of participants struggled with reinforcing patient's autonomy and evaluating concordance between the patient and the pharmacist on the therapeutic plan. Maybe if the participants have practiced related scenarios with simulated patients, performance on those items would have improved. This would be something to consider in future work.

Pre-module findings reported here are consistent with other research indicating that many health care providers, including pharmacists, lack knowledge of key issues related to diabetes management in Ramadan (Gaborit et al., 2011; Sugiharto et al., 2021; Yılmaz et al., 2021). Several descriptive and interventional studies have specifically addressed pharmacists' knowledge of diabetes management during Ramadan (Abdelaziz et al., 2019; Almansour et al., 2017; Wilbur et al., 2017). Interventional studies consisted of didactic lectures, case-solving scenarios, focus group discussions, and/or role-playing videos (Ahmedani et al., 2016; Darko et al., 2020; Dwivedi et al., 2018; Wilbur et al., 2017; Zainudin & Hussain, 2018). Similar to our findings, prior work related to Ramadan and diabetes shows mostly positive results for educational activities targeting other health professionals. Dwivedi et al. (2018) reported an improvement both in confidence and in perceived knowledge of diabetes medication management during Ramadan both for residents and staff, who are relatively more experienced than participants in the current study, when comparing the pre and post-training results, which consisted of educational lectures and case scenarios given over a month (Dwivedi et al., 2018). Further, the study of Zainudin et al. (2018) consisting of three educational sessions, each lasting half a day, participants (including GPs, nurses, and allied health professionals) showed good knowledge and improvement in their confidence for counseling people with diabetes on risk assessment, medication adjustments, self-care, and monitoring of blood glucose level as well as meal planning during Ramadan (Zainudin & Hussain, 2018). Collectively, one would infer that different designs of educational interventions can play a crucial role in improving current and future health professionals' competency in relation to caring for patients with diabetes observing Ramadan.

In general, when comparing the percentages of the pre and post-module survey, the knowledge about dietary modifications, exercise, monitoring of blood glucose, and some but not all medications did improve considerably. On the other hand, items addressing risk stratification showed smaller improvements, probably due to insufficient familiarity of pharmacy students with risk stratification as a topic compared to medication regimen adjustment, which made some of the related materials harder to comprehend. This was also reflected in the role-playing video grades where participants' performance in relation to risk stratification was generally lower than their performance in relation to addressing medication adjustment. Instructors working with pharmacy students may want to review the way information related to risk is presented making sure it is as clear as possible. Further, it is important to reemphasize to students and pharmacists taking this module that the importance for a practicing pharmacist to comprehend information related to risk stratification is no less important than information addressing adjustment of medication. This could get pharmacists and pharmacy students to pay extra attention when information addressing risk stratification is introduced to them.

Qualitative findings in this study provided helpful suggestions for those planning to carry out educational activities addressing this topic. Generally, pharmacy students appreciated including this component in the curriculum and some were eager to put what they learned to practice. Along the same lines, Ahmedani et al. (2016) recommended that, in relation to Ramadan, diabetes should be included in the medical curriculum of different health professionals to empower them with the proper knowledge and training (Ahmedani et al., 2016). The best strategy of covering such a topic in the curriculum is something to be considered by stakeholders. It is possible that pharmacy and other medical schools that serve communities with a significant Muslim population can consider integrating the topic in different classes of the curriculum as well as bringing the topic to the students' attention early in the curriculum as conditions permit.

The feasibility of this module creates opportunities for multiple stakeholders who can put the findings into practice. In particular, this module can be a resource for schools of pharmacy in Muslim majority countries, where the rates of fasting during Ramadan among patients with diabetes are very high (Al-Arouj et al., 2010; Almaatouq, 2012). Those schools should make every effort in addressing an issue that impacts a large segment of the population as they pursue evidence-based medicine through taking patient values and preferences into account (Sackett et al., 1996).

Findings are also important for countries that host increasing numbers of immigrants, which necessitates addressing culturally sensitive health care throughout the pharmacy curriculum (O'Connell et al., 2013). It would also provide an opportunity for culturally sensitive engagement when hosting students and/or faculty members from Muslim countries (Alsharif et al., 2019). Integrating such module earlier as a component of the students' training, would provide an opportunity for students to master the introduced materials in didactic, experiential and perhaps inter-professional settings. This would also provide students with the skills they need early in their career prior to graduating so that they can more easily comprehend and apply updates to practice guidelines as they emerge while they are practicing health professionals.

It would be interesting to use inter-professional education as a pedagogical approach for teaching students from different health professions about diabetes and Ramadan in a comprehensive manner that combines therapeutics and communication as demonstrated here. With the recent wider dissemination of online learning, it would also be interesting for future studies to explore how different versions of this module can be integrated into continuing education activities for other health care professionals.

This is one of the few studies that provide a detailed online educational module for pharmacy students on diabetes management in relation to Ramadan. It is also the first study that quantitatively assesses both self-efficacy and knowledge before and after the module using instruments of tested psychometric properties. This study is not without limitations. This comprehensive module has been integrated and evaluated at a single site, which limits generalizability. It is also possible that the use of the same instrument to assess knowledge before and after the module has overestimated the effect of the module on knowledge of diabetes management in relation to Ramadan, with students having familiarity with the items prior to the post-module assessment. Finally, while some measures were taken to promote the integrity of online assessment used to assess knowledge, the possibility of student cheating cannot be ruled out. Still, the use of multiple data sources including objective role-playing video score measures which show mostly positive student performance was reassuring.

## 5. Conclusion

An online module addressing caring for patients with diabetes considering fasting in Ramadan resulted in significant improvements both in participants' knowledge and self-efficacy. The module was generally well-received by participants who highlighted its role in addressing a prevalent issue in their communities. Findings from this study should be a starting point for testing iterations of this module in different settings, particularly where health professionals and students are serving sizable Muslim populations.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## References

Abdelaziz, T.A., Abdulraheem, M.A., Badi, S.A., Badawi, M.I., Saeed, A.O., Elobied, M. A., Ahmed, M.H., 2019. Knowledge, attitude and practice of Sudanese pharmacist with regard to management of diabetes during Ramadan: A cross-sectional survey. Diabetes Metab. Syndr.: Clin Res. Rev. 13 (1), 122–126. https://doi.org/10.1016/j.dsx.2018.07.019.

Ahmedani, M., Hashmi, B., Saif Ulhaque, M., 2016. Ramadan and diabetes - Knowledge, attitude and practices of general practitioners: A cross-sectional study. Pak J Med Sci 32, 846–850. https://doi.org/10.12669/pjms.324.9904.

Al-Arouj, M., Assaad-Khalil, S., Buse, J., Fahdil, I., Fahmy, M., Hafez, S., Hassanein, M., Ibrahim, M.A., Kendall, D., Kishawi, S., Al-Madani, A., Nakhi, A.B., Tayeb, K., Thomas, A., 2010. Recommendations for management of diabetes during Ramadan: Update 2010. Diabetes Care. 33, 1895–1902. https://doi.org/10.2337/dc10-0896.

Al-Hilali, M., & Khan, M. , 2005. *The English translation of the meanings and commentary. a: King Fahd Complex for the Printing of the Holy Qur'an.* Madinah, Kingdom of Saudi Arabi

Ali, M., Schifano, F., Robinson, P., Phillips, G., Doherty, L., Melnick, P., Laming, L., Sinclair, A., Dhillon, S., 2012. Impact of community pharmacy diabetes monitoring and education programme on diabetes management: A randomized controlled study. Diabet Med. 29, e326–e333. https://doi.org/10.1111/j.1464-5491.2012.03725.x.

Almaatouq, M., 2012. Pharmacological approaches to the management of type 2 diabetes in fasting adults during Ramadan. Diabetes Metab Syndr Obes. 5, 109–119. https://doi.org/10.2147/DMSO.S23261.

Almansour, H.A., Chaar, B., Saini, B., 2017. Pharmacists' perspectives about their role in care of patients with diabetes observing Ramadan. Res Social Adm Pharm 13 (1), 109–122. https://doi.org/10.1016/j.sapharm.2016.02.006.

Alsharif, N.Z., Brennan, L., Abrons, J.P., Chahine, E.B., 2019. An introduction to cultural sensitivity and global pharmacy engagement. Am J Pharm Educ 83 (4), 7221. https://doi.org/10.5688/ajpe7221.

Alsunni, A., Albaker, W., Almansour, A., Alenazi, A., Alaftan, M., & Badar, A. ,2020. Knowledge, attitude and practice regarding Ramadan fasting and related determinants in patients with type 2 diabetes at a saudi diabetes clinic. *Diabetes Metab Syndr Obes*;13:151-159. 10.2147/DMSO.S241496. eCollection 2020.

Aly, S.M., 2014. Role of intermittent fasting on improving health and reducing diseases. Int J Health Sci (Qassim) 8 (3), v–vi.

Amin, M.E.K., Abdelmageed, A., 2020. Clinicians' perspectives on caring for Muslim patients considering fasting during Ramadan. J Relig Health 59 (3), 1370–1387. https://doi.org/10.1007/s10943-019-00820-y.

Amin, M.E.K., Abdelmageed, A., Miller, A.C., 2020. RAMCOM: A qualitative study of clinicians' viewpoints on a tool for communication with Muslim patients considering fasting during Ramadan. PLoS ONE 15 (2), e0228888.

Amin, M.E.K., Abdelmageed, A., Farhat, M.J., 2021a. Communicating with clinicians on fasting during Ramadan: The patients' perspective. J Relig Health 60 (2), 922–940.

Amin, M.E.K., Chewning, B., 2014. Community pharmacists' knowledge of diabetes management during Ramadan in Egypt. Int J Clin Pharm 36 (6), 1213–1221.

Amin, M., Chewning, B., 2016. Pharmacist–patient communication about medication regimen adjustment during Ramadan. Int J Pharm Pract 24, 419–427. https://doi.org/10.1111/ijpp.12282.

Amin, M.E.K., Qudah, B.A., Kaur, A., Rawy, M., Chewning, B., 2021b. Construction and evaluation of an online module addressing counseling patients with diabetes observing religious fasting. Curr Pharm Teach Learn. 13 (12), 1602–1610. https://doi.org/10.1016/j.cptl.2021.09.022.

Bajaj, H.S., Abouhassan, T., Ahsan, M.R., Arnaout, A., Hassanein, M., Houlden, R.L., Khan, T., Khandwala, H., Verma, S., 2019. Diabetes canada position statement for people with types 1 and 2 diabetes who fast during Ramadan. Can J Diabetes 43 (1), 3–12. https://doi.org/10.1016/j.jcjd.2018.04.007.

Bandura, A., 2006. Guide for Constructing Self-Efficacy Scales. In: Pajares, F., Urdan, T. (Eds.), Self-Efficacy Beliefs of Adolescents. Information Age Publishing, Greenwich, CT, pp. 307–337.

Beshyah, S.A., Ali, K.F., Hajjaji, I.M., Hafidh, K., Raza, S.A., Ghour, N., Khochtali, I., 2021. Knowledge gaps and perceptions of future research directions on management of diabetes during Ramadan fasting: An online survey of physicians. Diabetes Res Clin Pract 177, 108923.

Collier, R., 2013. Intermittent fasting: the science of going without. CMAJ 185 (9), E363–E364. https://doi.org/10.1503/cmaj.109-4451.

Darko, N., Dallosso, H., Hadjiconstantinou, M., Hulley, K., Khunti, K., Davies, M., 2020. Qualitative evaluation of A safer Ramadan, a structured education programme that addresses the safer observance of Ramadan for Muslims with type 2 diabetes. Diabetes Res Clin Pract 160, 107979. https://doi.org/10.1016/j.diabres.2019.107979.

Dwivedi, R., Cipolle, C., Hoefer, C., 2018. Development and assessment of an interprofessional curriculum for managing diabetes during Ramadan. Am J Pharm Educ 82 (7), 6550. https://doi.org/10.5688/ajpe6550.

Fazel, M., 1998. Medical implications of controlled fasting. J R Soc Med 91 (5), 260–263. https://doi.org/10.1177/014107689809100505.

Gaborit, B., Dutour, O., Ronsin, O., Atlan, C., Darmon, P., Gharsalli, R., Pradel, V., Dadoun, F., Dutour, A., 2011. Ramadan fasting with diabetes: An interview study of inpatients' and general practitioners' attitudes in the South of France. Diabetes Metab 37 (5), 395–402. https://doi.org/10.1016/j.diabet.2010.12.010.

Hassanein, M., Al-Arouj, M., Hamdy, O., Bebakar, W.M.W., Jabbar, A., Al-Madani, A., Hanif, W., Lessan, N., Basit, A., Tayeb, K., Omar, M., Abdallah, K., Al Twaim, A., Buyukbese, M., El-Sayed, A., Ben-Nakhi, A., 2017. Diabetes and Ramadan: Practical guidelines. Diabetes Res Clin Pract 126, 303–316. https://doi.org/10.1016/j.diabres.2017.03.003.

Hassanein, M., Hanif, W., Malek, R., Jabbar, A., 2021. Changes in fasting patterns during Ramadan, and associated clinical outcomes in adults with type 2 diabetes: A narrative review of epidemiological studies over the last 20 years. Diabetes Res Clin Pract 172,. https://doi.org/10.1016/j.diabres.2020.108584 108584.

Hsieh, H.-F., Shannon, S.E., 2005. Qualitative Health Research. Three Approaches to Qualitative Content Analysis. Qual Health Res 15 (9), 1277–1288. https://doi.org/10.1177/1049732305276687.

International Diabetes Federation , 2019. International Diabetes Federation Diabetes Atlas, Ninth Edition. https://www.idf.org/e-library/epidemiology-research/diabetes-atlas/159-idf-diabetes-atlas-ninth-edition-2019.html (accessed 13 March 2021).

Mouhtadi, B.B., Alame, M.M., Malaeb, B., Hallit, S., Salameh, P., Malaeb, D., 2018. Physician-community pharmacist collaborative care in diabetes management: a pilot study. J Drug Assess 7 (1), 61–65.

Mygind, A., Kristiansen, M., Wittrup, I., Nørgaard, L.S., 2013. Patient perspectives on type 2 diabetes and medicine use during Ramadan among Pakistanis in Denmark. Int J Clin Pharm 35 (2), 281–288. https://doi.org/10.1007/s11096-012-9716-1.

O'Connell, M.B., Rodriguez de Bittner, M., Poirier, T., Karaoui, L.R., Echeverri, M., Chen, A.M.H., Lee, S.-Y., Vyas, D., O'Neil, C.K., Jackson, A.N., 2013. Cultural competency in health care and its implications for pharmacy part 3A: Emphasis on pharmacy education, curriculums, and future directions. Pharmacotherapy 33 (12), e347–e367. https://doi.org/10.1002/phar.1353.

Peeters, B., Mehuys, E., Van Tongelen, I., Van Bever, E., Bultereys, L., Avonts, D., Yıldız, G., Remon, J.P., Boussery, K., 2012. Ramadan fasting and diabetes: An observational study among Turkish migrants in Belgium. Prim Care Diabetes 6 (4), 293–296. https://doi.org/10.1016/j.pcd.2012.02.003.

Pew Research Center. , 2015. *The Future of World Religions: Population Growth Projections, 2010-2050*. Pew Research Center. https://www.pewforum.org/2015/04/02/religious-projections-2010-2050/ (accessed 13 March 2021).

Sackett, D. L., Rosenberg, W. M. C., Gray, J. A. M., Haynes, R. B., Scott, W., & Richardson. ,1996. Editorials evidence based medicine: What it is and what it isn't. *BMJ*, *312*(7023), 71–72. 10.1136/bmj.312.7023.71

Salti, I., Bénard, E., Detournay, B., Bianchi-Biscay, M., Le Brigand, C., Voinet, C., Jabbar, A., 2004. A population-based study of diabetes and its characteristics during the fasting month of Ramadan in 13 countries: Results of the epidemiology of diabetes and ramadan 1422/2001 (EPIDIAR) study. Diabetes Care 27 (10), 2306–2311. https://doi.org/10.2337/diacare.27.10.2306.

Sugiharto, S.h., Natalya, W., Otok, B.W., 2021. Healthcare providers' knowledge, attitude, and perspective regarding diabetes self-management during Ramadan fasting: A cross-sectional study. Nurse Media J Nurs 11 (1), 124–132. https://doi.org/10.14710/nmjn.v11i1.33926.

Tan, C., Yong, A., Haji Mohamad, M., Abdul Rahman, H., Naing, L., 2018. Fasting in Ramadan of Muslim patients with diabetes mellitus, and knowledge and practice in relation to diabetes control in Brunei. Diabetes Res Clin Pract 144, 171–176. https://doi.org/10.1016/j.diabres.2018.09.004.

Wilbur, K., 2016. More education needed for pharmacist diabetes advising roles during Ramadan throughout the world. Res Social Adm Pharm 12 (5), 813–814. https://doi.org/10.1016/j.sapharm.2016.05.041.

Wilbur, K., Shabana, S., Maraghi, F., ElMubark, A., Kheir, N., 2017. An evaluation of the translation of continuing education into diabetes public health care by pharmacists. Int J Clin Pharm 39 (4), 774–782. https://doi.org/10.1007/s11096-017-0477-8.

Willis, G., 2005. Cognitive Interviewing. A Tool for Improving Questionnaire Design. Thousand Oaks, CA.

Yılmaz, T.E., Başara, E., Yılmaz, T., Kasım, İ., Özkara, A., 2021. Approaches and awareness of family physicians on diabetes management during Ramadan. Int J Clin Pract 75 (7). https://doi.org/10.1111/ijcp.14205.

Zainudin, S.B., Hussain, A.B., 2018. The current state of knowledge, perception and practice in diabetes management during fasting in Ramadan by healthcare professionals. Diabetes Metab Syndr 12 (3), 337–342. https://doi.org/10.1016/j.dsx.2017.12.025.