



Religiosity and type 2 diabetes self-management among Muslims residing in California

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ABSTRACT

Type 2 diabetes (T2D) is a public health issue that needs to be addressed. In the U.S., 11.3% of the population have diabetes. It is estimated that 90–95% of all diabetes cases are T2D cases. One of the best methods to address T2D is self-management. Prior research found a relationship between religiosity and T2D self-management. The purpose of this study was to examine religiosity and T2D self-management. This was a cross-sectional and qualitative study, which included Muslim adults, who have T2D and live in California. We utilized snowballing to recruit participants and the saturation concept to determine the number of participants. Additionally, we used semi-structured design for the interviews and focus groups. We had 30 participants for the interviews (however, only 25 provided demographic data) and 28 for the combined focus groups. Zoom was used to conduct the interviews and two focus groups. The grounded theory was used to deduce themes from the interviews and focus groups. The main themes for religiosity and self-management are Allah sustains life, everything will be ok/hope, faith gives strength, and the role of self within the fate concept. The themes for self-efficacy are diabetes requires new life approach, stress, and Islamic religious practices promote self-management. The main theme for perceived seriousness is taking action and making changes. Our findings provide significant insight about the relationship between religiosity, perceived seriousness, fatalism, and self-efficacy and self-management of T2D. A recommendation based on this study is that providers and health educators should be aware of the different experiences Muslims with T2D face, and tailor recommendations and programs based on that.

1. Introduction

Diabetes is characterized by elevation of blood glucose levels [1]. The causes for the elevation of blood glucose varies by the type of diabetes [2]. Type one diabetes (T1D), type two diabetes (T2D), and gestational diabetes are the three major types of diabetes mellitus [3]. In the United States, there is about 11.3% of the population, or 37.3 million people, who have diabetes. Of those, only 28.7 million are diagnosed, the majority of them are adults [4]. Ninety to ninety-five percent of all diabetes cases are type two [5].

T2D causes a multitude of complications, especially among those who had a delay in diagnosis. Additionally, it is estimated that two-thirds of those with T2D will die from cardiovascular complications. The death rate of those with T2D are two times as likely compared to those who are of the same age, but do not have diabetes [6]. The population around the world account for 8.4% of the

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deaths due to T2D and its complications. This is not expected to remain stagnant, but to increase, as the cases of T2D increase. T2D continues to contribute to the mortality and morbidity of those who have it compared to the rest of the population, despite medical developments [7].

Treatment of T2D requires consideration of cultural differences of the community and not focus only on ethnicity. Furthermore, there needs to be a consideration of matching healthcare providers' cultural background with the patients' cultural background because that is proven to produce better outcomes [6].

In the Landscape Study conducted by the Pew Research Center, Mohamed [8] estimated that American Muslims will be the second largest religious group in the U.S. by the year 2040, after Christians. The researcher also estimated that the Muslim population in the U.S. was comprised of 1.1% of the total population in 2017, which represented 3.45 million American Muslims of all ages. Previous research has found that the global prevalence of non-communicable diseases in global populations is high [9], and it is also important to note that health behaviors resulted in non-communicable diseases might be different among the Muslim population from country to country due to cultural differences [10].

Self-management can be defined as the reliability of the patient to manage their own chronic condition(s) [11]. Self-management is the best method to manage T2D, resulting in lowering hemoglobin A1c to appropriate levels; helping to reduce premature deaths and preventing complications [12]. Self-management focuses on teaching patients the following topics: watching for new symptoms, medication management, problem solving and decision-making skills, and changing lifestyle behaviors that contribute to the worsening of the chronic condition. Learning about these different areas can lead to living the best possible life, given the health condition of the person [11]. Self-management in the case of type II diabetes is critical because patients, on average, spend less than 2 h per year with their healthcare provider [13].

Lundberg and Thrakul [14] indicate in their research that religious traditions are a component of self-management. Care-seeking behavior can result from following religious beliefs, which leads to reaching the desired blood glucose level among patients with T2D. The researchers also stated that religion, which is defined as following religious beliefs in this study, does affect the health of the individual. Darvyri, Christodoulakis [15] looked at the association between religiosity, spirituality, and T2D management in a systematic review. The finding of the systematic review is that glycemic control is better among those who believe in God, which was evaluated by measuring church attendance. Additionally, glycemic control comes from social support that is obtained when the individual is part of a religious community because being part of a religious community minimizes negative feelings and increases problem-solving skills. Based on these results, improved self-management, as a result of being connected to a religious group, could lead to reducing morbidity and mortality from T2D and its complications, as indicated by Darvyri, Christodoulakis [15]. It is important to note that this systematic review does not look at religiosity by religion, which means it did not specifically address religiosity among Muslims.

Research conducted in the area of healthy lifestyle behaviors has been done mostly in the West or within Judeo-Christian environments, but limited studies have been done within the Muslim population. The results of the Judeo-Christian research cannot be easily generalized to Muslims because the influence of Islamic resources and traditions might be different [10]. Two studies identified by Tey, Park [10], one done in Malaysia and the other in Israel, resulted in conflicting outcomes. In the study done in Malaysia [16], the researcher found that religiosity influenced healthy lifestyle behaviors; however, the study did not look at the health status of the participants. The study that was done in Israel [17] looked at Arabs and Jews and whether there is a relationship between religiosity and healthy behaviors in these two ethnic groups. The results showed no significant relationship between the two variables, but religiosity negatively predicted balanced nutrition among both Jews and Arabs. It should be noted that this study looked at religiosity among ethnic groups, and not religious groups, so their results cannot be generalized to Muslims. Similar to the relationship between religiosity and healthy lifestyle behaviors, the relationship between religiosity and anxiety had conflicting results, and they are mostly done in the Christian community [18]. In a meta-analysis of ten studies which looked at the relationship between religiosity and anxiety among Arabs who were mostly Muslim, Abdel-Khalek [18] found a negative correlation between the two factors, which is what was expected (median correlation -0.223 and all studies were significant, except for one study; although the exact p-values were not reported). However, it is important to note that the study was not done on Muslims in the U.S., which is where the current study took place, as the U.S. Muslim population might have different results.

It is established that religiosity affects an individual's health. There are several suggested pathways for that, which are: social support, religious belief, coping strategies, and religious practices [19]. In a religious group of African American participants, a study found that religiosity and/or spirituality led to better diabetes management. That same study showed that connection to religion was considered solid when the health is maintained, which resulted in consistent activities of diabetes self-management [20].

The religion of Islam is considered a way of life for Muslims. In a study of Javanese Muslims in Indonesia, the researchers found that culture and religion are intertwined in affecting the management of diabetes [19]. Despite Muslims making a sizable number of the U.S. population, T2D among them is understudied. In this study, we explored the relationship between religiosity and self-management of T2D among Muslims in California. We also examined how self-efficacy relates to self-management of T2D. Additionally, we investigated whether the perceived seriousness of T2D and fatalism affect T2D self-management.

2. Methods

This cross-sectional study started as a mixed methods design. Since the quantitative section is still in progress, we are only discussing the qualitative phase in this paper. The participants included adult Muslims residing in California who have T2D. Anyone who did not meet these criteria was excluded.

To recruit participants in the qualitative phase, we used information given by the participants in the quantitative, or phase one, of

the study. Those contacted during the quantitative part of the study had a question at the end of the survey asking them if they wanted to participate in interviews, focus groups, either, or neither; and if they selected interviews, focus groups or either, then they were asked to enter their email address for further communication. These emails between the researcher and the interested participants were used to decide on the best time for the interviews and focus groups. Additionally, this study was further promoted through social media (e.g. Facebook and Instagram) and snowballing [21] by sending a flyer with details of the study and QR codes on how to obtain the registration forms, which included questions determining eligibility based on the inclusion criteria, and their email which was used only for communication. Different forms and QR codes were developed for the interviews from the focus groups. Saturation [22] was used to determine the final number of participants for the interviews. However, when saturation was reached, the participant were all males, so the researcher did additional recruitment for female participants. The study utilized Zoom software [23] for the interviews and focus groups.

One day before the interview or focus group, a reminder email was sent regarding the time of the interview or focus group, and included a copy of the consent form and the demographics form (e.g., age, weight, height, ethnicity/race, household income, etc.) to be collected from the participants. For the interviews, the participants chose when to send the consent form and the demographics document; however, for the focus group, the participants were only given their incentives after submitting both documents, and after

Table 1
General characteristics of interview participants.

CHARACTERISTICS	STUDY SAMPLE N = 25 (%)
AGE ^A	32.84 ± 9.14
BMI ^A (KG/M ²) ^B	
LESS THAN 18.5	0 (0)
18.5–24.9	12 (48)
25–29.9	6 (24)
EQUAL TO OR MORE THAN 30	7 (28)
SEX/GENDER ^B	
MALE	12 (48)
FEMALE	13 (52)
RACE ^B	
AMERICAN INDIAN/NATIVE ALASKAN/NATIVE HAWAIIAN/PACIFIC ISLANDER	2 (8)
ASIAN	6 (24)
BLACK/AFRICAN AMERICAN	8 (32)
HISPANIC/LATINO	2 (8)
WHITE	3 (12)
MULTIRACIAL	3 (12)
MISSING	1 (4)
ANNUAL HOUSEHOLD INCOME ^B	
LESS THAN \$20,000	1 (4)
\$20,000-\$39,999	6 (24)
\$40,000-\$59,999	5 (20)
\$60,000-\$79,999	4 (16)
\$80,000-\$99,999	2 (8)
\$100,000 OR MORE	7 (28)
HIGHEST LEVEL OF EDUCATION ^B	
SOME COLLEGE	6 (24)
ASSOCIATE DEGREE	4 (16)
BACHELOR'S DEGREE	10 (40)
MASTER'S OR DOCTORATE	5 (20)
AGE WHEN FIRST DIAGNOSED WITH DIABETES ^A	26.68 ± 7.36
THE VALUE OF LAST HBA1C ^A	7.35 ± 4.22
SECT OF ISLAM ^B	
SHIA	14 (56)
SUNNI	11 (44)
LENGTH OF TIME AS MUSLIM ^A	21.08 ± 12.17
COUNTRY OF BIRTH ^B	
U.S.	14 (56)
OTHER	11 (44)
FIRST LANGUAGE ^B	
ENGLISH	17 (68)
OTHER	8 (32)

^aValues expressed as mean ± SD.

^bValues expressed as n (%).

In addition to the 25 subjects who reported the demographics, we had five individuals who did not report demographic information.

^a BMI is Body Mass Index.

completing the focus group. Participants received a \$20 gift card after completing the interview regardless of completing the demographic information, which resulted in five subjects with missing data.

The first author conducted all the interviews and focus groups when she was a Doctor of Public Health (DrPH) degree student. Prior to conducting this research, the interviewer conducted multiple interviews, and coded and summarized the results of multiple focus groups. The interviewer identifies as Muslim, which created a possibility for connection with the interviewees. All interviews and focus groups were audio and video recorded using Zoom [23], and another recording device. However, no field notes were made during or after the interviews or focus groups. The duration of the interviews ranged from 37 min-about an hour. The focus groups stopped after 90 min from the start time.

The interviews and focus groups were conducted between June and October 2022, and followed a semi-structured format. The questions asked were related to perceived seriousness of diabetes, self-efficacy when it comes to self-management, cues to actions (religiosity), and fatalism. We used grounded theory [24] for guidance for data analysis. We conducted line-by-line coding and analysis of the text of the interviews and focus groups. After identifying the codes, themes and sub-themes were derived through combining the codes into sub-themes, and then defining the themes from there. Furthermore, we utilized an external analyst to confirm, verify, and meet a consensus on the themes and sub-themes found out by the researcher. To complete this process, we used NVivo Qualitative Analysis software [25]. This study was approved by Loma Linda University Institutional Review Board (IRB; IRB approval # 5210207).

The questions used for the interviews and focus groups, which were created by the first author, are included as appendices to this document. All questions used constructs of the Health Belief Model [26] as a theoretical model. We chose to conduct interviews and focus groups at the same time to increase the strength of the results of the study.

This study employed triangulation as a method to strengthen results. The results from the focus groups were similar to the results of

Table 2
General characteristics of focus group participants.

CHARACTERISTICS	STUDY SAMPLE N = 28 (%)
AGE ^a	28.64 ± 5.76
BMI (KG/M ²) ^b	
LESS THAN 18.5	8 (28.6)
18.5–24.9	8 (28.6)
25–29.9	4 (14.3)
EQUAL TO OR MORE THAN 30	7 (28.6)
SEX/GENDER ^b	
MALE	22 (78.6)
FEMALE	5 (17.9)
I CHOOSE NOT TO ANSWER	1 (3.6)
RACE ^b	
AMERICAN INDIAN/NATIVE ALASKAN/NATIVE HAWAIIAN/PACIFIC ISLANDER	0 (0)
ASIAN	1 (3.6)
BLACK/AFRICAN AMERICAN	22 (78.6)
HISPANIC/LATINO	0 (0)
WHITE	0 (0)
MULTIRACIAL	5 (17.9)
ANNUAL HOUSEHOLD INCOME ^b	
LESS THAN \$20,000	0 (0)
\$20,000-\$39,999	3 (10.7)
\$40,000-\$59,999	13 (46.4)
\$60,000-\$79,999	6 (21.4)
\$80,000-\$99,999	3 (10.7)
\$100,000 OR MORE	3 (10.7)
HIGHEST LEVEL OF EDUCATION ^b	
SOME COLLEGE	9 (32.1)
ASSOCIATE DEGREE	8 (28.6)
BACHELOR'S DEGREE	9 (32.1)
MASTER'S OR DOCTORATE	2 (7.1)
AGE WHEN FIRST DIAGNOSED WITH DIABETES ^A	25.50 ± 4.71
THE VALUE OF LAST HBA1C ^a	9.43 ± 4.15
SECT OF ISLAM ^b	
SHIA	13 (46.4)
SUNNI	15 (53.6)
LENGTH OF TIME AS MUSLIM ^b	22.57 ± 7.09
COUNTRY OF BIRTH ^b	
U.S.	10 (35.7)
OTHER	18 (64.3)
FIRST LANGUAGE ^b	
ENGLISH	20 (71.4)
OTHER	8 (28.6)

^a Values expressed as mean ± SD.

^b Values expressed as n (%).

the interviews. Those results were then connected to what was done previously in the literature. Additionally, there were larger than average number of respondents. Furthermore, we had a consultant to look over the interviews and focus groups to have an agreement on the themes with the researcher.

3. Results

For this study, data were obtained from 58 participants (i.e., 30 individuals with one-on-one interviews, and a total of 28 additional subjects from two focus groups). The interview participants demographics are listed in [Table 1](#) and the focus groups demographics are summarized in [Table 2](#). For interviews' participants, two people committed to an interview, but they did not show up on the day and time of the interview, and were lost to follow up after that. It is important to note that the participants were not invited personally to participate in the study, instead, for the majority of them, we sent a link via social media platforms and distributed flyers to the different mosques we were able to reach, and people followed the QR code to sign up for an interview or a focus group.

3.1. Religiosity and self-management

The focus groups and interview participants provided insight into how their personal religious beliefs influence their self-management of diabetes. Several key themes were identified, which are presented below.

Allah Sustains Life. A large number of participants shared their belief that Allah (God) has the power to protect and sustain them, despite their diagnosis. As one of the participants stated: *"I help myself and Allah also helping me to continue sustaining me."* Another participant shared:

"I would say I consider myself to be religious person despite the fact that I am diabetes person. I don't intend to let go of my religious life because I'm a victim of diabetes. No. I tend to make everything work in accordance. I try to do a balance between my condition and that of the Allah. Are you getting me? So I try to create a balance between my health condition and that of Allah. So whenever it's time for fasting, I fast. When time it is [me to do] medication, I do the same thing. I take my medication. So I try to make a balance. Sometimes I even place Allah first before myself because I believe that Allah is the giver and the taker of life, so He's the one to sustain me. So I shouldn't place myself first before Allah."

This seemed to be a common theme between the interview and focus group participants suggesting that this population places a great value on the spiritual aspect of their faith in helping maintain their health and life. This seems to flow logically into the next theme we identified.

Everything will Be Ok/Hope. There were at least 68 times that fate was mentioned during the interviews. This concept refers to the person's ability to do what needs to be done, while recognizing the outcome is in God's hands. All our participants felt that if they follow Him, one day, Allah/God was going to heal them from diabetes, even if it is through a miracle. A number of participants in both interviews and focus groups echoes the same sentiment, *"So believe in— that one day, it's gonna be over.And I also believe that as a human being, you need to believe in magic powers of Allah that they're gonna heal you in one day."* Another person stated, *"I know one day I will get healed, I will get relief of this"*. All participants viewed fate as something that results in a positive outcome one day *"no matter where I'm going to, everything's gonna be okay."*

Faith Gives Strength. Many participants expressed that their faith gave them the strength and discipline to manage their health condition. Several mentioned the power of prayer, and others mentioned that faith gives them the motivation to go on. One participant stated that the knowledge that Allah will heal them gives them the motivation to do their part in self-managing their diabetes. Faith motivated them to manage their condition more strictly. As one focus group Participant mentioned: *"I consider myself religious because I keep my faith. I believe in Allah, that one day I'm going to get healed completely without depending on drugs. I'm just going to manage what I eat."* Another participant said:

"Definitely. Yes, it did. As an Islam, it is being written in the Quran that it is an haram [forbidden] if you do not take good care of yourself. Anybody that doesn't take good care of himself has committed a sin. So on the level of teaching I receive has actually made me to understand the essence of taking good care of myself, the essence of making sure I'm not hurting myself in any way. If I love Allah, I have to take good care of what Allah gave to me, that's my body, my entire wellbeing. Yeah. So that's the good part of the religion"

The Role of Self within the Fate Concept. The majority of the participants emphasized the great role of self in managing the condition. While they fully acknowledged Allah's role in healing, they specifically stated they had an active part in this process; this involved taking medications and adhering to certain behaviors.

"So, fate is basically the understanding and, it gives you the will to act upon it, to make some changes. So that's what believe I believe that the fate is partly determined by what we do and partly we cannot. Like, if for example, like our mom said that if somebody ask you to say stand on one foot, you can. But you cannot stand with both legs up."

3.2. Self-efficacy

In looking at self-efficacy, participants responses may be organized into the following themes.

Diabetes Requires a New Life Approach. Based on the interviews and focus groups, diabetes diagnosis contributed to a major change for the individual resulting in the need to adjust behaviors and adopt management behaviors. For many of the participants this

is a drastic change. “[I]t was very hard, the hardest thing I’ve ever done.” Another person said: “And I won’t say it’s easy. It’s not easy. It requires a lot of energy and effort to manage this condition. I hope it will end as soon as possible because I’m already tired. I’m very tired of it. I just want to live a normal life, and I want to eat stuff that is pleasing to my eyes. I want to give in to my cravings because so many times I have a lot of cravings.”

Stress. A number of participants mentioned that all the diabetes management instructions resulted in some stress, as they tried to comply with all of them correctly. One participant stated:

“I feel I see it be stressful because you have to be very cautious in taking medication, and it’s stressing me in during the process of mixing my quinine, also taking the insulin. I see them to be very hectic, because I look at other people that they just move about; they don’t have any problem. And I see that it makes me not very happy with myself in handling that situation.”

Some mentioned that high cost of food and medications also contributed to the stress. “I’m doing four jobs a day so that I can live up to the expectations because there are some drugs that are very costly.” Several other participants mentioned that family made it difficult to adhere to self-management practices. An example:

“As a South Asian, we brought up I do not cook my food for myself, and when my family cooks for me, they cook rice and the wheat and that is our staple food. So it is, uh, difficult to stay away from that.”

Islamic Religious Practices Promote Self-Management. Several participants mentioned that specific practices of the Islamic faith were promoting the self-management of diabetes. Dietary restrictions (i.e., not drinking, not smoking, and not eating pork meat) go along with the recommendations for diabetes management. One person mentioned the importance of rest as one of the Islamic practices helps them having rest as they manage their diabetes. An example is “[B]ecause I don’t drink. Okay, because all those things, I have tried to, like I’m trying to abstain from all those foods I used to eat. So from now I’m getting better.”

3.2.1. Perceived seriousness

In looking at perceived seriousness and self-management of diabetes, we found in our study both interviews and focus groups participants appeared to have clear awareness of the seriousness of diabetes. Many of them felt like it was a disease with the potential to kill. As one participant commented, “[D]iabetes, if not taken care of, it can kill.” A number of participants mentioned serious complications of diabetes. All were aware diabetes is a condition that requires management.

Taking Actions and Making Changes. This was a key theme in discussing the effect of perceived seriousness on diabetes self-management. Majority of participants stated they found diabetes management as very challenging, while there was a small number that felt it was an easy task. A number of participants mentioned the importance of following the doctor’s orders; many mentioned the need to apply lifestyle changes such as diet, weight loss, exercise, and stress management as part of the adjustment to the new diagnosis. All participants felt diabetes was a serious disease with the potential to kill.

Additional themes, sub-themes can be seen in [Table 3](#) and [Table 4](#).

Table 3
Additional themes and sub-themes of the interviews.

Theme	Sub-Themes
A1c level	1. Testing
Behavioral factors	2. Medications
Psychosocial factors	1. Self-management
Awareness	2. Diabetes control
Perceived needs	3. Traditional medicine
Illness belief	1. Needs and support
Lifestyle changes	2. Perception to others
Acceptance and faith	3. Environment and surroundings
Patient and healthcare	1. Diagnosis as a shock
Comprehension of diabetes	2. Reasons for getting diabetes
	3. Seriousness of diabetes
	1. Diagnosis
	2. Life changes
	1. Diabetes
	2. Culture
	1. Diet
	2. Weight loss
	3. Exercise
	4. Stress
	1. Fate
	2. Religiosity
	1. Following recommendations
	2. Healthcare professional involvement
	1. Knowledge

Table 4
Additional themes and sub-themes of the focus groups.

Theme	Sub-Themes
Participants' driven care	1. Self-management 2. Difficulties 3. Traditional medicine
Provider's attitude	1. Involvement of healthcare provider
Obstacles of disease	1. Challenges of disease
Personal perception	1. Seriousness 2. Fate 3. Hope
Spiritual beliefs	1. Religiosity

4. Discussion

To our knowledge, this study is the first of its kind to explore diabetes self-management issues in Muslims in the United States outside of the month of Ramadan, which is when Muslims fast during daylight hours. We had 30 interviews and two focus groups with Muslims in the state of California. We used the grounded theory [24] for the interview and focus groups to identify the themes and sub-themes.

A review of diabetes self-management in the U.S. population indicates that there is a strong association between diabetes self-management and cultural and spiritual beliefs [27]. In our study, most participants commented on the fact that their self-management was affected by their religiosity. Many of them felt that religiosity affected their self-management positively. Some of the participants indicated that it is a sin to not care for oneself, or it is encouraged by religious scholars to take care of self when you are sick. This is supported by results in another study of mostly religious African Americans, where the authors found a relationship between being spiritual or religious with adapting to diabetes [20].

In our findings of fate, hope and even religiosity, where many of the participants felt that as long as they meet their obligations to Allah, and prayed to Him, they believed that they will be healed one day. A study in Indonesia of Javanese Muslims by Permana et al. [19] found a common theme: "Keep trying and leave the rest to Allah," or the thought of *Twakkul*, a concept Muslims follow in their daily life, which encourages Muslims to be at peace with the outcome of their actions, supporting our findings. Additionally, our study had some participants discuss the social support they get from fellow Muslims and family. On the other hand, other participants said they feel like they are on their own, and that they would like more support from the community. In fact, one participant had major problems with her husband because she got diabetes and needed to change her diet, which is supported by another theme identified in the study by Permana et al. [19] which is "social ties."

In our literature review and background research, only one article examined Muslims, although only women, and their self-management of diabetes. The study was conducted in Thailand [28]. The study indicated that there was stress and worry among their participants, similar to what we found in our study. As for religious practices, Lundberg and Thrakul [28] found that all their study's Muslim women did not change their religious practices compared to the time before they were diagnosed with diabetes. In our study, the majority felt the same way, but there were a few participants who said their faith became weaker because the diagnosis made them contemplate their beliefs, or because they no longer observe the month of Ramadan in a community setting since they were not fasting, which makes their faith weaker.

For the month of Ramadan, Lundberg and Thrakul [28] found that some people fasted and just adjusted the time they take their medications, while others chose not to fast since Muslims are exempt from fasting if they have a disease such as diabetes, that can jeopardize their overall health if they fast. In our study, half of the participants (five participants) who mentioned not fasting during the month of Ramadan due to doctor's recommendations or self-assessment of ability to fast. As a result, many felt isolated during the holy month, felt alone, and could not attend the mosques or Islamic centers. Only a few said they fasted, but because of the type and amount of food consumed during this month, their blood sugar levels changed from the level it is usually at the rest of the year.

Finally, it is worth mentioning that there were difficulties recruiting for the study, which led us to keeping all the participants in the focus groups. We wanted to maximize the number of participants in the study.

4.1. Strengths and limitations

Some of the strengths of this study are the employment of different qualitative research methods, which showed similar patterns for the identified themes; the relatively large sample size for a qualitative study; the diverse population; and the employment of an external consultant to confirm the overarching themes of the study. Additionally, this research is reported using the COREQ qualitative research reporting method [29]. The study was not without limitations. Our limitations include the lack of representations of different races in the focus groups, as a majority of the participants were Black/African Americans. In addition to race, there was a lack of representation of the different age groups (most of the sample are younger participants; the range for interviews is 20–54 years, but the mean is 32.84 years, and the range for the focus group 21–38 years, and the mean is 28.64 years), and annual household income status, as most people were in the low/low-middle income. Because of these limitations, our results may not be generalizable to the larger Muslim community in the state of California, or other Muslim communities in the United States. Also, due to the nature of the questions asked, there might have been bias in answering the questions by the participants to tailor what they thought the researcher might want

to hear, or hesitation of speaking freely about the topic in the focus groups, despite emphasizing the confidentiality by the researcher, and the use of code names instead of actual names.

Further research is needed in other Muslim communities in the United States. Additional research would benefit from exploring diabetes self-management among those who are foreign born and if it is different from those born in the United States. Additionally, research might be enriched by conducting longitudinal studies following American Muslims over time and looking at their self-management, and the effect of different factors (diet, exercise, availability of additional support, social support) on self-management.

5. Conclusion

In conclusion, religiosity among Muslims could be a significant tool that healthcare and public health professionals could use in educating patients about self-management. For example, a patient could be more likely to manage their diabetes if they believe it is a sin to not take care of their bodies. Our findings provide varied experiences of Muslims from different backgrounds, and could provide leads to how to guide Muslims to better manage their T2D. More support should be provided to Muslims with T2D from healthcare professionals.

Ethics Statement

Before conducting this study, an approval from the Institutional Review Board (IRB) Committee under approval number 5210207 was obtained. Additionally, every participant was required to read and sign the consent form for the study before the interview or focus group. Furthermore, the interviewer took the first part of all the interviews and focus groups to explain the consent form, confirm acceptance and understanding of the consent form, and answer any questions the participants had.

Author contribution statement

Fatimah Alramadhan, MPH, DrPH: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

R. Patti Herring, RN, PhD; W. Lawrence Beeson, DrPH; Anna Nelson, DrPH; Huma Shah, DrPH: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Data availability statement

The data that has been used is confidential.

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

- [1] National Institute of Diabetes and Digestive and Kidney Diseases, Type 2 Diabetes (2017). Available from: <https://www.niddk.nih.gov/health-information/diabetes/overview/what-is-diabetes/type-2-diabetes>.
- [2] D.L. Eizirik, L. Pasquali, M. Cnop, Pancreatic β -cells in type 1 and type 2 diabetes mellitus: different pathways to failure, *Nat. Rev. Endocrinol.* 16 (7) (2020) 349–362.
- [3] National Institute of Diabetes and Digestive and Kidney Diseases. Diabetes Statistics | NIDDK. 2020 [cited 2022; Available from: <https://www.niddk.nih.gov/health-information/health-statistics/diabetes-statistics#:~:text=Diabetes%20Facts%20and%20Statistics&text=Learn%20more%20from%20the%20Diabetes,percent%20of%20the%20U.S.%20population>.
- [4] Center for Disease Control and Prevention. National Diabetes Statistics Report | Diabetes | CDC. 2022; Available from: <https://www.cdc.gov/diabetes/data/statistics-report/index.html>.
- [5] Center for Disease Control and Prevention. Type 2 Diabetes | CDC. 2021 [cited 2022; Available from: <https://www.cdc.gov/diabetes/basics/type2.html#:~:text=More%20than%2037%20million%20Americans,adults%20are%20also%20developing%20it>.
- [6] Y. Pinchevsky, et al., Demographic and clinical factors associated with development of type 2 diabetes: a review of the literature, *Int. J. Gen. Med.* 13 (2020) 121.
- [7] N. Nanayakkara, et al., Impact of age at type 2 diabetes mellitus diagnosis on mortality and vascular complications: systematic review and meta-analyses, *Diabetologia* 64 (2) (2021) 275–287.
- [8] B. Mohamed, New Estimates Show U.S. Muslim Population Continues to Grow, 2018.
- [9] F.I. Mustapha, et al., Addressing non-communicable diseases in Malaysia: an integrative process of systems and community, *BMC Publ. Health* 14 (2) (2014) 1–6.
- [10] S.E. Tey, M.S.-A. Park, K.J. Golden, Religiosity and healthy lifestyle behaviours in Malaysian Muslims: the mediating role of subjective well-being and self-regulation, *J. Relig. Health* 57 (6) (2018) 2050–2065.
- [11] N.H. Jonkman, et al., Self-management interventions: proposal and validation of a new operational definition, *J. Clin. Epidemiol.* 80 (2016) 34–42.
- [12] L. Laranjo, et al., Facilitators, barriers and expectations in the self-management of type 2 diabetes—a qualitative study from Portugal, *Eur. J. Gen. Pract.* 21 (2) (2015) 103–110.
- [13] M. Petersen, N.F. Hempler, Development and testing of a mobile application to support diabetes self-management for people with newly diagnosed type 2 diabetes: a design thinking case study, *BMC Med. Inf. Decis. Making* 17 (1) (2017) 91.
- [14] P.C. Lundberg, S. Thrakul, Self-care management of Thai Buddhists and Muslims with type 2 diabetes after an empowerment education program, *Nurs. Health Sci.* 20 (3) (2018) 402–408.

- [15] P. Darvyri, et al., On the role of spirituality and religiosity in type 2 diabetes mellitus management—a systematic review, *Psychology* 9 (4) (2018) 728–744.
- [16] S.H. Hassan, Effects of religious behavior on health-related lifestyles of Muslims in Malaysia, *J. Relig. Health* 54 (4) (2015) 1238–1248.
- [17] M. Cohen, F. Azaiza, Health-promoting behaviors and health locus of control from a multicultural perspective, *Ethn. Dis.* 17 (4) (2007) 636.
- [18] A.M. Abdel-Khalek, et al., The relationship between religiosity and anxiety: a meta-analysis, *J. Relig. Health* 58 (5) (2019) 1847–1856.
- [19] I. Permana, P. Ormandy, A. Ahmed, Maintaining harmony: how religion and culture are interwoven in managing daily diabetes self-care, *J. Relig. Health* 58 (4) (2019) 1415–1428.
- [20] S.A. Choi, J.F. Hastings, Religion, spirituality, coping, and resilience among African Americans with diabetes, *J. Relig. Spiritual. Soc. Work Soc. Thought* 38 (1) (2019) 93–114.
- [21] K. Leighton, et al., Using social media and snowball sampling as an alternative recruitment strategy for research, *Clinical simulation in nursing* 55 (2021) 37–42.
- [22] P.I. Fusch, L.R. Ness, Are we there yet? Data saturation in qualitative research, *Qual. Rep.* 20 (9) (2015) 1408.
- [23] I. Zoom Video Communications, Video Conferencing, Web Conferencing, Webinars, 2021. Available from: <https://zoom.us/>.
- [24] C. Turner, F. Astin, Grounded theory: what makes a grounded theory study? *Eur. J. Cardiovasc. Nurs.* 20 (3) (2021) 285–289.
- [25] Lumivero. NVivo - Lumivero. (2023) [cited 2023; Available from: <https://lumivero.com/products/nvivo/>].
- [26] V.L. Champion, C.S. Skinner, The health belief model, *Health behavior and health education: Theory, research, and practice* 4 (2008) 45–65.
- [27] A.A. Gonzalez-Zacarias, et al., Impact of demographic, socioeconomic, and psychological factors on glycemic self-management in adults with type 2 diabetes mellitus, *Front. Public Health* 4 (2016) 195.
- [28] P.C. Lundberg, S. Thrakul, Religion and self-management of Thai Buddhist and Muslim women with type 2 diabetes, *J. Clin. Nurs.* 22 (13–14) (2013) 1907–1916.
- [29] A. Tong, P. Sainsbury, J. Craig, Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups, *Int. J. Qual. Health Care* 19 (6) (2007) 349–357.