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# A prospective study of the effect of fasting during the month of Ramadan on depression and diabetes distress in people with type 2 diabetes

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## ABSTRACT

**Aims:** Depression in diabetes has been associated with hyperglycemia and an increase risk for metabolic disorder complications. Ramadan is a period of self-discipline, self control, and spirituality, which has shown benefits in physical, mental, and social well being. The aim of this study is to examine the association between fasting during the month of Ramadan and depression.

**Methods:** Data from 463 participants were collected at three time points. A paired *t*-test was used to examine the difference between PHQ-9 score and difference of PAID score before and after Ramadan to measure depression. A multivariable regression with adjusting for potential confounders was used to study the association between fasting and depression.

**Results:** The difference in PHQ-9 score before and after Ramadan was  $-3.5$  points (95% Confidence Interval (CI)  $-4.05$  to  $-2.95$ ). The difference in PAID score before and after the Ramadan was  $-5.02$  points (95% CI  $-6.38$  to  $-3.69$ ). For every one year increase in diabetes diagnosis PHQ-9 score decreased by  $0.09$  (95% CI  $-0.17$  to  $0.003$ ) after Ramadan. Female participants had  $1.17$  more points (95% CI  $-0.23$  to  $0.02$ ) decrease in PHQ-9 score compared to male participants.

**Conclusion:** Improving depression in people with diabetes is crucial in controlling blood glucose and metabolic disorder complications in people with diabetes. People with diabetes who experience depression may improve their depression by increasing self discipline, self control, and manage disease.

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## 1. Introduction

Depression (defined here as depressive disorder and depressive symptoms) is one of the most common illnesses and it is affecting more than 300 million people worldwide [1]. It is characterized by a pervasive low mood and loss of pleasure in everyday activities [2]. The prevalence rate of depression is increased 2-fold in people with type 2 diabetes [3]. Depression in type 2 diabetes has been associated with hyperglycemia [4], and an increase risk for diabetes complications such as retinopathy, nephropathy, neuropathy, macrovascular complications, and sexual dysfunction [4] and premature mortality [5,6]. Treatment of depression with antidepressants can sometimes improve glycemic control [7], thus decreasing the risk of diabetes complications in the longer-term. Depression is strongly associated with negative diabetes specific cognitions [8].

However many patients do not like administering antidepressants and in many cultures around the world, depression remains a stigma and taboo. The utility of religion, spirituality, and as a treatment for depression has not been extensively studied but may have a role in people of strong religion faith. [9–11]. Religiosity or spirituality refers to the importance of faith in one's life and a source for coping with stress. Ramadan is a holy month of the year for Muslims, and fasting during the month of Ramadan is one of the five central pillars of faith [9]. Fasting, which is practiced during the month of Ramadan has been found to be an opportunity to uplifts one's spirituality and cleanse the mind of the body [11]. Furthermore, it provides spiritual benefits for people with higher spiritual orientation or greater spiritual experience, and these people are found to take better care of themselves and are better at adhering to prescribed therapy for diabetes [12]. Ramadan also is a period of self discipline and self control, it is also a time of prayers where one comes close to God. Fasting has been not only shown to benefit in physical health [13], but also in mental and social well being [11].

There are 424.9 million people worldwide living with diabetes [14]. It is a major public health concern in the Middle East and North Africa region, with 39 million people living with diabetes between the ages of 20–79 years [14]. Muslims practice fasting from sunrise to sunset 30 days of the year during the month of Ramadan, and this month is considered spiritual [11,12]. The aims of this study are to test the hypothesis that Ramadan is associated with an improvement in depressive symptoms and diabetes related distress in people with type 2 diabetes.

## 2. Methods

### 2.1. Study design & setting

The study is a longitudinal study design with three repeated measures, and it received approval from Institutional Review Board at the Ministry of Health. The study was set in the Dasman Diabetes Institute (DDI), Kuwait, which is a fully integrated clinical and research facility. DDI serves a population of 2 million residents in Kuwait City without postcode restriction representing all governorates.

### 2.2. Sample

Almost all the participants in the study were type 2 diabetes patients (99.6%) based on the WHO clinical criteria [15]. Participants attending the diabetes outpatient department and clinical research department who met the study eligibility criteria were invited to take part in the study. Participation in the study was voluntary and responses were anonymous and confidential. Eligible participants for this study were adults aged 21 years and older, who were residents in Kuwait and participating at DDI. The exclusion criteria were: pregnancy, dementia, psychosis, non-Arabic or non-English speaking and any religion other than Islam.

### 2.3. Measures

Baseline data was collected one month before Ramadan, and follow up data was collected during the month of Ramadan, and 4–6 weeks after the month of Ramadan.

#### 2.3.1. Sociodemographic and lifestyle

Sociodemographic variables were participants' age, gender, and nationality (Kuwaiti or non-Kuwaiti). The participants were also asked about their lifestyle including whether they smoked, followed an exercise program and/or diet plan.

#### 2.3.2. Biomedical data

Duration of type 2 diagnosis were collected, haemoglobin A1c/glycated haemoglobin (HbA1c) value (DCCT standardized at the DDI laboratory), full lipid profile including total cholesterol, HDL-C, LDL-C and triglycerides (TG) measured in mmol/l. Participants' weight (kg), height (measured to closet 0.5 cm), and waist circumference (cm) were recorded. Body Mass Index (BMI) was calculated as  $\text{weight/height}^2$  [ $\text{kg/m}^2$ ] and used as an overall index of adiposity.

#### 2.3.3. Assessment of depression:

The Patient Health Questionnaire-9 (PHQ-9) was used to assess depression. It is a self-report measure of the presence and severity of 9 depressive symptoms as listed in the Diagnostic and Statistic Manual for Mental Disorders-IV (DSM-IV), over the past 2 weeks. Each of the 9 symptoms are rated as '0' (not at all), '1' (several days), '2' (more than half the days) or '3' (nearly every day) giving a range of scores between 0 and 27 with higher scores indicating greater severity [16]. A PHQ-9 score  $\geq 10$  was used to define PHQ-9 positive for depression cases and has acceptable validity in people with diabetes. The Arabic version has been validated [17]. Past history of depression was measured by asking patients for previous diagnosis of depression or if they have received care by a psychiatrist or psychologist in the past.

#### 2.3.4. Assessment of diabetes distress

The Problem Areas in Diabetes Scale PAID is a measure of a person's emotional adjustment to living with diabetes [18]. Each of the 20 items corresponds to a potential problem of living with diabetes (e.g. 'feeling constantly concerned about

food and eating'), and are rated as '0' (not a problem), '1' (minor problem), '2' (moderate problem), '3' (somewhat serious problem), '4' (serious problem). The final PAID score is calculated by summing all 20-item scores and multiplying by 1.25. A minimum score of 0 indicates no diabetes related distress, whereas a maximum score of 100 indicates significant diabetes-related distress [19]. A score of >40 is considered clinically significant psychological distress [20].

#### 2.4. Outcomes

The outcome measures of the study were PHQ-9 and PAID. To study changes in depression PHQ-9 was used, and to study emotional adjustment to living with diabetes PAID was used. PHQ-9 was collected before, during, and after the month of Ramadan. PAID was collected before the month of Ramadan and after the month of Ramadan.

### 3. Statistical analysis

A paired t-test was used to examine the difference between the PHQ-9 score before the month of Ramadan and after the month of Ramadan to measure changes in depression score. To examine the participants' emotional adjustment to living with diabetes, PAID score was analyzed before and after the month of Ramadan also using a paired t-test. The baseline characteristics were described using mean (standard deviation) or as proportions (%). Univariate association of depression (explanatory variable) with baseline diabetes characteristics was conducted using chi square or t-tests and for those with a statistically significant association, multivariable regression was used to adjust for potential confounding was conducted such as age, number of fasted days, gender, duration of diabetes, baseline HbA1c, and BMI.

Analyses were conducted with the STATA software (version 14.1 STATA Corp, College Station, TX, USA).

### 4. Results

Analysis were completed on 463 patients with diabetes to whether there was a statistical significance in the change of depression score prior to the start of the month of Ramadan to after the month of Ramadan. Of all the participants, 251 were males and 212 were females with a mean age of  $55.5 \pm 10.01$  years at baseline. Only two participants had type 1 diabetes while 461 participants had type 2 diabetes. Out of all the participants, 317 were Kuwaiti and 145 were non-Kuwaiti. The average BMI at baseline was  $33.09 \pm 7.44$  kg/m<sup>2</sup>. The mean HbA1c at baseline was 8.1%. The mean duration of diabetes diagnosis was  $12.16 \pm 8.71$  years at baseline. The mean number of fasted days during the month of Ramadan was  $26 \pm 9.24$  days (Table 1).

The mean score of the PHQ-9 before the start of the month of Ramadan was  $6.05 \pm 5.28$  points and the mean score of the PHQ-9 after the month of Ramadan was  $2.48 \pm 3.99$  points, with a statistical significant difference of  $-3.57$  points (95% Confidence Interval (CI)  $-4.14$  to  $-3.01$ ). The mean score of PAID before the month of Ramadan was  $10.10 \pm 14.36$  points, and the mean score of PAID after the month of Ramadan was  $4.97 \pm 8.91$  points, with a statistical significant difference of  $-5.13$  points (95% CI  $-6.48$  to  $-3.77$ ). There was no statistical significant difference between HbA1c at baseline and after Ramadan (Tables 2 and 3).

In the multivariable regression analysis, when we examined PHQ-9 score longitudinally, we found that for every one year of duration of diabetes, PHQ-9 score decreases after the month of Ramadan by 0.07 (95% CI  $-0.14$  to 0.001) adjusting for number of fasted days, age, gender, BMI, and HbA1c.

**Table 1 – Demographic characteristics (mean and standard deviation) of study participants at baseline.**

Variables	n	Mean (SD)
Males	251	na
Kuwaitis	317	na
Age (years)	463	$55.5 \pm 10.01$
Current BMI (kg/m <sup>2</sup> )	463	$33.09 \pm 7.44$
Duration of diabetes from diagnosis (years)	463	$12.16 \pm 8.71$
Number of days fasted (days)	463	$26 \pm 9.24$
HbA1c at baseline (%)	463	$8.1 \pm 1.65$

BMI: Body Mass Index.

HbA1c: haemoglobin A1c/glycated haemoglobin.

na: not applicable.

SD: standard deviation.

**Table 2 – Mean in PHQ-9 and PAID scores and standard deviation at baseline and after Ramadan.**

		Mean (SD) at baseline	Mean (SD) in grams after Ramadan
PHQ-9	463	$6.05 \pm 5.28$	$2.48 \pm 3.99$
PAID	463	$10.10 \pm 14.36$	$4.97 \pm 8.91$

PHQ: Patient Health Questionnaire-9.

PAID: The Problem Areas in Diabetes Scale.

SD: standard deviation.

**Table 3 – Difference in PHQ-9 and PAID scores and standard deviations pre-Ramadan and after Ramadan.**

N = 463	Mean change in score (95% Confidence interval)	p value
PHQ-9 score change	–3.57 points (–4.14 to –3.01)	<0.001
PAID score change	–5.013 points (–6.48 to –3.77)	<0.001

PHQ: Patient Health Questionnaire-9.

PAID: The Problem Areas in Diabetes Scale.

**Table 4 – Changes in PHQ-9 and PAID score from baseline to after Ramadan.**

N = 344	PHQ-9 score change (SE)	(95% Confidence Interval)	p value
Duration of diabetes	–0.07 (0.37)	(–0.14 to –0.003)	0.059
Females	–1.17 (0.58)	(–2.31 to 0.02)	0.046

Adjusted for fasted days, age, Body Mass Index, HbA1c: haemoglobin A1c/glycated haemoglobin (HbA1c).

PHQ: Patient Health Questionnaire-9.

PAID: The Problem Areas in Diabetes Scale.

SE: standard error.

Female participants had 1.17 more points (95% CI –0.23 to 0.02) decrease in PHQ-9 score compared to male participants adjusting for number of fasted days, age, duration of diabetes, BMI, and HbA1c (Table 4). There was no statistical significance when examining the association between changes in PAID scores and diabetes diagnosis duration and gender.

## 5. Discussion

This was a prospective cohort testing the effects of Ramadan in change in depressive symptoms and diabetes distress. We found that their depression scores using the PHQ-9 decreased by 3.57 points (95% CI –4.14 to –3.01), a decrease in score means a decrease in severity of depression. To our knowledge, there are no studies that tested the effects of fasting during Ramadan on depression scores in patients with diabetes. Improving depression in people with diabetes may be helpful in controlling blood glucose levels and reducing the longer term risk of diabetes complications [4–6].

When we studied the patients' emotional adjustment to living with diabetes using PAID, we found that this score also decreased by –5.13 points (95% CI –6.48 to –3.77) after the month of Ramadan, with a lower score meaning better diabetic-related distress. Neither the PHQ-9 nor PAID score means were high at baseline (mean PHQ-9 was <10 and mean was PAID <40), however, demonstrating a decrease in the score is showing the importance of the month of Ramadan and how spirituality plays a role in depression and emotional adjustment to living with diabetes. It was interesting to see that the longer the patient had diabetes, the greater the decrease in PHQ-9 score after the month of Ramadan; and that female participants had better outcomes in terms of decreasing PHQ-9 score compared to males.

The strength of our study is the longitudinal study design, with data collected with the same population over time. Data collection started at baseline (one month before the month of Ramadan), during the month of Ramadan, and 4–6 weeks after the month of Ramadan. Limitations of the study include

that the PHQ-9 and PAID scores were self reported and relatively small sample size in one Islamic nation. Whether these findings are replicable in other Muslims is not known, indeed whether they are replicable in other religions that have periods of fasting. The baseline depression scores were not considered high, it would be interesting to apply this study to a population with higher depression scores at baseline and see the effects of the month of Ramadan on depression. Another limitation is that the duration of the follow up was short; it was only 1 month after Ramadan, therefore, there is a possibility that the depressive symptoms returned after the period of fasting.

The psychological mechanism as to the process by which Ramadan improve depressive symptoms is not yet clear. It can be speculated that it may be similar to relaxation techniques based on mindfulness or meditation [21–23]. An alternative explanation is that intermittent starvation may improve insulin sensitivity, which in turn may reduce innate inflammation which is a mechanism implicated in both depression and type 2 diabetes pathophysiology [24]. A third possibility is that Ramadan is a time for social cohesiveness and social support [25] and this is known to be an effective non-pharmacological agent for the treatment of depression [26].

Medical treatment of depression has been found to improve glycemic control [7], thus decreasing diabetes metabolic disorder complications. Our study demonstrated the effect of spirituality on depression, and therefore, we can use spirituality as a way to help people with diabetes to improve or prevent depression. Spiritual interventions where spirituality is emphasized and practiced can be implemented to patients with diabetes to improve depression, not necessary during the month of Ramadan, but any time of the year. This can help people with diabetes that experience depression to improve their depression by increasing self-discipline, self-control, and connecting to God. There are several studies in the literature that support the effectiveness of interventions on early disease detection and promoting

health through education in religious settings or communities [27,28]. Religious involvement has been also found to consistently affect a range of mental health outcomes including depression [29–33].

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