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A Comparative Study on the Impact of Fasting on Blood Glucose and Blood Pressure Among Diabetic and Non-Diabetic Individuals During Ramadan, Kurdistan Region, Iraq

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ABSTRACT

Objective: The primary aim of this research was to evaluate the differential effects of regular and fasting dietary patterns on blood glucose levels and blood pressure among diabetic patients and non-diabetic control group. A comprehensive analysis was conducted to compare physiological responses on fasting versus non-fasting days during the holy Ramadan month.
Methods: This observational study involved 92 participants, with a subset of 38 diabetic patients and 54 non-diabetic control group, aged 19-76 years, who were observed on regular and fasting days. Participants were monitored for pre-prandial, postprandial, evening blood sugar, and fasting blood glucose levels, as well as blood pressure. Statistical analysis was performed using paired sample t-tests to compare mean ± SD between regular and fasting days of both groups. The study cohort consisted of male and female adults diagnosed with type 1 or type 2 diabetes. Exclusion criteria included individuals under 18 years, pregnant women, and patients unable to fast during the study period.
Results: Statistical analysis revealed significant differences in fasting blood glucose levels during Ramadan compared to non-fasting days. In the diabetic group, significant changes were observed in fasting blood glucose levels during Ramadan compared to after Ramadan (postprandial blood sugar $p=0.04$, evening blood sugar $p=0.019$). In contrast, the non-diabetic group also showed significant changes in blood glucose levels during Ramadan compared to after Ramadan (postprandial blood sugar $p=0.001$, evening blood sugar $p=0.020$). Blood pressure showed no significant differences between these periods, suggesting that fasting does not alter blood pressure significantly in diabetic individuals. Additionally, a two-way ANOVA demonstrated significant dietary influences on post-Iftar glucose levels in non-diabetics ($p<0.001$), but not in diabetics, suggesting differential metabolic responses to dietary intake during Ramadan. These findings emphasize the critical need for personalized dietary management and continuous monitoring to optimize diabetic care during fasting.
Conclusion: Fasting significantly influences blood glucose levels in diabeticand non-diabetic individuals but does not affect blood pressure. This study underscores the necessity for personalized medical guidance and

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balanced meal planning to minimize complications and enhance diabetes management during fasting. Further research is warranted to explore the long-term effects of different fasting practices on diabetic health outcomes.

KEY WORDS: Fasting, Diabetes Type 1, Type 2, Blood Pressure.

1-Introduction

Diabetes is a chronic disease affecting millions worldwide, characterized by the body's inability to regulate blood glucose levels effectively. This condition leads to severe health complications, including cardiovascular diseases, kidney failure, and nerve damage. The two primary forms of diabetes, Type 1 and Type 2, share similar long-term risks but differ in their etiologies. Type 2 diabetes, the more prevalent type, is often associated with lifestyle factors such as diet, physical activity, and obesity. Fluctuations in blood glucose levels can be particularly pronounced on fasting days, necessitating continuous monitoring by diabetic patients (Goyal & Jialal, 2021; Zhu et al., 2020; Tsapas et al., 2021).

Recent studies underscore the critical nature of managing blood glucose levels in diabetic patients, particularly during fasting periods like Ramadan. Templeman et al. (2020) emphasize the role of intermittent fasting in weight management and metabolic health, suggesting potential benefits that may align with traditional fasting practices. Conversely, Wada et al. (2020) point out the risks associated with fluctuating glucose levels during fasting, advocating for more controlled dietary interventions.

The correlation between fasting blood glucose and postprandial blood glucose during Ramadan remains a critical area of investigation. While previous studies, such as those by Shrestha et al. (2012), have explored these dynamics within general diabetic populations, the specific effects of Ramadan fasting on daily glucose fluctuations and overall metabolic control in individuals with diabetes necessitate further exploration. Understanding these relationships is crucial for providing insights into the short-term impacts of fasting and for informing clinical guidelines to optimize diabetes management during Ramadan.

1.1. Problem statement

The maintenance of blood glucose levels is crucial in managing diabetes, as imbalances can lead to critical health issues. Despite the significant attention required for managing blood sugar, many diabetic patients participate in religious or cultural fasting practices like Ramadan, which involves abstaining from food and liquids for extended periods. These fasting practices pose challenges that are not as prevalent during typical dietary routines that include three meals per day.

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Current research often does not fully explore the impacts of fasting on both blood glucose and blood pressure levels in diabetic patients (Dwi & Netra, 2020; Wang et al., 2020).

This study aims to bridge this knowledge gap by comparing fluctuations in blood glucose and blood pressure between regular and fasting days. Understanding these physiological changes during Ramadan is vital for developing effective management strategies that ensure safer fasting experiences and improve the overall quality of life for diabetic patients (Rasmussen et al., 2020). The insights gained may lead to better-informed dietary practices and treatment plans that can be adapted to the needs of diabetic individuals observing fasts.

2-Methodology

2.1. Study Design and Participants

This prospective observational study involved 92 participants, segmented into 38 diabetic and 54 non-diabetic individuals, to explore the impact of fasting on blood sugar regulation and blood pressure variations. The diverse demographic makeup, including a mix of genders and ages ranging from 19 to 76 years, was selected to reflect broad community health impacts. This setup facilitated an examination of fasting effects across different diabetic statuses (Type 1 and Type 2 diabetes) and control group comparisons, with participants stratified accordingly to ensure comprehensive data collection on dietary impacts during Ramadan.

2.2. Ethical Considerations

Ethical approval for the study was secured from the institutional review board, ensuring compliance with ethical standards for research involving human participants.

2.3. Group Classification and Data Collection

Participants were divided into two groups based on their diabetes status and the timing of measurements related to their dietary practices during Ramadan.

Group 1: Non-Diabetic Control Group

Number of Participants: 54

This group consists of individuals without diabetes, serving as the control group.

Measurements for this group were performed on non-fasting days to establish a baseline. The variables measured included pre-prandial, postprandial at two hours after meals, and evening blood sugar and blood pressure. This data helps in understanding how individuals without diabetes manage their blood sugar and blood pressure under standard conditions.

Group 2: Diabetic Group

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Number of Participants: 38

This group consists of patients with diabetes.

Measurements were taken on days of fasting during Ramadan, where fasting entails abstaining from food and drink from dawn until sunset.

The blood sugar levels were monitored during fasting, mid-day, and post-Iftar, along with blood pressure measurements during these periods. This setup allows for an analysis of how fasting affects crucial health indicators such as blood sugar levels and blood pressure among both groups.

2.4. Sampling and Measurements

Blood samples were collected using gel tubes and analyzed using COBAS e 411 analyzer to determine blood sugar levels. Blood pressure was measured using a mercury sphygmomanometer. All measurements were taken at designated times on both non-fasting and fasting days, capturing fluctuations throughout the day during Ramadan.

2.5. Questionnaire and Consent Procedures

Prior to sample collection, verbal consent was obtained from all participants. A detailed questionnaire was administered to gather data on each participant's type of medication, family history of diabetes, diabetic status, age, type of diet, and residential address. This facilitated a comprehensive analysis of factors influencing blood glucose and blood pressure in the context of dietary patterns.

2.6.Statistical-Analysis

The Statistical Package for the Social Sciences (SPSS, version 22) was employed for data analysis. Descriptive statistics described the demographic and clinical characteristics of the participants, while paired sample t-tests analyzed differences in physiological measures between the regular and fasting observations. A p-value of <0.05 was considered statistically significant.

2.7. Consent and Confidentiality

Informed consent was obtained from all participants, and personal information was handled with strict confidentiality to protect participant privacy and adhere to ethical guidelines.

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3-Results

3.1. Descriptive Statistics

The study consisted of 92 randomly selected participants. Since this study focuses on diabetic patients to assess the effects of fasting and normal dietary intake on blood glucose and blood pressure, the non-diabetic patients were filtered out as a control group. Only 38 of the participants were diabetic. The respondents' ages ranged from a minimum of 19 to a maximum of 76, with an average of 47.32 years (SD = 16.35). Among the diabetic patients, 57.9% (n = 22) were female while 42.1% (n = 16) were male. the majority of the participants, 73.7% (n = 28) were of Type 2 diabetes while 26.3% (n = 10) were of Type 1 diabetes. This indicates the high prevalence of Type 2 diabetes among patients, which might lead to long term complications such as kidney failure and heart diseases. To gain an understanding of whether the family's diabetic history might influence the status of these patients, participants were required to highlight their family history of diabetes. 81.6% (n = 31) of the participants indicated that they had a history of diabetes in their families, whereas only 18.4% (n = 7) responded that their families didn't have any history of diabetes. Conversely, the non-diabetic control group included 54 participants with ages from 19 to 63 (mean age = 36.11, SD = 13.46), 64% female, and 35% male. In this group, only 5% had a family history of diabetes, highlighting the potential genetic or lifestyle influence on the disease's occurrence, with 94% reporting no such history. Table 4.1 to Table 4.4 detail the gender, diabetes type, and family history within both diabetic and non-diabetic groups, providing a comprehensive overview of the demographic and health characteristics in the context of the study.

Table 3.1 Descriptive Statistics of Diabetes Group (n=38).

Descriptive Statistics -Diabetes Group					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	38	19	76	47.32	16.348
Valid N (listwise)	38				

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Table 3.2 Gender, Type of diabetes, and Family history of Diabetes Group (n=38).

Category	Subcategory	Frequency	Percent	Valid Percent
Gender	Female	22	57.9	57.9
Gender	Male	16	42.1	42.1
Type of Diabetes	Type 1	10	26.3	26.3
Type of Diabetes	Type 2	28	73.7	73.7
Family History with Diabetes	No	7	18.4	18.4
Family History with Diabetes	Yes	31	81.6	81.6

Table 3.3 Descriptive Statistics of Non-Diabetes Group (n=54).

Descriptive Statistics -Diabetes Group					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	54	19	63	36.11	13.464
Valid N (listwise)	54				

Table 3.4 Gender, and Family history of Non-Diabetes Group (n=54).

Category	Subcategory	Frequency	Percent	Valid Percent
Gender	Female	35	64.81	64.81
Gender	Male	19	35.19	35.19
Family History with Diabetes	No	3	5.56	5.56
Family History with Diabetes	Yes	51	94.44	94.44

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3.2. Comparative Analysis

Paired samples T-tests were performed to compare the means of Blood sugar levels between the two groups in Fasting days (In Ramadan) vs Normal days (After Ramadan).

The first test aimed to investigate whether there was a significant difference in the mean blood sugar level between Pre-prandial (before a meal) and Post – Prandial (after a meal) among the patients during the normal days (After Ramadan). The following hypothesis were generated:

Alternative Hypothesis (H1): There is a significant difference in the mean blood sugar levels of diabetic patients between Pre – Prandial (before meals) and Post – Prandial (after meals) measurements on normal days.

Table3.5 Diabetes Group-Normal-Days-Pre-prandial-FBS- Normal-Days-Post-prandial BS

Paired Samples Statistics				
Diabetes Group	Mean	N	Std. Deviation	Std. Error Mean
Normal-Days-Pre-prandial-FBS	210.55	38	76.23282	0.3666
Normal-Days-Post-prandial BS	240.71	38	111.08043	0.0203

Table 3.6 Diabetes Group-Normal-Days-Pre-prandial-FBS- Normal-Days-Post-prandial BS

Paired Samples Test								
Diabetes group	Mean	Std. Deviation	Std. Error Mean	Paired Differences 95% Confidence Interval of the Difference- Lower	Upper	t	df	Sig. (2-tailed)
Normal-Days-Pre-prandial-FBS- Normal-Days-Post-prandial BS	-30.15789	78.75708	0.77608	-56.04470	-4.27109	-2.360	37	.024

The above results (Table 4.5 and 4.6) indicate that there is a significant difference in the mean blood sugar levels between the two durations. The mean blood sugar level for Post – Prandial =

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240.71 (SD = 11.08) while the mean for Pre – Prandial = 210.55 (SD = 76.23). The test had a t statistic (t = -2.36, df = 37) with a p – value = 0.024. Since the p – value is less than 0.05, we reject the null hypothesis and conclude that there is a statistically significant difference in the mean blood sugar levels between Pre – Prandial (before meals) and Post – Prandial (after meals) measurements on normal days at 95% confidence level.

The second test aimed to investigate whether there was a significant difference in the mean blood sugar levels between mid-day of fasting and post-Iftar during the fasting days. The following hypothesis was generated:

Alternative Hypothesis (H1): There is a significant difference in the mean blood sugar levels of diabetic patients between measurements taken in mid-day of fasting and post-Iftar during the fasting days.

Table 3.7 Diabetes Group- Diabetes Group- Mid-day- Blood Sugar-fasting day- Post Iftar Blood Sugar-fasting day

Paired Samples Statistics

Diabetes Group	Mean	N	Std. Deviation	Std. Error Mean
Mid-day- Blood Sugar-fasting day	188.47	38	64.978	0.541
Post-Iftar Blood Sugar-fasting day	221.18	38	73.676	0.952

Statistics (Table 3.7): The mean blood sugar level for the diabetic patients After two hours of fasting = 188.47 with (SD = 64.978) while the mean blood sugar level After Iftar = 221.18 with (SD = 73.676).

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Table 3.8 Diabetes Group- Mid-day- Blood Sugar-fasting day- Post Iftar Blood Sugar-fasting day

Paired Samples Test								
	Mean	Std. Deviation	Std. Error Mean	Paired Differences 95% Confidence Interval of the Difference- Lower	Upper	t	df	Sig. (2-tailed)
Mid-day- Blood Sugar-fasting day- Post Iftar Blood Sugar-fasting day	-32.711	53.746	0.719	-50.376	-15.045	-3.752	37	.001

Paired Samples Test (Table 3.8): The significant rise post-Iftar is statistically confirmed (mean difference = -32.71 mg/dL, t = -3.752, df = 37, p = 0.001), illustrating the physiological impact of breaking the fast on blood glucose levels.

Table 3.9 Diabetes Group-In Ramadan (fasting day-Fasting BS vs Diabetes Group-Pre-prandial FBS-After Ramadan

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
1	Diabetes Group-In Ramadan (fasting day-Fasting Blood Sugar	197.76	38	78.896	0.799
	Diabetes Group-Pre-prandial Fasting Blood Sugar-After Ramadan	210.55	38	76.233	0.367

Statistics (Table 3.9): Comparison of fasting day morning levels and normal day pre-prandial levels shows relatively stable averages, with minor variations between the fasting day (197.76 mg/dL) and the normal day (210.55 mg/dL).

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Table 3.10 Diabetes Group-In Ramadan (fasting day-Fasting BS vs Diabetes Group-Pre-prandial FBS-After Ramadan

Paired Samples Test								
1	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference lower	Paired Differences 95% Confidence Interval of the Difference Upper	t	df	Sig. (2-tailed)
Diabetes Group-In Ramadan (fasting day-Fasting BS – Diabetes Group-Pre-prandial FBS-After Ramadan	-12.789	69.783	0.320	-35.726	10.148	-1.130	37	.266

Paired Samples Test (Table 3.10): No significant difference was found (mean difference = -12.79 mg/dL, t = -1.130, df = 37, p = 0.266), indicating stable glucose control in the morning irrespective of fasting status.

Table 3.11 Diabetes Group-In Ramadan (fasting day-Mid-day Blood Sugar vs Diabetes Group-Postprandial BS-After Ramadan

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
2	Diabetes Group-In Ramadan (fasting day-Mid-day Blood Sugar	188.47	38	64.978	0.541
	Diabetes Group-Postprandial BS- After Ramadan	240.71	38	111.080	0.020

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Table 3.12 Diabetes Group-In Ramadan (fasting day- Mid-day Blood Sugar vs Diabetes Group-Postprandial BS-After Ramadan

Paired Samples Test								
2	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference lower	Paired Differences 95% Confidence Interval of the Difference Upper	t	df	Sig. (2-tailed)
Diabetes Group-In Ramadan (fasting day-Mid-day Blood Sugar Diabetes Group-Postprandial BS-After Ramadan	-52.237	103.677	0.819	-86.315	-18.159	-3.106	37	.004

Table 3.11 & Table 3.12 contrast blood sugar levels two hours after fasting on a fasting day to post-prandial levels on a normal day, showing a significant decrease (p = 0.004) in blood sugar levels during the fasting period.

Table 3.13 Diabetes Group-In Ramadan (fasting day-Post iftar BS vs Diabetes-Evening BS After Ramadan

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
3	Diabetes Group-In Ramadan (fasting day-Post Iftar Blood Sugar	221.18	38	73.676	0.952
	Diabetes Group-Evening Blood Sugar-After Ramadan	252.97	38	96.138	0.596

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Table 3.14 Diabetes Group-In Ramadan (fasting day-Post iftar BS vs Diabetes-Evening BS After Ramadan

Paired Samples Test								
3	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference lower	Paired Differences 95% Confidence Interval of the Difference Upper	t	df	Sig. (2-tailed)
Diabetes Group-In Ramadan (fasting day-Post-Iftar BS - Diabetes-Evening BS After Ramadan	-31.789	79.880	0.958	-58.045	-5.533	-2.453	37	.019

Table 3.13 & Table 3.14 compare after iftar blood sugar levels on a fasting day to evening levels on a normal day, finding a significant increase in blood sugar levels post-iftar (p = 0.019).

Table 3.15 -3.20: Blood Sugar Levels Comparison (Non-Diabetic Individuals)

Table 3.15 Non-Diabetes Group-In Ramadan (fasting day-Fasting BS vs Non-Diabetes Group-Pre-prandial FBS-After Ramadan

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
1	Non-Diabetes Group-In Ramadan (fasting day-Fasting Blood Sugar	97.94	54	10.775	0.466
	Non-Diabetes Group-Pre-prandial Fasting Blood Sugar-After Ramadan	99.72	54	16.802	0.287

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Table 3.16 Non-Diabetes Group-In Ramadan (fasting day-Fasting BS vs Non-Diabetes Group-Pre-prandial FBS-After Ramadan

Paired Samples Test								
1	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference lower	Paired Differences 95% Confidence Interval of the Difference Upper	t	df	Sig. (2-tailed)
Non-Diabetes Group-In Ramadan (fasting day-Fasting BS- Non-Diabetes Group-Pre-prandial FBS-After Ramadan	-1.778	14.962	0.036	-5.862	2.306	-.873	53	.387

Table 3.15 & Table 3.16 analyze fasting blood sugar levels during Ramadan compared to pre-prandial levels after Ramadan, showing no significant difference (p = 0.387), indicating that fasting does not impact fasting blood sugar levels in non-diabetics significantly.

Table3.17 Non-Diabetes Group-In Ramadan (fasting day- Mid-day Blood Sugar vs Non-Diabetes Group-Postprandial BS-After Ramadan

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
2	Non-Diabetes Group-In Ramadan (fasting day-Mid-day Blood Sugar	98.74	54	11.215	0.526
	Non-Diabetes Group-Postprandial Blood Sugar-After Ramadan	111.41	54	19.237	0.618

Statistics (Table 3.17): Non-diabetic individuals showed minimal changes in blood sugar levels two hours after fasting (98.74 mg/dL) compared to post-prandial levels on fasting days (111.41 mg/dL).

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Table 3.18 Non-Diabetes Group-In Ramadan (fasting day- Mid-day Blood Sugar vs Non-Diabetes Group-Postprandial BS-After Ramadan

Paired Samples Test								
2	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference lower	Paired Differences 95% Confidence Interval of the Difference Upper	t	df	Sig. (2-tailed)
Non-Diabetes Group-In Ramadan (fasting day-Mid-day Blood Sugar-Non-Diabetes Group-Postprandial BS-After Ramadan	-12.667	22.545	0.068	-18.820	-6.513	-4.129	53	.000

Paired Samples Test (Table 3.18): The increase post-prandial during fasting days was significant (mean difference = -12.67 mg/dL, t = -4.129, df = 53, p < 0.001), suggesting that even in non-diabetics, meal composition and timing during fasting periods can influence glucose levels.

Table 3.19 Non-Diabetes Group-In Ramadan (fasting day-post-Iftar BS vs Non-Diabetes Group-Evening BS - After Ramadan

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
3	Non-Diabetes Group-In Ramadan (fasting day-post-Iftar Blood Sugar	108.74	54	15.040	0.047
	Non-Diabetes Group-Evening Blood Sugar -After Ramadan	113.07	54	24.579	0.345

Statistics (Table 3.19): Evening blood sugar levels during fasting days showed an increase from 108.74 mg/dL (after Iftar) to 113.07 mg/dL (after evening meal).

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Table 3.20 Non-Diabetes Group-In Ramadan (fasting day-post-Iftar BS vs Non-Diabetes Group-Evening BS -After Ramadan

Paired Samples Test								
3	Mean	Std. Deviation	Std. Error Mean	Paired Differences 95% Confidence Interval of the Difference lower	Paired Differences 95% Confidence Interval of the Difference Upper	t	df	Sig. (2-tailed)
Non-Diabetes Group-In Ramadan (fasting day-Post-Iftar BS- Non-Diabetes Group-Evening BS -After Ramadan	-4.333	24.901	0.389	-11.130	2.463	-1.279	53	.020

Paired Samples Test (Table 3.20): provided a mean difference of -4.333 mg/dL (i.e., evening levels on non-fasting days were higher by approximately 4.33 mg/dL compared to post-Iftar levels during Ramadan). The t-value of -1.279 with a degree of freedom (df) of 53 and a two-tailed p-value of 0.020 indicates that the difference is statistically significant at the 5% significance level, albeit the effect size and confidence interval suggest a modest clinical impact.

These findings suggest that while there is a statistically significant difference in blood sugar levels between post-Iftar during Ramadan and the evening on non-fasting days for non-diabetic individuals, the actual difference in blood sugar levels is relatively small and the confidence intervals suggest that this difference may not be of substantial clinical relevance. The results indicate minor fluctuations in blood glucose levels due to fasting, which are within a normal range and not indicative of significant metabolic disturbance.

An Independent samples T-test was then performed to assess whether there was a significant difference in the mean blood pressure of the study participants between the normal and fasting days. The following hypotheses were generated:

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Table 3.21 Diabetes Group-Blood Pressure

Diabetes-Group Statistics					
	Status	N	Mean	Std. Deviation	Std. Error Mean
Diabetes Group-Systolic-Blood Pressure	Fasting Day	38	121.7895	13.35616	0.1666
	Normal Day	38	126.7368	18.49716	0.0006
Diabetes-Group Statistics					
	Status	N	Mean	Std. Deviation	Std. Error Mean
Diabetes Group-Diastolic-Blood Pressure	Fasting Day	38	75.0263	10.84157	0.5635
	Normal Day	38	75.6842	10.12651	0.3285

Systolic Blood Pressure Analysis: The mean systolic blood pressure of the diabetic group on fasting days was recorded at 121.79 mmHg, which is notably lower than on normal days, where it was 126.74 mmHg. This difference suggests that fasting may have a beneficial impact in reducing systolic blood pressure in individuals with diabetes. The standard deviation, a measure of the spread of blood pressure readings around the mean, was smaller on fasting days (13.36 mmHg) compared to normal days (18.50 mmHg), indicating more consistent readings among the participants during fasting.

Diastolic Blood Pressure Analysis: The diastolic blood pressure data shows less variation between fasting and normal days compared to systolic blood pressure. The mean diastolic pressure during fasting was 75.03 mmHg, slightly lower than on normal days, where it was 75.68 mmHg.

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Table 3.22 Independent Samples Test-Systolic Blood pressure in Diabetes Group

Independent Samples Test								
	Levene's Test for Equality of Variances				t-test for Equality of Means			
Systolic-BP	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Paired Differences 95% Confidence Interval of the Difference Lower	Paired Differences 95% Confidence Interval of the Difference Upper
Equal variances assumed	3.276	.074	-1.337	74	.185	-4.94737	-12.32199	2.42725
Equal variances not assumed			-1.337	67.336	.186	-4.94737	-12.33414	2.43940

The above results indicate that there is a non – significant difference in the mean Systolic blood pressure between normal and fasting days, the t – statistic (t = -1.337, df = 74) and p – value = 0.074. The p – value > 0.05, thus we fail to reject the null hypothesis and conclude that there is a statistically non – significant difference in the mean Systolic blood pressure of the patients between normal and fasting days.

Table 3.23 Blood Pressure - Non-Diabetes Group

Non-Diabetes-Group Statistics					
	Status	N	Mean	Std. Deviation	Std. Error Mean
Non-Diabetes Group-Systolic-Blood Pressure	Fasting Day	54	117.8333	16.4382	0.2369
	Normal Day	54	117.6667	17.11779	0.3294
Non-Diabetes-Group Statistics					

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	Status	N	Mean	Std. Deviation	Std. Error Mean
Non-Diabetes Group-Diastolic-Blood Pressure	Fasting Day	54	73.09259	12.5897	0.7132
	Normal Day	54	75.16667	13.0467	0.3285

Systolic Blood Pressure Analysis: The mean systolic blood pressure recorded was slightly higher on fasting days (117.83 mmHg) compared to normal days (117.67 mmHg), although the difference is minimal. The standard deviation, which measures the variability of blood pressure readings among participants, was somewhat lower on fasting days (16.44 mmHg) than on normal days (17.12 mmHg). This suggests a slightly tighter clustering of systolic blood pressure measurements around the mean during fasting. The standard error of the mean on fasting days (0.237 mmHg) versus normal days (0.329 mmHg) indicates that the mean systolic blood pressure estimated on fasting days is slightly more precise, reflecting a smaller variability between individual measurements compared to normal days. However, given the minimal difference in mean values and overlapping variability, these differences might not be clinically significant.

Diastolic Blood Pressure Analysis: For diastolic blood pressure, the data shows a more noticeable difference between fasting and normal days. The mean diastolic pressure during fasting days was 73.09 mmHg, compared to 75.17 mmHg on normal days. This indicates a slight reduction in diastolic blood pressure during fasting. Furthermore, the standard deviation was slightly higher on normal days (13.05 mmHg) compared to fasting days (12.59 mmHg), suggesting greater variability in diastolic blood pressure on non-fasting days.

A two-way ANOVA was conducted to test the hypothesis that dietary patterns affect the level of blood sugar in diabetes and non-diabetes participants:

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Table 3.24 Diabetes Group

Tests of Between-Subjects Effects					
Dependent Variable: Diabetes Group-In Ramadan (fasting day-Post-Iftar Blood Sugar					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5921.817	1	5921.817	1.094	.303
Intercept	1860486.449	1	1860486.449	343.619	.000
Diabetes-Group-InRamadanf-asting-day-Eating-datefruit-lentil-vegetable	5921.817	1	5921.817	1.094	.303
Total	2059893.000	38			

The analysis revealed several key findings Model Significance: The overall regression model, as indicated by the corrected model F-statistic (F (1, 36) = 1.094, p = .303), was not statistically significant. This suggests that the inclusion of the dietary pattern does not significantly explain the variations in post-Iftar blood sugar levels among the diabetic participants.

Table 3.25 Non-Diabetes Group

Tests of Between-Subjects Effects					
Dependent Variable: Non-Diabetes-Group-In Ramadan (fasting day-Post-Iftar Blood Sugar					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	7805.689[a]	1	7805.689	16.763	.000
Intercept	681311.245	1	681311.245	1463.127	.000
Non-Diabetes-Group-InRamadan-fastingday-Eating-datefrui-tlentil-vegetable	7805.689	1	7805.689	16.763	.000
Total	722450.000	54			

The corrected model showed a significant F-statistic of 16.763 with a p-value of .000, indicating a statistically robust model. This result suggests that the variations in blood sugar levels post-Iftar could be meaningfully attributed to the participants' diet, thereby affirming the hypothesis that what is consumed can influence blood glucose levels in non-diabetics.

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4-Discussion

The management of diabetes during fasting periods, such as Ramadan, presents unique challenges and opportunities for therapeutic intervention. Comparative studies like the one conducted by Al-Arouj et al. (2010) provide foundational insights into the effects of fasting on blood glucose stability in diabetic patients. These studies have noted significant variations in glucose control depending on the type of diabetes and the management strategy employed during the fasting period.

Pathophysiological aspects are crucial in understanding the metabolic changes during fasting. Fasting, especially prolonged periods without food as observed during Ramadan, affects both glucose production and utilization. Insulin sensitivity might improve, but there is also a risk of exacerbated hypoglycemic events if not properly managed (Bravis et al., 2010). The adaptive response includes increased gluconeogenesis initially, followed by a reduction in insulin secretion and an increase in lipolysis and ketone production, which can be precarious for patients with diabetes (Salti et al., 2004).

4.1 Dietary Influences on Glucose Control

The dietary intake during fasting, particularly in the context of Ramadan, plays a crucial role in the management of blood glucose levels in both diabetic and non-diabetic individuals. The significant changes in fasting blood glucose levels observed during Ramadan in both diabetic and non-diabetic groups highlight the acute metabolic adaptations that occur in response to intermittent fasting. These findings are consistent with researches by Bravis et al. (2010) and Herz et al. (2023), which indicates that fasting can significantly alter glucose metabolism and insulin sensitivity. The increase in post-Iftar glucose levels particularly underscores the need for careful meal planning during fasting periods to prevent excessive postprandial glucose excursions.

This research expands on the work by Templeman et al. (2020), which discusses intermittent fasting's role in improving metabolic health through better weight management and insulin sensitivity. However, the study contrasts with findings by Vasim et al. (2022), who report minimal impacts of fasting on blood pressure, suggesting that fasting's

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cardiovascular implications might be less pronounced than its metabolic effects.

This study highlights the critical role of dietary composition in managing blood glucose levels during both fasting and non-fasting days. Significant spikes in glucose levels post-Iftar illustrate the impact of meal composition and timing on blood sugar control. Aligning with the findings of Herz et al. (2023) and Liu et al. (2020), integrating low-glycemic-index foods and balancing macronutrient intake are essential strategies to mitigate sharp increases in blood glucose levels. This approach is particularly crucial for diabetic patients who must carefully manage both the quantity and quality of food intake to maintain optimal glycemic control.

Moreover, the observed variations in blood glucose measurements between pre-prandial and postprandial periods within usual days, and more markedly, between the periods before and after Iftar during fasting days, underscore the importance of dietary intake in glucose regulation (Templeman et al., 2020; Wada et al., 2020). Regular days show significant fluctuations, with pre-prandial blood sugar averaging 210.55 mg/dL and postprandial levels climbing to approximately 240.71 mg/dL, illustrating the daily challenges diabetic patients face in maintaining their glucose levels within an ideal range with the aid of post-meal medications (Hassanein et al., 2022; Song et al., 2021; Ibrahim et al., 2020; Albosta & Bakke, 2021).

During fasting, especially at Iftar, the sudden rise in glucose levels—from 188.47 mg/dL to 221.18 mg/dL—highlights the significant impact of traditional high-carbohydrate meals typical of Iftar. This peak underscore the necessity for diabetic patients to closely monitor their blood sugar throughout the day and adjust their dietary habits accordingly, especially during periods of fasting. The appropriate management of meal composition and timing is crucial to prevent sudden and potentially harmful spikes in blood glucose (Tang et al., 2020).

4.2 Non-Significant Changes in Blood Pressure

Contrary to the observed changes in blood glucose levels, our study found no significant alterations in blood pressure during fasting, these findings are consistent with other research, including Vasim et al. (2022), which reports minimal impact of Ramadan fasting on blood pressure in both hypertensive and normotensive individuals, suggesting

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that short-term fasting does not significantly affect cardiovascular stability. However, counterarguments are presented in studies like the one by Sijavandi et al. (2017), which noted significant reductions in both systolic and diastolic blood pressure among participants fasting during Ramadan, attributed to decreased salt intake and overall calorie reduction.

This observed stability in our study may be due to the preservation of fluid and sodium intake during non-fasting hours, helping to maintain blood volume and vascular resistance. Additionally, the lack of significant blood pressure reduction could be linked to adaptive physiological mechanisms that counterbalance potential hypotensive effects of fasting, such as increased sympathetic activity and alterations in renal sodium handling, as noted by Zhang et al. (2020) and Li et al. (2022).

4.3 Implications for Diabetes Management

These findings underscore the importance of personalized medical guidance and meticulous dietary management for individuals with diabetes, particularly during fasting periods such as Ramadan. The observed peak increase in blood sugar levels post-Iftar highlights the critical need for cautious dietary planning. Meals should be balanced, incorporating foods with a low glycemic index to minimize glucose absorption and reduce peaks in blood sugar levels (Liu et al., 2020; Herz et al., 2023). Health experts recommend that individuals break their fast with small quantities and avoid high-calorie, high-sugar foods (Wilhelmi de Toledo et al., 2020). Monitoring blood glucose levels more frequently during fasting is vital to mitigate the risks associated with fluctuating glucose levels, helping to prevent both hypo- and hyperglycemic episodes which are particularly hazardous for those with type 1 or advanced type 2 diabetes (Ibrahim et al., 2020).

Furthermore, while fasting does not typically harm blood pressure provided that medications are taken and nutrition is adequate (Vasim et al., 2022; Wicaksana et al., 2020), it remains crucial to monitor the blood pressure of fasting individuals. This is especially important for those with a history of high blood pressure or cardiovascular conditions. Regular monitoring and adjustment of medicinal doses as needed can help manage potential fluctuations and minimize complications. This study emphasizes the need for individualized diabetes management plans that take into account personal health status,

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medication needs, and eating behavior to optimize both glucose and blood pressure conditions during fasting.

5-Conclusion and Recommendation

the current study has demonstrated significant variations in diabetic blood glucose management during fasting compared to non-fasting days. Specifically, the findings revealed substantial differences in post-prandial, and after iftar glucose levels. These variations highlight the critical influence of fasting on blood glucose fluctuations and underscore the necessity for meticulously tailored dietary strategies during fasting periods to maintain optimal glycemic control.

Conversely, our findings did not indicate a statistically significant impact of fasting on systolic blood pressure ($p > 0.05$). This suggests that within the constraints of our study population and design, fasting does not significantly alter blood pressure among participants. These results contribute to the growing body of knowledge indicating that fasting can be safely practiced by individuals with diabetes, provided that proper medical guidance is followed.

Future studies are encouraged to explore these relationships further, potentially with larger sample sizes and a more varied demographic profile to substantiate these findings and examine other physiological impacts of fasting. Additionally, investigating the long-term effects of fasting on both glucose control and cardiovascular health in diabetic patients would provide deeper insights into the comprehensive management of diabetes during fasting periods

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