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Effects of Ramadan fasting on anthropometric and body composition changes according to *ADRB2* rs1042714 genotype

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ABSTRACT

Background: *Obesity is a metabolic disorder characterized by excessive fat accumulation. Intermittent fasting, including Ramadhan fasting, has been shown to regulate eating patterns and reduce the risk of obesity. Genetic variations in the ADRB2 gene, particularly rs1042714, may influence differences in anthropometric and body composition responses to Ramadan fasting between genotype groups via β2-adrenergic signalling.* ***Objective:*** *This study aimed to analyze the effects of Ramadan fasting on anthropometric and body composition changes between ADRB2 rs1042714 genotype groups.* ***Methods:*** *The natural experiment within a cohort design included 35 adults (8 males and 27 females) aged 19–52 years from Semarang, Indonesia. Repeated measurements were obtained over approximately seven weeks: one week before Ramadan, during the third week of Ramadan, and two weeks after Eid al-Fitr. The ADRB2 rs1042714 genotype data were obtained from a previous study and had been determined using a TaqMan allelic discrimination assay using real-time polymerase chain reaction (PCR). Waist circumference was measured with a Medline tape, body weight and body composition with an Omron HBF-214 bioelectrical impedance analyzer, and height with a stadiometer. Dietary intake was assessed using a semi-quantitative food frequency questionnaire (SQ-FFQ), whereas physical activity was assessed using the International Physical Activity Questionnaire-Short Form (IPAQ-SF). Differences between genotype groups were analyzed using t-tests or Mann–Whitney tests, as appropriate.* ***Results:*** *The CG+GG group (n = 10) exhibited significantly greater reductions in body weight (p = 0.016), BMI (p = 0.046), and visceral fat (p = 0.028) than the CC group (n = 25) during Ramadan fasting. Changes in physical activity also differed significantly between genotype groups during Ramadan fasting (p = 0.041).* ***Conclusion:*** *ADRB2 rs1042714 may contribute to interindividual variability in anthropometric and body composition changes during Ramadan fasting, with G-allele carriers exhibiting greater reductions in body weight, BMI, and visceral fat.*

KEYWORDS: *ADRB2; anthropometry; body composition; obesity; Ramadan fasting*

INTRODUCTION

Obesity is a metabolic disorder characterized by excessive body fat accumulation. Obesity increases the risk of numerous health conditions, including cardiovascular diseases, diabetes mellitus, and hypertension. Obesity increases the risk of numerous health conditions, including cardiovascular diseases, diabetes mellitus, and hypertension. It is influenced by multiple factors, including sex, genetic factors, dietary patterns, physical activity, socioeconomic status, and nutritional knowledge [1–3]. The prevalence of obesity has been increasing annually. According to the 2023 Indonesian Health Survey, 23.4% of adults aged >18 years are classified as obese, while 36.8% of individuals aged ≥15 years have central obesity [4]. Obesity can be classified using body mass index (BMI), with a BMI ≥25 kg/m^2 indicating obesity according to Asia-Pacific criteria. Central obesity

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is defined as a waist circumference >90 cm in men and >80 cm in women based on Asia-Pacific standards [5,6].

Weight management has become a key focus due to the increasing prevalence of obesity. Numerous dietary interventions have been developed to support the achievement and maintenance of a healthy body weight. Intermittent fasting (IF) is one of the dietary interventions that regulates eating patterns by limiting the eating window or significantly reducing caloric intake [7]. Previous studies have demonstrated that IF can contribute to weight loss, reduce the risk of central obesity, improve insulin sensitivity, and promote heart health. Evidence from meta-analyses and systematic reviews has shown that IF effectively reduces body weight and body fat percentage. IF has been found to decrease waist circumference, a key indicator of central obesity and a risk factor for metabolic diseases [8–13].

Intermittent fasting is widely practiced in Indonesia, with Ramadan fasting among the most common forms. During Ramadan fasting, significant changes occur in eating patterns. Muslims fast for approximately 12 hours a day, consuming one meal before dawn and another after sunset. In addition, dietary choices during Ramadan often differ from those during non-Ramadan periods, with greater consumption of energy-dense and high-fat foods. These dietary changes may influence metabolic regulation and contribute to variability in anthropometric and body composition responses during Ramadan fasting [14,15]. During fasting, the body uses stored fat as an energy source, converting it into fatty acids and glycerol. This process leads to weight loss and a reduction in waist circumference [16]. However, the effects of fasting on anthropometric and body composition changes vary among individuals and are influenced by factors such as genetics.

Genetic factors are crucial in determining body phenotypic variations, including body composition, fat distribution, and metabolic function. The adrenergic receptor beta-2 (*ADRB2*) gene plays a significant role in lipid metabolism. It encodes a receptor that responds to epinephrine and norepinephrine, thereby activating lipolysis. Previous studies have demonstrated that certain *ADRB2* gene variants are associated with greater body fat accumulation, particularly among individuals consuming high-calorie or nutritionally imbalanced diets. The *ADRB2* gene variant rs1042714 is associated with lipid profile and obesity. Individuals carrying the C allele have been reported to exhibit higher triglyceride levels, while the G allele is protective against hypertriglyceridemia. These findings suggest that the C allele may influence lipid metabolism, thereby increasing obesity risk [17,18].

Fasting has been shown to provide various health benefits, including anthropometric and body composition changes. Previous studies have demonstrated that fasting can reduce waist circumference by an average of 1.95 cm [19]. A study conducted among individuals with diabetes in Saudi Arabia also showed reduction in waist circumference of by 2.9 cm among patients with type 2 diabetes and 0.9 cm among patients with type 1 diabetes during fasting [20]. These findings suggest substantial interindividual variability in responses to fasting. Genetic variations in *ADRB2* may contribute to these differences by influencing fat mobilization during fasting, thereby affecting patterns of fat distribution. Martínez-Salas et al. also reported that the frequency of *ADRB2* rs1042714 variants differs across populations and ancestral backgrounds, potentially contributing to variability in anthropometric and body composition responses [21]. However, no study has investigated anthropometric and body composition changes during fasting in relation to *ADRB2* gene variants in an Indonesian population. Understanding these genotype-related differences may help explain individual variability in anthropometric and body composition responses during Ramadan fasting. Therefore, this study aimed to analyze the effects of Ramadan fasting on anthropometric and body composition changes between *ADRB2* rs1042714 genotype groups in an Indonesian population.

METHODS

Study design and participants

This study was designed as a natural experiment within a cohort design, with repeated measurements at three time points: one week before Ramadan (baseline), the third week of Ramadan (intervention), and two weeks after Eid al-Fitr (follow-up). This research was conducted in Semarang, Indonesia, from February to April 2025. The study included 35 adults (8 males and 27 females) aged

19–52 years whose *ADRB2* rs1042714 genotype data had been obtained from a previous study. Participants were recruited through purposive sampling by recontacting participants from the previous study using the available contact information. Eligible participants were Muslims who observed Ramadan fasting, were not following a strict diet, had no acute or chronic illness, were not pregnant or lactating, and were not taking medications known to affect metabolism function. Participants were excluded if they withdrew from the study or failed to complete follow-up assessments. Female participants experiencing menstruation during Ramadan fasting were not excluded because women may temporarily refrain from fasting during menstruation as part of the natural practice of Ramadan fasting. Ethical approval was obtained from the Ethics Committee of the Faculty of Medicine, Universitas Diponegoro (Approval No.059/EC/KEPK/FK-UNDIP/III/2025). Written informed consent was obtained from all participants prior to study participation.

Measures

Body weight and body composition were assessed using a bioelectrical impedance analyzer (Omron HBF-214), with participants standing barefoot on the device electrodes throughout the measurement procedure. Height was measured using a stadiometer with a precision of 0.1 cm while participants stood in the Frankfurt horizontal plane. Waist and hip circumferences were measured using a Medline non-stretchable measuring tape with a precision of 0.1 cm. Waist circumference was measured at the midpoint between the lowest rib and the top of the iliac crest, while hip circumference was measured at the widest circumference of the gluteal region.

Dietary intake was assessed using a semi-quantitative food frequency questionnaire (SQ-FFQ) adapted to Indonesian dietary patterns and comprising commonly consumed foods and beverages from major Indonesian food groups. Nutrient intake was calculated using NutriSurvey software based on the Indonesian Food Composition Database. Physical activity was assessed using the International Physical Activity Questionnaire Short Form (IPAQ-SF) and expressed as metabolic equivalent task (MET)-minutes per week according to the standard scoring guidelines.

Genotype data for the *ADRB2* rs1042714 variant were obtained from a genotyping analysis conducted in 2024 by a previous research team within the same study population. These existing data were used to classify participants into three genotype groups (CC, CG, and GG) for the present study. Due to the low frequency of the G allele in the study sample and previous evidence suggesting a protective role of the G allele, the CG and GG genotypes were combined into a single group for analysis to minimize potential bias associated with small sample sizes [17,18]. Differences in anthropometric and body composition changes during Ramadan fasting were subsequently analyzed between genotype groups.

Genotyping was performed using a TaqMan allelic discrimination assay (Assay ID: C___2084765_20) with real-time polymerase chain reaction (PCR). Genomic DNA was isolated from whole-blood samples using the GeneAid Genomic DNA Mini Kit, and DNA concentration was assessed prior to amplification. PCR conditions consisted of an initial enzyme activation step at 95°C for 10 minutes, followed by 45 cycles of denaturation at 95°C for 15 seconds and annealing/extension at 60°C for 30 seconds. Genotypes were determined based on allele-specific fluorescence signals and visualized using an allelic discrimination scatter plot.

Data analysis

The collected research data were analyzed using IBM SPSS Statistics version 22. Genotype and allele distributions were analyzed using the Chi-Square test. Data distribution was assessed using the Shapiro–Wilk test. Normally distributed data were presented as mean ± standard deviation (SD), while non-normally distributed data were presented as median (interquartile range). Differences between genotypes were analyzed using the independent t-test for normally distributed variables or the Mann–Whitney test for non-normal distributed variables. A p-value of less than 0.05 ($p<0.05$) was considered statistically significant.

RESULTS

The distribution of *ADRB2* rs1042714 genotypes and alleles is presented in **Table 1**. The C allele was

the predominant allele in the study population (82.9%), whereas the G allele was the minor allele (17.1%). The Hardy–Weinberg equilibrium (HWE) for the *ADRB2* rs1042714 variant was assessed using Chi-Square analysis, and the genotype distribution was consistent with HWE (p = 0.262).

Table 2 presents the baseline characteristics of the study participants according to *ADRB2* rs1042714 genotype groups. In general, the two genotype groups exhibited similar demographic and anthropometric characteristics, including age, height, body weight, body mass index (BMI), waist circumference, hip circumference, and waist-to-hip ratio. Participants with the CC genotype tended to have lower BMI, hip circumference, and waist-to-hip ratio, but a higher waist circumference than those with the CG+GG genotypes. However, none of these differences reached statistical significance (p > 0.05).

No significant differences were observed between genotype groups in body composition parameters, including body fat percentage and visceral fat level (p > 0.05). However, participants with the CC genotype tended to exhibit a higher body fat percentage and a lower visceral fat level than those with the CG+GG genotypes. Table 2 also shows that participants with the CG+GG genotypes had significantly higher total energy and carbohydrate intake (p = 0.034 and p = 0.003, respectively), while no significant differences

Table 1. Genotypes and alleles distribution of the *ADRB2* rs1042714

Total participants	Genotype (n,%)			Allele (n,%)		HWE *p-value*
	CC	CG	GG	C	G	
35	25 (71.4)	8 (22.9)	2 (5.7)	58 (82.9)	12 (17.1)	0.262

HWE = Hardy–Weinberg equilibrium was assessed by Chi-Square test

Table 2. Baseline characteristics of the study participants according to *ADRB2* rs1042714 genotype groups

Parameter	CC (n = 25)	CG+GG (n = 10)	p-value
Age (years)	21 (7)	22.5 (16)	0.839[a]
Sex (n,%)			
Male	4 (16)	4 (40)	
Female	21 (84)	6 (60)	
Anthropometric measurements			
Height (cm)	160.24±6.49	159.07±10.52	0.747[b]
Body weight (kg)†	63.57±15.77	64.37±13.65	0.839[b]
BMI (kg/m^2)†	24.70±5.65	25.42±3.65	0.574[b]
Waist circumference (cm)	82.82±12.82	81.55±9.84	0.781[b]
Hip circumference (cm)†	95.66±11.82	95.91±7.03	0.832[b]
Waist-to-hip ratio	0.85 (0.1)	0.86 (0.1)	0.715[a]
Body composition parameters			
Body fat (%)	29.86±6.49	28.39±7.22	0.560[b]
Visceral fat	4 (9.5)	8 (7.75)	0.264[a]
Dietary intake			
Energy (kcal/day)	1350.98±390.70	1734.39±618.04	0.034[b*]
Carbohydrate (g/day)	152.77±52.66	224.91±73.60	0.003[b*]
Protein (g/day)	59.67±17.54	69.15±31.01	0.382[b]
Total fat (g/day)	56.61±18.88	63.96±33.02	0.411[b]
Saturated fat (g/day)	19.92±12.04	17.75±8.86	0.609[b]
PUFA (g/day)	10.30 (9.6)	11.45 (13.1)	0.463[b]
Physical activity (MET-min/week)†	1386 (1929)	1358 (1959.8)	0.877[b]

†Log-transformed data; a = Mann–Whitney test; b = Independent-samples t-test; *Statistically significant p<0.05

were observed between genotype groups in protein, total fat, saturated fat, and polyunsaturated fatty acid (PUFA) intake, or physical activity ($p > 0.05$).

Table 3 presents changes in anthropometric and body composition parameters during Ramadan fasting according to *ADRB2* rs1042714 genotype groups. Significant differences between the CC and CG+GG genotype groups were observed in body weight, BMI, and visceral fat changes. The CG+GG group exhibited greater reductions in body weight and BMI from baseline to the intervention period than the CC group ($p = 0.016$; $p = 0.046$, respectively). Regarding body composition, the CG+GG group exhibited greater reductions in visceral fat from baseline to the intervention and follow-up periods than the CC group ($p = 0.013$; $p = 0.028$, respectively). No significant differences were observed between genotype groups in waist circumference, hip circumference, waist-to-hip ratio, or body fat percentage changes (all $p > 0.05$).

Table 4 presents changes in dietary intake and physical activity by *ADRB2* rs1042714 genotype groups during Ramadan fasting. Changes in total energy, carbohydrate, protein, total fat, and PUFA intake did not differ significantly between the CC and CG+GG genotypes at any time point (all $p > 0.05$). However, changes in saturated fat intake differed significantly from baseline to the follow-up period ($p = 0.037$), with the CG+GG group exhibiting a greater increase than the CC group. In addition, changes in physical activity differed

Table 3. Changes in anthropometric and body composition parameters during Ramadan fasting according to *ADRB2* rs1042714 genotype groups

Parameter	CC (n = 25)	CG+GG (n = 10)	p-value
Anthropometric measurements			
Body weight (kg)[a]			
Intervention – Baseline	-0.94±1.058	-2.00±1.22	0.016*
Follow-up – Baseline	-0.20±1.298	-0.97±2.00	0.186
Follow-up – Intervention	0.74±1.299	1.03±1.60	0.591
BMI (kg/m^2)[b]			
Intervention – Baseline	-0.30 (0.65)	-0.60 (0.93)	0.046*
Follow-up – Baseline	-0.10 (0.80)	-0.45 (1.30)	0.296
Follow-up – Intervention	0.20 (0.65)	0.60 (0.77)	0.200
Waist circumference (cm)[a]			
Intervention – Baseline	-3.16±6.10	-1.30±3.33	0.371
Follow-up – Baseline	-2.42±6.04	0.00±3.16	0.239
Follow-up – Intervention	0.73±4.45	1.30±4.14	0.733
Hip circumference (cm)[b]			
Intervention – Baseline	-0.50 (5.55)	0.00 (5.38)	0.798
Follow-up – Baseline	-1.00 (4.00)	-0.30 (5.13)	0.333
Follow-up – Intervention	0.00 (5.00)	0.75 (6.63)	0.558
Waist-to-hip ratio[b]			
Intervention – Baseline	-0.03 (0.07)	-0.02 (0.06)	0.583
Follow-up – Baseline	-0.01 (0.09)	0.00 (0.04)	0.419
Follow-up – Intervention	0.01 (0.07)	0.03 (0.05)	0.825
Body composition parameters			
Body fat (%)[b]			
Intervention – Baseline	-0.80 (1.35)	-0.60 (0.48)	0.770
Follow-up – Baseline	-0.40 (2.30)	-0.15 (1.20)	0.487
Follow-up – Intervention	0.40 (1.75)	0.75 (1.55)	0.264
Visceral fat[b]			
Intervention – Baseline	0.00 (0.50)	-1.00 (1.00)	0.013*
Follow-up – Baseline	0.00 (0.50)	-1.00 (1.00)	0.028*
Follow-up – Intervention	0.00 (1.00)	0.00 (1.25)	1.000

a=Independent-samples t-test; b=Mann–Whitney test; *Statistically significant $p<0.05$

Table 4. Changes in dietary intake and physical activity during Ramadan fasting according to *ADRB2* rs1042714 genotype groups

Parameter	CC (n = 25)	CG+GG (n = 10)	p-value
Dietary intake			
Energy (kcal/day)[a]			
Intervention – Baseline	-246.30 (648.85)	-260.30 (892.13)	0.742
Follow-up – Baseline	13.90 (572.30)	-48.45 (1060.30)	0.827
Follow-up – Intervention	246.40 (298.65)	266.65 (922.52)	0.661
Carbohydrate (g/day)[b]			
Intervention – Baseline	-32.06±44.73	-69.28±91.19	0.244
Follow-up – Baseline	6.60±55.30	-7.78±103.12	0.595
Follow-up – Intervention	38.67±47.79	61.50±54.93	0.230
Protein (g/day)[a]			
Intervention – Baseline	-11.40 (36.85)	-4.10 (59.53)	0.971
Follow-up – Baseline	-1.40 (40.00)	1.95 (29.78)	0.465
Follow-up – Intervention	4.70 (27.95)	4.40 (42.77)	0.381
Total fat (g/day)[a]			
Intervention – Baseline	-7.90 (27.25)	1.35 (38.55)	0.342
Follow-up – Baseline	-5.20 (40.50)	3.05 (23.90)	0.214
Follow-up – Intervention	2.80 (17.75)	6.65 (38.23)	0.488
Saturated fat (g/day)[a]			
Intervention – Baseline	-4.70 (13.45)	2.85 (21.30)	0.100
Follow-up – Baseline	-6.90 (20.90)	0.50 (20.73)	0.037*
Follow-up – Intervention	-0.80 (12.60)	3.05 (15.55)	0.523
PUFA (g/day)[a]			
Intervention – Baseline	-2.00 (6.35)	0.15 (12.27)	0.306
Follow-up – Baseline	-1.40 (9.25)	-0.10 (7.43)	0.342
Follow-up – Intervention	0.50 (7.85)	0.20 (9.63)	0.701
Physical activity (MET-min/week)[a]			
Intervention – Baseline	-180.00 (1092)	28.00 (1242.75)	0.041*
Follow-up – Baseline	-280.00 (1238.5)	-160.00 (1056.75)	0.701
Follow-up – Intervention	0.00 (634.5)	-286.50 (3199.50)	0.151

a= Mann–Whitney test; b= Independent-samples t-test; *Statistically significant p<0.05

significantly from baseline to the intervention period (p = 0.041), with the CG+GG group exhibiting a greater increase than the CC group. No significant differences in saturated fat intake or physical activity changes were observed at the remaining time points (all p > 0.05).

DISCUSSION

The genotype distribution was consistent with HWE (p > 0.05), indicating no deviation from the expected genotype distribution. The C allele was the predominant allele (82.9%), whereas the G was less frequent (17.1%). These proportions are consistent with previous studies reported in Asian populations, whereas higher frequencies of G-allele have been observed in European populations. Variation in allele distribution across populations may influence metabolic responses [17,21,22]. However, the limited number of participants carrying the GG genotype should be considered when interpreting genotype-specific effects.

This study showed no significant differences between the two genotype groups for most baseline characteristics. Baseline anthropometric characteristics, including height, body weight, BMI, waist circumference, hip circumference, and waist-to-hip ratio, were similar between groups. However, participants carrying the CC genotype tended to exhibit a lower BMI but a higher body fat percentage and larger waist circumference than G-allele carriers. Although these differences were not statistically significant, they may reflect the

role of *ADRB2* in regulating energy balance and lipid metabolism.

The *ADRB2* gene encodes the β2-adrenergic receptor, which plays an important role in energy balance by activating lipolysis and thermogenesis. The *ADRB2* variant rs1042714 can modify receptor sensitivity to catecholamines, thereby affecting the body's ability to mobilize fat and respond to changes in dietary intake and physical activity [23]. Biologically, β2-adrenergic receptors stimulate lipolysis via the cAMP–PKA signaling pathway. When catecholamines bind to β2-adrenergic receptors, G protein activation increases cyclic adenosine monophosphate (cAMP) production, which in turn activates protein kinase A (PKA). PKA stimulates hormone-sensitive lipase (HSL) and adipose triglyceride lipase (ATGL), promoting triglyceride breakdown into free fatty acids and glycerol. This mechanism provides energy from fat stores during stress or fasting [24].

In this study, G-allele carriers exhibited greater reductions in body weight, BMI, and visceral fat than participants with the CC genotype. These findings may be attributed to higher β_2-adrenergic activity, which promotes lipolysis. The enhanced lipolytic response may lead to greater weight loss during the intervention [23]. Consistent with this finding, Ruiz et al. (2011) reported that G-allele carriers were more responsive to a low-calorie diet, resulting in greater reductions in body weight compared with C-allele carriers [25]. Nevertheless, no significant differences were observed in waist circumference, hip circumference, waist-to-hip ratio, or body fat percentage changes between genotype groups.

Szendrei et al. (2016) reported differences in weight loss responses between *ADRB2* rs1042714 genotype groups following lifestyle interventions. These differences may be attributed to variations in β_2-adrenergic receptor regulation, adrenergic sensitivity across populations, and differences in study design [26]. Dietary intake may contribute to differences in metabolic responses between genotype groups. In the present study, greater increases in saturated fat intake were observed among G-allele carriers from baseline to the follow-up period. However, the contribution of dietary intake to the observed anthropometric changes remains unclear.

Beyond dietary intake, physical activity may also help explain the differences in metabolic responses observed between genotype groups. In the present study, G-allele carriers exhibited greater reductions in body weight, BMI, and visceral fat, with higher physical activity observed from baseline to the intervention period. Although the relationship cannot be interpreted as causal, these observations raise the possibility that physical activity contributed to the greater anthropometric improvements observed among G-allele carriers. Previous studies have demonstrated that the *ADRB2* rs1042714 variant plays an important role in individual variability in responses to physical activity, particularly in relation to anthropometric and metabolic changes. Physically active G-allele carriers have been reported to achieve greater reductions in body weight, BMI, and body fat percentage than non-carriers. These reductions may be attributed to the G allele's greater resistance to β_2-adrenergic receptor downregulation, which enhances lipolytic activity and improves metabolic efficiency during exercise [27–29]. However, the evidence remains mixed. Corbalan et al. (2002), reported that G-allele carriers tended to have higher body weight despite being physically active, suggesting that the effects of *ADRB2* rs1042714 may depend on factors, such as ethnicity, exercise intensity, or dietary habits [30]. Therefore, *ADRB2* rs1042714 may play a role in shaping individual responses to physical activity, thereby influencing anthropometric and body composition parameters.

Moreover, the effects of *ADRB2* rs1042714 may also be influenced by interactions with other gene variants [31,32]. Recent studies have demonstrated that polygenic risk scores (PRS) can predict obesity predisposition by combining the effects of multiple genetic variants. In the present study, the *ADRB2* rs1042714 variant exhibited varying effects across anthropometric and body composition parameters when analyzed independently. This variant may also contribute to obesity risk in combination with other variants, such as FTO rs9939609 and MC4R rs17782313 [33,34]. Therefore, a polygenic approach may provide a more comprehensive understanding of obesity predisposition and metabolic responses.

Several limitations should be considered when interpreting the findings of the study. First, the small number of participants carrying the GG genotype required

the combination of CG and GG carriers into a single group, which may have reduced the ability to detect of genotype-specific differences. Second, the analysis focused on a single genetic variant and did not examine potential interactions with other variants that may also influence anthropometric and metabolic responses. Finally, although dietary patterns and physical activity were assessed during the study, variations in everyday eating habits and activity levels could not be fully controlled. As a result, these environmental factors may have contributed to the observed outcomes.

CONCLUSIONS

The findings of the study suggest that the *ADRB2* rs1042714 variant may contribute to individual differences in anthropometric and body composition changes during Ramadan fasting. Participants carrying the G allele experienced greater reductions in body weight, BMI, and visceral fat than those with the CC genotype. These differences may be related to variations in β_2-adrenergic activity, physical activity, and interactions with other genetic variants. Further studies with larger sample sizes and more comprehensive genetic analyses are needed to clarify the role of *ADRB2* rs1042714 in anthropometric and body composition changes during Ramadan fasting.

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Conflict of interest statement

The authors declare no conflicts of interest related to this research.

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