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Safety, health improvement, and expression of aging-related genes during 10-day periodic fasting in overweight and obesity

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Abstract

This study aimed to analyze the safety, health improvement, and expression of aging-related gene inhibition during a 10-day periodic fasting (PF) in individuals with overweight and obesity. A quasi-experimental design consisting of control groups (CG) and 10-day PF groups (PFG) was conducted among 40 participants. The pre-and post-tests involved measuring various health parameters (vital signs, anthropometric measurements, fasting glucose (FG), binge eating disorder (BED), and quality of life (QoL)), as well as gene expression of the mammalian target of rapamycin complex 1 (mTORC1) using quantitative real-time polymerase chain reaction (RT-PCR). PF can significantly reduce several health parameters in PFG, including systolic blood pressure (SBP), FG, and anthropometric measurements (all $p < 0.05$). The post-test expression of mTORC1 in PFG was 0.13-fold, significantly lower than the pre-test level ($p < 0.05$). There was no significant difference in BED and QoL scores between the pre-test and post-test in either group ($p > 0.05$). Only 3.1% of participants had mild complaints during fasting. A 10-day PF has been reported to be safe and effective in improving numerous health indicators, preventing BED, maintaining QoL, and inhibiting the expression of the aging-related gene (mTORC1) in individuals with overweight and obesity.

Keywords: Aging, Binge eating disorder, mTORC1, Obesity, Overweight, Periodic fasting, Quality of life, Safety.

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1. Introduction

One of the worldwide health issues that needs significant attention is obesity. Obesity potentially affects most organ systems, increases the risk of non-communicable diseases, induces metabolic imbalance, and may accelerate aging at the cellular and molecular levels [1, 2]. According to current trends, by 2030, around 3 billion adults roughly 50% of the adult population worldwide, will suffer from overweight and obesity [3]. As a premature aging phenotype, obesity increases adiposity, induces systemic inflammation and reactive oxygen species production, stimulates epigenetic changes, and accelerates shortening telomeres due to excessive fat accumulation, excessive dietary intake, and lack of physical activity [1, 4].

Obesity may accelerate aging by influencing several factors, such as the dysregulation of nutritional signaling mediated by the dysregulation of the mechanistic/mammalian target of the rapamycin (mTOR) pathway. A serine/threonine kinase, mTOR, regulates all human physiological activities and plays a vital role as a regulator of glucose and lipid metabolism, cell growth, cellular response to nutrition and stress, adipose tissue function, and as a grand conductor of aging [5, 6]. In obesity, mTOR complex 1 (mTORC1) plays a major role in glucose and lipid metabolism by regulating adipose and liver function, increasing glucose intolerance and insulin resistance [7]. Since mTORC1 has been abnormally elevated in diabetes or metabolically challenged situations, addressing the mTORC1 signaling pathway suggests a potential therapeutic approach for metabolic dysregulation in obesity and an interesting area for further study [6, 7].

Several strategies have been implemented to achieve healthy aging, specifically in people with obesity, including diet modulation, such as intermittent fasting (IF) [8]. Periodic fasting (PF) is one type of IF that effectively enhances metabolic function in obese individuals and can help prevent aging [9, 10]. It is interesting that a 12-hour time-restricted eating PF regimen may be used for preventing obesity-induced premature aging by modulating longevity gene expression [11]. Previous studies have also been conducted to prove the effect of IF on mTOR. The 16:8 IF (8-hour eating and 16-hour fasting) can significantly reduce mTOR levels [12]. In healthy individuals, Early Time-Restricted Eating (eTRE) modulates the expression of genes that control longevity genes, such as mTOR, in the evening [13].

Although fasting is very effective for weight loss, the safety of the diet has been questioned. Fasting has also been scrutinized for its impact on psychological well-being and quality of life (QoL) [10, 14-16]. Furthermore, a potential side effect of fasting, such as an imbalance between satiety and hunger hormones, can lead to the development of eating disorder behaviors (overeating or binge eating disorder (BED)), which remains debatable [17, 18]. Additionally, earlier studies on the relationship between dietary management, such as calorie restriction and mTOR, have been conducted; however, there has still been limited discussion of PF and mTORC1 specifically [13, 19, 20]. This study aimed to demonstrate the safety, physical and psychological health improvements, and expression of aging-related gene (mTORC1) inhibition during a 10-day periodic fasting in individuals with overweight and obesity.

2. Materials and Methods

2.1. Study Design

This study utilized a quasi-experimental research design with a pretest-posttest control group that consisted of a control group (CG) and a treatment (PFG) groups. The pre- and post-tests involved measuring the health parameters, mTORC1 gene expression, BED, and QoL in both groups before and after PF, respectively. Participants in the PFG performed PF for 10 days, while no therapy was administered to the CG.

2.2. Participants

The participants who met the inclusion criteria (aged ≥ 20 years, in good health, BMI ≥ 23, and had a light-moderate level of physical activity [< 600 MET or 600–3000 MET as measured by the Global Physical Activity Questionnaire] were included in the study. On the other hand, individuals with a history of diabetes mellitus, thyroid, parathyroid, and heart disease, hypertension, and malignancy, alcohol consumption, smoking habit, dietary restrictions (vegetarianism and veganism), daily consumption of acetylsalicylate drugs, use of hormonal drugs, and current involvement in weight-loss programs were excluded.

The sample size in this study was calculated based on the sample size formula according to standard deviation and mean difference values referring to the previous study [21] and Wilhelmi et al. [22]. Only 40 of the total 73 participants met the inclusion criteria, completed the study, and were split randomly into two groups. After recruitment, the enrolled individuals were asked to come to the physiology lab in Muhammadiyah Surabaya and Airlangga and were invited to a WhatsApp group for further tests.

2.3. Periodic Fasting and Safety Monitoring

PF in this study was defined as a 12-hour-per-day fasting for 10 days. During the trial, participants had breakfast (about 6:00 am) and dinner (approximately 6:00 pm). The daily menu did not have any specific rules. To guarantee that a 40% daily calorie reduction (or 500–800 kcal/day) was maintained, PFG participants were only allowed to eat meals provided by the authors. Hydration status was guaranteed at least 2 liters/day or eight glasses and monitored by daily urine conditions. The CG and PFG groups were encouraged to comply with their current eating protocol, exercise, and physical activity throughout the study. For safety concerns, the daily conditions of participants (including food intake and health problems related to fasting) were observed through daily digital self-reports.

2.4. Health Parameters Measurements

Health parameters in this study consisted of vital signs, anthropometric, and fasting glucose (FG) tests. Vital signs consisted of systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), and respiratory rate (RR) examinations. SBP and DBP were measured three times on the non-dominant arm using a digital tensimeter (Omron Healthcare Manufacturing Vietnam Co., Ltd, Binh Duong, Vietnam). The measurement of body weight (BW), height (BH), body mass index (BMI), abdominal circumference (AC), waist circumference (WC), hip circumference (HC), and upper arm circumference (UAC) was performed according to standard procedures. BW and BH were measured using scales while standing (Zhongshan Camry Electronic Co., Ltd, Guangdong, China), and results were rounded to the nearest 0.5 kg. BMI was calculated by dividing BW by BH squared (kg/m^2) and categorized into several groups based on Asia–Pacific [23]. Fasting glucose (FG) levels were measured using a glucometer (Zhongshan CAMRY Electronic Co., Ltd, Jhunan Township, Taiwan).

2.5. Expression of Aging-Related Genes

2.5.1. Blood Sampling and Storage

Blood samples were obtained from the antecubital vein of all participants. A total of 7 cc of blood was allowed to flow into the vacutainer and placed into a tube with ethylenediaminetetraacetic acid without additives. Tubes with blood samples were then sent to the laboratory on dry ice [24, 25].

2.6. Peripheral Blood Mononuclear Cells (PMBC) and RNA Extraction and mTORC1 Quantification

PMBC extraction was performed by centrifuging the blood samples at 2,000 rpm for 10 min and adding 3 mL of Dulbecco's phosphate buffered saline (Cat. No 17-1440-02, Sigma, Ltd.) 1x and 5 mL of Ficoll-Paque PLUS (Cat no.17-14440-02, Cytiva). Samples were centrifuged at different speeds, and the final sample was transferred into a 1.5-mL tube and stored at −30°C [24, 25].

RNA extraction was performed on the samples using the QIAamp RNA Blood Mini Kit (Cat. 52304, Qiagen, Valencia, CA, USA). The obtained RNA was then converted into first-strand cDNA with the GoScript™ Reverse Transcription System (Cat. No. A5000, Promega, USA). cDNA quantification was performed using GoTaq® qPCR Master Mix (Cat. No. A6001, Promega, USA). Thermal cycling was conducted with GoTaq® Hot Start Polymerase, which included initial denaturation at 95°C for 120 seconds, followed by 40 cycles of amplification at 95°C for 10 seconds, 55°C for 17 seconds, and 72°C for 17 seconds, and melting at 60°C for 60 seconds and 90°C for 1 second.

mTORC1 was quantified using quantitative RT-PCR and appropriate primers (Macrogen, Korea) [24, 25]. The relative mRNA expression level of mTORC1 was adjusted to the geometric mean of the housekeeping gene Glyceraldehyde 3-phosphate dehydrogenase (GAPDH). The mRNA expressions of mTORC1 were calculated using the Livak method and expressed as a ratio (relative expression) [25]. The post-test expression of mTORC1 mRNA was then compared with that of the pre-test. The relative mRNA expression level of mTORC1 was normalized to the geometric mean of GAPDH. To better describe the data of mRNA expression, the data were also displayed based on the dCT value of each gene.

Note:

$\Delta\Delta CT = \Delta CT$ (test) – ΔCT (calibrator)

Δ CT (test) = CT (target, test) – CT (reference, test)

ΔCT (calibrator) = CT (target, calibrator) – CT (reference, calibrator)

Targets = mTORC1

TEST = CG and PFG

Calibrator = control group

Reference = GADPH

2.7. Binge Eating Disorder and Quality of Life Assessment

BED was identified using the eating habits checklist, which consisted of 16 items that can describe behavioral manifestations and feelings/cognitions during a binge episode [26]. Quality of life was assessed by completing the World Health Organization Quality of Life (WHOQOL)-BREF questionnaire, which was adapted into the Indonesian version. This questionnaire consisted of 26 questions, which were divided into four domains: physical health (7 items), psychological well-being (6 items), social relationships (3 items), and environmental health (8 items). Each item was scored on a scale from 1 to 5. The measurement results were determined by calculating the score from the questionnaire that the respondents had completed. Quality of life was considered poor if the WHOQOL-BREF score was < 60 and quality of life was considered good if the WHOQOL-BREF score was ≥ 60 [27-29]

2.8. Statistical Analysis

Analysis was performed using IBM SPSS Statistics 26. Data were reported as mean ± standard deviation for continuous variables or number and percentage for categorical variables. The Kolmogorov–Smirnov test was used to determine the normality of the data. The paired t-test and Wilcoxon test were used to analyze differences in pre- and post-test health parameter values, mTORC1 expression, BED, and QOL of participants. The independent t-test/Mann–Whitney U-test was used to analyze group differences. The association between variables was analyzed using the Spearman correlation test.

3. Results

3.1. The Characteristics of Study Participants

Table 1 displays the demographic characteristics of 40 participants of CG and PFG groups such as age, SBP, DBP, HR, RR, FG, BW, BH, BMI, AC, WC, HC, and UAC. The Independent T-Test and Mann–Whitney U-test did not show any significant differences ($p > 0.05$) in the baseline characteristics of the participants in both study groups (Table 1).

3.2. Effects of PF on Health Parameters

The effects of PF on some health parameters (vital signs, FG, anthropometric parameters) are shown in Table 1 significant differences in the pre-and post-test anthropometric parameters were found in the CG ($p > 0.05$). Meanwhile, there were significant differences in the SBP ($p = 0.01$), FG ($p = 0.00$), BW ($p = 0.00$), BMI ($p = 0.00$), AC ($p = 0.00$), and WC ($p = 0.00$) between the pre-and post-test values after PF in PFG group. The significant differences (Δ) in BW ($p = 0.00$), BMI ($p = 0.00$), AC ($p = 0.01$), and WC ($p = 0.02$) were also identified between the CG and PFG.

Table 1.
Differences in anthropometric parameters of the participants in the control (CG) and periodic fasting (PFG) groups.

Parameters	CG (n = 20)			PFG (n = 20)			p-value baseline parameters	p-value Δ group parameters
	Pre-test	Post-test	p-value	Pre-test	Post-test	p-value		
Age (years)	20.85 (±1.04)	-	-	820.80 (±1.32)	-	-	0.61	-
SBP (mmHg)	125.00 (±9.87)	123.20 (±9.87)	0.40†	120.40 (±8.65)	116.50 (±8.85)	0.01‡*	0.09ɻ	0.37ɻ
DBP (mmHg)	86.00 (±10.46)	84.50 (±8.26)	0.38‡	85.50 (±7.60)	81.50 (±9.33)	0.10‡	0.86ɻ	0.24ɻ
HR (x/minute)	84.70 (±12.53)	86.95 (±14.36)	0.47†	88.05 (±8.54)	86.30 (±12.84)	0.58†	0.59ɻ	12.84ɨ
RR (x/minute)	18.80 (±1.51)	18.80 (±1.77)	1.00‡	17.90 (±2.29)	18.20 (±2.41)	0.49‡	0.10ɻ	0.84ɻ
FG (ng/dl)	94.25 (±10.58)	98.30 (±11.17)	0.23†	102.85 (±16.58)	96.15 (±10.94)	0.00‡*	0.13ɻ	0.00ɻ
BW (kg)	84.75 (±14.73)	85.16 (±14.57)	0.13†	83.78 (±10.59)	81.37 (±11.03)	0.00†*	0.99ɨ	0.00ɨ*
BH (m)	169.78 (±6.55)	-	-	169.50 (±6.60)	-	-	0.89ɨ	-
BMI (kg/m^2)	29.37 (±5.11)	29.65 (±4.90)	0.15‡	29.12 (±2.45)	28.30 (±2.63)	0.00†*	0.70ɻ	0.00ɻ*
HC (cm)	97.57 (±10.04)	97.85 (±10.33)	0.39‡	99.45 (±10.20)	98.58 (±9.33)	0.38†	0.57ɨ	0.10ɻ
AC (cm)	96.02 (±11.68)	96.12 (±11.81)	0.84‡	95.12 (±7.87)	93.38 (±8.02)	0.00†*	0.96ɻ	0.01ɻ*
WC (cm)	89.90 (±9.21)	89.77 (±9.74)	0.81†	88.87 (±7.16)	87.05 (±6.85)	0.00†*	0.70ɨ	0.02ɨ*
UAC (cm)	33.07 (±4.09)	32.62 (±3.69)	0.16†	33.17 (±3.04)	32.85 (±2.77)	0.31†	0.93ɨ	0.78ɨ

Note: Systolic blood pressure (SBP), diastolic blood pressure (DBP), heart rate (HR), respiratory rate (RR), fasting glucose (FG), body weight (BW), body height (BH), body mass index (BMI), abdominal circumference (AC), waist circumference (WC), hip circumference (HC), and upper arm circumference (UAC). Data were reported as mean ± standard deviation. The analysis was determined based on the 10-day observation points before and after PF. Data were analyzed using the Paired T-Test (†) or Wilcoxon Test (‡), and delta (Δ) in both groups was determined using the Independent T-Test (ɨ) or Mann–Whitney U-test (ɻ). (*) indicated a significant difference.

3.3. Effects of PF on the Expression of Aging-Related Genes

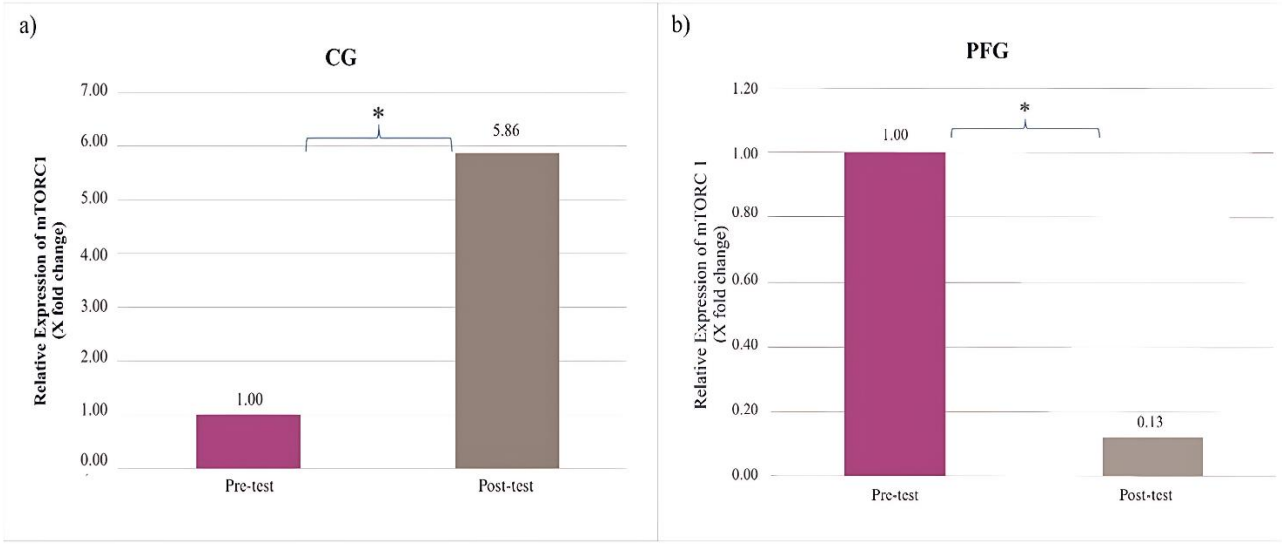

Figure 1.
Changes in the expression of aging-related genes in the control group (CG) and periodic fasting group (PFG) after 10 days. a) CG groups; b) PFG groups.
Note: (*) indicated significant difference between pretest and posttest result.

Analysis results of the expression of aging-related genes, specifically mTORC1, are shown in Figure 1. When analyzing this relative expression, it was assumed that the pre-test examination result was one and that the post-test examination result was determined by multiplying the post-test results by the number of results. Analysis of mTORC1 expression in the CG (Figure 1a) showed that the post-test value was 5.86-fold higher than the pre-test value; the difference was significant according to the Wilcoxon signed rank test ($p < 0.05$). The post-test value of mTORC1 expression in the PFG was 0.13-fold lower than the pre-test value (Figure 1b); the difference was significant according to the Wilcoxon signed rank test ($p < 0.05$). The difference in mTORC1 expression (Δ group parameters) between the CG and PFG was significant ($p < 0.05$) according to the Mann–Whitney U-test.

3.4. Correlation between Anthropometric Parameters and mTORC1 Expression

According to Table 2, statistical analysis revealed a significant correlation between the parameters that had significant differences between the CG and PFG groups (Table 1) in terms of post-test mTORC1 expression and in the Δ relative expression of mTORC1 (Δ mTORC1).

Table 2.
Relationship between the post-test values and Δ parameters of mTORC1 expression.

Parameters	mTORC1				Parameters	Δ mTORC1			
	CG		PFG			CG		PFG	
	r	p-value	r	p-value		r	p-value	r	p-value
SBP (mmHg)	-0.01	0.98⁝	-0.32	0.17⁝	Δ SBP (mmHg)	0.23	0.32⁝	-0.21	0.37⁝
FG (ng/ml)	0.31	0.18⁝	-0.01	0.97⁝	Δ FG (ng/ml)	0.16	0.50⁝	0.12	0.61⁝
BW (kg)	-0.11	0.63⁝	-0.57	**0.01⁝***	Δ BW (kg)	0.41	0.07⁝	-0.01	0.97⁝
BMI (kg/m^2)	-0.35	0.13⁝	-0.21	0.38⁝	Δ BMI (kg/m^2)	0.54	**0.02⁝***	-0.18	0.46⁝
AC (cm)	-0.27	0.25⁝	-0.38	0.10⁝	Δ AC (cm)	-0.32	0.17⁝	-0.122	0.61⁝
WC (cm)	-0.25	0.28⁝	-0.21	0.38⁝	Δ WC (cm)	-0.09	0.72⁝	0.16	0.49⁝

Note: Systolic blood pressure (SBP), fasting glucose (FG), body weight (BW), body mass index (BMI), abdominal circumference (AC), and waist circumference (WC). Data were analyzed using the Spearman correlation test (⁝). (*) indicated a significant correlation.

Spearmen correlation analysis indicated a significant correlation between the post-test BW and mTORC1 expression in the PFG (Table 2). Meanwhile, the post-test BW in the PFG demonstrated a significant negative correlation with mTORC1 expression after 10 days with very weak strength (r=0.-57).

3.5. Binge Eating Disorder (BED)

Table 3.
Comparison of binge eating disorder in CG and PFG groups.

Classification of BED	CG n (%)			PFG n (%)		
	Pre-test	Post-test	p-value	Pre-test	Post-test	p-value
No binge eating	20 (100%)	20 (100%)	0.58	16 (80%)	17 (85%)	0.62
Mild to moderate binge eating	0 (0%)	0 (0%)		4 (20%)	3 (15%)	
Severe binge eating	0 (0%)	0 (0%)		0 (0%)	0 (0%)	

The paired sample T-test in Table 3 shows no significant difference in BED scores at the pre-test and post-test in the CG and PFG groups. However, the data distribution showed an increased number of people without BED in the therapy group (85%).

3.6. Quality of Life (QOL)and Health Complaints

Table 4 shows the quality of life for CG and PF. Participants' quality of life was divided into four domains: domain 1 (physical health), domain 2 (psychology), domain 3 (social relationships), and domain 4 (environment). Based on the table, it was clear that physical health in the control and execution of tasks fell within the category of good living quality. Generally, based on the paired sample T-test, there were no significant differences in quality of life between CG and PFG. However, if the frequency distribution was comprehended, it was clear that there was an increase in the quality of life based on domain 2 (psychology) of up to 90%.

Table 4.
The Differences in quality of life of control and treatment groups.

QOL category	CG			PFG		
	Pre-test n (%)	Post-test n (%)	p-value	Pre-test n (%)	Post-test n (%)	p-value
Domain 1 (Physical Health)						
Poor	0 (0%)	0 (0%)	0.39	0 (0%)	0 (0%)	0.54
Good	20 (100%)	20 (100%)		20 (100%)	20 (100%)	
Domain 2 (Psychological)						
Poor	4 (20%)	5 (25%)	0.47	4 (20%)	2 (10%)	0.11
Good	16 (80%)	15 (75%)		16(80%)	18(90%)	
Domain 3 (Social Relationship)						
Poor	5 (25%)	6 (30%)	0.36	4 (20%)	5 (25%)	1.00
Good	15(75%)	14 (70%)		16 (80%)	15 (75%)	
Domain 4 (Environment)						
Poor	2 (10%)	4 (20%)	0.32	2 (10%)	2 (10%)	0.08
Good	18 (90%)	16 (80%)		18 (90%)	18 (90%)	

The safety of the fasting program was assessed by collecting all the daily self-reported mild health complaints (Table 5). Of the 20 participants who fasted for 10 days, only 8 mild complaints were found, including weakness, coldness, headache, and dry mouth.

Table 5.
Self-reported health complaints of participants.

Health complaints	n (%)
Weakness	4 (2.00%)
Coldness	1 (0.05%)
Headache	2 (1.00%)
Dry Mouth	1 (0.05%)

4. Discussion

This study examined the safety and health advantages experienced by PF participants. According to the findings in this study, PF over ten days might significantly reduce SBP, FG, and several types of anthropometric parameters, including BW, BMI, AC, and WC. These findings were supported by previous study data that explained how IF could lower SBP [30]. Decreased anthropometric parameters were consistent with the previous, which suggested that a 10-day fasting strategy led to weight loss and decreased HC [22]. IF in our study helped people lose weight and improved their anthropometric parameters by lowering their calorie intake [31].

The role of FG in this study also showed important clinical benefits in overweight and obese individuals with a higher incidence of diabetes. The decrease in FG in this study was generally in accordance with previous studies. The decrease in FG during fasting might occur due to a relationship with weight loss and via mechanisms independent of weight loss [32]. Weight and fat mass decreased over time when food intake was reduced during PF. Because the concentration of adiponectin

rises in proportion to the decrease in body weight, this condition may produce an increase in adiponectin. By acting on several receptors, this rise in adiponectin subsequently increases fatty acid oxidation in the liver and skeletal muscle, decreases hepatic gluconeogenesis, increases cell glucose absorption, and ultimately lowers glucose in vascular [33].

A "metabolic switch" causing FG reduction is the key mechanism independent of weight loss. This transition signifies a change from lipid synthesis and fat storage to fat mobilization. During fasting, lipids of adipocytes are broken down to create the ketones acetoacetate and β-hydroxy-butyrate. High volumes of ketones are carried into metabolically active cells, like neurons and muscle cells, where they produce adenosine triphosphate (ATP), which is used as energy. Ketone bodies at the cellular level improve the mammalian target of rapamycin (mTOR) pathways, which are involved in β-cell proliferation and function. It has been demonstrated that mTOR inhibits the expression of thioredoxin-interacting protein (TXNIP), a strong inducer of oxidative stress and β-cell death. Accordingly, it has been demonstrated that TRF decreases insulin resistance and boosts β-cell responsiveness in people [8, 34].

Another interesting finding of this study was the decline in mTORC1 expression in the PFG. This finding also emphasized that fasting could influence mTOR expression in various human and animal tissues [13, 35]. It appeared that the decrease in mTORC1 expression in this study was caused by a decrease in glucose during fasting [36]. Glucose deprivation triggers mechanisms that can lower levels of insulin-like growth factor-1, suppress phosphoinositide 3-kinase (PI3K)/Akt pathway activity, increase levels of tuberous sclerosis proteins 1 and 2, and decrease levels of ras homolog enriched in the brain, in addition to inhibiting mTORC1 expression [37].

The relative expression of mTORC1 in the CG group at the post-test was greater than that at the pre-test. Decreased mTORC1 expression was not observed in the CG because of increased adiposity, as evidenced by an increase in BW, BMI, and other anthropometric indices [38]. Increased adiposity, such as a high-fat diet, will partially inhibit mTORC1, leading to increased adipogenesis and obesity. DEP domain-containing mTOR-interacting protein, an endogenous mTORC1 inhibitor, increases adipogenesis and exacerbates the increase in BW and white adipose tissue mass by dampening the negative feedback on insulin receptor substrate function and intracellular insulin signaling exerted by mTORC1/serum and glucocorticoid-induced protein kinase 1, which enhance the PI3k/protein kinase B/peroxisome proliferator-activated receptor pathways [38].

As a major conductor of ageing and longevity, the reduction of mTORC1 expression in our study was evidence that PF might also regulate lifespan and cellular senescence [39]. As obesity is related to the marked activation of mTORC1 in adipose tissue, decreased mTORC1 expression in the PFG might indicate that PF could regulate lipid metabolism and adipocyte formation in obese individuals [38]. When considering the mTOR regulation mechanism, the decrease in mTORC1 expression might explain the improvement of anthropometric parameters in the PFG [40]. In obese individuals, IF may partially repair hypothalamic responses, reduce neuroinflammation, and improve hypothalamic sensitivity to anorectic hormones, thus re-establishing energy balance [40]. The significant correlation between mTORC1 expression and mean BW after PF in this study supported this theory. However, further investigation was required because other data did not support this theory.

PF in this study was also known to be safe, with few complaints and a high quality of life. The findings in this study were consistent with those of a study including 1,422 participants, which reported that fasting for 4 to 21 days was generally safe and enhanced well-being. The reported complaints were mild, and most participants did not experience adverse effects [10]. The findings of this study suggested that PF could enhance psychological well-being in addition to physical well-being. Fasting participants in this study did not suffer from binge eating disorders, which were characterized by higher consumption of food than normal in a short period of time and frequently accompanied by a loss of control over eating. Participants in the PFG group also had improvements in domain 2 (psychological) and were able to maintain their quality of life in comparison to the previous condition. These findings were consistent with earlier research showing that IF could lower depression and binge eating disorder. Fasting can have good psychological experiences, such as greater sensations of accomplishment, pride, and gratitude, as well as greater control over increasing hunger and the difficulty of fasting, despite possible minor negative effects [14, 41]. IF also significantly improved several aspects of the QoL and decreased fatigue in healthy people, while maintaining a good safety profile [15].

This study demonstrated that PF could improve some health and safety metrics while decreasing the expression of aging-related genes. The impact of PF must be studied further in order to study various health metrics such as body composition, which may include assessment of total and visceral fat proportion as the metabolic phenotype in obesity, metabolism, insulin resistance, and so on. Because obesity is a multifaceted condition, the impact of PF on the expression of other related genes, signaling pathways and effectors, and other hallmarks must be explored [39]. However, other earlier investigations showed different outcomes. In addition to the multiple variances in IF, disparities in lifestyles among participants suggested an urgent need of further research [32, 42]. However, this study was also an interesting preliminary work that disclosed new information about how PF can alter the physical and physiological health parameters of obese people, as well as the genes involved with aging in humans [18]. Further study would be critical because PF might reduce the risk of cardiovascular and metabolic illness in overweight and obese individuals.

5. Conclusion

10-day periodic fasting could enhance physical health improvement and expression of aging-related gene (mTORC1) inhibition during overweight and obesity. PF was also safe, preventing the onset of BED while maintaining a high quality of life among participants. Dietary adjustments, particularly PF, were effective in treating obesity, increasing physical and physiological health, and reducing the onset of age-related diseases.

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