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THE IMPACT OF INTERMITTENT FASTING ON CARDIOVASCULAR HEALTH IN YOUNG ADULTS

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ABSTRACT

Introduction: Cardiovascular disease (CVD) is the leading cause of global mortality, particularly burdening low- and middle-income countries like India. Rising rates of obesity, diabetes, and sedentary lifestyles significantly contribute to this trend. Intermittent fasting (IF), a time-restricted eating pattern, has emerged as a potential non-pharmacological intervention to improve cardiovascular and metabolic health.

Objectives: This study aimed to assess the effects of intermittent fasting on anthropometric, haemodynamic, and inflammatory parameters among young obese adults.

Methods: An observational, hospital-based study was conducted in the Department of Physiology at Index Medical College, Indore, India, involving 300 obese adults (aged 20–28 years) who followed an 18-hour daily fast for three months. Baseline and post-intervention anthropometric measurements, blood pressure, heart rate, and biochemical markers (including CK-MB and HS-CRP) were recorded. Statistical analyses included paired t-tests, with $p<0.05$ considered significant.

Results: Participants had a mean age of 23.87 ± 2.8 years; 67.7% were male. After three weeks of IF, significant reductions were observed in weight (72.0 to 69.4 kg), BMI (26.8 to 25.6 kg/m²), waist and hip circumference ($p<0.001$). Blood pressure and heart rate also declined, along with improved glucose levels, and markers of cardiac function. Notably, HS-CRP levels increased, warranting further investigation.

Conclusion: Intermittent fasting demonstrated significant short-term benefits on cardiovascular parameters in young obese adults. However, limitations such as small sample size and short duration necessitate further large-scale, long-term studies to confirm these findings and evaluate sustainability and safety.

Keywords: Intermittent fasting, obesity, cardiovascular health, metabolic syndrome, lipid profile, CK-MB, HS-CRP.

Introduction

Cardiovascular disease (CVD) is the leading cause of death worldwide and is recognised by the United Nations as a major global health burden.[1] cardiovascular disease comprises a range of disorders. This encompasses heart failure, hypertension, ischemic heart disease, including stable angina and acute coronary syndromes, cerebrovascular illness such as stroke, valvular abnormalities including aortic stenosis, and arrhythmias such as atrial fibrillation.[2,3] Cardiovascular disease (CVD) is major cause of global morbidity and mortality, imposing massive health expenditures in economies worldwide.[4,5] Global burden of disease report shows a rise of CVD cases and deaths significantly from 1990 to 2019,[6] with highest deaths (80%) taking place in low- income and middle- income countries (LMICs).[7] Projections forecast a soaring are expected by 2030.[8] WHO estimated CVD economic costs in LMICs amount to US$3.7 trillion from 2011 to 2025.[9] Despite the significant health and economic burden of cardiovascular disease in low- and middle-income countries, healthcare resources

remain exceedingly limited in these nations. The National Cardiovascular Disease- Acute Coronary Syndrome (NCVD- ACS) Registry reported that Malaysians experience heart disease earlier than people in comparable nations.[10] In 2019, the age range of these patients was 56–59 years, roughly 10 years younger than their counterparts in developed nations; moreover, as of 2019, nearly one in four (24.5%) cardiovascular disease patients were under 50 years of age.[10] In 2016, the Global Burden of Disease Stroke Statistics Worldwide report predicted that one out of every four Malaysians would have a stroke by 2040.[11] CVD is largely due to the pathological process of atherosclerosis. Atherosclerosis is a chronic inflammatory process involving build-up of lipids within the inner wall of arteries, stimulating infiltration by immunocytes and the subsequent formation of a fibrous cap by vascular smooth muscle cells.[12] As the atherosclerotic plaque develops, a central necrotic core is formed containing necrotic cells, cell debris and cholesterol crystals.[13] The plaque can lead to blood vessel stenosis and progress to plaque rupture causing a myocardial infarction (MI).[14] Numerous factors elevate the risk of developing cardiovascular disease (CVD), including a sedentary lifestyle, tobacco use, a diet rich in sodium, saturated fats, and sugars, obesity, inadequate lipid management (elevated plasma low-density lipoprotein (LDL) and total cholesterol levels), hypertension, and diabetes.[15] Obesity is significantly linked to cardiovascular illness, elevating the risk of heart failure, coronary heart disease, hypertension, and atrial fibrillation.[16] Recent results indicate that obesity elevates the risk of heart failure with preserved ejection fraction (HFpEF).[17] Additionally, obesity causes a chronic state of low-grade inflammation in the body leading to increased macrophage activation and plaque instability, further driving coronary heart disease.[18,19] The prevalence of obesity has also increased drastically over the last few decades and may be a key factor in increasing the prevalence of CVD.[20]

Atherosclerosis is the predominant cause of vascular disease globally. This is a significant issue of pathogenicity and mortality in both developed and poor nations. It is

manifested by clinical symptoms, such as ischemic heart disease, peripheral artery disease, and ischemic stroke. It is responsible for acute myocardial infarction and cerebrovascular events, and it is responsible for the most deaths from cardiovascular causes in the world.[21] Adiponectin is a collagen-like plasma protein whose concentration decreases in the course of atherosclerosis, insulin resistance, diabetes, and coronary disease. The use of the IF diet increases the secretion of adiponectin from adipocytes.

Thus, the present study aimed to find the impact of intermittent fasting on cardiovascular health in young adults.

Material & Methods

The present observational hospital-based study performed in Department of Physiology, Index Medical College, Hospital and Research Centre Indore MP, India. on 300 young obese adult patients attending Medicine OPD/IPD with metabolic disorder. Healthy asymptomatic young adults, aged 20–28 years (males and females) who have 3 months daily 18 h fast and then and 6-h nutritional window (fasted from 12.00 am to 6.00 pm and ate 6.01 pm to 11.59 pm); they were in no wise forced to fast were enrolled in this study. Any acute illness, Antihypertensive medication, History of chest pain, breathlessness, and orthopnea, Handicapped individuals, Trained subjects (sports and yoga), any current and past aspirin or hormone replacements therapy, autoimmune disease acute and chronic infections, hepatic diseases were excluded from the study.

Anthropometric measurements

Anthropometric measurements were made for each participant. Body weight was measured using an adult balance and standing height was measured to nearest centimeter using a wall-mounted stadiometer without shoes prior to eating in the morning. BMI values were determined by weight (kg) divided by height (m) squared. Waist circumference (WC) was directly measured on the skin midway between the mean point of iliac peak and the inferior

border of the last rib at level of the umbilicus while in a standing position at end of gentle expiration. Hip circumference was measured over widest part of gluteal region at level of pubic tubercle in standing position. Waist to Hip ratio were determined by WC (cm) divided by hip circumference (cm).

Blood Pressure

The patient was instructed to sit quietly for five minutes prior to having their blood pressure taken. The patient was also instructed to be seated comfortably with their back supported and their upper arm bare without constrictive clothing, with their legs not crossed and their arm supported at heart level. Finally, bladder of cuff should encircle at least 80% of their arm circumference. Larger or smaller cuffs were used as needed. First & last audible sounds would be interpreted as systolic & diastolic pressure, & mercury column would be deflated at rate of two to three mm/sec.

Blood sample collection

Every case had a peripheral blood sample of around 4 mL drawn into a red top tube (without the use of any anticoagulant). After the serum was separated, one aliquot was quickly stored between -20 and -30 °C until more research was done. Right away, a second serum sample was dispatched for biochemical examinations

4.0 ml blood (serum) will be used for estimation of blood glucose by GOD-POD end point colorimetric method and HbA1C was estimation by Resin Binding Method. Serum HS-CRP level determined by enzyme immunoassay (EIA) method (DRG International Inc., USA). And Estimation of serum creatine kinase (CK-MB) by IFCC method.

Statistical analysis

Categorical variables are reported as frequencies and percentages and continuous variables as mean ± SD. Categorical variables were compared using Chi Square/Fisher's exact

test. Continuous variables were compared using paired t test. All variables were tested to check the normal distribution of the data. P value <0.05 was consider as significance level.

Observation & Results:

The demographic profile of the studied cases (n=300) revealed a mean age of 23.87±2.8 years, with the majority (36.3%) belonging to the 23-25year age group, followed by 20-22 years (35.0%) and 25-28 years (28.7%). The sample was predominantly male (67.7%), with females constituting 32.3%. In terms of religion, 61.7% of the cases were Hindu, 25.0% Muslim, 10.0% Sikh, and 3.3% belonged to other religions. The majority of cases (55.3%) were undergraduates, followed by postgraduates (32%), intermediate (7%), and high school (5.7%). Most cases (75.7%) were non-vegetarian, while 24.3% were vegetarian. Regarding lifestyle habits, 25.3% of cases were smokers, and 15.7% consumed alcohol, while the majority (74.7% and 84.3%, respectively) did not engage in these habits. These demographic characteristics provide insight into the profile of the studied population **[Table No. 1]**.

The study found significant reductions in anthropometric measures over the 3-week period. Mean weight decreased by 2.6 kg (from 72.0±5.9 kg to 69.4±4.5 kg, $p<0.001$), BMI decreasing by 0.96 kg/m² (from 26.8±2.4 kg/m² to 25.6±1.6 kg/m², $p<0.001$). Waist circumference (WC) and hip circumference showed significant reductions at all follow-up time points, with progressive increases in the magnitude of change. In contrast, waist-to-hip ratio (WHR) showed small but significant decreases at all follow-up time points, indicating a slight improvement in body composition. These changes indicate a reduction in body weight and fat distribution, suggesting improved body composition. The significant decreases in weight, BMI, WC, and hip circumference after 3 weeks suggest a positive impact on overall body measurements. **[Table No. 2]**

The study observed significant reductions in blood pressure and heart rate over the 3-week period. Systolic blood pressure (SBP) showed significant increases from baseline to 2

weeks (0.85 mmHg, p=0.005) and 3 weeks (2.1 mmHg, p<0.001), but not after 1 week. Diastolic blood pressure (DBP) also increased significantly from baseline to 2 weeks (1.03 mmHg, p<0.001) and 3 weeks (1.96 mmHg, p<0.001). Heart rate showed a similar pattern, with significant increases from baseline to 2 weeks (0.98 beats per minute, p<0.001) and 3 weeks (2.25 beats per minute, p<0.001). **[Table No. 3]**

The mean blood sugar level showed a progressive decrease over the 3-week period, from 161.4 mg/dl at baseline to 150.1 mg/dl after 3 weeks (p<0.001). Intermediate decreases were observed at 1 week (158.6 mg/dl) and 2 weeks (153.8 mg/dl). While the decrease after 1 week (2.82 mg/dl) was statistically significant (p=0.007), the reductions after 2 weeks (9.33 mg/dl, p=0.001) and 3 weeks (11.3 mg/dl, p<0.001) were significant, with the latter being highly significant. **[Table No. 4]**

The study found contrasting results for inflammatory and cardiac biomarkers. High-sensitivity C-reactive protein (HS-CRP) levels showed no significant change overall (p=0.671), but a significant increase was observed after 3 weeks (p<0.001). In contrast, creatine kinase-myocardial band (CK-MB) levels decreased significantly from baseline to 3 weeks (p<0.001), indicating reduced cardiac stress or damage. The CK-MB decrease was highly significant after 3 weeks (p=0.001), with a significant decrease after 2 weeks (p=0.003). **[Table No. 5]**

Table No. 1: Distribution of the studied cases based on basis on Demographic variables

Demographic variables		**Number of case (n=300)**	**Percentage**
Age group	**20-22 year**	105	35.0%
	23-25 year	109	36.3%
	25-28 year	86	28.7%
	Mean±SD	23.87±2.8	
Gender	**Male**	203	67.7%
	Female	97	32.3%

Religion	**Hindu**	185	61.7%
	Muslim	75	25.0%
	Sikh	30	10.0%
	Others	10	3.3%
Education	**High school**	17	5.7%
	Intermediate	21	7.0%
	Undergraduate	166	55.3%
	Postgraduate	93	32.0%
Diet	**Nonveg**	227	75.7%
	Veg	73	24.3%
Smoking	**Yes**	76	25.3%
	No	224	74.7%
Alcohol	**Yes**	47	15.7%
	No	253	84.3%

Table 2: Anthropometry of the studied cases at follow-up

Anthropometry	**At baseline**	**After 1 week**	**After 2 weeks**	**After 3 weeks**	**p-value**
Height (cm)	164.7±5.4	164.7±5.4	164.7±5.4	164.7±5.4	1.00
Weight (kg)	72.0±5.9	72.0±4.6	71.0±3.7	69.4±4.5	**<0.001**
BMI (kg/m2)	26.8±2.4	26.2±2.7	26.1±2.0	25.6±1.6	**<0.001**
WC (cm)	90.2±5.6	90.0±4.3	89.3±5.0	88.4±4.9	**<0.001**
Hip Circumference (cm)	104.1±1.3	103.1±0.8	102.2±1.2	100.9±0.9	**<0.001**
WHR	0.86±0.04	0.87±0.02	0.87±0.03	0.88±0.02	**<0.001**

Table 3: Vitals of the studied cases at follow-up

Vitals	At baseline	After 1 week	After 2 weeks	After 3 weeks	p-value
SBP (mmHg)	131.9±3.7	131.8±3.1	131.0±2.8	129.7±3.4	**0.001**
DBP (mmHg)	82.4±4.3	82.6±4.3	81.3±3.4	80.4±4.5	**<0.001**
Heart rate (per minutes)	75.9±2.8	75.7±3.3	74.8±3.0	73.5±3.6	**0.029**

Table 4: Blood sugar of the studied cases at follow-up

Blood sugar	At baseline	After 1 week	After 2 weeks	After 3 weeks	p-value
Blood sugar	161.4±13.4	158.6±12.5	152.1±16.3	150.1±19.8	**<0.001**

Table 5: HS-CRP & CK MB of the studied cases at follow-up

Variable	At baseline	After 1 week	After 2 weeks	After 3 weeks	p-value
HS-CRP	45.9±14.6	45.2±15.2	44.0±14.7	42.6±16.6	0.451
CK-MB (ng/mL)	5.4±1.9	5.2±2.1	5.1±1.9	4.4±2.0	**<0.001**

Discussion

In our study majority of the cases (36.3%, n=109) fell within the 23–25year age group, followed by the 20-22year age group (35.0%, n=105), and the 25-28year age group (28.7%, n=86). Mean age of studied cases was 23.87 years, with a standard deviation of 2.8 years. In a similar study **Shaik A et al**[22] reported that the age group of participants in study was 18 to 27 years. The mean age was 22.5 years with standard deviation of 2.763.

In our study male were predominantly, with 203 (67.7%) cases, while females accounted for 97 (32.3%) cases. Majority of cases (61.7%, n=185) identified as Hindu, followed by Muslim (25.0%, n=75), Sikh (10.0%, n=30), and others (3.3%, n=10). Majority of cases (55.3%, n=166) held an undergraduate degree, followed by postgraduate degree holders (32.0%, n=96). A smaller proportion of cases had completed intermediate education (7.0%, n=21) or high school education (5.7%, n=17). Majority of 227 (75.7%) cases consuming non-vegetarian food. In contrast, a smaller proportion of cases, 73 (24.3%), followed a vegetarian diet.

Patients' personal history in this study noted that out of 300 studied cases; majority of the 253 (84.3%) cases reporting no alcohol consumption. In contrast, a small proportion of cases, 47 (15.7%), reported consuming alcohol. Majority of the 224 (74.7%) cases reporting no smoking habit. In contrast, a smaller proportion of cases, 76 (25.3%), reported smoking.

Present study noted that significant reductions were observed after 3 weeks, with mean weight decreasing by 2.6 kg (from 72.0±5.9 kg to 69.4±4.5 kg, $p<0.001$), BMI decreasing by 0.96 kg/m² (from 26.8±2.4 kg/m² to 25.6±1.6 kg/m², $p<0.001$), waist circumference decreasing by 1.7 cm (from 90.2±5.6cm to 88.4±4.9cm, $p<0.001$), and hip circumference decreasing by 3.2 cm (from 104.1±1.3cm to 100.9±0.9 cm, $p<0.001$), while waist-to-hip ratio showed a slight but significant decrease (from 0.86±0.04to 0.88±0.02, $p<0.001$). In a similar study **Shaik A et al**[22] reported that mean body weight of subjects Pre-Ramadan and Post Ramadan are

65.84±7.46 kg and 61.31±7.37 kg respectively. This reduction in body weight after Ramadan fasting is found statistically significant. (P Value < 0.05). Mean BMI is 22.83±2.36 kg/m2 pre-Ramadan and post Ramadan mean BMI is 19.17±2.11 kg/m2. The difference of these values shows also statistically significant reduction in BMI (P value < 0.05). they also noted that reduction in waist-circumference and waist to hip ratio is statistically significant (P value < 0.05). **Salis S et al[23]** reported that the post-intervention data showed significant reduction in mean body weight (88.5±19 to 83.8±17.6 kg), waist circumference (M: 108.2±11.3 to 103.6±4.4 cm, F: 98.9±8.8 to 93.3±3.3 cm), and BMI (31.4±5.3 to 29.6±5.1 kg/m2. **Varady KA et al[24]** reported that the intermittent fasting is safe diet therapy that can produce clinically significant weight loss in individuals with overweight / obesity. **Schubel R et al[25]** reported relative weight decrease during the intervention phase was -7.1%±0.7% (mean±SEM) for intermittent calorie restriction (ICR), -5.2%±0.6% for continuous calorie restriction (CCR), and -3.3%±0.6% for the control regimen (overall P<0.001, PICR vs. CCR=0.053). **Trepanowski JF et al[26]** indicated that the average weight loss was comparable between individuals in the alternate-day fasting group and those in the daily calorie restriction group at month 6 (-6.8% vs -6.8%) and month 12 (-6.0% vs -5.3%) in comparison to the control group. **Bhutani S et al[27]** revealed that body weight decreased (P<0.05) by 6±4 kg, 3±1 kg, and 1±0 kg in the combo, ADF, and exercise groups, respectively. In the combo group, fat mass and waist circumference diminished (P<0.001), although lean mass was preserved.

In our study we noted that the mean blood sugar level significantly decreased over the 3-week period, dropping from 161.4±13.4 mg/dl at baseline to 150.1±19.8 mg/dl after 3 weeks (p<0.001), with notable reductions observed at intermediate time points (158.6±12.5 mg/dl after 1 week and 152.1±16.3 mg/dl after 2 weeks). The reduction became statistically significant after 3 weeks, with mean difference of 11.3±23.45 mg/dl (p<0.001), indicating a

substantial improvement in glycemic control. **Sutton EF et al**[28] indicated that five weeks of intermittent fasting enhanced insulin levels, insulin sensitivity, and β cell responsiveness.

Our study noted that over the 3-week period, significant reductions were observed in mean SBP, which decreased by 2.1 mmHg (from 131.9±3.7 mmHg to 129.7±3.4 mmHg, p=0.001), DBP, which decreased by 1.96 mmHg (from 82.4±4.3 mmHg to 80.4±4.5 mmHg, p<0.001), and heart rate, which decreased by 2.25 beats per minute (from 75.9±2.8 to 73.5±3.6 beats per minute, p=0.029), indicating improved cardiovascular health. **Varady KA et al**[24] reported that the intermittent fasting is safe diet therapy that improve some aspects of cardiometabolic health such a blood pressure. Contrast to our findings study **Shaik A et al**[22] reported that the reduction in mean SBP and DBP were statistically insignificant (P>0.05). This again may be due to fact that the subjects were not suffering from prolonged starvation as they were consuming food at night and were also being rehydrated at same time. **Trepanowski & Bloomer**[29] noticed that resting BP fell simultaneously with weight loss. They found a systematic correlation between weight changes and BP, and predicted a BP fall of 1.5 or 2.5 mmHg/ per kg of weight loss; therefore, our study results are in consistence with these findings. Fasting helps keep BP normal and control body weight, which is of high significance, especially for diabetic patients.[30]

In present study we noted that over the 3-week period, a significant decrease was observed in mean CK-MB levels, from 5.4±1.9 ng/mL to 4.4±2.0 ng/mL (p<0.001), indicating reduced cardiac stress or damage. In contrast, HS-CRP levels showed no significant change overall (p=0.671), but a significant increase was noted between baseline and after 3 weeks (3.35±12.3 mg/L, p<0.001). The reduction in CK-MB levels suggests improved cardiac health, despite the increase in HS-CRP levels. Our study's findings on reduced CK-MB levels, indicating decreased cardiac stress or damage, are consistent with previous research on interventions aimed improving cardiac health. For instance, a study **Papamichail A et al**[31]

reported that on effects of exercise on cardiac biomarkers found similar reductions in CK-MB levels, suggesting improved cardiac function. However, the observed increase in HS-CRP levels, a marker of inflammation, contrasts with some previous studies that reported decreases in inflammatory markers with improved cardiac health.[32] This discrepancy was due to differences in study populations, interventions, or durations.

Bartholomew et al[33] demonstrated that participants, who self-reported practicing routine IF once a month for at least 5 years, experienced a 71% reduction in HF risk compared with non-fasters. In contrast, another study showed that extended eating windows are associated with reduced cardiovascular mortality patients with HF,[34] supporting the findings from preclinical studies with chemotherapy-induced cardiomyopathy. Subsequent prospective observational research indicated that later timings of the first and last meals correlated with an increased risk of cardiovascular events,[35] which is in line with randomized trials reporting that later evening meals can potentiate cardiovascular risk factors.[36] These inconsistent observations warrant further exploration of the relationship between IF and HF through large randomized controlled trials on effect of fasting at different times of the day.

Conclusion

The present study demonstrates that intermittent fasting has a positive impact on cardiovascular health in young adults, with significant reductions in anthropometric measures, blood pressure, heart rate, and blood sugar levels over a 3-week period. The decreases in weight, BMI, waist circumference, and hip circumference suggest improved body composition, while the reductions in blood pressure and heart rate indicate enhanced cardiovascular health. Additionally, the decrease in CK-MB levels suggests reduced cardiac stress or damage. However, the increase in HS-CRP levels after 3 weeks warrants further investigation. Overall, this study suggests that intermittent fasting may be a beneficial dietary approach for improving cardiovascular health in young adults.

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