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Effect Of Long Term Time Restricted Feeding On Anthropometry And Metabolic Characteristics, Hba1c, Crp; A Case Control Study

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ABSTRACT

Objective: An observational study was planned to observe the effects of long-term time restricted feeding (LTRF) on the anthropometric HbA1c, FBS and CRPin the study population.

Material & Methods: The above study was conducted in the Dept. of Physiology, G. R. Medical College and JA Group of Hospitals, Gwalior (M.P.), the study period was from October 2019 to September 2020 (Data Collection Time.A total of 60 subjects in the age group 30-60 years were taken of which cases were 30 normal healthy individuals practicing Long Term Time Restricted Feeding (LTRF group, feeding period of 10 hours and fasting period of 14 hours and practicing LTRF for > 3 years) and controls were 30 normal healthy individuals age and sex-matched not practicing Time Restricted Feeding (NTRF group, fasting period <12 hours a day). Anthropometric parameters, weight & height were recorded and BMI and waist-hip ratio were calculated. Metabolic parameters, HbA1c were tested along with the inflammatory marker; quantitative C-reactive protein (CRP).**An** independent t-test was used as a main statistical tool. Statistical analysis was done using SPSS software. P-value <0.05 was considered a significant value.

Results: Anthropometric parameters naming body weight in LTRF group was 66.31 ± 7.74 Kg and in NTRF group was 71.87 ± 10.27 Kg with P-value 0.021. BMI in LTRF group was 23.67 ± 2.23 Kg/m^2 and in NTRF group was 25.35 ± 2.96 Kg/m^2 with P-value 0.017.Waist-hip ratio in LTRF group was 0.852 ± 0.07 and in NTRF group was 0.89 ± 0.08 with P-value 0.035. Biochemical parameters including HbA1c in the LTRF group was 5.22 ± 0.39 % and in NTRF group was 5.54 ± 0.62 % with P-value of 0.022.CRP in the LTRF group was 1.95 ± 1.14 mg/L and in NTRF group was 3.44 ± 2.37 mg/L with P-value of 0.003.

Conclusion:LTRF as a lifestyle could be a novel method to improve health, decrease comorbidities associated with obesity and other lifestyle diseases.

Key Words: Time Restricted Feeding, Intermittent Fasting, Long Term Time Restricted Feeding

INTRODUCTION

The availability of artificial light in modern society has led to a *nocturnal lifestyle*(1) along with a *longer period of food consumption*, as the increased variety of methods to purchase foods has enabled easier and faster access to food than in the past(2,3). In addition to these environmental changes, eating patterns have changed, including increased frequencies of skipping meals, snacking(4), and nigh-time eating(5). These eating patterns, including meal timing and frequency, have been proposed to reduce weight management leading to obesity and cardiometabolic health in humans(3,5,6). **Hatori et al. (2012), Melkani et al. (2017) and**

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Chaix et al. (2014) found in their studies that the *timing of food* intake appears to affect the robustness of circadian rhythms in metabolic organs, and circadian rhythm disruption is emerging as a new risk factor for cardiovascular diseases(7–9).

Sanvictores et al. (2020)found that *Fasting is a practice that involves a restriction of food or drink intake for any period*. Fasting has been practiced for a variety of reasons that range from dieting to religious beliefs to medical testing(10). In recent studies it is found that a intermittent fasting (IF) is a diet strategy that has been shown to improve metabolism, regulate immunity, reduce oxidative stress, and prolong life. There are many forms of IF, including fasting every other day, fasting for 2 consecutive days every week (also known as 5: 2 diet), *Time Restricted Feeding (TRF),* and fasting in Ramadan(11).

Sutton et al. (2018), Ganeshan et al. (2018) and **Mattson et al. (2017)** defined Time Restricted Feeding (TRF) as a type of Intermittent Fasting(IF) that extends the daily fasting period between dinner and breakfast and it can be practiced either with or without reducing calorie intake and losing weight(12–14).

The practice of alternating periods of eating and fasting has emerged as an effective therapeutic strategy for improving multiple cardio-metabolic endpoints in rodent models of disease. Studies in rodents using feeding windows of 3–10 hr report that TRF reduces body weight, increases energy expenditure, improves glycemic control, lowers insulin levels, reduces hepatic fat, prevents hyperlipidemia, reduces infarct volume after stroke, and improves inflammatory markers, even in the presence of a high-fat diet(12,14,15).

Sutton et al. (2018) and **Jamshed et al. (2019)** conducted human trials which suggests that TRF has similar benefits in humans. TRF can reduce body weight or body fat, improve insulin sensitivity, reduce glucose and/or insulin levels, lower blood pressure, improve lipid profiles, and improves inflammatory markers and oxidative stress(12,16).

A study done by **Amy T. Hutchison et al. (2017)** has shown that Time-restricted feeding (TRF) is a very novel dietary tool that time-limits energy intake for up to 12 hour/day without necessarily altering diet quality or quantity(17).

Some people are practicing TRF as a daily lifestyle habit for years. This type of life style is seen in *JAIN community (INDIA),* who are practicing TRF as a religious practice along with simple dietary habits (consuming pure veg food, avoiding spicy food) and avoid smoking, alcohol consumption etc. from ancient times.

Morteza A. Khafaie et al. (2019) reported that glycemic measures (i.e., high fasting and post-meal plasma glucose) are linked to risk of dyspnea. HDL concentration was directly associated with % FVC(18).

Studies on TRF has also shown reduction in Inflammatory marker (CRP, TNF-α etc.)(16,19). A study done by **Razavi et al. (2021)** examined effects of a modified alternate-day fasting diet vs. calorie restriction on inflammatory indices and found significant reduction in hs-CRP values(20).

There are limited studies on TRF and we could not find any study on long term TRF (TRF as a lifestyle habit and is being practiced for years).

As above studies suggest that TRF is beneficial for glycemic control, cardiovascular health and obesity. Hence, we designed this study to compare metabolic characteristics (fasting blood glucose & HbA1c, lipid profile & Inflammatory marker - C reactive Protein) between subjects practicing long term TRF (LTRF) and those not practicing TRF (NTRF) of Jain community in Gwalior, Madhya Pradesh, India.

1. MATERIAL AND METHODS

The study was conducted in the Dept. of Physiology, G. R. Medical College and JA Group of Hospitals, Gwalior (M.P.). Duration of the Study was 2 years. Total Sample Size was

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60 of which 30 normal healthy individuals practicing Long Term Time Restricted Feeding since more than 3 years (LTRF/ Study Group) and 30 normal healthy individuals not practicing Time Restricted Feeding (NTRF/ Control Group)

- LTRF - Feeding window (day time) of 10 hours and fasting window (overnight) of 14 hours
- NTRF - fasting window (overnight)<12 hours a day

An informed consent was taken from every subject and control. Medical examination including detailed relevant medical, personal, family history & Dietary history was noted and filled on a separate proforma for each subject and control.

Healthy subjects were included with no history of chronic disease, any subject with any chronic medical history were excluded.

2. METHODOLOGY

Detailed history of the subjects was taken for both the groups LTRF & NTRF respectively including dietary history and history of sleep. General Physical Examination was done in all subjects. Mercury Sphgmomanometer and Stethoscope were used for the measurement of Blood Pressure in resting state. pulse rate was recorded manually in resting state.

Anthropometry measurements were taken via measuring tape and digital weighing machine.

1. **Body weight:** The weight of each subject was recorded on the digital weighing machine. The zero error was minimized to the maximum.
2. **Height:** using o vertical measuring rod.
3. **Waist circumference** was measured at the level of umbilicus with nearest 0.1cm and person breathing silently.
4. **Hip circumference** was measured using a standard measuring tape in inches. Measurement was taken around the widest portion of the buttocks.
5. BMI and Waist-Hip ratio was calculated following standard protocol.

Criteria for BMI calculation by WHO:WHO classification of adults according to BMI:

Measurement Units	Formula and Calculation
Kilograms and meters (or centimeters)	Formula: weight (kg) / [height (m)]2 With the metric system, the formula for BMI is weight in kilograms divided by height in meters squared. Because height is commonly measured in centimeters, divide height in centimeters by 100 to obtain height in meters.

Classification	BMI
Underweight	<18.50
Normal range	18.50 - 24.99
Overweight/Pre – obese	25.00 - 29.99
Obese class – I	30.00 - 34.99
Obese class – II	35.00 - 39.99
Obese class – III	>40.00

Blood collection of each subject was done taking all aseptic precautions.

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STATISTICAL ANALYSIS

- Independent t test was used as a main statistical tool. Correlation among the parameters were done using Pearson correlation test. Statistical analysis was done using SPSS software.
- P value <0.05 will be considered as significant value.

OBSERVATION AND RESULTS

Table 1: Anthropometric Data of LTRF and NTRF groups

Parameters	**Mean ± SD**			**P-value**
	LTRF (n=30)	**NTRF (n=30)**	**Total (n=60)**	
Age (years)	43.67 ± 10.34	46.90 ± 12.03	45.28 ± 11.24	0.269
Height (cm)	167.43 ± 7.84	168.29 ± 7.44	167.86 ± 7.59	0.664
Weight (Kg)	66.31 ± 7.74	71.87 ± 10.27	68.81 ± 9.20	**0.021**
BMI (Kg/m^2)	23.67 ± 2.23	25.35 ± 2.96	24.41 ± 2.63	**0.017**
Waist C. (inches)	32.02 ± 3.28	33.83 ± 3.98	32.88 ± 3.66	0.059
Hip C. (inches)	37.52 ± 2.69	37.68 ± 2.39	37.58 ± 2.51	0.809
Waist /Hip	0.852 ± 0.07	0.89 ± 0.08	0.873 ± 0.08	**0.035**
SBP (mmHg)	119.67 ± 6.74	122.4 ± 11.98	121.03 ± 9.73	0.281
DBP (mmHg)	79.47 ± 6.86	81.93 ± 9.57	80.7 ± 8.35	0.256
Pulse (bpm)	83.2 ± 7.28	84.13 ± 9.29	83.67 ± 8.29	0.667
RR (breaths/min)	17.47 ± 1.22	17.63 ± 1.58	17.55 ± 1.4	0.325
FBS (mg/dL)	90.01 ± 5.12	94.71 ± 15.52	92.36 ± 11.70	0.121
HbA1c (%)	5.22 ± 0.39	5.54 ± 0.62	5.38 ± 0.54	**0.022**
CRP (mg/L)	1.95 ± 1.14	3.44 ± 2.37	2.68 ± 2.00	**0.003**

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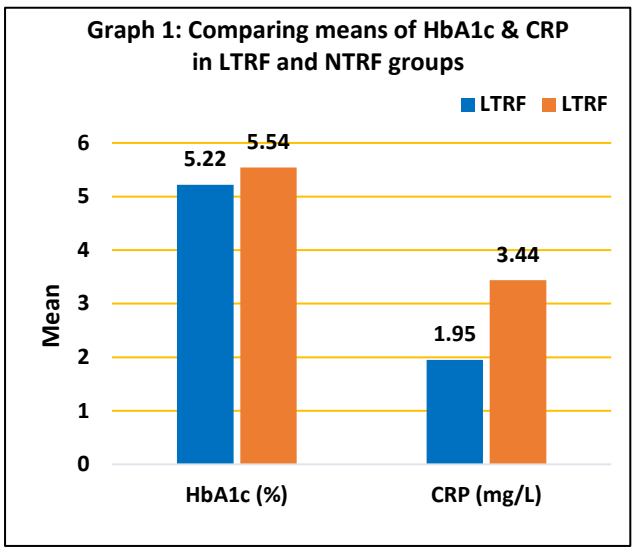


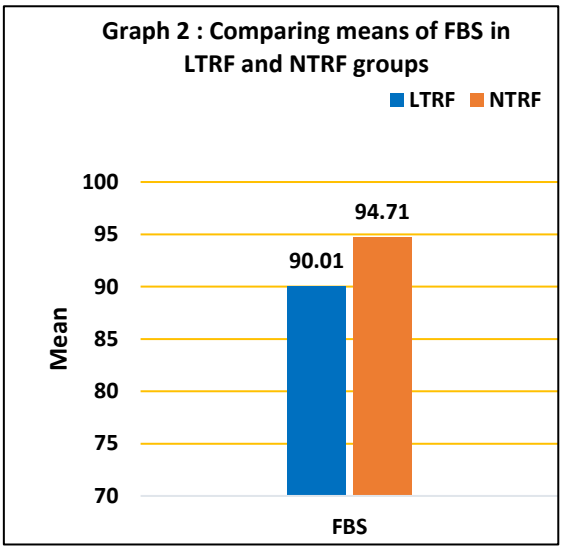
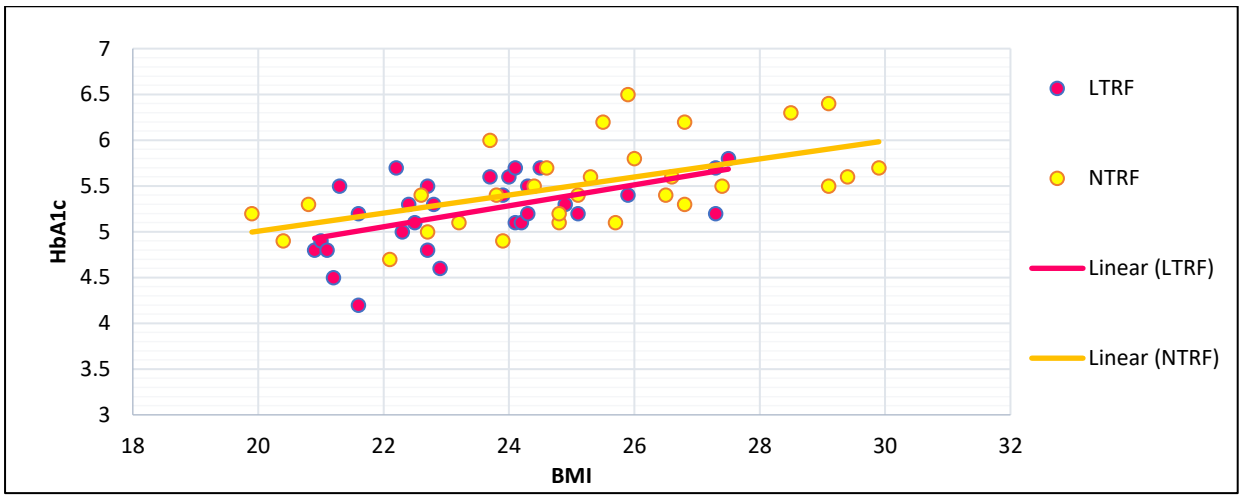


Table 2: Correlation between various parameters and BMI in LTRF and NTRF groups

Sno.	Parameters	LTRF (n=30)		NTRF (n=30)	
		BMI r-value	P-value	BMI r-value	P-value
1	**HbA1c**	0.57	**0.001**	0.538	**0.002**
2	**CRP**	0.069	0.719	0.222	0.238



3. DISCUSSION

Intermittent fasting (IF) is a broad term encompassing eating patterns with regularly occurring periods of food abstention longer than a typical overnight fast. In contrast to traditional methods of continuous energy restriction, IF programs utilize intermittent energy restriction by interspersing periods of less restricted or unrestricted feeding with periods of severely limited energy intake. Several forms of IF have been described, including time-restricted feeding (TRF), alternate-day fasting (ADF), alternate-day modified fasting, and periodic fasting.

Time-restricted feeding (TRF) protocols involve adhering to a daily routine that requires fasting for a certain number of hours and feeding for the remaining hours in a 24-hour period(21). The vast majority of existing research of TRF in humans has focused on weight loss and health effects in overweight and obese adults, and most of the studies are pre-post

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studies and no one in our knowledge has studied the effects of long-term time restricted feeding (people practicing TRF as a daily habit for years). Therefore, this research was planned to Study the Metabolic Characteristics in Long Term Time Restricted feeders.

Anthropometric data showed that there was a significantly lower Weight, BMI & waist-hip ratio in the LTRF group when compared to the NTRF group. LTRF group showed a significant lower value of the biochemical parameters (HbA1c and CRP).

ANTHROPOMETRIC PARAMETERS

LTRF group has lower Weight, BMI and waist hip ratio

The subjects who were practicing long term time restricted feeding (LTRF group) have shown significantly lesser values of body weight when compared to non-time restricted feeders (NTRF group). LTRF 66.31 ± 7.74 Kg, NTRF 71.87 ± 10.27 Kg; P-value 0.021. Change in body weight also translated to a significant difference in BMI of both the Groups (LTRF 23.67 ± 2.23 Kg/m^2, NTRF 25.35 ± 2.96 Kg/m^2; P-value 0.017). A significant difference in the waist-hip ratio (LTRF 0.852 ± 0.07, NTRF 0.89 ± 0.08, P-value 0.035) was also noted. Although not statistically significant we noted that LTRF group participants had lower mean waist circumference (32.02 ± 3.28) in comparison to the NTRF group (33.83 ± 3.98) and almost similar mean hip circumference in the two groups (LTRF 37.52 ± 2.69, NTRF 37.68 ± 2.39), due to higher difference in the waist circumference and hip circumference in the LTRF group we found a significant waist hip ratio.

In a pre-post study done by **Wilkinson et al. (2019) and Kesztyus et al. (2019)** found that 10 h TRE for 12 weeks, significantly reduces weight (p = 0.00028), waist (p = 0.0097) and waist-hip ratio of <0.5. Weight loss associated with the desired reduction in body fat percentage was also noted (p = 0.00013). Significant decrease in visceral fat content was also noted (p = 0.004)(22).

Gabel et al. (2018) investigate the effects of an 8-h limited feed intervention (ad libitum feed between 10:00 to 18:00 h, fasting between 18:00 and 10:00 h) 12 weeks on weight loss and risk factors for metabolic syndrome in obese adults. Weight decreased in the time-bound group relative to controls (P <0.001). BMI decreased in the feed-related limit group relative to control group (P <0.001). They suggested that the weight loss is due to overall calorie restriction in TRF(23).

Schroder et al. (2021) proposed a study to determine the effect of TRF on body composition and the association of weight loss with metabolic and cardiovascular risks in obese middle-aged women. Randomized clinical trials were performed within 3 months for obese women (TRF group, n = 20, BMI 32.53 ± 1.13 vs. Control n = 12, BMI 34.55 ± 1.20) following approved TRF protocol was 16 hours without taking 8 hours to follow a normal diet. TRF was effective in weight loss (~ 4 kg), BMI, % body fat (% BF), waist circumference from baseline. Weight (kg) [Conditions (base = 83.62 ± 3.95 after 3 months TRF = 80.24 ± 3.87), controls (base = 87.14 ± 3.25 after 3 months TRF = 88.49 ± 3.04 p-value <0.001)]. BMI (kg / m2) [Conditions (base = 32.53 ± 1.13 after 3 months TRF = 31.19 ± 1.11), controls (base = 34.55 ± 1.20 after 3 months TRF = 35.00 ± 1.10 p-value <0.0010](24).

Klempel et al. (2012) examined the effects of IF plus CR (with or without liquid diets) on body weight, body composition, and the risk of CHD. Obese women (n = 54) were randomly assigned to IFCR-liquid (IFCR-L) or IFCR-based diet (IFCR-F). The test was divided into two phases: 1) 2-week weight-saving period, and 2) 8-week weight loss period. Weight loss was significantly lower (P = 0.04) in the IFCR-L group versus IFCR-group. Fat weight decreased similarly (P <0.0001) in the IFCR-L and IFCR-F groups. Visceral fat was reduced (P <0.001). They concluded that IF combined with CR and liquid diet is an effective strategy to help obese women lose weight and reduce their risk of CHD(25).

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The above studies showed a significant decrease in body weight, BMI and waist-hip ratio after TRF regimes, this could be due to reduction in daily calorie consumption. A study done by **Gill et al. (2015)** examined the effect of a diurnal pattern on diet and fasting on human health. Participants showed a decrease in total body weight (average loss of 3.27 kg) and BMI (reduction of average 1.15 kg / m2). They concluded that reducing daily meal time to 10h / d reduces caloric intake ~ 400 kcal / d, without deliberately counting calories, as a result participants were in a daily state of daily insufficiency, thus lowering body weight and BMI. Similar results were found in our study but here LTRF group practiced 10 hour feeding period and 14 hour fasting period and practicing for a longer duration as a part of their lifestyle when compared to the above studies (minimum 4 years, Maximum 36 years and average 16.53 years), and they got the benefit of that. Participants are habitual to this TRF regime and practice it as a daily routine, therefore maintaining the body weight at lowers values versus controls (NTRF group). Lower overall fat percentage and visceral fat was noted in the above TRF studies, as a result waist circumference is lower and the waist hip ratio is better. We also found significant difference in waist hip ratio in the two groups, LTRF group having lower waist-hip ratio, could be due to less visceral fat as an outcome of TRF.

VITAL PARAMETERS

In our study mean systolic blood pressure of the LTRF group was a little lower than the NTRF group (119.67 ± 6.74 mmHg and 122.4 ± 11.98 mmHg respectively) and similarly, mean diastolic blood pressure of the LTRF participants showed a Lower value than the NTRF group (79.47 ± 6.86 mmHg and 81.93 ± 9.57 mmHg respectively) however, they were not significant with respective p-values (SBP 0.281, DBP 0.256). (Table 4 and Graph 4)

Wilkinson et al. (2020) observed significant reductions in systolic and diastolic blood pressure (5.12 ± 9.51 mmHg [4%], p = 0.041 and 6.47 ± 7.94 mmHg [8%], p = 0.004, respectively. The reduction in blood pressure in their study was similar to that expected by weight loss. Weight loss by any degree (0 -10) may reduce blood pressure at 6 to <12 months by 2.625mmHg (systolic) and 1.337 (diastolic)(22).

Zomer et al. (2016) explained that the TRE blood pressure reduction in their study was similar to that expected for weight loss in other ways. Any degree of weight loss (from 0 to <10%) is generally expected to result in a reduction in moderate blood pressure at 6 to <12 months at 2.675 mmHg (systolic) and 1.337 mmHg (diastolic)(26).

Gabel et al. (2018) Systolic blood pressure significantly decreased in the time restricted feeding group (–7 ± 2 mm Hg) relative to controls during the study (P = 0.02).(23)

Kessler et al. (2018) conducted research to assess whether intermittent fasting (IF) is an effective preventative measure, and whether it is possible for healthy volunteers under daily conditions. Diastolic blood pressure decreased in the fasting group from baseline (5.5.45 ± 9.25 p-value 0.01) and not in the control group, but there was no significant change in systolic blood pressure in both fasting and control group.

Average pulse and the respiratory rate were also not significantly different in both the groups.

Most of the above studies were interventional studies where the researcher actively performs an intervention in some or all study population, to determine the effects of TRF. On the contrary our study is an observational study in which we observe the effects of LTRF on the study population without changing the course of the nature. On the other hand, our study was on healthy subjects when we compare it with the above studies with the subjects who are obese, overweight, suffering from metabolic syndrome etc. This could be the reason that in our study the vital data is already set in its normal range not depicting any significant change in both the groups.

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BIOCHEMICAL PARAMETERS

C-Reactive Protein (CRP)

The biochemical parameters in the study included C-reactive protein (CRP), HbA1c and fasting blood sugar (FBS).

CRP in the LTRF group (1.95 ± 1.14 mg/L) was significantly less than NTRF group (3.44 ± 2.37 mg/L) with a significant P-value of 0.003. (Table 5 and Graph 5.2)

A pre-post study done by **Ooi et al. (2019)** found that the hs-CRP inflammatory mark was significantly reduced from 2.0 milligrams per litre (mg / L) initially to 0.6 mg / L after the first two consecutive days of fasting. Decrease continuously in the next two cycles and remain at 0.3 mg / L after fasting. They also found that the participant lost 1.3 kilograms (kg) of body weight (weight baseline = 65.9kg Vs weight post fasting = 64.6kg). This case shows that fasting from time to time can cause short-term weight loss and reduce the risk of burnout in a healthy adult. They concluded that weight loss was known to be associated with a decrease in C-reactive protein (CRP) levels, an inflammatory marker at risk of developing chronic diseases including heart disease, diabetes, and cancer. The changes in hsCRP as a result of occasional fasting are dramatic (from 2.0% to 0.3%).

They interpret that hs-CRP is a critical phase reaction to an inflammatory response that is mediated by many conditions. It is not a measure of the risk of inflammation. In addition, the body may incorporate less CRP into fasting due to a lack of protein sources. Therefore, any change in CRP does not really represent a change in the initial clinical setting as other inflammatory processes may affect CRP values(16).

McAllister et al. (2020) found in their study that the ad libitum group had significantly higher levels of CRP (p = 0.02) in comparison to the TRF group.(27)

A study done out by **Askari et al. (2015**) effect of ramadan Fasting in asthmatic studies. Serum hs-CRP levels in control and asthmatic groups decreased significantly after Ramadan fasting month (P <0.001)

We also found a positive correlation of the CRP ratio of lipid parameters comprising TC, LDL and VLDL in the LTRF group with the corresponding coefficients and p values (TC 0.562, p-value 0.001), (LDL 0.406, p-value 0.026), (VLDL 0.449, p-value 0.013)].

Not like us but **Zahari Sham et al. (2021)** found in their study a positive correlation between C-reactive protein concentration and triglyceride level ($r = 0.567$; $p < 0.05$) But their subjects were Diabetic and ours were healthy individual.

A survey showing correlation of CRP with cardiovascular risk factors conducted by **Rohde et al. (1990)** concluded that CRP was positively correlated with age, body weight index, systolic and diastolic blood pressure, total cholesterol, triglycerides (all with p-value <0.04) and had significantly different relationships considered high- density lipoprotein cholesterol (p-value <0.02)(28).

As we know that CRP is an acute phase reactant, which is a marker for underlying systemic inflammation. a recent report conducted by **Calles-Escandon et al. (1996)** suggests that weight reduction may downregulate acute phase proteins in elderly obese subjects(29). **Schultz et al. (1990)** stated that CRP is usually referred to as an acute phase protein with multiple known biologic effects(30) that may be involved in several steps in the initiation and/or progression of atherosclerosis lesions. Our study also found significant lower values of body weight in LTRF group due to the effect of the long-term time restricted feeding as a daily routine, it could be related to the lesser CRP values in LTRF group than the NTRF group.

Glycosylated haemoglobin (HbA1c)

HbA1c in the LTRF group (5.22 ± 0.39 %) was less than NTRF group (5.54 ± 0.62 %) with a significant P-value of 0.022. (Table 5 and Graph 5.2)

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A study done by **Bala et al. (2019)** associating glycated haemoglobin (HbA1c) levels with body mass index (BMI) and waist hip ratio (WHR) in diabetic patients. The study included 30 diabetic patients aged 20-40 years who were diagnosed with HbA1c basis (5.7-6.4%). Venous blood sample was extracted to measure HbA1c levels. The correlation coefficient between BMI (27.01 ± 2.91 kg / m2) and HbA1c (5.94 ± 0.21%) is r = 0.583 at p = 0.001 and between the hip joint level (0.87 ± 0.38) & HbA1c with p value = 0.005. Both BMI and WHR are positively associated with HbA1c. They explained that this may be due to low oxidative stress in the TRF group, as it is found that oxidative stress is a major factor in hemoglobin glycation leading to increased HbA1c levels in oxidative stress. Oxidative stress affects HbA1c levels in two ways.

First, hemoglobin glycation is a two-step Maillard reaction that involves the initial formation of the labile Schiff base and subsequent Amadori reorganization. Oxidative stress helps autoxidation of glucose into dicarbonyl intermediate in the first step of the Maillard reaction and thus improves protein saturation. Second, oxidative stress induced insulin resistance within the adipose tissue and skeletal muscle and subsequent development of hyperglycemia which will further increase oxidative stress. As the increase in BMI is a major factor in the increase in oxidative stress and BMI closely related to HbA1c in the above study, the same is shown in our study with higher BMI and HbA1c values in the NTRF group compared to the LTRF group(31).

This gave us the idea to correlate the two parameters BMI and HbA1c in both the groups and we found a significant positive correlation among the two. Correlation coefficient in the LTRF group was 0.57 with a p – value of 0.001 and in NTRF group was 0.538 with the p – value of 0.002. (Table 8 and Graph 8.1)

Kesztyus et al. (2019) described a TRF study with obese participants (waist-to-height ratio, WHtR ≥0.5). Participants (n = 40, aged 49.1 ± 12.4, 31 women) were asked to limit their daily meal time to 8-9 hours to extend their overnight fasting period to 15-16 hours. List of questions, anthropometrics, and blood samples used initially and follow-up. After three months of TRF, participants had achieved the goal of fasting, on average, HbA1c reduced by -1.4 ± 3.5 mmol / mol (p = 0.003)(32).

Table 3: Comparison of our study with another study in context of HbA1c

S.no.	Study	Participants	Trial length	Protocol	Major findings
1	Our study	Healthy subjects n = 60 Age = 30-60 y LTRF (cases)= 30 NTRF (controls)= 30	Cases = TRF for > 3 years Controls = not practicing TRF	LTRF = normal veg diet Feeding window = <10 h Fasting window = 14 h	In LTRF: ↓HbA1c compared to NTRF
2	Kesztyus et al. (2019)	N = 40 (31 females, 9 males), with abdominal obesity	3 months	TRE: 8 -9 h Baseline: AL	↓ HbA1c

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Above studies suggests that HbA1c is positively correlated to BMI. Our results were similar as we found higher BMI and HbA1c in NTRF group and lower BMI and HbA1c in LTRF group. Therefore, LTRF helps in maintain BMI and HbA1c and reduces the risk of Diabetes mellitus and obesity.

Fasting Blood Sugar (FBS)

Mean FBS was slightly lower in the LTRF group (90.01 ± 5.12) than in NTRF group (94.71 ± 15.52) with p-value 0.121.

4. CONCLUSION

life style as an important factor of health. According to WHO, 60% of related factors to individual health and quality of life are correlated to lifestyle (33). Millions of people follow an unhealthy lifestyle. Hence, they encounter illness, disability etc. Problems like metabolic diseases, joint and skeletal problems, cardio-vascular diseases, hypertension, obesity, COPD and so on, can be caused by an unhealthy lifestyle.

Overweight and obesity are now widely recognized as not only a major public health problem but literally an epidemic. Due to the consumption of energy dense food (i.e., unhealthy food habits), *sedentary life style*, lack of health care services and financial support, the developing countries are facing high risk of obesity and their adverse consequences (i.e. diabetes, ischemic heart disease, Respiratory disorders, metabolic syndrome, etc.).

Time restricted feeding can be a preventive measure against obesity and its complications. Previous studies had shown that TRF can reduce body weight, BMI, improves insulin sensitivity and glucose tolerance. In our study we found that LTRF may help to maintain weight and BMI without intentional calorie counting, thus there is less risk of obesity and hence prevent metabolic diseases.

LTRF improves several facets of health through fasting-related mechanisms. LTRF boost glycaemic control by lowering HbA1c.

Our study was the first to show that LTRF has benefits in humans by improving the metabolic health. This indicates that LTRF is an efficacious strategy as a daily habit for longevity of human health.

In conclusion, LTRF as a lifestyle could be a novel method to improve health, decrease comorbidities associated with obesity and other lifestyle diseases and decrease the risk of respiratory diseases. Additional studies are needed to confirm our results and to investigate the long-term effects of TRF.

SUGGESTION

Good lifestyle is necessary for better living, so one should take measures to keep oneself healthy. Due to bad lifestyle now a days, we encounter various diseases (cardiovascular diseases, obesity, metabolic syndrome, Musculo-skeletal disorders etc). Our study has shown the effects of long term time restricted feeding (LTRF) in decreasing the risk of lifestyle diseases by improving Metabolic parameters and Lung functions. Thus, we suggest that LTRF should be considered as a lifestyle habit, so that one could be Physically and mentally strong and healthy always.

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