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Effect of *Ayambil* (A type of Jain intermittent fasting) on Plasma glucose, Lipid Profile, Anthropometric and Psychological parameters: An observational study

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Abstract

The practice of voluntary abstinence from food and drink for 16 to 48 hours is known as intermittent fasting (IF). Jain *Ayambil*, a type of intermittent fasting, where a special meal of boiled grains without spice, oil, milk, ghee, sugar, curd, fruits, or raw vegetables is taken once during the daytime. The aim of the study was to find out safety and its effect on plasma glucose, lipid profile, anthropometric and psychological parameters. We are reporting first ever scientific study on effect of Aymabil intermittent fasting on health parameters. The present study was carried out on 52 volunteers who did 9 days *Ayambil* fasting. Physical, and psychological assessment were done on the pre-fasting day (day 0), 4th day, and 9th day whereas biochemical examinations were carried out on pre-fasting (day 0) and 9th day of *Ayambil* fasting. Out of the total 52 participants (mean age of 52.77 ± 13.51 years), there were 28 (53.85%) females (51.54 ± 12.94) and 24 (46.15%) males (54.21 ± 14.30). A statistically significant reduction was observed for fasting blood glucose (p=0.002), HbA1c (p=0.002), body weight (p=0.001), BMI (p=0.001), diastolic BP (p=0.005), serum creatinine (p= 0.036), and

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a positive correlation was noted for Hamilton Depression Rating Scale (HDRS) (p=0.001) noted during *Ayambil* fasting. However, there was no significant change in lipid profile. Our findings suggest that *Ayambil* fasting is beneficial to metabolic, psychological, and holistic health with no health-related hazards. It is a safe fasting method and exploration of more clinical studies on this can open newer futuristic directions as one of the therapeutic options for a variety of clinical situations.

Introduction

The practice of voluntary abstinence from food and drink for 16 to 48 hours is known as intermittent fasting (IF). This type of intermittent fasting is done for the purpose of either calorie restriction or as a part of religious practice. Intermittent fasting more relates and is expressed in hours while the period in days (which may last from 2 to 21 days) for which such intermittent fasting is done is designated as periodic fasting.[1] It has many health advantages. It is known to improve metabolic as well as cardiovascular health.[2] The recommendations about diet and dietary practices are an important consideration in almost all religions across the world. Intermittent fasting is considered to be a choice for a healthier lifestyle.[3] Calorie restriction is considered to be the initial treatment strategy in any weight reduction program, however, adherence to such a diet in form of controlled feeding is a problem.[4] Religious fasting is motivated practice and thus adherence to controlled feeding is good. Religious purposes are type of motivated fasting and their positive effect is shown by the number of research papers.

Ayambil or *Aaimbil* is a specific type of periodic and intermittent fasting. The word '*Ayambil*' has its root in the Sanskrit word *Achamala* which has components of '*Acham*' (means soup) and Amla (means tangy or sour). The periodic fast for nine (Nirav) days by performing *Ayambil* is also known as Navpad Oli. ('Navpad' means nine steps and 'Oli' means a line or in a series). *Ayambil* promotes Ras parityag (controlling taste buds and renouncing taste) and helps in promoting digestive and psychological health like detoxification.[5] During *Ayambil*, a person takes food only once during day before the sunset. He or she eats only one kind of boiled cereals and pulses in one sitting at one place. Boiled water can be taken any time during the day 48 minutes post sun rise and before sunset. It is not permitted to eat foods that are considered 'tasty' by cooking without salt, pepper, milk, curd, ghee, oil, sugar/jaggery, and fried foods. It is a spice free food and one is not permitted to eat sprouts, green/raw vegetables, and fruits. Thus, one avoids eating foods that are considered 'tasty'. If we analyze the diet of devotees during *Ayambil* in terms of current scientific literature, it is a diet with fewer calories, carbohydrates, and fat. As it is without spices (bland), it will be advantageous for the gastrointestinal tract in form of less irritation to mucosa and prevention of acid reflux. With restriction of fat, sugar, and spices for 9 days, one may have an advantageous effect on lowering of body mass index (BMI), blood pressure, and low-density lipoproteins (LDL) with improvement in metabolic parameters.[6, 7] Intermittent fasting is practiced by Hindu religion on "Ekadeshi Day" (The eleventh day of lunar cycle). This type of calorie restriction is done every fifteen days. This can be called as "Spiritual Nutrition". *Ayambil*, Jain fasting is also a type of spiritual nutrition practice which has health benefits.[8]

Sun clock is geared in such a way that the it gets benefited in setting biological clock on which body metabolism and hormonal secretion depends. The biological clock also known as the circadian rhythm is 24 hours cycle regulated by the body's (biological) clock. This is through endogenous molecular oscillators.[9] One of the implications of chronobiology is application to the neuro-endocrinal system because body's sleep-wake cycle is related to hormone secretion. The role of chronobiology and cicardian rhythm is investigated in the management of Type 2 DM.[10] An emerging field of chrono-nutrition relates to eating behavior like timing of the meals, frequency, and regularity. Chrono-nutrition is linked with cardio-metabolic health.[11] Jain Fasting like *Ayambil* and Jain lifestyle like Chauvihar may be related to chrono-nutrition. The impact of this practice needs further research. Though research is available on intermittent fasting which is done for calorie restriction and for religions purposes,

evidence generation in regards to fasting done in Jainism is lacking.

With the hypothesis that *Ayambil* intermittent fasting may have health benefits; this research work was planned. The primary outcome was to find out the safety of this type of fasting in healthy individuals as well as in participants who had co morbidities. A secondary outcome was to observe the effect of *Ayambil* on metabolic, psychological and lifestyle factors which can affect health.

Methodology

The present study aimed to study the effects of *Ayambil* fasting, a specific type of IF, on anthropometric, clinical and biochemical parameters.

Study Setting, Study Period and Ethical Consideration

This was an observational study done for 9 days from October 01, 2022 to October 09, 2022 when Jain disciples practice *Ayambil* Aradhana (worship). The study was conducted after approval from the institutional ethics committee (SVIC/ ON/Medi/ RP/2213). A purposive sample of 63 adult (aged >18 years) participants were taken for the study on day 0 who gave informed consent. 52 adult participants who had completed *Ayambil* fast for 9 days were included in the study. Participants who were not able to complete 9 days of fasting and whose follow-up investigations and clinical parameters could not be recorded were excluded from the study. All participants completed a basic demographic questionnaire including age and date of birth, gender, marital status, occupation, income, and education on a pre structured proforma. A complete physical examination and review of their medical records were done. Basic systemic examination was done in all subjects.

Anthropometric and Biochemical Parameters

Clinical examination was carried out of all participants on day 0, 4, and 9 with special reference to height, weight, BMI, pulse, blood pressure, signs of dehydration, and general nutrition status in relation to anemia, obesity and other relevant parameters. They were also examined for any obvious endocrinal deficiency like hypo/hyperthyroidism.

Height was measured without shoes to the nearest 0.5 cm. Body weight (BW) was measured (to the nearest 0.1 kg) with a calibrated digital weighing scale in the morning in light clothing without shoes. Body mass index (BMI) was calculated using the formula BMI = BW (kg)/height squared (m). Pulse was recorded for one minute while lying down after a rest for 5 minutes. At the same time, systemic arterial systolic (SBP) and diastolic blood pressure (DBP) was measured (in millimeters of mercury) in the right arm by auscultatory method using a mercury sphygmomanometer. SpO_2 was measured with the help of a pulse oximeter.

They were subjected to investigations on day 0 or pre-fasting day and on 9th day of fasting. Fasting venous blood samples were collected and was analysed for complete blood counts (CBC), highly sensitive C-Reactive Protein (hs-CRP), plasma glucose, HbA1c, blood urea, serum creatinine, Serum Glutamate Pyruvic transaminase (SGPT), serum lipid profile (total cholesterol TC, low density lipoprotein LDL, very low density lipoprotein VLDL, high density lipoprotein HDL, triglyceride TG), serum thyroid stimulating hormone (TSH), and serum electrolytes by autoanalyzer. Urine samples were analysed for ketones, albumin, and sugar. Electrocardiogram (ECG) recording was done and analysed to assess any changes in cardiac status.

Psychological Measures

To find out outcome in relation to psycho-socio-spiritual aspect and above-mentioned metabolic aspects, questionnaire was prepared based on concept of The Quality-of-Life Scale [12] (Table S1). Ten questions pertaining to life quality were asked and was graded 1 to 5 scale; maximum score being.[50] Factors in subjects group were related to feeling of Well-Being, Health status and fulfilment of personal, social, and community commitment in the individual's life.[13] This tool was prepared taking above concepts in consideration and making relevant questions in relation to *Ayambil* fasting. Hamilton Depression Rating Scale (HDRS) was used for depression assessment.[14] The scale of 17 items was used having score for each item between 0 and 4 points. Scores of 0–7 was considered normal, 8–16 suggest mild depression, 17–23 moderate depression and scores over 24 are indicative of severe depression.

Statistical Analysis

Statistical analysis was done using SPSS version 16. All the data passed the normality test. All paired

parameters (pre and post fasting) were analysed by paired 't' test. Significance of changes in all parameters between genders and duration of fast were calculated by Students 't' test. All tests were two sided, and the probability (P) level of less than 0.05 was considered as significant.

Results

Total 52 participants completed the study and their data were analysed. There were 28 (53.85%) females and 24 (46.15%) males. Mean age of all participants was 52.77 ± 13.51 years. Mean age of female and male was 51.54 ± 12.94 and 54.21 ± 14.30 respectively. Out of 52 participants, 33 (63.46%) had diabetes mellitus (DM), 10 (19.23%) had hypertension, 03 (5.76%) had hypothyroidism, and 02 (3.8%) had ischemic heart disease (IHD). Family history of DM, hypertension and IHD was present in 17 (32.69%) participants. Eighteen (35.15%) participants were obese as per BMI cut off range of South Asians.[15]

Table 1: Comparison of physical and psychological parameters on day 0, 4 and 9 of Ayambil fasting (n=52) (To check p value column and bold for col Pulse & HDRS)

Variable	Day 0		Day 4		Day 9		p value
	Mean	SD	Mean	SD	Mean	SD	(day 0 & day 9)
Weight kg	67.44	15.602	66.13	14.849	64.21	14.368	0.001
BMI kg/m^2	26.76	5.445	26.25	5.196	23.24	5.033	0.001
Pulse/Min	84.74	13.601	81.87	15.294	78.94	14.487	0.047
SBP mmHg	126.9	22.759	123.02	17.863	119.25	18.928	0.119
DBP mmHg	78.86	11.202	76.58	8.975	71.63	9.675	0.005
SpO2 %	97.81	1.302	97.84	1.344	98.29	1.395	0.207
QoL	38.42	4.992	39.84	4.42	40.35	3.729	0.117
HDRS	4.32	2.868	2.48	1.387	2.84	1.44	0.001

BMI= body mass index; SBP= systolic blood pressure; DBP- diastolic blood pressure; QoL= Quality of life; HDRS= Hamilton depression rate scale

Physical examinations

Mean weight on day 0 was 67.44±15.602 kg that decreased to 66.13±14.849 kg and 64.21±14.368 kg on day 4 and day 9, respectively (Table 1). Similarly the mean BMI showed a declining trend and it was 26.76±5.445 kg/m^2, 26.25±5.196 kg/m^2 and 23.24±5.033 kg/m^2 respectively on day 0, day 4, and day 9. The changes in body weight and BMI were statistically significant at day 9 compared to that of pre-fast observations. No significant change was observed for pulse, systolic BP (SBP), and SpO_2 on day 9 compared to that of day 0. However, a statistically significant reduction was observed for diastolic blood pressure (DBP). Four (7.69%) participants were unaware of high blood pressure in them and only on clinical evaluation were noted to be hypertensive.

Biochemical Examinations

There was a statistically significant decline in the FBS, HbA1c and serum. creatinine on day 9 compared to that on and day 0 (Table 2). However, there was no statistically change in lipid profile, hs-CRP, TSH, serum electrolytes and SGPT. Two subjects had trace urine ketones on day 0. On the 4th day of fasting, 10 participants had mild (trace to +) and one had moderate (++) ketonuria. On 9th day of fasting, 4 subjects had mild (trace to +) and 3 had moderate (++) of ketonuria. No change was observed on the ECG record on day 9 compared to that on day 0.

Changes in Quality of Life

Though there was some improvement in mean score of Quality-of-Life (QOL) following 9 days of *Ayambil*

fast but this increment was statistically not significant (Table 1). Hamilton Depression Rating Scale (HDRS) showed statistically significant improvement on day 9 in comparison to day 0.

Table 2: Biochemical parameters on day 0 and day 9 (n = 52)

Blood Investigation	Day 0		Day 9		p-value
	Mean	Std. Deviation	Mean	Std. Deviation	
FBS mg/dl	132.48	31.90	115.00	49.23	0.002
HbA1C	6.08	0.49	5.59	0.76	0.002
S. Creatinine	0.73	0.19	0.65	0.10	0.036
SGPT	20.48	15.77	21.61	8.04	0.685
hs-CRP	4.71	3.10	3.37	2.14	0.292
Lipid profile					
CHOL	174.15	43.86	184.39	53.37	0.366
TG	129.09	83.28	104.34	41.28	0.085
HDL	55.79	13.02	50.42	9.38	0.052
LDL	93.29	43.64	113.18	45.96	0.058
VLDL	25.82	16.66	20.87	8.26	0.085
Serum TSH	4.41	11.95	3.49	5.87	0.3
Serum electrolytes					
Na	139.71	3.07	140.31	3.76	0.3
K	3.98	0.3	4.18	0.39	0.07
Cl	100.9	4.9	100.98	2.23	0.9

Discussion

Practice of fasting, whether periodic or intermittent is practiced in almost all religions across the globe.[16] The most researched religious fasting is Ramadan fasting. It is a type of intermittent fasting with no specific restriction in calorie intake during feeding period.[17,18] There are different types of fasts with different durations that are observed in Jain tradition.[16] The important factor observed in Jain fasting is calorie restriction coupled with spiritual practices. *Ayambil* is a type of Jain fast where only one meal is allowed between 9am to 5pm. The food items consumed during feeding is devoid of any taste (ras parityag). It is restricted to the boiled food without oil, ghee, sugar, vegetables and salt is taken once in a day time.[19] The main aim of our study is to find out the effect of *Ayambil* fast on physical, biochemical and psychological parameters. Total 63 participants were involved in the study and 52 had completed the study without any major consequences. Many of the participants who had taken up commitment to do fasting knew that they had associated co-morbidities. However, none of them had any safety problems during or immediate post-fast period of 10 days.

In the present study, we have observed a significant reduction in mean body weight of 1.31 Kg and 3.23 kg on day 4 and day 9 respectively. A similar trend was observed for BMI also. Such changes have been observed with other types of religious fasting such as Ramadan and Christian fast.[17, 18, 20, 21] These changes in body weight and BMI can be attributed to the type of diet taken during the *Ayambil* and other intermittent fasting. The restriction of calories is the main factor contributing to weight reduction. While a major contributor for weight loss during the initial period is loss of water, body fat and muscle mass rescue the calorie deficiency in later stage.[16]

We have also observed a statistically significant reduction of fasting blood sugar (p=0.002) and HbA1c (p=0.001) in the present study. While Sanchetee *et al* (2020) have observed an increase in plasma glucose during periodic Jain fasting, most of the studies have observed a decrease in blood glucose level during Ramadan fasting.[16,22]

We have also observed a statistically significant reduction of fasting blood sugar (p=0.002) and HbA1c (p=0.001) in the present study. While

Sanchetee *et al* (2020) have observed an increase in plasma glucose during periodic Jain fasting, most of the studies have observed a decrease in blood glucose level during Ramadan fasting.[16,22] Fasting like Ramadan has been shown to reduce weight, blood sugar, and LDL in healthy individuals. It also improves inflammatory markers and oxidative stress. These health effects benefits conditions like acute myocardial infarction as well as atherosclerotic vascular diseases.[23] Fasting which is a process of starvation may lead to a process of autophagy. During starvation, degenerated old cells are broken down by autophagosomes.[24] If this finding is extrapolated to the situation where starvation is created like in fasting, it may have a beneficial effect in the form of rejuvenation of the senescent cell. Intermittent fasting has a positive impact on health, ageing, and disease. It increases longevity and stress resistance with a reduction in disorders like obesity and cancer.[25] The reduction in blood sugar levels may be due to type of the diet as only boiled food without oil, ghee, sugar, vegetables and salt had been taken during the *Ayambil* fast that drastically restricts the intake of sugar. Our preliminary findings suggest that *Ayambil* fast can be beneficial for diabetic patients. Although more studies are required, our study open newer therapeutic directions to treat diabetic patients.

Obesity, metabolic syndrome, and Type 2 DM are linked with weight, insulin resistance, and various endocrine hormones like leptin, Ghrelin, Glucagon, and Incretins. These hormones are linked directly or indirectly to each other which serve as regulatory mechanisms. The important impact is its effect on the inflammatory, neuro-hormonal, and proliferative pathways.[26] Can intermittent fasting for the short term be safe for a person who is diabetic? It is shown that it is safe and tolerable.[27] It can also be considered one of the therapeutic tools in T2DM. Intermittent fasting can provide intensive calorie restriction and similar hormonal milieu benefits as it is created by bariatric surgery.[28] Short-term fasting in healthy individuals can also be beneficial. It may lead to an increased sense of achievement, reward, pride and control.[29]

Religious practice in India is linked to Ayurved which is a holistic and harmonious approach to health and disease. It takes a distinctive approach to lifestyle and human value systems. It is one of the old traditional systems of medicine in India. It is a part of religious endeavor where Shastra (authoritative religious or scientific treatise) and science, both are comprehended together for health and healing.[30] Fasting is a practice for both ancient Indian religions and Ayurveda. Langhana is one of the key elements of treatment in Ayurveda, the purpose is to remove toxins from the body which creates a lightness of the body and has beneficial effects on the brain and body. *Langhana* is done by fasting, purgation, emesis, and decoction enema. One of the doctrines of Jain fasting is the “purification” of the body which is done through fasting.[31]

In present study we have not observed any appreciable changes in the lipid levels including their fractions following 9 days of *Ayambil* intermittent fasting. Most of the earlier studies have not observed changes in blood lipids with short duration fasts.[32,33] As fast progresses, fats are mobilized in addition to carbohydrates. However, there is a likelihood that a major shift in lipid balance will not occur during intermittent fasting as there is a constant replacement to glycogen stores during feeding periods. During fasting, when glucose is exhausted, the body begins to utilize ketones that arise as a result of fatty acid transformations.[34,35] Hence fatty acids and ketones become the main source of energy for cells during fasting; this transition is called intermittent nutrients metabolic switching (IMS) or glucose-ketone (G-to-K) switchover. Inverse switching, i.e., ketone-glucose (K-to-G) switchover occurs after the interruption of fasting and meal intake.[1] Such biochemical changes are accompanied by cellular and molecular adaptations of neuronal networks in the brain. The result is an improvement of their functionality and resistance to stress, injuries, and diseases.[34] The above biochemical transformations of lipids, along with intermittent fasting, result in weight loss. According to studies conducted by Surabhi Bhutani *et al*., ADF (alternate day fasting)—for 2–3 weeks showed a reduction in body weight by 3%, while longer attempts to use ADF showed a reduction of 8% and reduced fat mass in the viscera.[35,36] Diabetes manifesting secondary to obesity is characterized by hyperglycaemia, insulin resistance, and progressive beta cell failure. Intermittent fasting effectively improves glucose metabolism in patients with type 2 diabetes. It has

been proven that weight loss helps in normalising fasting blood glucose, significant reduction of glycated hemoglobin (HbA1c), and increases insulin sensitivity in people with type 2 diabetes.[28,37] The mechanism of this phenomenon is associated with increased sensitivity of the insulin receptor, due to which insulin stimulates quick uptake of glucose by muscle cells and hepatocytes.[38]

Ayambil fasting did produce statistically significant reduction in diastolic blood pressure (p=0.005) and also reduction in pulse rate. This effect of *Ayambil* fasting can be because of a special diet which has less calories and salt. Mindfulness process attached with this type of fasting may also be the cause of significant reduction of pulse and blood pressure. Hypertension is often associated with obesity and diabetes. These disorders are an important risk factor for coronary artery disease. Research investigators have studied the effect of intermittent fasting on blood pressure. Fasting participants who are hypertensive do benefit with this type of calorie restriction as observed in Ramadan fasting.[28] If adherence to calorie restriction is not the problem, weight reduction also occurs due to intermittent fasting.[39]

Religious Jain fasting includes well-structured calorie restriction along with additional features of Satsang (religious discourses). It will have a positive reinforcement effect. It will serve as cognitive behavioral therapy (CBT). There seems to be a protective role of healthy diet on depression disorder. It is related to the postulation that a healthy diet has anti-inflammatory properties. Psycho-nutrition also play part in the prevention and causation of psychological manifestations like depression, anxiety and other.[37]

Though quality of life score did not change, statistically significant positive correlation was seen between *Ayambil* fasting and Hamilton Depression rating scale. (p=0001). Spiritual practices observed during *Ayambil* fasting can contribute to psychological wellbeing. Following several hours of fasting, the human body enters a physiological state of ketosis characterized by low blood glucose levels, depleted liver glycogen stores, and the hepatic production of lipid-derived ketone bodies, which serve as a major energy source for the brain.[34,40] The liver is the primary site of ketogenesis, but brain astrocytes also generate ketones.[41] Within several days of initiating a fast, ketones become the brain's preferred source of energy, providing up to 70% of its requirements.[42] Ketone bodies enhance the neuron bioenergetics and cognitive performance. Ketones not only serve as energy source for neurons; but they also serve important signaling functions. In hippocampal and cortical neurons, Beta-hydroxy-butyric acid (BHB) plays a vital signaling role by inducing the transcription of brain-derived neurotrophic factor (BDNF) via its inhibition of histone deacetylases, enzymes that repress BDNF expression,[43] which is an important regulator of neuron function; it stimulates mitochondria biogenesis, maintains synaptic structure, spurs the production and survival of new hippocampal neurons, and enhances neuron resistance to injury and disease.[44] Fasting decreases leptin but increases adiponectin and ghrelin, and altogether these alterations prove to be beneficial for neuron bioenergetics and the maintenance of neural pathways, and thereby improving cognition. Our study suggests that Aymabil fasting can be a therapeutic option for obesity and lifestyle related disorders. It is known that lipid lowering agents as well as life style changes takes at-least six weeks in alteration of lipid levels.[45] As we repeated the lipid profile within 9 days only, changes in lipid profile were not observed. Long term studies on the same may provide new insights into this. Though quality of life score did not change, statistically significant positive correlation was seen between *Ayambil* fasting and Hamilton Depression rating scale. (p=0001).

Conclusion

We have reported the first research study of *Ayambil* fasting; the type of Jain religious intermittent fasting which has been followed by thousands of people every year. The study was carried out on 52 volunteers who were doing *Ayambil* fasting. A statistically significant reduction in body weight (p=0.001), BMI (p=0.001), fasting blood sugar (p=0.002) and HbA1c (p=0.001) was noted due to this type of fasting. Statistically significant positive correlation was seen between *Ayambil* fasting and Hamilton Depression rating scale. (p=0001). There was no significant change in lipid profile. This pilot work suggests that there is scope of research work in the field of intermittent fasting by *Ayambil* performed according to the Jain tradition system and their

impact on health. *Ayambil* is a safe fasting method and do-not have health related hazards. *Ayambil* fasting can be one of the therapeutic options for a variety of clinical conditions.

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Conflict of Interest
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