FINAL REPORT

of

MAJOR RESEARCH PROJECT
of

Bhagwan Mahaveer International Research Institute (BMIRC),
Jain Vishva Bharti Institute, Ladnun

[JVBI/2015/2387 dated 01 Sep 2015
W.E.F. September 01, 2015]

for

Effect of Prolong Fasting on Human Health

Submitted by:

Dr Pratap Sanchetee
MD, DM

Principal Investigator &
Chair, Division of Experimental Research,
Bhagwan Mahaveer International Research Institute (BMIRC),
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CONTENT OF FINAL REPORT

of

Major Research Project of JVBI, Ladnun

[JVBI/2015/2387 dated 01 Sep 2015
W.E.F. September 01, 2015]
Entitled

"Effect of Prolong Fasting on Human Health"
"

1. Title page 1
2. Content 2
3. Certificate 3
4. Utilization certificate 4
5. Statement of expenditure 5
6. Proforma for submission 6-8
7. Technical Report 9-49

CERTIFICATE

I, Dr. Pratap Sanchetee, MD, DM declare that the work presented in this report is original and carried throughout independently by me during the complete tenure of major research project of Bhagwan Mahaveer International Research Institute (BMIRC), Jain Vishva Bharti Institute, Ladnun-341306

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Annexure 1

Bhagwan Mahaveer International Research Institute (BMIRC),

Jain Vishva Bharti Institute, Ladnun-341306, India

Utilization certificate

Certified that the grant of Rs. Rs. 2,85,640/- (Rupees Two lakhs eighty five thousand six hundred forty only) received Bhagwan Mahaveer International Research Institute (BMIRC), Jain Vishva Bharti Institute, Ladnun-341306, India for Major Research Project entitled **Effect of Prolong Fasting on Human Health** vide JVBI/2015/2387 dated 01 Sep 2015W.E.F. September 01, 2015 has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the JVBI.

SIGNATURE OF THE
PRINCIPAL
INVESTIGATOR

REGISTRAR/PRINCIPAL STAUTORY

Annexure II

Bhagwan Mahaveer International Research Institute (BMIRC), Jain Vishva Bharti Institute, Ladnun-341306, India

STATEMENT OF EXPENDITURE IN RESPECT OF MAJOR/MINORRESEARCH PROJECT

1. Name of Principal Investigator Dr Pratap Sanchetee

2. Deptt. of University/College BMIRC, JVBI, Ladnun

3. JVBI approval No. and Date JVBI/2015/2387 dated 01 Sep 2015

4. Title of Research Project Effect of Prolong Fasting on Human Health

5. Effective date of starting the project 01 Sep 2015

6. a. Period of Expenditure: From 01 Sep 2015 to 28 Feb 2016
   b. Details of Expenditure

S. No	Item	Amount Approved Rs	Expenditure Incurred Rs
1	Research Assistant	30,000/-	30,000/-
2	Blood tests	3,00,000/-	2,36,240
3	Non-recurring/ Lab equipment	45,000/-	-
4	Travel	20,000/-	19,400/-
5	Contingencies	30,000/-	30,000/-
	Total	4,25,000/-	2,85,640/-

1. It is certified that the appointment(s) have been made in accordance with the terms and conditions laid down by the Commission.

2. It as a result of check or audit objective, some irregularly is noticed, later date, action will be taken to refund, adjust or regularize the objected amounts.

3. Payment @ revised rates shall be made with arrears on the availability of additional funds.

4. It is certified that the grant of Rs. 2,85,640/- (Rupees Two lakhs eighty five thousand forty only) received from the JVBI under the scheme of support for Major Research Project has been fully utilized for the purpose for which it was sanctioned and in accordance with the terms and conditions laid down by the JVBI.

SIGNATURE OF PRINCIPAL INVESTIGATOR **REGISTRAR/PRINCIPAL**

Annexure III

Bhagwan Mahaveer International Research Institute (BMIRC), Jain Vishva Bharti Institute, Ladnun-341306, India

PROFORMA FOR SUBMISSION OF INFORMATION AT THE TIME OF SENDING THEFINAL REPORT OF THE WORK DONE ON THE PROJECT

1. NAME AND ADDRESS OF THE PRINCIPAL INVESTIGATOR **Dr PratapSanchetee, 429, Pal Link Road, Jodhpur- 342008…**…..

2. NAME AND ADDRESS OF THE INSTITUTION **Jain Vishva Bharti Institute, Ladnun-341306, India**…….

3. JVBI APPROVAL NO. AND DATE **JVBI/2015/2387 dated 01 Sep 2015**

4. DATE OF IMPLEMENTATION **01 Sep 2015**……

5. TENURE OF THE PROJECT **6 Months**……

6. TOTAL GRANT ALLOCATED **Rs 4,25,00**0/-……

7. TOTAL GRANT RECEIVED Rs**. 2,85,640/-**

8. FINAL EXPENDITURE **Rs. 2,85,640/-**

9. TITLE OF THE PROJECT **Effect of Prolong Fasting on Human Health**

10. OBJECTIVES OF THE PROJECT **This study aims to study impact of prolong fasting on health i.e. weight, BMI, pulse, blood pressure, lipid profile, blood sugar, haemoglobin, serum proteins, serum cortisol etc.**

11. WHETHER OBJECTIVES WERE ACHIEVED ……
(GIVE DETAILS)
Through the efforts of organising team at Kolkata we could motivate the people to undergo research when they are fasting. We have demonstrated a favorable change in body weight, BMI and some of biochemical parameters. While there is apparent stress during fast, people undergoing longer duration of fast tends to have stabilisation of metabolic and stress parameters. This study paves the way for further studies to delineate change with fasting.

12. SUMMARY OF THE FINDINGS ……..
(IN 500 WORDS)

Fasting has been practiced both as a religious ritual and for preventing and curing diseases. Controlled studies in animals have confirmed fasting protects against diabetes, cancers, heart disease, and neurodegeneration. Some studies in humans have found fasting helps reduce

obesity, hypertension, asthma, and rheumatoid arthritis. To standardised observations, this experimental study has been undertaken to study effect of voluntary fasting on human health. This will be the first experimental study accessing the impact of prolong fasting on human health.

During Paryusan parva, lots of people do prolong fasting of 3 days or more. They can be motivated to be subject of study. There exists lot of apprehension of taking part in experimental research. Through the blessing of religious teachers (Sadhviji) we could motivate the participants. The study was carried out at Jodhpur, and Kolkata centres on subjects doing fast during paryushan parva.

A total of 110 cases healthy volunteers free from any major physical and mental illness (Females 83 and Males 27) in the age range of 13-86 years (average age of 51 years) were studied. They had undergone fast for varying duration between 3-30 days (Group A 1-5 days = 71; Group B 6-10 days = 34 and Group C >10 days = 5). All subjects were studied for weight, BMI, pulse rate, blood pressure, haemoglobin level, biochemical parameters (serum protein and albumin-globulin ratio, blood sugar, blood urea, serum creatinine, lipid profile and serum cortisol level at beginning of fast and repeated at close of fast. All measurements were done in the morning in basal condition. All data obtained were entered in excel sheet and analysed.

There was decrease in body weight by 2.1 Kg in study group. It was observed that weight & BMI did showed decline upto 10 days but stabilised thereafter. There was slight increase in pulse rate (80.8 to 82.7/min), diastolic BP (80.8 to 81.0 mm Hg), serum cholesterol (204.0 to 204.4 mg/dl). In contrast, there was slight decrease in systolic BP (130.6 to 128.0 mm Hg), serum total protein (7.5 to 7.37 gm/dl), serum albumin (4.4 to 4.37 gm/dl), serum globulin (3.1 to 3.0 gm/dl), serum HDL (48.3 to 45.7 mg/dl), serum LDL (133.0 to 134.0 mg/dl). However, these changes were insignificant.

Renal functions (blood urea and serum creatinine) showed increase till 6 days and then decline with longer fast. Blood sugar levels increased (from average of 102.9 to 132.0 mg/dl) following fast and it was more apparent with shorter duration fast. A similar trend was observed with serum triglyceride (from 137.6 to 149.0 mg/dl). Serum cortisol levels (marker of metabolic stress and anxiety) showed an increase from 13.9 to 17.6 µg/dl, which was uniform at various duration of fast.

Thus fasting offers significant advantages in terms of improvement in different parameters related to health to a variable extent which required further study on large sample to strengthen the results of the study. It is a cost-effective, non-invasive, has minimal risk of adverse effects or drug interactions, does not require medical supervision for practice in most cases, and has the added benefit of improving physical fitness.

13. CONTRIBUTION TO THE SOCIETY ……..
(GIVE DETAILS)

Indiscriminate dietary habits are major contributor to ill health and impaired physical capacity. Fasting offers one of the means to tackle it. Scientific demonstration of its benefits will enhance its acceptance in society. Jain way of fast has an additional benefit of spiritual component and its contribution is area of further research.

14. WHETHER ANY PH.D. ENROLLED/PRODUCED OUT OF THE PROJECT **No**…….

15. NO. OF PUBLICATIONS OUT OF THEPROJECT (PLEASE ATTACH RE-PRINTS) **Under process…**…….

(PRINCIPAL INVESTIGATOR) **(REGISTRAR/PRINCIPAL)**

Abstract

Objectives

This study aims to study impact of fasting on health i.e. weight, BMI, pulse, blood pressure, lipid profile, renal functions, blood sugar, hematological parameters, serum proteins and serum cortisol.

Materials and Methods

This was a prospective, non-randomized, single-blind, case control study to measure the effect of fasting on 110 subjects of either gender. These subjects fasted voluntarily for a varying duration of 3 days to 30 days. Observations were done in the morning hours in fasting state at the beginning and repeated after the last day of fast. It included height in cm, weight in Kg, pulse rate, blood pressure in mm of Hg with a sphygmomanometer. Venous blood samples were drawn for analysis of blood sugar, blood urea, serum protein, serum lipid le and serum cortisol levels. Data were recorded on excel sheet and analysed.

Results

A total of 110 cases healthy volunteers free from any major physical and mental illness (Females 83 and Males 27) in the age range of 13-86 years (average age of 51 years) were studied. They had undergone fast for varying duration between 3-30 days (Group A 1-5 days = 71; Group B 6-10 days = 34 and Group C >10 days = 5). There was decrease in body weight by 2.1 Kg in study group which was 1.8 Kg in group A and 2.6 Kg in group B and C. There was increase in pulse rate (80.8 to 82.7/min), diastolic BP (80.8 to 81.0 mm Hg), serum cholesterol (204.0 to 204.4 mg/dl), serum triglyceride (137.6 to 149.0 mg/dl), blood sugar (102.9 to 132.0 mg/dl)and serum cortisol levels (13.9 to 17.6 µg/dl) . In contrast, there was slight decrease in systolic BP (130.6 to 128.0 mm Hg), haemoglobin (13.2 to 12.5 gm/dl), serum total protein (7.5 to 7.37 gm/dl), serum albumin (4.4 to 4.37 gm/dl), serum globulin (3.1 to 3.0 gm/dl), serum HDL (48.3 to 45.7 mg/dl), serum LDL (133.0 to 134.0 mg/dl).

Conclusions

Fasting results in improvement in different parameters related to physical health to a variable extent. It can be recommended as a mean for improving quality of life.

Introduction

"Fasting will bring spiritual rebirth to those of you who cleanse and purify your bodies. The light of the world will illuminate within you when you fast and purify yourself. What the eyes are for the outer world, fasts are for the inner." – Mahatma Gandhi

Food is very foundational necessity for all forms of life. The world over, animals and plants rely on feeding of some sort. Eating is such a censorial experience and a normal part of my human experience. The issue of healthy eating has long been an important concern to individuals and cultures. Among other practices, fasting, dieting, and vegetarianism are all techniques employed by individuals and encouraged by societies to increase longevity and health. Contrary to popular belief, fasting isn't dangerous or unhealthy if it's done properly; it's actually healthy and beneficial.

Long-term calorie restriction (CR) causes many physiological changes that alter life-history traits such as growth, reproduction and lifespan. Studies have shown that reducing typical calorie consumption by 30-40% extends life span by a third or more in many animals, including nematodes, fruit flies and rodents (**Stripp 2013**). Even if CR does not help anyone live longer, a large portion of the data supports the idea that limiting food intake reduces the risks of diseases common in old age and lengthens the period of life spent in good health.

Fasting as a spiritual practice

From an evolutionary perspective, three meals a day is a strange modern invention. Fasting has long been associated with religious rituals, diets, and political protests. It has been practiced for thousands of years by various cultures all over the world. Religions have long maintained that fasting is good for the soul, but its bodily benefits were not widely recognized until the early 1900s. For most faiths, the sacrifice of food and water -- for hours, days, or weeks at a time -- is understood to be an intensely spiritual practice that allows for reflection and asceticism. While religious fasts are partaken primarily for spiritual purposes, they also have the potential to greatly affect one's physical health **(Trepanwski and Bloomer 2010)**.

Fasting has a long tradition in most cultures and religions. Religious fasting is intertwined with ritual and spiritual discipline and became a form of penitence and identification with the poor and unfortunate.

Fasting is associated with better health status. It is an accepted practice in all sections of society and across all religions. Controlled studies with animals and human have found fasting protects or improves diabetes, obesity, hypertension, asthma, cancers, heart disease, rheumatoid arthritis and neurodegeneration. Spirituality and science are coming together to show logical interlinking between science and religion. The majority of research that exists on fasting is testimonial, consisting of individual personal accounts of healing without statistics or controlled scientific experiments.

Review of Literature

Definition

Shrink the "eating window"; expand the "fasting window"

Today, fasting is considered to be taking place if you don't eat for a period of at least 8-12 hours. So technically, most of us are participating in a period of fasting every night when we sleep. In the morning, we break our fast; this is where the term breakfast comes from.

Fasting is primarily an act of voluntary abstinence or reduction from certain or all food, drink, or both, for a period of time to focus on health and / or spiritual upliftment (**Wikipedia, Rizza et al 2014**). An **absolute fast** is normally defined as abstinence from all food and liquid for a defined period, usually a single day (24 hours), or several days. In the traditional sense, fasting is the total and absolute abstinence from food and other liquid except water. Though a metabolic event, it is different from starvation in that it is voluntary and is done for enhancing physical and mind health. Fasting is distinct from caloric restriction (CR), in which the daily caloric intake is reduced chronically by 20%–40%, but meal frequency is maintained.

Fasting is a conscious and purely human action of abstaining from some or all kinds of food and drinks. Fasting may also be done by abstaining from other pleasurable activities like sleep, sex, and other vices. As religious philosophy and customs evolve; the term has become more liberal and loose in its application. Other fasts may be only partially restrictive, limiting particular foods or substances. Some of the most popular kinds of fasting are meat fasting, sweets fasting, juice fasting, lent fasting, a liquid fasting diet, and water fasting. The three most commonly studied fasts are caloric restriction (CR), alternate-day fasting and dietary restriction (DR).

History

The reasons for fasting include both health and spiritual reasons. The history of fasting goes back into antiquity **(Buchinger 1950, BusseGrawitz 1952, Heun 1954)**. There's no reason to think that early man did not fast in the normal course of his existence. All animals, even today, will fast during times of stress or illness. It is a natural tendency for the organism, whether human or animal, to seek rest, balance and to conserve energy at critical times. Dietary

restrictions were common in primitive cultures as most of these cultures have their own system of belief on what is safe to eat or what one must avoid eating.

The practice of ancient fasting had highly spiritual motivations. Many religious groups incorporate fasting into their rituals and fast on designated days of the week or calendar year (**Longo 2014**). Ancient traditions require that one should fast before undergoing an important event in their life. Shorter spiritual fasting in ancient cultures symbolizes cleansing rites. Other motivations of ancient fasting include the belief in purity of the spirit, rewards, and mysticism.

Fasting as a religious or spiritual activity has been a part of human customs even before major religions were established. The belief on the spiritual benefits of fasting is prevalent in Christianity, Islam, Buddhism, Hinduism, Jainism and other religions. All 24 Jain Tirthankers have been mentioned to do prolong great fast and meditation to achieve salvation. Fasting is also mentioned in great religious books like the Agams, Bible, Quran, Mahabharata, and Upanishads.

Yogic practices, including that of fasting, date back thousands of years and fasting is one of the oldest therapies in medicine. Many of the great doctors of ancient times and many of the oldest healing systems have recommended it as an integral method of healing and prevention. Ayurvedic medicine, the world's oldest healing system, has long advocated fasting as a major treatment. Hippocrates, Plato, Socrates, Aristotle and Galen all praised the benefits of fasting.

The scientific study of the health benefits of fasting seriously began in 1935 when Clive McCay and his colleagues observed that restricting the calories fed to rats in a laboratory, without producing malnutrition, prolonged their lifespan (**McCay 1935**). Thus science of Calorie Restriction (CR) was born. Hundreds of studies since then have shown that CR slows aging not only in mice and rats, but also in yeast, flies, worms and fish. In rats, it was shown that the intermittent ‘fasting’ could produce the same result as continuous fasting.

Fasting in different faiths

Fasting has a long tradition in most cultures and religions. Religious fasting is intertwined with ritual and spiritual discipline and became a form of penitence and identification with the poor and unfortunate. The reasons for fasting include both health and spiritual reasons. There is a widespread practice of fasting in many religious cultures, both ancient and modern, around the world. Fasting has long been associated with religious rituals, diets, and political protests. It has

been practiced for thousands of years by various cultures all over the world. Religions have long maintained that fasting is good for the soul, but its bodily benefits were not widely recognized until the early 1900s. For most faiths, the sacrifice of food and water -- for hours, days, or weeks at a time -- is understood to be an intensely spiritual practice that allows for reflection and asceticism. While religious fasts are partaken primarily for spiritual purposes, they also have the potential to greatly affect one's physical health. Jains do fast as a penance and self-control and a healthier life are secondary gains.

Buddhism

Prior to attaining Buddhahood, prince Siddhartha practiced a short regime of strict austerity—following years of serenity meditation during which he consumed very little food. Buddhist monks and nuns commonly do not eat each day after the noon meal. This is not considered a fast but rather a disciplined regimen aiding in meditation and good health. Lay Buddhists are instructed to observe the eight precepts which include refraining from eating after noon till the following morning on Uposatha days (roughly once a week).

Christianity

Biblical fasting and fasting rules under the Christian tradition are broad and varied. While do not believe in fasting, other Christian denominations and churches consider it as an external and acceptable practice. The Lenten fast observed in the Catholic Church and the Eastern Orthodox Church is a forty-day partial fast to commemorate the fast observed by Christ during his temptation in the desert. As per Christianity, fast is not merely abstinence from food or water, but a decision to fully obey God's commands to care for the poor and oppressed.

Hinduism

Fasting is a very integral part of the Hindu religion. Individuals observe different kinds of fasts based on personal beliefs and local customs. Some Hindus fast on certain days of the month such as Ekadasi, Pradosha, or Purnima. Certain days of the week are also set aside for fasting depending on personal belief and favorite deity. For example, devotees of Shiva tend to fast on Mondays, while devotees of Vishnu tend to fast on Thursdays and devotees of Ayyappa tend to fast on Saturdays. Fasting during religious festivals is also very common e.g. Mahashivratri and the nine days of Navratri.

Methods of fasting also vary widely and cover a broad spectrum. If followed strictly, the person fasting does not take any food or water from the previous day's sunset until 48 minutes after the following day's sunrise. Fasting can also mean limiting oneself to one meal during the day and/or abstaining from eating certain food types and/or eating only certain food types. Amongst Hindus during fasting, starchy items such as potatoes, sago and sweet potatoes; milk products, peanuts and fruits are allowed.

Islam

Fasting in the month of Ramadan is one of the Pillars of Islam. It is essentially an attempt to seek nearness to God and increase one's piety. Fasting is a unique moral and spiritual characteristic of Islam. Literally defined, fasting means to abstain "completely" from foods, drinks, intimate intercourse and smoking, before the break of the dawn till sunset during the entire month of Ramadan. Fasting also includes abstaining from any falsehood in speech and action, abstaining from any ignorant and indecent speech, and from arguing, fighting, and having lustful thoughts. They are also encouraged to temper negative emotions such as anger and addiction **(Sherif and Lakhdar 2010)**. The Siyam (fast) is intended to teach Muslims patience and self-control, and to remind them of the less fortunate in the world.

Bahá'í Faith

In the Bahá'í Faith, fasting is observed from sunrise to sunset during the Bahá'í month of `Ala'. It is the complete abstaining from both food and drink during daylight hours. Consumption of prescribed medications is not restricted. Along with obligatory prayer, it is one of the greatest obligations of a Bahá'í. It is essentially a period of meditation and prayer, of spiritual recuperation and to refresh and reinvigorate the spiritual forces latent in his soul.

Sikhism

Sikhism is probably the only major organised world religion that does not promote fasting except for medical reasons. The Sikh Gurus discourage the devotee from engaging in this ritual as it is considered to "bring no spiritual benefit to the person". It does not regard fasting as religiously meritorious. As per them, God has given us the human body which has to be nourished and cared for. Fasting as an austerity, as a ritual, as a mortification of the body by means of wilful hunger is forbidden in Sikhism. A Sikh is encouraged to practise constant

temperance and moderation in matters of food. Neither starves nor over-eats; just eat simple and nourishing food: this is the golden rule. Healthy food but in small quantities (Alap Ahar), just to keep body and soul together and to prevent sleep and sloth, this is recommended for a Sikh.

Jainism

The principles of Jain religion are most compatible and most relevant in present context for reinstating total physical and mental health, creating a positive health and removing diseases. Fasting is very common among Jains spirituality and as a part of Jain festivals. Although a Jain may take it upon him or herself to fast at any time especially if he or she feels some error has been committed, most of them will fast at special times during the year e.g. Paryushan (Wikipedia).

Paryushan is the most prominent festival, lasting eight days in Svetambara Jain tradition and ten days in Digambar Jain tradition during the monsoon. If one fasts for the eight days of Paryushana, it is called Atthai, and if one fasts for 10 days it is called dhash-lakshan, and when it is for one month, it is known as maskhamana. During this period they maintain a strict water-only fast. The warm water to be consumed should be only between sunrise and sunset and not during the night, since night is a highly-susceptible time for micro-organism activity.

Santhara is a form of fasting which is carried out to voluntary death. It is supposed to help shed karma according to Jain religion. The vow of Santhara is taken when one feels that one's life has served its purpose. The goal of Santhara is to purify the body and, with this, the individual strives to abandon desire. However, further discussion on Santhara is beyond scope of this paper.

Also, it is common for Jains not to fast but only to limit their intake of food. When a person only eats lentils and tasteless food with salt and pepper as the only spices, the person is said to do Ayambil. There are other types of fasting in which a Jain eats only one meal a day, which is known as Ekassana. Similarly, another fast, called Beasana, allows for two meals a day. The goal of all these fasting is to decrease desire and passion for the physical world, and attain spirituality by meditation.

Aim of fasting: It is not sufficient for a Jain simply to not eat when fasting. They must also stop wanting to eat. If they continue to desire food the fast is pointless. Jain fasts may be

done as a penance and to purify body and mind. It also reminds the practitioner of Mahavira's emphasis on renunciation and asceticism.

Methods of fasting in Jains

Fasts can be performed for varying lengths of time, depending on the person and his or her health requirements. There are several types of fasting:

- **Continuous fasting:** A continuous fast for varying duration as defined below.
- **Intermittent fasting:** It includes everything from periodic multiday fasts to skipping a meal or two on certain days of the week alternating with period or days of eating.
- **Complete fasting:** giving up food and water completely for a period.
- **Partial fasting (unodar)**: Eating less than you desire and to simply avoid hunger. It may also have **Rasa Parityaga** or giving up favourite foods and **Vruti Sankshepa** or limiting the number of items of food eaten

Duration of fast

- **Upvas:** To give up only food for the whole day.(starting from previous sunset to 2nd day sunrise - approximately 36 hours)
- **Chauvihar Upvas:** Like upvas, to give up food as well as water.
- **Tivihar Upvas:** One may drink boiled water between sunrise and sunset.
- **Digambar Upvas:** One may drink water only once a day before sunset.
- **Shvetamber Upvas:** One may drink boiled and cooled water after Porsi, provided this is done before sunset.
- **Bela/ Chhath:** To give up both food and water or only food continuously for two days.
- **Tela / Aththam:** To give up food and water or only food continuously for three days.
- **Aththai:** To give up food and water or only food continuously for eight days.
- **Navai:** To give up food and water or only food continuously for nine days.

- **Masakshaman:** To give up food and water or only food continuously for a whole month.
- **Varsitap:** Thus this fast is very rigorous since it entails a whole year with eating no food on alternate days and eating food on rest of the days, while following the prescribed rules like not eating in the evening after sunset, not eating root vegetables (like potatoes, onions, ginger), and various other rules. In Swetamber Varsitap they do Ekasanu alternate days and Upavas on the rest days.
- **Great fasts:** Some Jain monks fast for months at a time, following the example of Mahavira, who is said to have fasted for over 6 months to one year or more.
- **Santhara or to "fast unto death":** To give up food and water entirely.
- **Ekasana:** To eat one meal a day at one sitting and drink boiled water as desired between sunrise and sunset.
- **Beasana:** To eat two meals a day in two sittings and drink boiled water anytime between sunrise and sunset.
- **Ayambil:** Eating food once in one sitting. The food contains only cereals and pulses not sprouted and it is spice free and boiled or cooked, without salt, milk, curds, ghee, oil, oil seeds, or green/raw vegetables, fruits and sugar and its products.
- **Navkarsi:** Food and water is consumed a minimum forty-eight (48) minutes after sunrise. Devout Jains brush their teeth and rinse their mouths only after sunrise.
- **Porsi:** Taking food and water after 1/4 (25%) of the day passes.
- **Sadh-porsi:** Taking food and water after 3/8 (37.5%) of the day passes.
- **Purimuddh:** Taking food and water after 1/2 (50%) of the day passes.
- **Avadhdh:** Taking food and water after 3/4 (75%) of the day passes.
- **Chauvihar:** No food or water after sunset till at least Navkarsi next day. Many Jains practise this daily. Many Jains leave food or water before forty-eight (48) minutes of sunset.
- **Tivihar:** Like Chauvihar, but one may drink water.

- **Navapad Oli:** During every year for 9 days starting from the 6/7th day in the bright fortnight until the full moon day in Ashwin and Chaitra months, one does Ayambil. This is repeated for the next four and half years. Ayambils may be restricted to one kind of grain per day.

Preparations: To enter a fast, the diet should be gradually lightened over a few days. First, heavy foods such as meats and dairy products should be eliminated for a day or two. The day before a fast, only easily digested foods like fruits, light salads, and soups should be eaten. This period is called Dharna. During the fast, only pure water and occasional herbal teas should be drunk.

Fasts should be ended as gradually as they are entered, going from lighter to heavier foods progressively (**Parna**). The diet after a fast should emphasize fresh, wholesome foods. Fasters should particularly take care not to overeat when they complete a fast.

Physiology of fasting

Fasting has been practiced both as a religious ritual and for preventing and curing diseases. Fasting purifies the body of earth's wide variety of pollutants, thereby improving bodily health and function. Many health advocates today fast several times a year. Fasting improves the body's capacity and ability to better utilize the food eaten.

While the spiritual importance of fasting is widely known, its physical effects on the body are less clear. How does the human body begin to change when it is systematically deprived of food and water, particularly over the long period? Are there any biological benefits that accompany spiritual ones? Scientists do not yet know if long-term CR is safe, beneficial and practical for humans. Currently, the bulk of the scientific evidence for the health benefits of intermittent fasting has come from animal studies (**Longo and Mattson, 2014**)

Circadian rhythm, feeding and health: Story has been developing for a number of years about the connection between the gut and the brain. There is a need for increased metabolism during state of alertness and a decreased metabolism during state of sleepiness **(Longo and Panda 2016)**. Circadian disruptions can prime animals toward obesity. It has been observed that sleep-deprived night owls, eating less during late night hours may help curb the deficits in concentration and alertness that accompany sleep deprivation**. Hatori et al (2012)**

observed that mice fed a high-fat diet only during normal waking hours staved off obesity, metabolic dysfunction, and liver damage—all of which plagued animals with access to food around the clock. In a human study, it has been observed that there is negative neurobehavioral performance including significantly slower reaction times and more attention lapses during sleep restriction **(Spaeth et al 2013).** They also concluded that late-night fasting attenuates the performance decrement on vigilant attention caused by sleep restriction.

The body has a special mechanism that is initiated when no food is eaten. For many centuries, fasting was probably a normal occurrence for most people, and the body adapted to it. Through evolution, the body became very efficient at storing energy and handling situations when no food was available. When the intake of food is temporarily stopped, many systems of the body are given a break from the hard work of digestion. The extra energy gives the body the chance to heal and restore itself, and burning stored calories gets rid of toxic substances stored in the body.

Physical vs. psychological hunger: Fasting is not starvation but rather the body's burning of stored energy. It is estimated that even very thin people can survive for 40 days or more without food. Many people think hunger is an emergency and panic when it kicks in. When we experience hunger, it is not a true physiological (body) hunger, but rather psychological hunger.

When fast or calorie restriction is initiated, there is a critical transition period of about 3-6 weeks during which the body and brain adapt to the new eating schedule (**Longo and Mattson, 2014**). This period can be very uncomfortable, as restricted eating has been associated with extreme hunger, irritability, loss of strength, loss of libido, and other side effects (**Johnstone 2007; Heilbronn et al 2005**). Once the body is accustomed, however, the hunger levels may decrease and mood could become more positive compared to before the fasting program started

Lack of fuel in the body can be corrected by a variety of substances that provide energy. Many physiological changes occur in the body during fasting. The food resources during the fast are mainly fat and to a lesser degree the cytoplasm of muscle, liver, bones marrow and other organ cells. Most of its energy source is depleted within the first 24 hours of fasting and after that body begins using fat as source of energy. Fat burning results in ketosis that occurs usually during the third day of a fast for men and the second day for women. In this highly efficient state,

the liver begins converting stored fat and other nonessential tissues into ketones, which can be used by the brain, muscles, and heart as energy. It is at this point in the fast that sensations of hunger generally go away and many people experience normal or even increased energy levels. Hormone levels and certain functions become more stable in this state as well. The goal of most fasts is to allow the body to reach the ketosis state in order to burn excess fat and unneeded or damaged tissue. However, ketosis is not sufficient to meet energy requirement and the body gets the rest of it from breaking down the amino acids in muscle tissue.

To fuel the additional requirement, the body would need to burn over a pound of muscle a day. However, body has developed another way to create energy that saves important muscle mass. After prolonged fasts of more than a week, the body starts seeking out non-body protein sources of fuel, which include nonessential cellular masses like degenerative tissues, bacteria, viruses or anything else in the body that can be used for fuel. The conservation of the body's protein is believed by many to be an evolutionary development that exists to protect muscle tissue and vital organs from damage during periods of insufficient food availability.

Protection of vital organs: A most brilliant design characteristic about life is that while we are fasting and securing our nutrition from many internal resources, not one minuscule fragment of the eyeball or the brain is consumed as food. None of these living tissue structures are sacrificed. They are only reduced in size. The more vital the tissue, the less it is touched.

Role of the brain: Brain has a complex neural and humoral (chemical) circuitry to control food intake. Feeding is resumed either because of emptying of the digestive tract by digestion and absorption or because of fuel depletion by catabolism. Taste, and perhaps other (e.g. visual), receptors are stimulated by palatable food and motivation for feeding is increased. Signals from distended digestive tract and behaviour pattern results in satiety and feeding motivation is lowered. The net result of this interplay of positive and negative feedbacks from food responses is that caloric intake, observed over a sufficiently long period (at least several days), is equal to energy output over that period, so that body fuel content (body weight in fully grown individuals) remains constant.

The neural circuitry involves limbic system (the marginal zone of the forebrain) and the hypothalamus that detect hunger and satiety signals from other parts of the body. The lateral hypothalamus has hunger centre that facilitates feeding responses. Electrical or chemical

stimulation of this area elicits voracious feeding in satiated subjects, and its destruction causes more or less prolonged noneating (aphagia). In contrast, the ventromedial (lower central) nucleus of the hypothalamus controls satiety. Subjects with lesions in this area stop feeding only at an abnormally high level of energy content and grossly overeat.

There are two peptides in the hypothalamus that produce hunger, melanin concentrating hormone (MCH) and orexin. MCH plays a bigger role in producing hunger. Orexin plays a greater role in controlling the relationship between eating and sleeping. Other peptides in the hypothalamus that induce eating are neuropeptide Y (NPY) and agouti-related protein (AGRP). Satiety in the hypothalamus is stimulated by leptin. Leptin targets the receptors on the arcuate nucleus and suppresses the secretion of MCH and orexin. The arcuate nucleus also contains two more peptides that suppress hunger. The first one is cocaine- and amphetamine-regulated transcript (CART) and the second is α- melanocyte-stimulating hormone (α- MSH).

Molecular mechanism of benefits from fasting

Fasting acts in part as a form of mild stress that continually stimulates cellular defences against molecular damage. For instance, occasional fasting increases the levels of "chaperone proteins," which prevent the incorrect assembly of other molecules in the cell. Additionally, fasting mice have higher levels of brain-derived neurotrophic factor (BDNF), a protein that prevents stressed neurons from dying **(Stanek et al 2008)**. Low levels of BDNF have been linked to everything from depression to Alzheimer's, although it is still unclear whether these findings reflect cause and effect. Fasting also ramps up autophagy, a kind of garbage-disposal system in cells that gets rid of damaged molecules, including ones that have been previously tied to Alzheimer's, Parkinson's and other neurological diseases.

Animal studies have routinely showed that intermittent fasting strengthens the body's innate response to stress **(Chung et al 2002, Longo and Mattson 2014**). In a human study in which eight males and eight, females of a healthy body weight, fasted every other day for 21 days participants lost about 2.5 ± 0.5% of their body weight including 4 ± 1% of fat mass (**Heilbronn 2005**). Neither fasting blood glucose nor ghrelin (an appetite hormone) concentrations changed before vs. after the intervention, but fasting insulin concentrations decreased suggesting greater insulin sensitivity. They did not observe changes in genes involved in mitochondrial biogenesis, fatty acid transport or fatty acid oxidation suggesting that the

metabolic machinery required for generating energy from fat was sufficient at the start of the study.

In trying to find the mechanism by which CR produces its benefits, scientists have discovered a family of proteins called the *sirtuins* with a variety of functions in keeping cells healthy. It has been shown that CR leads to an activation of SIRT1, the first and the best-studied sirtuin **(Qin et al 2006).** This raises the possibility that instead of reducing calories, one could achieve the same result by consuming these substances, or even a pill containing resveratrol and similar compounds. Human growth hormone release (HGRH) showed an increase of an average of 1,300 percent in women and nearly 2,000 percent in men later in the fast.

Benefits of fasting

"Everyone has a doctor in him; we just have to help him in his work. The natural healing force within each one of us is the greatest force in getting well. …to eat when you are sick, is to feed your sickness." – Hippocrates

The bulk of the scientific evidence for the health benefits of fasting has come from animal studies (**Longo and Mattson, 2014**). An ill or injured animal's first instinct is to abstain from solid food until it is again healthy. They instinctively know that the healing process will be much faster and more effective when it abstains from solid food. This instinct has always existed within the animal kingdom. The human body also has this same instinct, for it is common for most people to stop eating when illness strikes.

Fasting has been both as a religious ritual and for preventing and curing diseases **(Wikipedia)**. With fast, body starts releasing stored low-grade energy stored as fat. Since the blood always tries to keep its level of protein constant, it will keep these levels up by also breaking down inferior tissues of diseases, damaged, aged or dead cells, abnormal growth tissues, tumors, and other undesirable tissues. After 10 to 12 hours of time fasting, the body enters into a self-protection mode and starts scavenging for other sources of energy throughout the body to sustain itself. One of the related actions is to pull LDL (bad) cholesterol from the cells of the body. It can ameliorate disease processes and improve functional outcome in disorders such as cancer, myocardial infarction, hypertension, asthma, diabetes, obesity, rheumatoid arthritis, stroke, Alzheimer's' disease, and Parkinson's disease (**Panowsky et al 2007, Sundvall et al 2011, Horne 2015**).

Like all age-old customs and traditions, fasting has interesting health benefits that we are only discovering today with modern technology **(Wikipedia)**. Although it started out as a religious or spiritual activity, fasting has become a legitimate secular practice especially when applied to Western and alternative medicine. Medically, fasting allows the body to reorganize its nutrients. Human organs regenerate during the fast. Most of these benefits are realized only after a longer periods of fasting – around 20-24 hours. Many diseases are prevented with occasional fasting and extended fasting is recommended as therapy for various conditions. The majority of health-specific findings related to fasting are mixed and it depends on breed of animal, age when fasting was initiated, health and disease status of individual, activity status including exercises, type and duration of fast, history of smoking, earlier food choices and eating habits (**Longo & Mattson, 2014**).

Brain health

Mattson and other researchers have championed the idea that intermittent fasting lowers the risks of degenerative brain diseases such as Parkinson's and Alzheimer's disease. They have also shown that periodic fasting protects neurons against various kinds of damaging stress, at least in rodents. In follow-up rodent studies, his group found that intermittent fasting protects against stroke damage, suppresses motor deficits in a mouse and slows cognitive decline in mice genetically engineered to mimic the symptoms of Alzheimer's.

Improved neurogenesis, neuronal plasticity and high insulin levels have been linked to better cognition. In mice, reducing calories also promotes neurogenesis and slows certain Alzheimer's-related changes in parallel with reductions seen in blood insulin and inflammation. Thus, there is great interest in examining the effects of CR on brain health in humans and in comparing its effects with those of other diets (for example, diets rich in healthier unsaturated fats) that may also help memory.

Longevity

The role of IF in aging and diseases in rodents is still controversial. Mouse studies using different genetic backgrounds indicate that IF can have no effect on mean lifespan and may even reduce lifespan when started at 10 months of age. Even when the IF was started at 1.5 months, the effects on longevity were minor and not consistent. In contrast, it has been observed that bacteria and baker's yeast, switched from rich medium to NaCl or water, respectively, survive

several fold longer, and the removal of bacteria from this medium causes a major lifespan extension **(Fontana et al 2010).** Long-term calorie restriction (CR) causes numerous physiological changes that ultimately increase mean and maximum lifespan of most species examined to date (**Kristan 2008, Arumugam et al 2010**). Calorie restriction (CR) is an effective and reproducible intervention for increasing life span, reducing oxidative damage, enhancing stress resistance and delaying/preventing aging and age-associated diseases such as cancer in various species, including mammals

Research in some animals has shown calorie restriction of up to 40 percent or fasting every other day (intermittent fasting) have an impressive positive effect on diseases, stress resistance, insulin sensitivity, markers of aging and life span (**Mattson et al, 2004, Martin 2006**). Even though calorie restriction appears to work in a variety of species, its effects on longevity are far from universal. It has been found to extend the life of protozoa (very small, one-celled organisms), yeast, fruit flies, some strains of mice, and rats, as well as other species. However, several animal models, including wild mice, show no lifespan extension by CR. In some strains of mice, calorie restriction even appears to shorten lifespan. Studies in nonhuman primates have also had conflicting results.

Given the growing older population and the rising rates of obesity, the role of diet in maintaining peak brain performance has taken on added importance. Although the links between CR and longevity are still not fully proven in humans, short-term human trials have clearly shown that CR can improve many vital surrogate health markers such as body weight, blood pressure, blood sugar, insulin, cholesterol and triglyceride levels and measures of inflammation. Prolonged fasting also lowered levels of IGF-1, a growth-factor hormone that has been linked to aging, tumor progression and cancer risk **(Arumugam et al 2010, Brecchia et al 2006)**.

Weight loss

Exercise is the King and Diet is the Queen

Weight loss occurs most rapidly during the first few days of a fast, up to 2 pounds per day. In following days, the figure drops to around 0.5 pound per day. An average weight loss of a pound a day for an entire fast can be expected. A weight loss rate of almost 3 pounds per day was achieved in water fasting weight loss experiment, while less than half of the lost weight were actual body fat losses. Everything else was fat-free mass, which included water released

from glycogen stores depletion, water released because of zero-sodium intake, muscle tissue breakdown and the emptying of the colon. There are conflicting views on whether intermittent CR vs. daily CR best preserve lean muscle mass **(Araya et al 2008, Varady et al 2009, Johnstone 2007**).

According to nutritionist, fasting should never be undertaken to lose weight. At the same time, some weight loss is reported by most people who fast. They warn, however, that excess fasting can lead to starvation and should be avoided at all costs.

Metabolic syndrome and atherosclerosis

Metabolic changes with fasting are lowering of body mass, increased high-density lipoprotein cholesterol (HDL or good cholesterol), decreased triglycerides and low-density lipoprotein cholesterol (LDL or bad cholesterol), lower fasting glucose and insulin concentrations, increased sensitivity to insulin-mediated glucose uptake and reduced biomarkers of oxidative stress and markers of inflammation (including CRP, IL-6, TNF, BDNF, and more) (**Wing et al 1991, Chung et al 2002, Horne 2008**). One of fasting's main effects is to increase the body's responsiveness to insulin. Long-lived animals and people tend to have unusually low insulin, because their cells are more sensitive to the hormone and therefore need less of it. Decreased sensitivity to insulin often accompanies obesity and has been linked to diabetes and heart failure **(DeFronzo 1992, Halberg et al 2005, Mattson 2004**). There is a lowering of heart rate, blood pressure, atherosclerosis and risk for coronary disease with increase in heart rate variability and improved cardiac response to myocardial infarction (**Varady and Hellerstein 2007**).

Findings of the Comprehensive Assessment of Long-term Effects of Reducing Intake of Energy (CALERIE) pilot study in humans showed that overweight adults who cut their calorie consumption by 20 to 30 percent lowered their fasting insulin levels and core body temperature (**Stewart 2013**). Both of these changes correlate with increased longevity in animal models. The lower calorie intake also reduced their risk for major causes of mortality such as heart disease and diabetes (**Anson et al 2003, Fontana et al 2004**).

Hypertension

PF may also be beneficial in the treatment of hypertension. In a study, 13 days of water-only fasting reduced systolic blood pressure below 120 in 82% of subjects with mild hypertension (**Goldhamer et al., 2002**). Blood pressure remained significantly lower after subjects had returned to their normal diet for 6 days. In another study, 10–11 days of fasting decreased systolic blood pressure of hypertensive patients by 37–60 mm, but this study did not follow patients after they returned to their normal diet (**Goldhamer et al., 2001**). In summary, both IF and PF have potential applications for inflammatory and cardiovascular diseases, but additional, larger, and randomized studies are needed before these strategies can be integrated into the standard of care by physicians.

Cancer

Fasting can theoretically inhibit several critical pathways in the development and progression of cancer while simultaneously causing malignancies more sensitive to treatments, for instance chemotherapy and radiotherapy. However, more clinical trials are needed in this area to warrant optimal outcomes. Short-term fasting (48 hours) was shown to be effective in protecting normal cells and mice but not cancer cells against high dose chemotherapy, termed Differential Stress Resistance (DSR) **(Zhu et al 1999, DeLorenzo et al 2011)**.

Fasting not only protects against immune system damage -- a major side effect of chemotherapy -- but it also stimulates the regeneration of the immune system by shifting stem cells from a dormant state to a state of self-renewal. (**Cheng et al 2014**). One of the amazing characteristic of fasting is the principle of *autolysis*. This is the ability of the organism to selectively self-digest and removes unwanted material and accumulations from within the body without touching vital structures. In fasting, this quality of life becomes greatly enhanced so that many tumors, cysts, abscesses, abnormal accumulations, fatty deposits etc. may be completely or largely absorbed.

Mental Health

Fasting may be religiously mandated but the social and communal traditions that accompany the practice carry just as much benefit. Engaging in fasting brings families and social

groups closer together. This often helps people suffering from depression and loneliness by reassuring them that they are not alone.

Mood improvement

In a controlled exploratory study of 55 subjects with chronic pain, 8-day fasting (300 kCal/d) showed a significant mood improvement after 5 days independently of weight loss, decreased leptin level or increase of plasmatic cortisol **(Haleem 1993, Fekete et al 2006, Michalsen et al 2006**). Another uncontrolled study reported an improvement in subjective sleep quality, mood and concentration after eight days of modified fasting (**Michalsen et al 2003a**). Mechanism behind mood improvement is still not clear. It could be the release of endogenous endorphins, found in humans after 5-10 days of fasting with no correlations with weight loss. One study reported an increase by 5 levels of endogenous opiate production in rats during the first 24 hours of fasting and 2 during the first 48 hours. Production of ketone bodies could be involved in improving mood, decreasing pain sensation, and promoting neuro-neuronal protection against hypoglycemia and different types of brain damage possibly through anticonvulsant properties (**Brown, 2007; White et al 2007, Gasior et al., 2007; Hasebe et al 2010; Likhodii et al 2003; Zarnowska et al 2009**).

Reproductive health

Diet and reproduction have a mutually benefiting relationship. Overweight and obesity in early adulthood appear to increase the risk of menstrual problems, polycystic ovary syndrome (PCOS), hypertension in pregnancy, and subfertility (**Lake et al 1997, Nair and Khawale 2016**). Studies reveal that as little as 5–10% weight loss has significant clinical benefits improving psychological outcomes, reproductive features (menstrual cyclicity, ovulation, and fertility), and metabolic features (**VanDam et al 2002**)

Immune system

IF fasting may also have some effects on inflammatory diseases, since 2 months of alternate day fasting resulted in a significant reduction in inflammatory markers in patients suffering from asthma. One of the well-established clinical uses of PF is in the treatment of rheumatoid arthritis (RA). Four different controlled studies have indicated that fasting periods lasting from 1 to 3 weeks reduce the symptoms of RA, although these effects are reversed by a

return to the normal diet unless the PF is followed by a vegetarian diet (**Müller et al., 2001, Lavin et al 2011**).

Other diseases

CR delays the onset of the autoimmune diseases, cardiomyopathies, renal diseases, neurodegenerative diseases and respiratory diseases. Fasting can be used for nearly every chronic condition, including allergies, anxiety, arthritis, asthma, headaches and digestive disorders. It is frequently prescribed as a detoxification treat people who have been exposed to high levels of toxic materials. Fasting is thought to be beneficial as a preventative measure to increase overall health, vitality, and resistance to disease. Malnourished or people with malabsorption symptoms can benefit from occasional fasting.

Political application

Fasting is often used as a tool to make a political statement, to protest or to bring awareness to a cause. A hunger strike is a method of non-violent resistance in which participants fast as an act of political protest, or to provoke feelings of guilt, or to achieve a goal such as a policy change.

Restriction on Fasting

Restrictions have been imposed on too young (<15 years) and too old (>70 years); those suffering from illnesses; women who are pregnant, lactating or menstruating; travelers who meet specific criteria; and individuals whose profession involves heavy labor and in whom fasting would be dangerous (**Longo and Mattson, 2014**). For those involved in heavy labor, they are advised to eat in private and generally to have simpler and/or smaller meals than are normal. Contraindications for fasting are those with asthma, cancer, diabetes, eating disorders, schizophrenia, tuberculosis, ulcerative colitis etc.

Side effects

Medical supervision is recommended for any fast over three days. Those with health conditions should always have medical support during fasting. Those performing extended fasts and those with health conditions may require blood, urine, and other tests during fasting. Plenty of water should be taken by fasters since dehydration can occur. However, excessive intake of water without the corresponding amount of electrolytes can lead to hyponatraemia. Any fast

longer than 48 hours runs the risk of metabolism to slow down and one may gain weight more easily once the fast is over (**Cheng 2014**). Taking time off of work is helpful, or at least reducing the work load. Exercise should be kept light, such as walking and gentle stretching.

Those fasting may experience side effects of fatigue, malaise, aches and pains, emotional duress, acne, headaches, allergies, swelling, vomiting, bad breath, and symptoms of colds and flu. Fasting leads to a loss of water, Na+, and K+, resulting in postural hypotension, and decreased blood sugar. Excessive fasting for calorie restrictive purposes, accompanied by intense fears of becoming overweight, are associated with mental disturbances including anorexia nervosa.

A recent study on athletic performance during Ramadan concluded that hunger and thirst cause stress to the athlete and only a modest decline in performance are observed (**Chaouachi et al 2009**). These athletes have a high propensity for dehydration during Ramadan unlike during other approaches to intermittent fasting.

Limitations

Several major obstacles may be responsible for the very limited contribution of PF to standard medical practice: (1) the lack or pre-clinical and clinical data supporting specific and consistent effects of fasting on the prevention and treatment of diseases, and the mechanisms involved; (2) the safety concerns related to the adoption of water-only consumption or the frequently adopted very low calorie diets (200 kcal) outside of a clinic; and (3) the difficulties associated with this approach.

Material & Methods

This was a prospective, randomized, case control study conducted during Paryusan parv to measure the effect of fasting on 110 subjects of either gender. They were explained the purpose and goal of the study. Strong motivating factor was the guidance provided by Sadhviji Shri Trishila Kumariji during her pravas at North Howrah, Kolkata. It was supplemented with efforts of local volunteers from Jain Vigyan Academy of Kolkata. Participants with the help of volunteers completed a basic demographic questionnaire including age and date of birth, gender, marital status, occupation, income, and education on a pre-structured proforma (appendix 1). A complete physical examination and review of their medical records were done. Basic systemic and neurological examination was done in all subjects.

Objectives

Present study aims to study impact of fasting on health i.e. weight, lipid profile including cholesterol levels, blood sugar, hemoglobin, serum proteins etc.

Intervention: During Paryusan parva, lot of people does prolong fasting of 3 days or more. They were motivated to be subject of study. All subjects were doing water only fast. In addition they were engaged mostly in religious rituals with reduction in physical activity.

Place of study: At Jodhpur, Kolkata,

Inclusion Criteria:

1. Age between 18years to 86 years
2. Informed consent given after explaining purpose of study.
3. Voluntary doing the fast.
4. Physically fit for fasting.

Exclusion Criteria:

1. Neurological, cognitive and physical disabled to the extent of not able to do effective fasting and undergo various tests of study.

2. Those participants whose health significantly deteriorates because of any acute illness during study period.

Detailed research plan

Measurements were made at start of fast and after termination of fast. These included height, weight, pulse, systolic and diastolic blood pressure, and blood sampling. All assessments were conducted in the morning in fasting state.

Parameters of study

Anthropometric parameters: Height was measured without shoes to the nearest 0.1 cm. Body weight was measured (to the nearest 0.1 kg) with a calibrated digital weighing scale (Tanita BWB-800A; Tanita, Corp., Tokyo, Japan) in the morning in light clothing without shoes. Body mass index (BMI) was calculated by dividing body weight (in kilograms) by the square of height (in meters).

Pulse was measured for one minute while lying down.

Blood pressure: BP was measured with mercury sphygmomanometer while lying down after 5 min of rest in a quiet environment.

Blood Analyses: A fasting venous blood sample was taken in the morning to determine lipid and hormone concentrations. Blood sample were analysed at a designated laboratory. It included complete blood count, blood sugar, blood urea, serum creatinine, serum protein (including albumin and globulin levels), serum lipid profile and serum cortisol levels.

Statistical analysis: The data generated were entered in excel sheet and analysed by appropriate statistical tests.

Expected Outcome

A positive improvement in weight and BMI and various biochemical parameters will be demonstrated.

Study Start Date	September 1, 2015
Date of completion of primary data	Sep 30, 2 015
Date of completion of data analysis	31 Jan 2016
Submission of report	31 Jul 2016

Results

A total of 110 subjects participated in the study. Majority of subjects were female (83) in the age range of 40-69 years (Table 1). Most of them did fast for 3-5 days (71) followed by 6-10 days (34). Five subjects fasted for 11-30 days.

Table 1 Age & gender distribution

Duration of fast (days)	10-39 Years			40-69 Years			70 + Years			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
1-5	1	6	7	9	44	53	4	7	11	14	57	71
6-10	3	12	15	6	10	16	2	1	1	11	23	34
>10	0	0	0	2	3	5	0	0	0	2	3	5
Total	4	18	22	17	57	74	6	8	14	27	83	110

Changes in physical parameters

Body weight & BMI: There was a reduction in body weight from average of 66.8 Kg to 64.7 Kg following fast (Table 2). It was more evident in those who fasted for 6 days or more. BMI also showed similar trend (Table 3).

Table 2. Average change in body weight & BMI

Duration of fast (days)	Body weight (Kg)		BMI	
	Pre-fast	Post-fast	Pre-fast	Post-fast
1-5	68.5	66.68	27.9	27.17
6-10	62.0	59.36	24.7	23.69
>10	76.0	73.36	31.7	30.6
Total	66.8	64.67	27.1	26.22

Pulse rate: Following fast, there was slight increase in pulse rate from average 80.8 to 82.7 per minute (Table 3). This increase was for those who fasted for shorter duration (3-5 days). Those who fasted for longer duration (>10 days) conversely shows reduction in pulse rate.

Table 3. Average change in pulse rate

Duration of fast (days)	Pulse rate / min	
	Pre-fast	Post-fast
1-5	81.4	84.4
6-10	79.7	79.9
>10	83.8	79.2
Total	80.8	82.7

Blood pressure: Following fast, there was small reduction in systolic blood pressure from average of 130.6 to 128.0 mm Hg (Table 4). In contrast, a small and insignificant increase in diastolic BP was observed. These changes were most pronounced in those who fasted for >10 days.

Table 4 Average change in systolic BP (mm Hg)

Duration of fast (days)	Systolic BP		Diastolic BP	
	Pre-fast	Post-fast	Pre-fast	Post-fast
1-5	135.97	134.0	83.0	84.0
6-10	121.53	120	77.4	77.0
>10	124.0	119.0	80.4	80.0
Total	130.58	128.0	80.8	81.0

Serum protein: Following fast, serum total protein, albumin and globulin levels slightly increased with shorter duration fast (upto 5 days) but start decreasing with longer duration fast (Table 5).

Table 5: Change in Serum Protein (Gm%)

Duration of fast (days)	Total Protein		Serum Albumin		Serum Globulin	
	Pre-fast	Pre-fast	Pre-fast	Post-fast	Pre-fast	Post-fast
1-5	7.455	7.61	4.4	4.496	3.09	3.12
6-10	7.56	7.01	4.46	4.216	3.1	2.8
>10	7.028	6.47	4.04	3.712	2.99	2.76
Total	7.469	7.37	4.4	4.371	3.09	3.01

Renal functions: Following fast, blood urea and serum creatinine increased with shorter duration fast (upto 5 days) but start decreasing with longer duration fast (Table 6).

Table 6: Changes in renal parameters (Blood urea and serum creatinine-mg%)

Duration of fast (days)	Blood urea mg%		Serum Creatinine mg%	
	Pre-fast	Post-fast	Pre-fast	Post-fast
1-5	25.2	34.9	0.72	0.75
6-10	27.47	20.5	0.81	0.70
>10	23.6	14.8	0.93	0.77
Total	25.72	29.3	0.76	0.73

Blood Sugar: Fasting blood sugar increased with fast upto 10 days but started declining with longer duration fast (Table 7).

Table 7: Changes in blood sugar level during fast

Duration of fast (days)	Total	
	Pre-fast	Post-fast
1-5	103.7	144.01
6-10	99.09	111.26
>10	121.4	109.2
Total	102.9	131.95

Lipid levels: Serum triglyceride and cholesterol levels increased with fast upto 10 days but started declining with longer duration fast (Table 8). While high density lipoprotein (HDL) levels showed an increase, low density lipoprotein (LDL) demonstrated reverse changes during the fast.

Table 8: Changes in serum lipid level (mg%) with fast

Duration of fast (days)	S Triglyceride		S Cholesterol		S HDL		S LDL	
	Pre-fast	Post-fast	Pre-fast	Post-fast	Pre-fast	Post-fast	Pre-fast	Post-fast
1-5	135.7	143	205.7	217.1	50.36	48.4	134	145.03
6-10	141.4	167	204.44	185.1	45.06	41.1	135	117.97
>10	149.6	128	165.8	159.2	42.6	39.6	99.2	98.6
Total	137.6	149	202.95	203.8	48.34	45.7	133	133.96

Serum cortisol levels: Serum cortisol levels increased throughout the fast. This increment was most in fast of greater than 10 days duration.

Table 9: Changes in serum cortisol level with fast

Duration of fast (days)	**13-30 Years**	
	Pre-fast	**Post-fast**
1-5	12.53	16
6-10	15.59	19.6
>10	14.86	19.8
Total	13.53	17.2

Discussion

Fasting is considered a pious practice and it is auspicious to do it during Paryusan parv. Of the 110 participants in this study, 83 (73.5%) were females (Table 1). Majority of the participants (67.2%) were in the age range of 40-69 years. These demographic features are in parallel with prevalence of religious belief in the society. There is need to study this pattern in detail and younger people require being motivated for fasting.

Body weight & BMI: Fasting does result in weight loss (**Varady et al 2009, Johnstone 2007)**. In present study we have observed reduction in body weight from average of 66.8 Kg to 64.7 Kg following fast (Table 2). It was more evident in those who fasted for 6 days or more. BMI also showed similar trend (Table 3). While in initial period major contributor is loss of water. Body fat and muscle mass rescue the calorie deficiency in later stage. However, fasting should not be recommended for weight loss and its long term effect in post-fast period is a matter of future research.

Pulse rate & BP: There are sufficient evidence that heart rate and blood pressure slow down during fasting (**Goldhamer et al., 2002**). In present study, while systolic BP came down slightly, diastolic BP showed slight increment (Table 4). These changes were more apparent in subjects who fasted for longer duration. In contrast, pulse rate showed increment during shorter duration fast and decrement with longer duration fast (Table 3). These changes in pulse and BP could be due to initial stress with fasting to which subject gets adjusted as the fast progresses.

Blood sugar: In the event of fast, carbohydrates are first mobilized and body store of complex carbohydrates (e.g. glycogen) is converted to simple carbohydrate (e.g. glucose) to meet body requirement. In present study also an increment was also noted throughout the fasting. However, it was more evident with shorter duration fast than later on (Table 7). It can be hypothesized that as fast progresses, physical activity declines and reduces energy requirement

Serum lipids: As fast progresses, fats are also mobilized in addition to carbohydrates. There is increase in serum triglyceride levels with no significant change in total cholesterol levels (Table 8). This suggests that body is looking for fat as source of energy. While high density cholesterol (HDL) did showed reduction, there was no change in low density cholesterol (LDL). Significance of this change need further study.

Serum proteins: While fat component of body meets immediate deficiency of calories in the event of fast, in next stage proteins are mobilized. However, this compensation fails in later stage. Thus serum proteins will initially rise and will fall as fast progresses. Predictably in this study, serum total protein, albumin and globulin levels slightly increased with shorter duration fast (upto 5 days) but start decreasing with longer duration fast (Table 5).

Renal functions: Blood urea and serum creatinine reflects breakdown of proteins in the body. In this study, these parameters increased with shorter duration fast (upto 5 days) but start decreasing with longer duration fast (Table 6). Increase observed during initial period is contributed by protein breakdown as well as by dehydration. During later period of fast, decrement in renal parameters is the result of decrease in serum protein levels.

Serum cortisol: It is an indicator of stress of both types in the body i.e. physical (metabolic) and mental. Fasting is a strong metabolic stress for the body and cortisol makes an attempt to correct glucose deficit in blood. For few subjects, even fasting is a stress on mind as well. Predictably, in this study we have observed an increase in cortisol level throughout the fast (Table 9). It was further observed that corisol level increased in initial period but stabilised or decline with prolong fast.

Fasting results in varied changes in metabolic milieu of the body. It is related to duration of fast as well as to associated physical and religious activity. Fasting offers significant advantages in terms of improvement in different parameters related to health to a variable extent which required further study on large sample to strengthen the results of the study. It is a cost-effective, non-invasive, has minimal risk of adverse effects or drug interactions, does not require medical supervision for practice in most cases, and has the added benefit of improving physical fitness.

Limitations

1. This is preliminary attempt and it opens the way for advanced studies.
2. In this study, the main limitation is that subjects were not followed in post-fast period to assess impact on their health.
3. Physical activities as well as mental activity (in form of religious practices) were not monitored.

Conclusion

Fasting has profound beneficial effects on the human health. Present study, first of its kind on prolong fasting, has convincingly demonstrated an improvement in all parameters.

A total of 110 cases healthy volunteers free from any major physical and mental illness (Females 83 and Males 27) in the age range of 13-86 years (average age of 51 years) were studied. They had undergone fast for varying duration between 3-30 days (Group A 1-5 days = 71; Group B 6-10 days = 34 and Group C >10 days = 5). All subjects were studied for weight, BMI, pulse rate, blood pressure, haemoglobin level, biochemical parameters (serum protein and albumin-globulin ratio, blood sugar, blood urea, serum creatinine, lipid profile and serum cortisol level at beginning of fast and repeated at close of fast. All measurements were done in the morning in basal condition. All data obtained were entered in excel sheet and analysed.

There was decrease in body weight by 2.1 Kg in study group. It was observed that weight & BMI did showed decline upto 10 days but stabilised thereafter. There was slight increase in pulse rate (80.8 to 82.7/min), diastolic BP (80.8 to 81.0 mm Hg), serum cholesterol (204.0 to 204.4 mg/dl). In contrast, there was slight decrease in systolic BP (130.6 to 128.0 mm Hg), serum total protein (7.5 to 7.37 gm/dl), serum albumin (4.4 to 4.37 gm/dl), serum globulin (3.1 to 3.0 gm/dl), serum HDL (48.3 to 45.7 mg/dl), serum LDL (133.0 to 134.0 mg/dl). However, these changes were insignificant.

Renal functions (blood urea and serum creatinine) showed increase till 6 days and then decline with longer fast. Blood sugar levels increased (from average of 102.9 to 132.0 mg/dl) following fast and it was more apparent with shorter duration fast. A similar trend was observed with serum triglyceride (from 137.6 to 149.0 mg/dl). Serum cortisol levels (marker of metabolic stress and anxiety) showed an increase from 13.9 to 17.6 µg/dl, which was uniform at various duration of fast.

Indiscriminate dietary habits are major contributor to ill health and impaired physical capacity. Fasting offers one of the means to tackle it. Scientific demonstration of its benefits will enhance its acceptance in society. Jain way of fast has an additional benefit of spiritual component and its contribution is area of further research.

Areas of future research

Research on the physiological basis and consequences of prolong fasting are limited. This research has a tremendous future. Apart from absence of food, contribution of religious activities and faith need to be assessed. It was observed by us that participants were very eager and inquisitive about health benefits associated with fasting. However, they were apprehensive of being subjects of study particularly with collection of blood samples. Role of religious teachers and social leaders is immense to mitigate this fear.

There is immense ignorance with many myths in public & scientific community abouth benefits and limitation with fasting. Researchers need to be dedicated and motivated. The majority of research that exists on fasting is testimonial, consisting of individual personal accounts of healing without statistics or controlled scientific experiments. Some of the areas of research are as below;

1. To study physiological changes in details with fasting and to delineate anatomical, biochemical and hormonal pathways.
2. To identify and standarise parameters for carbohydrate, fat, protein & mineral
3. To standarise neurophysiological & neuroimaging studies
4. To standarise hormonal assays
5. Specific psychosocial parameters study and to identify beneficial effect on human health including cognition, mental health and physical fitness
6. Long term sequels of fasting
7. Beneficial effect on various diseases
8. Public education
9. Literature review: Fasting as a model of total health, Pattern of feeding and fasting across animal kingdom, Pattern of feeding and fasting across human evolution

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Appendix 1

Effect of Fasting on Health

Name of center:_____ Serial No._____

Demographic Data

1. **Name**:_____2. **Gender**: Male /Female

3. Age:_____Years 4. **Rural /Urban.** 5 **Occupation: _____**

6 Address:

_____

Mobile/ Landline number _____

7 **Marital Status**: Married/ Separated/ Widow/ Widower/ Single.

9. **Monthly income**: <2,000/ 2,000-4,999/ 5,000-9,999/ 10,000 and above

Health Status

- Sleep: Normal/ Disturbed
- Appetite: Satisfactory/ Less
- Bowel habits: Normal/ Constipation/ Diarrhea
- Other problems: If any
- **Co-morbid diseases:** Diabetes; IHD; Hypertension; Asthma; COPD; Other

PHYSICAL EXAMINATION (by a doctor)

	At beginning of fast	**At end of fast**	**Remarks**
Date			
Weight (kg):			
Height (meters)			
BMI			
Pulse Rate: / mint			
Blood pressure mm Hg			
Blood Investigations			