Scientific View on Fasting

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Abstract

The issue of healthy eating has long been an important concern to individuals and cultures. Fasting, dieting, and vegetarianism are various techniques used to increase longevity and improving health. Fasting is certainly not bad for health, as is generally thought, if it is observed properly.

The principles of Jainism are most compatible and relevant for reinstating total physical and

mental health as well as for spiritual development. Long-term calorie restriction causes many physiological changes that alter life-history traits such as growth, reproduction and lifespan. Studies have shown that reducing calorie consumption by 30-40% extends life span in many animals. Controlled studies in animals and human have confirmed that fasting protects against diabetes, cancers, heart diseases, and neuro-degeneration. Some studies in humans have found that fasting helps reduce obesity, hypertension, asthma, and rheumatoid arthritis. Fasting is a cost-effective and non-invasive technique, has minimal risk of adverse effects or drug interactions, and does not require medical supervision in most cases.

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Studies of physiological basis and consequences of prolong fasting are limited. In a landmark study on 110 healthy volunteers, we have observed widespread benefit in body weight, BMI and

systolic BP. Metabolic changes of stress have been observed in blood glucose, proteins and lipid levels.

1. Introduction

Food is very foundational necessity for all forms of life. The world over, animals and plants rely on feeding of some sort. Eating is a sensorial experience and a normal part of 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 various techniques employed by individuals and encouraged by societies to increase longevity and health. Contrary to popular belief, fasting is not dangerous or unhealthy if it is done properly; it is 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.

2. 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 1900's. 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 improve one's physical health.

"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

Definition:

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

Now-a-days, fasting is considered to be taking place if one does not eat for a period of at least 8-12 hours. So technically, most of us are 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). An **absolute fast** is defined as abstinence from all food and liquid for a predefined period, usually a day (24 hours), or several days. In the traditional sense, fasting is the total and absolute abstinence from food and other liquids 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 may also be done by abstaining from other pleasurable activities like sleep, sex, and vices. As religious philosophy and customs evolved, the term has become more liberal and loose in its application. Some fasts may be only partially restrictive, limiting particular foods or substances. Some of the popular kinds of fasting are meat fasting, sweets fasting, juice fasting, Lent fasting, a liquid fasting diet, and water fasting. Apart from total fast, the three most commonly studied fasts are caloric restriction (CR), alternate-day fasting and dietary restriction (DR).

3. History

The reasons for fasting include both health and spiritual betterment. The history of fasting goes back to antiquity. 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. Ancient traditions require that one should fast before undergoing any important event in 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. It is mentioned that all the 24 Jain *Tīrthaṅkaras* observed prolonged fast and meditation to achieve salvation. Fasting is also mentioned in great religious books like the *Āgama*s, Bible, Quran, *Mahabhārata*, and *Upaniṣada*s.

Yogic practices, including that of fasting, date back thousands of years and fasting is one of the oldest therapies in medicine. Many doctors of ancient times and many of the oldest healing systems have recommended it as an integral method of healing and prevention. *Āyurved*ic medicine, the world's oldest healing system, has 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 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.

4. Physiology of fasting

While the spiritual importance of fasting is widely believed, 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 long periods? 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).

4.1 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 sleep. 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 round 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 is 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.

4.2 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 carbohydrate 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 500 grams 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.

4.3 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.

4.4 Role of 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 non-eating (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 whereas 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).

4.5 Molecular mechanism of benefits from fasting

Fasting acts as a form of mild stress that continually stimulates cellular defenses 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. 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 showed that intermittent fasting strengthens the body’s innate response to stress (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 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. 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.

5. 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.

5.1 Buddhism

Prior to attaining Buddhahood, Prince *Siddhārtha* 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).

5.2 Christianity

Biblical fasting and fasting rules under the Christian tradition are broad and varied. The Lent 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.

5.3 Hinduism

Fasting is an 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* depending on personal belief and favorite deity. For example, devotees of *Śiva* 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.

5.4 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. Weather these practices can be termed as fast or it is a change in circadian pattern, we need to discuss out. 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. The Siyam (fast) is intended to teach Muslims patience and self-control, and to remind them of the less fortunate in the world.

5.5 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 theirsoul.

5.6 Sikhism

Sikhism is probably the only major organised world religion that does not promote fasting except for medical reasons. The Sikh Gurus discourage the devotees 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. According to 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 willful hunger is forbidden in Sikhism. A Sikh is encouraged to practice 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 (*AlpaĀhāra*), just to keep body and soul together and to prevent sleep and sloth, this is recommended for a Sikh.

5.7 Jainism

The principles of Jain religion are most compatible and most relevant in the present context for reinstating total physical and mental health. Fasting creates positive health and removes diseases. Fasting is very common among Jains, spiritually 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 that some misconduct has been committed, most of them will fast at special times during the year e.g. *Paryuṣaṇaa*.

Paryuṣaṇaa is the most prominent festival, lasting eight days in *Śvetambara* Jain tradition and ten days in *Digambara* Jain tradition during the monsoon. If one fasts for the eight days of *Paryuṣaṇaa*, it is called *Atthai*, and if one fasts for 10 days it is called *dash-lakshan*, and when it is for one month, it is known as *maskhaman*. 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 or *Sallekhanā*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 and is discussed in some accompanying articles.

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 or without salt and pepper as the only spice, the person is said to do *Ayambil*. There are other types of fasts 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 fasts is to decrease desire and passion for the physical world, and attain spirituality by meditation.

5.7.1 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 *Mahāvīra*'s emphasis on renunciation and asceticism.

5.7.2 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 Parityāga***or giving up favourite foods and ***VrutiSankshepa*** or limiting the number of items of food eaten

5.7.3 Duration of fast:

- ***Upvas*:** To give up only food for the whole day (starting from previous sunset to 2nd day sunrise - approximately 36 hours)
- ***ChauviharUpvas*:** Like *upvas*, to give up food as well as water.
- ***TiviharUpvas*:** One may drink boiled water between sunrise and sunset.

- ***DigambarUpvas*:** One may drink water only once a day before sunset.
- ***ShvetamberUpvas*:** 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*:** 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 *SvetamberVarsitap* they do *Ekasanu*alternate days and *Upavas* on the rest of days.
- ***Great*fasts:** Some Jain monks fast for months at a time, following the example of *Mahāvīra*, 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 all their life. Many Jains leave food or water before forty-eight (48) minutes of sunset.
- ***Tivihar*:** Like *Chauvihar*, but one may drink water.
- ***NavapadOli*:** 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. *Ayambil*s may be restricted to one kind of grain per day.

5.7.4 Preparations

To enter a fasting period, 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 taken. This period is called *Dharna*. During the fast, only pure water and, in some cases, occasional herbal teas are allowed.

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.

6. 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

Like all age-old customs and traditions, fasting has interesting health benefits that we are now discovering with modern technology. 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).

6.1 Brain health

Mattson and other researchers have championed the idea that intermittent fasting lowers the risks of degenerative brain diseases such as Parkinson's disease 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.

6.2 Longevity

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, 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 in humans are still not fully established, 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.

6.3 Weight loss

Weight loss occurs most rapidly during the first few days of a fast, up to 1 kg per day. In following days, the figure drops to around 250 grams per day. An average weight loss of half a kg a day for an entire fasting period can be expected. A weight loss rate of almost one and half kg per day was achieved in water fasting weight loss experiments, 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 preserves lean muscle mass (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.

6.4 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; Horne, 2008). One of the main effects of fasting 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 (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 (Fontana, 2004; 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.

6.5 Cancer

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.

6.6 Mental Health

Fasting may be religiously mandated but the social and community traditions that accompany the practice carry just as much benefit. Engaging in fasting brings families and social groups closer and together. This often helps people suffering from depression and loneliness by reassuring them that they are not alone.

6.7 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 treatment to 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.

6.8 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.

6.9 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 normal. Contraindications for fasting are those with asthma, cancer, diabetes, eating disorders, schizophrenia, tuberculosis, ulcerative colitis etc.

6.10 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 from work or at least reducing the work load, is helpful. 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 of intermittent fasting.

7. Research Potential

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 and needs proper documentation. Some of the areas of research are as below;

Literature review:

1. Fasting as a model of total health.
2. Pattern of feeding and fasting across animal kingdom.
3. Pattern of feeding and fasting across human evolution.

Experimental studies:

4. To study physiological changes with fasting and delineate anatomical, biochemical and hormonal pathways.
5. Beneficial effect on human health including cognition, mental health and physical fitness.
6. Beneficial effect on various diseases.

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