



INTERMITTENT FASTING FACTS AND MYTHS: METABOLIC BENEFITS OF INTERMITTENT FASTING

¹Preeti Chaudhary and ²Shivani

¹Assistant Professor, ²Guest Faculty
Department of Food Science and Technology,
College of Horticulture and Forestry,
Dr. YS Parmar University of Horticulture and Forestry,
Neri, Hamirpur, Himachal Pradesh, India

Correspondence author: Shivani
Department of Food Science and Technology,
College of Horticulture and Forestry,
Dr. YS Parmar UHF, Neri, Hamirpur, Himachal Pradesh, India
Email: dadwal.1995shiva@gmail.com
Mobile No.: 8628053186

ABSTRACT

Fasting is an age-old practice, often done for religious reasons, but fasting for weight loss is still capturing the public imagination. Intermittent fasting is a form of time restricted eating (typically 16 h fasting and 8 h eating), which has gained popularity over the last few years and shows potential as a possible new paradigm in the approach to weight loss and the reduction of inflammation, and has many potential long term health benefits. It also has positive as well as negative impact on the metabolic activities. In this review article authors had collected the evidences form various articles that describe the myths and facts regarding the intermittent fasting (IF). There were potential researches that analyses intermittent fasting (IF), calorie-restricted (CR) diets is beneficial for weight loss, cardiovascular diseases, cancer, cognitive, Type 2 diabetes and reduce the oxidative stress. Similarly, there are some facts and myths that are related to IF and CR which is worth knowing. The heterogeneity in the current evidence limits comparison of IF to other weight-loss strategies. Longer-term research is needed to understand the sustainable role IF can play in weight loss.

IndexTerms: Intermittent fasting, Calorie-restricted diet, Weight loss, Diabetes, Cardiovascular diseases.

INTRODUCTION

The intermittent fasting which is most commonly adapted by the overweight individuals, who want to lose their weight. Fasting is defined as a period of voluntary abstinence from food and drink. People fast for a variety of reasons such as health, weight loss, or even spiritual reasons. This approach doesn't change what you eat, rather it changes when you eat. Intermittent fasting isn't a diet plan so much as it is a pattern of eating.

Intermittent fasting is a dietary intervention similar to caloric restriction, as it utilizes the principle of restricting food intake. However, intermittent fasting focuses on the timing of when one can consume meals either within a day or a week. Two overarching types of intermittent fasting are alternative day fasting and time-restricted fasting. In alternative day fasting, subset may consist of 24-hour fasts followed by a 24-hour eating period that can be done several times a week such as a 5:2 strategy when there are 2 fast days mixed into 5 nonrestrictive days. For time restricted fast programs, variations include 16-hour fasts with 8hour feeding times, 20-hour fasts with 4-hour feed times or other similar versions. While both caloric restriction and intermittent fasting may result in overall decreased caloric intake, this is not integral to intermittent fasting. Intermittent fasting has been linked to better glucose control in both humans and animal [1, 2]. However, long-term adherence to caloric restriction is low while adherence intermittent fasting may be more promising. Alternate-day fasting, this approach is the simplest to understand, and involves alternating fasting days with eating days. Sometimes referred to as the 24-hour fast, you simply fast for a 24-hour period. This could mean eating breakfast and lunch one day and then fasting until lunch the next day. It could also be a normal day of eating until dinner time followed by a 24 hour fast until dinner the next day. Some people may push this to a 36-hour fast that starts after dinner on day 1 and doesn't end until breakfast on day 3. Prolonged fasting, some fasts can extend into 48 hours or even a week or more. Often times, these are for religious or spiritual purposes. These types of fasts can come with significant health risks and should not be attempted without first discussing it with your health care provider to understand the risks and potential complications [3].

According to World Health Organization (WHO) in 2016 reported that more than 1.9 billion people in the world were overweight and over 650 million people were obese which has tripled in number since 1975 [4]. The lifestyle changes are one of the most effective methods in reducing weight and the risks for cardiovascular diseases. There are many forms of diet and exercises programs available for weight loss, however, one of the least recognized diet changes is the alternate day fasting (ADF) which includes eating 20% of energy requirements on a fast day and then consume food ad libitum on the feed days which has been suggestive to be highly effective for weight loss[5]. This review will be summarize the facts, myths and biological effects of intermittent diet for a healthier lifestyle.

MATERIAL AND METHOD

The data for this review article was collected from research papers, articles and online citations on health, nutrition, intermittent fasting with the latest updates. And finally collaborate the complete data on the basis to evidence provided in the research papers.

Facts Regarding using the intermittent fasting (IF) diet

There are many studies conducted on humans and animals confirming the therapeutic effectiveness of the IF diet [6]. It reduces body fat and body mass, which supports the healthy functioning of the cardiovascular system, and reduces the incidence of myocardial infarction [7]. Individuals can influence the concentration of many metabolic biomarkers, for example, the concentration of insulin and glucose, thereby reducing the risk of metabolic syndrome [8]. It also reduces the risk of type 2 diabetes [9]. There are studies confirming the impact of long-term use of the IF diet on the extension of the viability of individuals [10]. The IF diet positively affects the functioning of the nervous system. By affecting the reduction of free radical formation in the body and stress response systems, it protects neurons from environmental and genetic factors that cause them to age [7]. Intermittent fasting in animal models induce some cardiovascular benefits such as improving blood pressure and heart rate, as well as circulating cholesterol and triglycerides, and reduce carotid intima-media thickness. Moreover, it improves survival from myocardial ischemia through proangiogenic, anti-apoptotic and anti-remodelling effects [11].

Intermittent fasting also has its drawbacks. Periods of fasting of a few hours at the start cause huge problems. This is accompanied by a bad mood at the beginning of the diet, such as fatigue or dizziness, because the body needs time to get used to using ketones instead of glucose. Certainly, this is not a good diet for patients with

reactive hypoglycemia. Moreover, caloric restriction with the simultaneous use of antidiabetic drugs may lead to severe hypoglycemia and even death [12]. In the elderly, it is associated with an increased risk of cardiovascular disease, arrhythmia, and stroke. Fluctuations in glucose concentration cause instability of the body, which results in an increased number of falls and frequent fractures due to osteoporosis [13]. The ACCORD trial confirmed greater risk of cardiovascular events during the presence of hypoglycemia in both older and younger individuals [14]. Higher risk of diabetic ketoacidosis is also not without significance, especially when there is not enough insulin due to low food intake during fasting. In addition, excessive restriction of calories causes dysregulation of hormone management.

Such disturbances may cause menstrual cycle disorders in women and reduced testosterone in men.

Intermittent fasting should not be used by children, pregnant women, and people performing heavy physical work [15]. Intermittent fasting can also disrupt your sleep cycle or lead to restless nights. Multiple studies have shown that fasting can decrease amount of REM sleep, which is believed to improve memory, mood, and learning capacity [15].

Metabolic effects of intermittent diet

The IF diet can be used as a supplement to training processes for people with a normal weight who want to improve their health regardless of their weight loss. In these people, intensive energy restriction (IER) requires a concentration on energy restriction (ER) for specific days of the week, which is easier to achieve than daily, continuous energy reduction, as is the case in traditional CER (continuous energy restriction) [16]. Moreover, many beneficial metabolic effects, taking place during weight loss and energy limitation, are associated only with the limitation of energy and are suppressed when a person no longer has a negative energy balance [17]. However, according to the National Institute for Health and Care Excellence (NICE) guidelines for the treatment of obesity in adults, routine use of very low calorie diets (VLCDs) in the therapeutic regimen of obesity in adults is not recommended. According to this institute, such an approach should be recommended when there is a clinical justification for rapid weight loss and it must supply all necessary nutrients. Additionally, it should be attempted for a maximum of 12 weeks (continued continuously or intermittently) [18]. Many studies based on human and animal models on weight loss using an IF diet confirm the reduced risk of developing cardiovascular diseases. This is related to the modulating effect of the IF diet on various risk factors of development, such as obesity, improper diet, insulin resistance, type II diabetes, and arterial hypertension [19]. During use of the IF diet, which consists of introducing fasting periods, there are marked metabolic changes in the body [20]. For example, when using a diet during which all food during the day is consumed in a 6-h nutritional window, the glucose level is elevated during and about 6 h after a meal, but remains low for the remaining 16 h until the next day. During the 6–8 h in an 18-h fasting window, ketones remain increased [21]. The human body is naturally adapted to such periods of fasting and in the moment of starving, adaptation mechanisms are used to obtain energy. During fasting, when glucose is exhausted, the body begins to utilize ketones that arise as a result of fatty acid transformations [22,23]. Fatty acids and ketones become the main source of energy for cells. This transition is called intermittent metabolic switching (IMS) or glucose-ketone (G-to-K) switchover. Inverse switching, i.e., ketone-glucose (K-to-G), occurs after the interruption of fasting and meal intake [20]. Atherosclerosis is a chronic inflammatory disease during which atherosclerotic plaque form in arterial vessels, which causes sclerosis of the walls and narrowing of the arteries. The development of atherosclerotic plaque is caused by vascular endothelial dysfunction and long-term exposure to cardiovascular disease development factors. One of the most important risk factors is high levels of low density lipoproteins (LDLs) [24]. Excess LDLs accumulated in the sub-epithelial layer of arterial walls is oxidized to oxLDL [25]. This induces an inflammatory response and adhesion to the endothelium of blood leukocytes, mainly monocytes. They migrate to the inner membrane of the vessels and are converted into macrophages [26]. Macrophages, through internalization with oxLDL, are transformed into foam cells that present antigens to immune cells. Activated cells release factors that contribute to smooth muscle cell migration from the medial to the inner membrane [27]. Vascular smooth muscle cells over proliferate and secrete extracellular matrix proteins. There is a further accumulation of lipids both within cells and extra cellularly [28]. The majority of risk factors for cardiovascular diseases and factors of atherosclerosis may be modified [29]. One of the modifications is the use of the IF diet.

Myths Regarding Intermittent Fasting

The intermittent fasting play important role in losing weight, but "It doesn't matter how long the fast is for if you're breaking the fast by throwing down burgers, pizza, and candy, results are going to be slim to none,"9.. Some people claim that if they don't eat carbs every few hours, their brain will stop functioning. This is based on the belief that your brain can only use glucose for fuel. However, our body can easily produce the glucose it needs via a process called gluconeogenesis. Even during long-term fasting, starvation, or very very-low-carb diets, your body can produce ketone bodies from dietary fats. Ketone bodies can feed parts of our brain, reducing its glucose requirement significantly. However, some people report feeling fatigued or shaky when they don't eat for a while. In such cases person should consider keeping snacks on hand or eating more frequently [30]

Many people believe that eating more meals increases your metabolic rate, causing your body to burn more calories overall. Our body indeed expends some calories digesting meals. This is termed the thermic effect of food (TEF) on average, TEF uses around 10% of our total calorie intake. Eating six 500-calorie meals has the same effect as eating three 1,000-calorie meals. Given an average TEF of 10%, we will burn 300 calories in both cases. Numerous studies demonstrate that increasing or decreasing meal frequency does not affect total calories burned. One of the rumors that intermittent fasting harms our health, studies reveal that it has several impressive health benefits. For example, it changes our gene expression related to longevity and immunity and has been shown to prolong lifespan in animals. It also has major benefits for metabolic health, such as improved insulin sensitivity and reduced oxidative stress, inflammation, and heart disease risk. It may also boost brain health by elevating levels of brain-derived neurotrophic factor (BDNF), a hormone that may protect against depression and various other mental conditions [30]. And one huge misconception about fasting is the reason why it works. Though it's often thought that digestion doesn't occur after a certain time, this myth is not true. "our body will digest food no matter what time it is," "It's a matter of allowing our body a significant time (whether experts agree on 12-16-18 hours remains unseen) to focus on other metabolic processes like autophagy and cellular repair, instead of diverting attention to digestion [31]

SUMMARY AND CONCLUSION

The IF diet limits many risk factors for the development of cardiovascular diseases and therefore the occurrence of these diseases. Fatty acids and ketones become the main energy fuel, because the body undergoes metabolic switching of glucose-ketone (G-to-K). By affecting the biochemical transformations of lipids, it decreases body mass and has a positive influence on lipid profile. The positive effect of the IF diet has also been documented in obese and diabetic people. The reduced amount of food consumed when using the IF diet results in a decrease in body weight. It also improves glucose metabolism and increases the sensitivity of tissues to insulin by increasing the B cells of the pancreatic islets. The IF diet also limits cardiac hypertrophy. It remains questionable if these benefits are solely due to weight loss or non-weight loss mechanisms. The success of every type of diet depends on rule compliance—following a prescribed diet according to the circadian rhythm. Despite the intermittent fasting diet having many benefits, its disadvantages are not without significance. Fasting may be dangerous and it is not recommended for people with hormonal imbalances, pregnant and breastfeeding women, and diabetics. Moreover, people with eating disorders, a BMI under 18.5, and underweight people are also not recommended to use the intermittent fasting diet. In recent years, the IF diet and its varieties have become increasingly popular. This diet not only serves to reduce body weight, but can also be used as an effective non-pharmacological treatment method. This has been proven through various studies performed on people and animals. However, individuals' current health and situation should be considered before commencing the IF diet.

References

- Aly S M.2014. Role of Intermittent Fasting on Improving Health and Reducing Diseases. International Journal of Health Sciences, Qassim University, 8:3.
- Aly, S. M. 2014. Role of Intermittent Fasting on Improving Health and Reducing Diseases. International Journal of Health Sciences, Qassim University 8:3.

- Ambrosius, W.T. Lovato, L. and Applegate, W.B. 2014. Effects of randomization to intensive glucose control on adverse events, cardiovascular disease, and mortality in older versus younger adults in the ACCORD Trial. *Diabetes Care* 37: 634–643.
- Barnosky, A.R. Hoddy, K.K. Unterman, T.G. and Varady, K.A. 2014. Intermittent fasting vs. daily calorie restriction for type 2 diabetes prevention: A review of human findings. *Translational Research: the Journal of Laboratory and Clinical Medicine* 164(4): 302–311.
- Bays, H.E. 2009. “Sick fat,” metabolic disease, and atherosclerosis. *American Journal of Medicine* 122(1): 26–37.
- Beshyah, S.A. Hassanein, M. Ahmedani, M.Y. Shaikh, S. Ba-Essa, E.M. Megallaa, M.H. Afandi, B. Ibrahim, F. and Al-Muzaffar, T. 2019. Diabetic Hypoglycaemia during Ramadan Fasting: A Trans-National Observational Real-World Study. *Diabetes Research and Clinical Practice* 150(18): 31843–31846.
- Braun, M. Pietsch, P. Felix, S.B. and Baumann, G. 1995. Modulation of intercellular adhesion molecule-1 and vascular cell adhesion molecule-1 on human coronary smooth muscle cells by cytokines. *Journal of Molecular and Cellular Cardiology* 27(12): 2571–2579.
- Bronwen, M. Mattson, M.P. and Maudsleya, S. 2006. Caloric restriction and intermittent fasting: Two potential diets for successful brain aging. *Ageing Research Review* 5(3): 332–353.
- Cabo, R. and Mattson, M.P. 2019. Effects of Intermittent Fasting on Health, Aging, and Disease. *The New England Journal of Medicine* 381(26): 2541-2551.
- Camandola, S. and Mattson, M.P. 2017. Brain metabolism in health, aging, and neurodegeneration. *The EMBO Journal* 36(11): 1474–1492.
- Carter, S. Clifton, P.M. and Keogh, J.B. 2016. The effects of intermittent compared to continuous energy restriction on glycaemic control in type 2 diabetes; a pragmatic pilot trial. *Diabetes Research and Clinical Practice* 122: 106–112.
- Catenacci VA, et al. A randomized pilot study comparing zero-calorie alternate-day fasting to daily caloric restriction in adults with obesity *Obesity (Silver Spring)*, 24 (2016), pp. 1874–1883 CrossRef View Record in Scopus Google Scholar [PubMed: 27569118]
- Catenacci, V. A., Pan, Z. Ostendorf, D. Brannon, S. Gozansky, W. S. Mattson, M. P. Martin, B. MacLean, P. S. Melanson, E. L. and Donahoo, W. T. 2016. *The Obesity Society* 24: 1874–1883.
- Dardano, A. Penno, G. Del Prato, S. and Miccoli, R. 2014. Optimal therapy of type 2 diabetes: A controversial challenge. *Ageing (Albany NY)* 6(3): 187–206.
- Furmlı, S. Elmasry, R. Ramos, M. and Fung, J. 2018. Therapeutic use of intermittent fasting for people with type 2 diabetes as an alternative to insulin. *BMJ* 10: 1-5.
- Ganesan, K. Habboush, Y. and Sultan, S. 2018. Intermittent Fasting: The Choice for a Healthier Lifestyle. *Cureus* 10(7): 2-8.
- Ganesan, K., Habboush, Y. and, Sultan, S. 2018. Intermittent Fasting: The Choice for a Healthier Lifestyle. *Cureus* 10:7.
- Harvie, M. and Howell, A. 2017. Potential benefits and harms of intermittent energy restriction and intermittent fasting amongst obese, overweight, and normal weight subjects—A narrative review of human and animal evidence. *Behavioral Sciences* 7(1): 4-10.

- Heilbronn, L.K. Smith, S.R. Martin, C.K. Anton, S.D. and Ravussin, E. 2005. Alternate-day fasting in nonobese subjects: Effects on body weight, body composition, and energy metabolism. *The American Journal of Clinical Nutrition* 81(1): 69–73.
- Jane, L. Atkinson, G. Jaime, V. Hamilton, S. Waller, G. and Harrison, S. 2015. Intermittent fasting interventions for the treatment of overweight and obesity in adults aged 18 years and over. A systematic review protocol. *JBI Database of Systematic Reviews and Implementation Reports* 13(10): 60–68.
- Kozaki, K. Kaminski, W.E. Tang, J. Hollenbach, S. Lindahl, P. Sullivan, C. Yu, J.C. Abe, K. Martin, P.J. and Ross, R. 2002. Blockade of platelet-derived growth factor or its receptors transiently delays but does not prevent fibrous cap formation in ApoE null mice. *American Journal of Pathology* 161(4): 1395–1407.
- Lee, Y.T. Lin, Y.H. Chan, Y.W. Li, K.H. To, O.T. Yan, B.P. Liu, T. Li, G. Wong, W.T. Keung, W. and Tse G. 2017. Mouse models of atherosclerosis: A historical perspective and recent advances. *Lipids in Health Disease* 16(12): 2-11.
- Mager DE, et al. Caloric restriction and intermittent fasting alter spectral measures of heart rate and blood pressure variability in rats *Faseb j*, 20 (2006), pp. 631–637 CrossRef View Record in Scopus Google Scholar [PubMed: 16581971]
- Mager, D. E. Wan, R. Brown, M. Cheng, A. Wareski, P. Abernethy, D. R. and Mattson, M. P. 2006. Caloric restriction and intermittent fasting alter spectral measures of heart rate and blood pressure variability in rats. *Federation of American Societies of Experimental Biology* 20: 631-637.
- Mattson, M.P. Longo, V.D. and Harvie, M. 2017. Impact of intermittent fasting on health and disease processes. *Ageing Research Review* 39: 46–58.
- Mattson, M.P. Moehl, K. Ghena, N. Schmaedick, M. and Cheng, A. 2018. Intermittent metabolic switching, neuroplasticity and brain health. *Nature Review Neuroscience* 19: 63–80.
- Parthasarathy, S. Quinn, M.T. and Steinberg, D. 1988. Is oxidized low density lipoprotein involved in the recruitment and retention of monocyte/macrophages in the artery wall during the initiation of atherosclerosis? *Basic Life Sciences* 49: 375–380.
- Patterson, R.E. and Sears, D.D. 2017. Metabolic Effects of Intermittent Fasting. *Annual Review of Nutrition* 37: 371–393.
- Sano, H. Sudo, T. Yokode, M. Murayama, T. Kataoka, H. Takakura, N. Nishikawa, S. Nishikawa, S.I. and Kita, T. 2001. Functional blockade of platelet-derived growth factor receptor-beta but not of receptor-alpha prevents vascular smooth muscle cell accumulation in fibrous cap lesions in apolipoprotein E-deficient mice. *Circulation* 103(24): 2955–2960.
- Toledo, F.W. Grundler, F. Bergouignan, A. Drinda, S. and Michalsen, A. 2019. Safety, health improvement and well-being during a 4 to 21-day fasting period in an observational study including 1422 subjects. *PLOS ONE* 14: 2-13.
- Wing, R.R. Blair, E.H. Bononi, P. Marcus, M.D. Watanabe, R. and Bergman, R.N. 1994. Caloric restriction per se is a significant factor in improvements in glycemic control and insulin sensitivity during weight loss in obese NIDDM patients. *Diabetes Care* 17: 30–36.
- World Health Organization; <https://www.who.int/news-room/fact-sheets/detail/obesity-and-overweight> (15th July, 2020).