

# Intermittent Fasting

Tarandeep Kaur

Assistant Professor, Department of Home Science, Kanya Maha Vidyalaya, Jalandhar, India

Corresponding Author: [tarandeeplibra\[at\]gmail.com](mailto:tarandeeplibra[at]gmail.com)

**Abstract:** *Fasting enhances the energy in removing waste from the blood and detoxifying the body. Fasting promotes creativity and improves peace and contentment. Most citizens in western age have unhealthy, sedentary lifestyles that do not include such regular exercise. Sedentary behaviour and three meals a day (breakfast, lunch, dinner, and snacks in between) frequently result in metabolism illness, which can cause a variety of disorders that people are incapable of. In such scenarios, the notion of intermittent fasting must have gained tremendous popularity around the world. Intermittent fasting (IF) is more of a refectory pattern than a diet that must be adhered to. In general, IF is a diet in which a person can fast for a set number of hours, usually more than 12 hours, and then eat for the meantime while. The objective of this review paper is to summarise and bring out the fruitful wellness benefits of Intermittent Fasting that have shown clinical results from human studies. IF can be used to generate unique strategies to weight loss, inflammation reduction, skin disease minimisation and prevention, metabolic swapping, diabetes prevention and maintenance, maintaining insulin levels and increasing insulin sensitivity, cardiovascular disease and stroke prevention and treatment, wound healing, boosting the immune system, promoting autophagy, and helping to treat neurodegenerative diseases such as Alzheimer's disease. Weight loss is connected with improved health outcomes such as Cholesterol, LDL, Blood pressure, Blood Sugar, and insulin when daily food intake is restricted.*

**Keywords:** Obesity, Health, Weight Loss, Heart Disease, Fasting, Skin & Autophagy

## 1. Introduction

When the human body absorbs the right amount of food in the right quantity and quality in a precise order, it performs properly. People in today's society prefer to prioritise quantity above quality since they are oblivious of the consequences. People who eat healthily live much longer and are quite prone to developing significant health problems including cardiovascular disease, prediabetes, and overweight. Eating healthy can assist individuals with chronic illnesses regulate their diseases and reduce morbidity and mortality. As the prevalence of obesity expands, hence the need for an adequate nutritional approach which supports in the restriction of calories and body mass, which is how Intermittent Fasting (IF) gained notoriety. According to the World Health Organization (WHO), more than 1.9 billion people worldwide are overweight, with over 650 million being obese, a figure that has tripled since 1975 [1]. Overweight too is linked to a number of metabolic disorders, including cardiovascular disease, cancer, joint pain, and breathing difficulties. [2].

It has been stated that changing one's lifestyle is among the most efficient methods for weight reduction and lower the risk of coronary heart disease. Patients' general wellness and indicators like blood pressure and heart rate, glucose levels, insulin, serum levels cholesterol, inflammatory biomarkers, and reduced cholesterol [3]. There are many different types of diet and exercise plans available, but most popular regimens is intermittent fasting (IF), which alternates between fasting and eating on a regular schedule and has been shown to be incredibly effective for weight reduction.

The significance of this research is that it reveals a whole slew of health benefits linked to intermittent fasting. That the very first benefits of IF are weight loss and body composition, followed by several other health benefits i. e. Inflammation, Autophagy, Gut Microbiome, Insulin Sensitivity, Oxidative Stress, Neurodegenerative Disease,

Metabolic Health, CVD, Diabetes, Vascular Dementia, Aging and cognition, Inflammation, Autophagy, Gut Microbiome, Insulin Sensitivity, Oxidative Stress, Neurodegenerative Disease are major health benefits that came into consideration via animal studies and some clinical studies. Intermittent fasting has been seen in animals to reduce inflammation in the brain, which has been linked to neurological disorders. Intermittent fasting has also been shown in animal experiments to lessen the possibility of neurological illnesses and stroke.

### Types of IF:

**Time - restricted eating (TRF):** It entails fasting for 12 hours or longer every day and eating during the remaining hours. The 16/8 technique is a popular example. It is based on 16: 8 (fasting: eating), 18: 6, 20: 4 pattern, Religious Fasting. Fasting based on religious purpose i. e., Navratri, Ramadan, some fixed days in a week, etc. Recent study demonstrates that this eating pattern improves insulin resistance and glucose regulation, reduces blood pressure and oxidative stress (all of which contribute to ageing), enhances hunger, and maintains circadian clock, lowering the probability of adverse health impacts associated with an interrupted circadian. TRE enhances gastrointestinal function and cardiometabolic health while lowering body weight, enhancing glycemic control, defending from hepatosteatosis, boosting metabolism, lowering systemic inflammation lipids and hypertension. [4].

**Prolonged fasting (PF):** This regimen is based on fasting for 24hours once/twice a week with 20 - 25% energy food consumption or it can be consecutively 2days fasting i. e., 48hours or 120 hours with minimal energy food intake. Even in people who are already at a healthy weight, prolonged fasting can help them lose weight, reduce belly fat, and improve blood pressure levels [5]. It is not a rapid weight -

loss fix and should be repeated on a regular basis, such as once a month, to observe long - term physical improvements. Long - term fasting has an advantage over short - term intermittent fasting in that it triggers autophagy, a cellular rejuvenation process. Autophagy is a biological mechanism in which cells recycle damaged organelles in order to regenerate [6]. It is also activated by caloric restriction and is used during nutrient stress to balance available energy sources for survival.

**Alternate Day Fasting (ADF):** This schedule involves fasting for a single or couple of fixed days in a week. Basically 2: 5 i.e., 2 days fasting alternatively for 24hours following 5 days eating with ad libitum. Although ADF may be beneficial for weight loss, studies have shown that this sort of calorie restriction is no more successful than standard daily calorie restriction. Adults who are overweight or obese may lose 3–8% of their body weight in 2–12 weeks by participating in ADF, according to studies. Although ADF may help with fat reduction, new research suggests that it is no more effective than regular calorie restriction in terms of weight loss and muscle mass preservation.

**Mechanism of Intermittent Fasting:**

- When our body puckish, it is due to the hormonal influence we often feel hunger strikes due to a gut hormone Ghrelin that sends signals to the brain and let it know that the body is lacking glucose.
- As often, food is the major source of energy that our body digests to produce energy to perform cellular as well as physical coordination of our body.
- Once the food is eaten, insulin is released from pancreas that speed up the rate at which body cells take up the glucose.
- Insulin is released under the influence of incretin in our blood stream as it stimulates pancreas to release more insulin.
- Once the insulin has performed its action (Hypoglycemic), the blood glucose level becomes normal due to cellular uptake of glucose.
- However, if glucose spikes very high, most of it is transported to liver and is stored as glycogen in adipose tissue.
- Once You are full, fat cells (adipocytes) secrete hormone leptin which inhibits our appetite. This cycle continues till another meal.

**Hungry hormones**

Whether you're a bit peckish or totally ravenous, it's all down to the hormones in your system

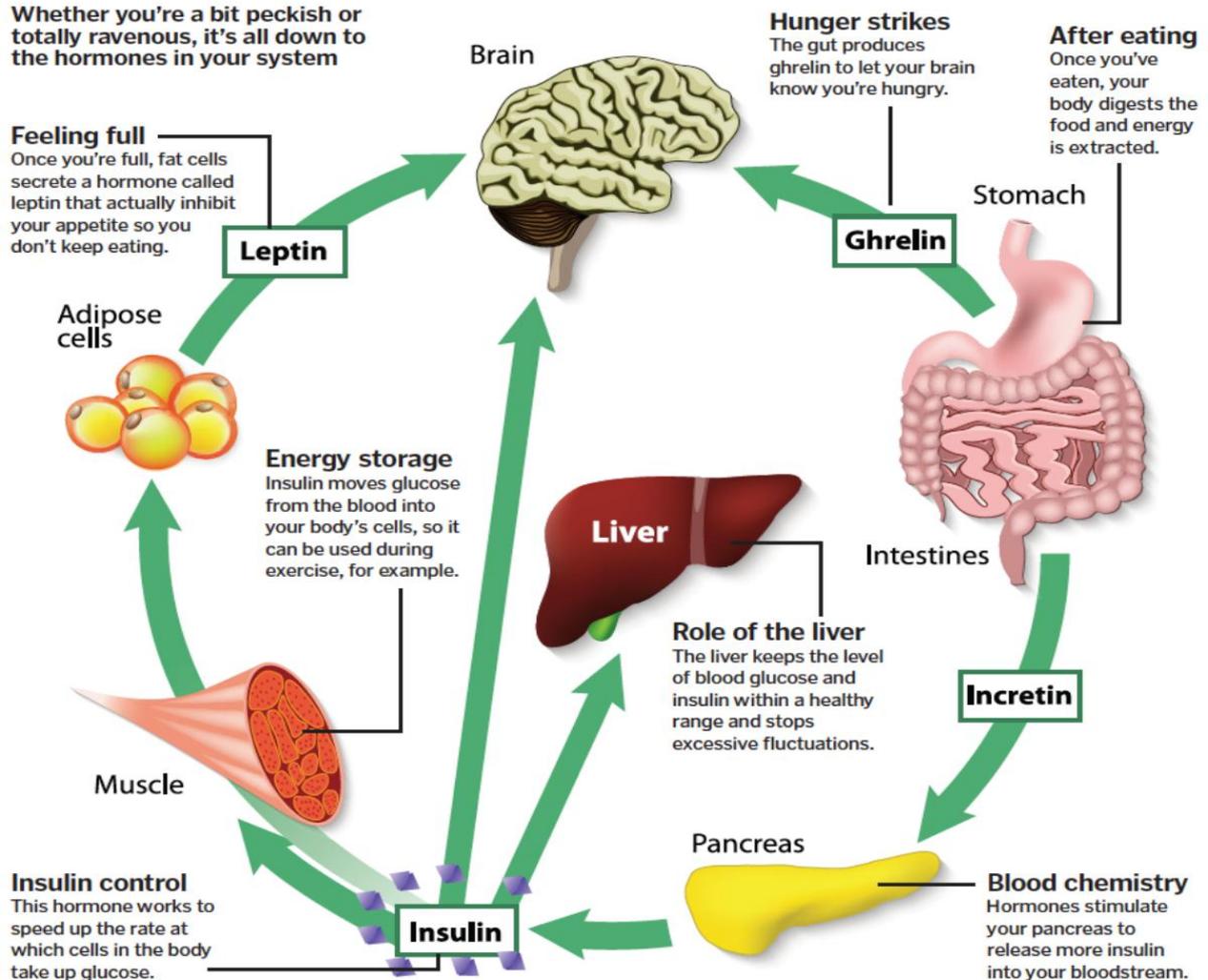


Figure 1  
Source: Ecosystem United

**Impact of Intermittent Fasting on Weight Loss:**

Weight gain leads to so many problems if not controlled earlier. It will lead to Obesity, develop risk of Cardiovascular disease, Diabetes, Hypertension, Dementia etc. Many studies showed promising results in reducing weight through IF. A study done by Moro et al. on comparing two groups: one is the TRF group and another one is the Interventional group/ normal diet group. TRF group energy intake time period is of 8 hours and fragmented into three - time junctions (1p. m., 4p. m., 8p. m.) whereas, routine diet group food intake time period is of 12 hours divided into three - time junctions (8a. m., 1p. m., 8p. m.) [7]. In the next 8 weeks Moro et al. observed a reduce in fat mass in the TRF group while fat free mass, muscle around arm and thigh have shown no change in both groups [7].

Study done by Wilson et al. on 39 male mice and 49 female mice 8 - week - old respectively divided into 5 groups: First group constituted of Overweight control mice (OBC), Second group included Mice without intervention, third group mice were subjected to IF diet, fourth group was subjected to High intensity interval training (HIIT) and last was the combination of IF+HIIT. It was observed that IF, IF+HIIT both exhibited reduced weight of the body and LDL as compared to leftover group [8]. A study done on 107 premenopausal women (30 - 45yrs) divided into two groups: First group is Continuous Energy restriction (CER) and Second group is Intermittent Calorie Restriction (IER) [9]. Weight loss in the IER group decreased from 81.5 (77.5 to 85.4) kg to 75 (71.2 to 78.8) kg, compared to a decline in the CER group from 84.4 (79.7 to 89.1) kg to 78.7 (74.2 to 83.2) kg. IER group also showed higher reduction of insulin compared to CER [9]. Another study was done between the Intermittent calorie restriction group (ICR) and Continuous calorie restriction (CER) showed weight loss by 12.6% in ICR while 7.2% in CER, Fat mass reduction is also higher in ICR group. Another study showed a significant result of weight loss conducted on mice with time restricted feeding of 12 - 20 hours per day. In Spite of weight loss, Cholesterol reduction, insulin reduction and also showed improvement in Insulin sensitivity. It was observed that all the IF studies have shown reduction in body composition and weight [10].

**Impact of Intermittent Fasting in Maintaining Insulin Level:**

Hyperglycemia is a frequent metabolic disease caused by a number of causes, particularly reduced insulin production, insulin sensitivity, poor glucose metabolism, increased hepatic glucose synthesis, and widespread low - grade inflammation [11]. Diabetes affects 34.2 million individuals (10.5 percent of the overall population) in the United States, according to the CDC [12]. Diabetes is known to cause a variety of long - term consequences, all of which add to the disease's morbidity and mortality rates. In the United States, diabetes, for example, is the greatest cause of renal failure, new onset blindness, and nontraumatic lesser extremities amputation [13]. Diabetes problems can be vascular or nonvascular. Retinopathy, retinal edoema, mono - and polyneuropathy, autonomic dysfunction, nephropathy, coronary heart disease, peripheral vascular disease, and stroke are some of the vascular consequences [13]. Issues with the gastrointestinal tract (gastroparesis), changes in skin

colour, higher infection risk, cataracts, glaucoma, periodontal disease, and hearing loss are also non - vascular problems [13]. There are three hormones that are expected to play a substantial role in the therapeutic impact of intermittent fasting in diabetic patients. Insulin, as well as the adipokines leptin and adiponectin, are among them. Insulin resistance leads to increase in inflammatory state includes high CRP (C - reactive protein), low adiponectin, and other metabolic factors, and all these factors are in association with CAD (coronary artery disease), CHF (Congenital Heart Failure) and atherosclerosis [14, 15]. Insulin resistance is a common cause of type 2 diabetes. Intermittent fasting improves insulin sensitivity and reduces sugar levels. [16]. In neurons, insulin sensitivity is also enhanced by IF [17]. Diabetes Remission clinical trial study on patients with diabetes mellitus. For 12 weeks they only consume 850cal/day [18]. Weight loss was observed and it led to normalize the fasting blood glucose, reduction in glycated haemoglobin was also observed [18]. Furmli et al. reported that after IF for 5 - 18 days three patients could cease their insulin treatment by following ADF protocol. Study done on rats with streptozotocin induced diabetes and citrate buffers was injected in the control group. For 30 days rats were put on night fasting (IF) with ad libitum. Decreased glucose concentration, increased plasma insulin, increased beta cells of pancreas and decreased HOMA index was observed in streptozotocin induced diabetes rats [19].

**Impact of Intermittent Fasting on Skin: Ageing and Wound Healing:**

They discovered that calorie restriction reduced cellular damage and helped retain healthy DNA when they delved deeper. Because damaged and inflamed cells lead to chronic disease, and ageing begins when DNA wears down, these are two crucial components in combating ageing.

Despite calorie restriction has anti - aging advantages, most people can't stick to a diet that necessitates decreasing their caloric intake by 30 - 40% and sticking to it every day for a lengthy period of time.

The hypodermis layer of skin begins to atrophy as we age, contributing to a wrinkled appearance [20]. Increased lifespan and decreased ageing have been linked to IF and calorie restriction [21]. The accumulation of specific Glycooxidation products in cutaneous collagen, such as pentosidine and CML (carboxymethyl lysine), contributes to skin ageing [22]. Cefalu et al. showed that reducing calorie restriction by 60% over a lengthy period of time in rodents resulted in a reduction of glycation protein, which reduced skin ageing [23]. IF on human skin fibroblasts in vitro demonstrated a longer lifetime than controls [24]. Their ageing process was also inhibited, and they restored young morphology, whereas controls had senescent morphology [25]. A surge in stem cell numbers can also be attributed to calorie - restricted diets, which are a key element in tissue homeostasis and growth [26]. The process of wound healing was observed to be faster in those who were fasting than those who were not in an experiment conducted on mouse models in which they were subjected to fasting for 4 consecutive days every 2 weeks following a period of 2 months where it was observed that the process of wound healing was faster in those who were fasting than those who

were not [27]. It is theorised that when the number of macrophages increases, the wound healing process accelerates, resulting in an increase in Transforming Growth Factor (TGF) - alpha production during the re-epithelialization phase of wound healing, which promotes keratinocyte proliferation [27].

### Impact of Intermittent Fasting on Cardiovascular Disease:

Intermittent fasting enhances a number of metabolic and inflammatory processes, including cellular autophagy, adiponectin production, and inflammation cytokines [28]. As a result, improved cardiovascular disease risk will be hoped for. The most common cause of cardiovascular illness is atherosclerosis, a chronic inflammatory disease. Atherosclerosis is caused by high levels of LDL cholesterol [29]. Plasma protein, which is similar to a collagen, adiponectin decreases during atherosclerosis. Inhibiting the monocyte adhesion to endothelial cells, adiponectin exhibits anti-atherosclerotic and anti-inflammatory effects [30].

Intermittent fasting also showed promising results in cerebrovascular disease, including stroke. When there is an interruption in blood supply it leads to damage in the brain area and termed as stroke. Hypertension is the global health problem and plays a stellar role in CVD, chronic kidney disease and stroke [31]. Hypertension is considered when systolic/diastolic blood pressure is 140/90 or more than this [32]. Study was conducted in which prediabetic patients put on an 18hours fasting regimen for 5 weeks showed reduction in systolic and diastolic BP  $11\pm 4$ mmHg and  $10\pm 4$ mmHg respectively [33]

### Impact of Intermittent Fasting on Cancer:

In cancer, intermittent fasting is a variation in how cells adapt to stress. Healthy cells are regarded to be considerably better at adjusting to their surroundings with fewer nutrients. Cancer cells, on the other hand, continue to proliferate and hence have a higher nutritional requirement. This could make cancer cells more prone to oxidative stress and DNA damage during treatment, such as chemotherapy, and hence more sensitive to the treatment.

- For a normal healthy (disease-free) individual, weight loss is the main advantage of intermittent fasting. Recent animal studies and a few early human trials have shown that cancer risk and growth rates are reduced. According to these research, this could be attributed to the following consequences of fasting:
- lowered blood glucose synthesis
- A well-balanced nutritional diet
- Enhanced tumor-killing cell production

Fasting was demonstrated to halt the evolution of obesity and type 2 diabetes in mice in a study involving time-restricted feeding during 9–12 hour periods. Obesity is a major risk factor for cancer, hence fasting as a cancer treatment may be beneficial. A bimonthly fasting-like diet lowered the risk of cancer in mice, according to a study. The body produced more common lymphoid progenitor cells (CLPs) and tumor-infiltrating lymphocytes as a result of the combined therapy techniques. CLPs are progenitor cells for lymphocytes, which are white blood cells that migrate into tumours and are known to kill them. Short-term

fasting, according to the same study, renders cancer cells more susceptible to chemotherapy while sparing normal cells and promotes stem cell formation.

## 2. Conclusion

Intermittent fasting has been shown to be a great way to keep your body in good shape. The therapeutic benefit of IF on the human body has been proven in numerous IF research. IF has been shown to reduce obesity and overweight, visceral fat mass, skin disease, ageing, blood pressure, stroke, stimulate the immune system, promote autophagy, and many other conditions in both animal and human research. It was also discovered that when IF is used to treat a specific ailment, the first and most noticeable result is weight loss. Diabetes, hypertension, and dyslipidemia are all affected positively by IF. Neurodegenerative disease is also reduced by IF. In general, IF may be beneficial in order to deter and curing of a variety of ailments. In today's world, many people's sedentary lifestyles necessitate lifestyle changes. Combining IF and calorie restriction may yield better outcomes.

## References

- [1] Obesity and overweight. (2017). Accessed: June 18, 2018; <http://www.who.int/newsroom/factsheets/detail/obesity-and-overweight>.
- [2] Haffner SM: Relationship of metabolic risk factors and development of cardiovascular disease and diabetes. *Obesity* (Silver Spring).2006, 14: 121 - 127.10.1038/oby.2006.291.
- [3] Galani C, Schneider H: Prevention and treatment of obesity with lifestyle interventions: review and meta-analysis. *Int J Public Health*.2007, 52: 348 - 359.10.1007/s00038-007-7015-
- [4] Prashant Regmi and Leonie K. Heilbronn Time-Restricted Eating: Benefits, Mechanisms, and Challenges in Translation.
- [5] <https://fasting.com/fasting-methods/prolonged-fasting/>
- [6] <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6314618/>
- [7] de Toledo FW, Grundler F, Bergouignan A, Drinda S, Michalsen A. Safety, health improvement and well-being during a 4 to 21-day fasting period in an observational study including 1422 subjects. *PLoS one*.2019 Jan 2; 14 (1): e0209353.
- [8] Mattson MP, Longo VD, Harvie M. Impact of intermittent fasting on health and disease processes. *Ageing research reviews*.2017 Oct 1; 39: 46 - 58.
- [9] Anton SD, Moehl K, Donahoo WT, Marosi K, Lee SA, Mainous III AG, Leeuwenburgh C, Mattson MP. Flipping the metabolic switch: understanding and applying the health benefits of fasting. *Obesity*.2018 Feb; 26 (2): 254 - 68.
- [10] Dashti HM, Al-Zaid NS, Mathew TC, Al-Mousawi M, Talib H, Asfar SK, Behbahani AI. Long term effects of ketogenic diet in obese subjects with high cholesterol level. *Molecular and cellular biochemistry*.2006 Jun 1; 286 (1-2): 1.
- [10] Powers AC, Niswender KD, Evans - Molina C. Diabetes mellitus: diagnosis, classification, and

- pathophysiology. In: Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J, editors. *Harrison's principles of internal medicine*, 20e. New York: McGraw - Hill Education; 2018.
- [11] National Diabetes Statistics Report. CDC. gov: U. S. Department of Health and Human Services; 2020.
- [12] Powers AC, Stafford JM, Rickels MR. Diabetes mellitus: complications. In: Jameson JL, Fauci AS, Kasper DL, Hauser SL, Longo DL, Loscalzo J, editors. *Harrison's principles of internal medicine*, 20e. New York: McGraw - Hill Education; 2018.
- [13] Bloomgarden ZT. Inflammation, atherosclerosis, and aspects of insulin action. *Diabetes care*.2005 Sep 1; 28 (9): 2312 - 9.
- [14] M Breen D, Giacca A. Effects of insulin on the vasculature. *Current vascular pharmacology*.2011 May 1; 9 (3): 321 - 32.
- [15] Longo VD, Mattson MP. Fasting: molecular mechanisms and clinical applications. *Cell metabolism*.2014 Feb 4; 19 (2): 181 - 92.
- [16] Anson RM, Guo Z, de Cabo R, Iyun T, Rios M, Hagepanos A, Ingram DK, Lane MA, Mattson MP. Intermittent fasting dissociates beneficial effects of dietary restriction on glucose metabolism and neuronal resistance to injury from calorie intake. *Proceedings of the National Academy of Sciences*.2003 May 13; 100 (10): 6216 - 20.
- [17] Leslie WS, Ford I, Sattar N, Hollingsworth KG, Adamson A, Snihotta FF, McCombie L, Brosnahan N, Ross H, Mathers JC, Peters C. The Diabetes Remission Clinical Trial (DiRECT): protocol for a cluster randomised trial. *BMC Family Practice*.2016 Dec; 17 (1): 1 - 0.
- [18] Belkacemi L, Selselet - Attou G, Hupkens E, Nguidjoe E, Louchami K, Sener A, Malaisse WJ. Intermittent fasting modulation of the diabetic syndrome in streptozotocin - injected rats. *International journal of endocrinology*.2012 Oct; 2012.
- [19] Pasparakis M, Haase I, Nestle FO. Mechanisms regulating skin immunity and inflammation. *Nature reviews immunology*.2014 May; 14 (5): 289 - 301.
- [20] Bhattacharyya TK, Merz M, Thomas JR. Modulation of cutaneous aging with calorie restriction in Fischer 344 rats: a histological study. *Archives of facial plastic surgery*.2005 Jan 1; 7 (1): 12 - 6.
- [21] Bragazzi NL, Sellami M, Salem I, Conic R, Kimak M, Pigatto PD, Damiani G. Fasting and its impact on skin anatomy, physiology, and physiopathology: A comprehensive review of the literature. *Nutrients*.2019 Feb; 11 (2): 249.
- [22] Cefalu WT, Bell - Farrow AD, Wang ZQ, Sonntag WE, Fu MX, Baynes JW, Thorpe SR. Caloric Restriction Decreases Age - Dependent Accumulation of the Glycoxidation Products,  $\epsilon$  - (Carboxymethyl) lysine and Pentosidine, in Rat Skin Collagen. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences*.1995 Nov 1; 50 (6): B337 - 41.
- [23] Sodagam L, Lewinska A, Wnuk M, Rattan SI. Chronic exposure to rapamycin and episodic serum starvation modulate ageing of human fibroblasts in vitro. *Biogerontology*.2017 Oct 1; 18 (5): 841 - 54.
- [24] Sailaja BS, He XC, Li L. Stem cells matter in response to fasting. *Cell reports*.2015 Dec 22; 13 (11): 2325 - 6.
- [25] Hayati F, Maleki M, Pourmohammad M, Sardari K, Mohri M, Afkhami A. Influence of short - term, repeated fasting on the skin wound healing of female mice. *Wounds*.2011 Feb 12; 23 (2): 38.
- [26] Cheng CW, Adams GB, Perin L, Wei M, Zhou X, Lam BS, Da Sacco S, Mirisola M, Quinn DI, Dorff TB, Kopchick JJ. Prolonged fasting reduces IGF - 1/PKA to promote hematopoietic - stem - cell - based regeneration and reverse immunosuppression. *Cell stem cell*.2014 Jun 5; 14 (6): 810 - 23.
- [27] Golbidi S, Daiber A, Korac B, Li H, Essop MF, Laher I. Health benefits of fasting and caloric restriction. *Current diabetes reports*.2017 Dec 1; 17 (12): 123.
- [28] Lee YT, Lin HY, Chan YW, Li KH, To OT, Yan BP, Liu T, Li G, Wong WT, Keung W, Tse G. Mouse models of atherosclerosis: a historical perspective and recent advances. *Lipids in health and disease*.2017 Dec 1; 16 (1): 12.
- [29] an R, Ahmet I, Brown M, Cheng A, Kamimura N, Talan M, Mattson MP. Cardioprotective effect of intermittent fasting is associated with an elevation of adiponectin levels in rats. *The Journal of nutritional biochemistry*.2010 May 1; 21 (5): 413 - 7.
- [30] Alexander M. R., Madhur M. S., Harrison D. G., Dreisbach A. W., Riaz K., Sander G. E., Yang E. H. Hypertension: Practice Essentials, Background, Pathophysiology. [(accessed on 1 February 2019) ]; *Cardiology*.2018 Available online: <https://emedicine.medscape.com/article/241381-overview>.
- [31] Benjamin EJ, Virani SS, Callaway CW, Chamberlain AM, Chang AR, Cheng S, Chiuve SE, Cushman M, Delling FN, Deo R, de Ferranti SD. Heart disease and stroke statistics—2018 update: a report from the American Heart Association. *Circulation*.2018 Mar 20.
- [32] Sutton EF, Beyl R, Early KS, Cefalu WT, Ravussin E, Peterson CM. Early time - restricted feeding improves insulin sensitivity, blood pressure, and oxidative stress even without weight loss in men with prediabetes. *Cell metabolism*.2018 Jun 5; 27 (6): 1212 - 21.