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Sports Performance and Intermittent Fasting: Impact on Training and Results, Mechanisms and Health Benefits in Weight Management, Metabolic Health, and Chronic Diseases – A Review of Risks, Current Evidence, and Future Research Directions

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Abstract

Introduction:

Intermittent Fasting (IF) has become a popular method in the contemporary medical world as an up-to date technique of the health and wellbeing in the last several years.

Purpose:

This research aims to investigate the both impact of IF on sports performance and therapeutic potential of IF on cardiovascular, metabolic and neurological diseases with focus on obesity, diabetes and impact on cardiometabolic risk.

State of Knowledge:

Intermittent fasting has been found to extend both life and health span by positively impacting weight management, reducing the risk of cardiovascular incidents, promoting cellular repair, and exhibiting anti-inflammatory actions. It improves blood sugar levels, provides protection against hepatosteatosis, enhances lipid metabolism and has beneficial effects on the brain-gut-microbiome system. IF leads to improved mental performance and offers benefits for neurological disorders such as epilepsy, Alzheimer's, and multiple sclerosis IF has shown beneficial effects on body composition and lean muscle mass without compromising physical performance nor impair strength. However, concerns about nutritional deficiencies, sustainability, and social implications are evident. Common drawbacks of IF include feelings of hunger, irritability, fatigue and hypoglycemia risk. IF is not recommended for pregnant woman and individuals suffering from eating disorders.

Conclusions:

IF is as a promising tool alongside traditional therapeutic strategies, particularly for addressing obesity, diabetes, and managing cardiovascular risk. For athletes it is a valuable tool in managing fat-mass particularly combined with high-intensity interval training (HIIT). However it is not recommended for certain groups. The diverse landscape of IF patterns, coupled with drawbacks, underscores the necessity for long-term research before routinely recommending IF for athletes and patients.

Key words: Intermittent Fasting; Sport; Cardiovascular Diseases; Obesity; Diabetes Mellitus; resistance exercise;

1. Introduction and Purpose:

In the coming age, more debates on whether intermittent fasting (IF) is efficient and whether its supposed benefits are real or insubstantial could arise. Such issues need to be examined critically to determine if IF really acts positively on human health or if its benefits are just mirage. This review strives to explore the variety regarding IF, noting a number of its types, advantages, and disadvantages so as to help determine if it is, indeed, a straight path to success in healthy living or just a fad that will only last for some time.

The concept of intermittent fasting that involves the popular “fasting” has drawn on the attention of a lot of people today, and it is touted as the new revolutionary approach to health and well-being. The growing popularity of IF can be depicted in myriad ways. The popularity of the internet and health consciousness which continue to grow make an increasing interest in the IF lifestyle around the world (1). Social media has turned intermittent fasting into a trend, where people share their habits, feelings and outcomes. Other media outlets have also hopped on the trend and they are putting the spotlight in its popularity as well as the reasons which can make people undergo the treatment. Research on the topic of IF has been constantly growing, signaling an increasing attention from scientists in this area (1). Generally, intermittent fasting has become a commonly used dietary method by many people with research and interest in its possible health benefits and weight loss.

1.1. Numerous Dietary Patterns:

Intermittent fasting refers to a variety of eating patterns that involve abstaining from or significantly reducing calorie intake for extended periods, ranging from 12 to 24 hours or even several days, on a recurring basis (2). IF encompasses different techniques, which differ in the length and frequency of fasting and normal feeding. Some of them take into account the compatibility of feeding with the circadian rhythm as a factor influencing the overall impact of IF. Three mainly applied approaches are time-restricted feeding, alternate-day fasting and 5:2 method.

1.2. Pros of Intermittent Fasting:

Intermittent fasting has been shown to have a range of health benefits, including increased life and health span, improved cognition, and decreased cardiovascular risk (3). It can also lead to weight loss, improved glucose homeostasis, and anti-inflammatory effects (4). Moreover, IF protects against hepatosteatorosis and improves gut function (5). Some studies have demonstrated the benefits of intermittent fasting in neurological and mental disorders (6). The metabolic

health benefits of fasting, particularly in religious contexts, have been explored, with positive effects on body weight, glycemia, and cardiometabolic risk markers (7).

The underlying mechanisms of these benefits include the activation of repair and rejuvenation pathways during fasting, as well as the role of circadian rhythm and gut microbiota (8). Additional research supports these findings, emphasizing the physiological responses of major organ systems to the onset of the metabolic switch during fasting (2).

1.3. Cons of Intermittent Fasting:

Most studies on intermittent fasting list hunger, irritability, fatigue, impaired cognition, negative impacts on both physical and mental health, and the risk of hypoglycemia as the main drawbacks associated with this dietary pattern. Moreover, concerns have been raised about its sustainability for long-term adherence. However, despite these drawbacks, IF may be effective for weight loss and improving cardiovascular and metabolic health (9). Landscape of intermittent fasting is not without its complexities and potential drawbacks. Balancing the purported benefits against the practical challenges and potential risks requires a careful examination of existing research and insights from varied perspectives. Lack of well-designed clinical studies makes it difficult to draw definitive conclusions about its long-term effects (10).

2. Description of the State of Knowledge:

The state of knowledge surrounding intermittent fasting as a debated phenomenon oscillates between claims of profound health benefits and persistent skepticism, reflecting a diverse body of existing research that scrutinizes this dietary pattern from multiple perspectives. This section details the impact of IF on individual diseases and various aspects of health.

2.1. Weight Management:

Intermittent fasting may be an effective approach in losing weight, decreasing body fat, and normalize blood lipids levels, thereby marking it as a potential instrument for addressing obesity and other related diseases (11). IF shows efficiency in reducing body mass, as the results specially vary between 0.7 and 11.3 kg, respectively for different studies. A reduction in body weight and fat mass in adults with overweight and obesity was demonstrated in other studies (12, 13). Therefore IF not only reduces cardiovascular risk by reducing abdominal fat, but it also leads to body composition change - the loss of fat mass and no decrease in muscle mass (14). The results indicate that intermitted fasting can be one of the effective approaches in reduction of body mass, particularly in overweight people and obese (14). On the other hand,

the long-term constituencies and the thus likely challenges in maintaining weight for a prolonged period are the areas that require further research.

2.2. Impact on Metabolic Health and Chronic Diseases:

Different research studies have proved that IF can enhance various health indicators such as clinical markers and metabolic health (15, 16). On top of that, IF has been shown to relate to treatment and prevention of diseases that include diabetes, cancer, cardiovascular disease, and many others by its ability to reduce body mass index (BMI), decrease inflammation, and improve blood glucose levels.

Studies have shown that IF has varying effects on glucose homeostasis. Some studies proved that there had been no notable effects on glucose control (18), however other works demonstrated the improvement in glucose tolerance, insulin levels, insulin sensitivity, blood glucose and glycosylated hemoglobin levels as well (19, 20, 21). These improvements were particularly notable in obese diabetic patients. Intermittent fasting can be used as a method of treating diabetes in addition to improving glucose regulation, but this impact needs to be further investigated before any conclusion on its effectiveness can be made.

Intermittent fasting has been shown to have a significant impact on hepatosteatosis and gut function. Studies have demonstrated that IF can induce rapid hepatocyte proliferation (22). This kind of dietary modification can as well act on intestinal stem cell function by activating fatty acid oxidation (23). Additionally, IF is associated with positive effects on the brain-gut-microbiome system which is a system that has the prime role in obesity and metabolic health (24). Such results indicate that the intermittent fasting method might be especially beneficial for improving the health of the liver and gut function. Nonetheless, further study should be carried out in-depth to comprehend the exact intervening period between IF use and the ultimate development of the same.

Research on the effects of intermittent fasting (IF) on cancer has shown some promising results. The results imply that the fasting process can be critical in treatment of cancer cells by creating conditions that worsen the cancer and thus enable the cancer cells to withstand, grow, and thrive thus enhancing the effectiveness of cancer treatment and minimizing the side effects (25, 26) . A prolonged fast in some cancer patients is regarded as not harmful and may have a protective effect by reducing the number of chemotherapy-related side effects and tumor growth (27). In spite of this, the long-term advantages of energy restriction versus potential health damage by underfeeding on any level is still subject to further inquiry. Thus these studies concluded that

IF, as an additional treatment, can exhibit cancer preventive qualities and we need more evidence regarding its implement mechanisms and longer-term effects.

2.3. Cellular Repair Processes and Longevity:

IF has been demonstrated in numerous studies to be protective against brain damage and neurological deficits following ischemic stroke. Also, it decreases inflammatory pathways and inflammasome activation that can worsen stroke outcome (28, 29). More investigates also suggest the same fact, pointing that IF can help to switch metabolic and contribute to reduction inflammation and oxidative stress, as well as increase plasticity and regeneration (30). Nevertheless, there are likely individual differences in response to IF according to the presence of related diseases like diabetes and hypertension. Most studies have shown, with a few exceptions, that IF, has no adverse effects on incidence of cardiovascular disease or the number of hospitalizations due to cardiac disease events (31). Further research is needed to clarify impact of IF on ischemic stroke particularly on individuals with diabetes.

Proponents of intermittent fasting often highlight its putative benefits for cellular metabolism and positive effect on major organ systems. Intermittent fasting induces a metabolic switch from glucose to ketones, which can optimize brain function and resilience (32). This switch is triggered by a 6-hour eating period and an 18-hour fasting period, leading to various health benefits (33). The resulting swap, approximately 12 hours following the fasting initiation, accomplishes two things: it releases fatty acids from fat stores, and depletes glycogen reserves in the liver (2). Intermittent fasting which aids to the metabolic switch according to some research have demonstrated disease-modifying characteristics and increased longevity (34).

2.4. Challenges and Potential Risks:

The literature highlights the limitations and dangers that might result from intermittent fasting. Nutritional issues such as the occurrence of nutrient deficiency and imbalance are always brought up which is a particular concern for those who have difficulties in meeting their nutritional needs within restricted meals periods.

The long-term security and efficiency of IF are still questionable and it is not recommended for particular groups of people, e.g. pregnant woman, nursing mothers and children, elderly people and vulnerable individuals suffering from eating disorders (9).

Above everything, the fixed periods of fasting might generate a high risk of weakness and nutritional imbalances. People with severe muscle wasting, for example, those diagnosed with Duchenne dystrophy, spinal muscular atrophy and congenital myopathy may be subject to the

development of hypoglycemia during fasting (35). Additionally it is documented that any form of fasting raises the risk of hypoglycemia in patients with Type 2 diabetes (36). In some rare cases, fasting hypoglycemia may occur without a known cause, as seen in a reported case of idiopathic fasting hypoglycemia in an adult (37).

2.5. Hormonal Responses

Intermittent fasting may bring about the modification of glucose and lipid metabolism, the rise and fall of hormone levels, for example insulin, thyroid hormones, and glucocorticoids (38, 39). Also, IF has been shown to have a great effect both on ghrelin, GLP-1 and GH levels specifically. As researches show, Intermittent fasting (IF) leads to the raise of ghrelin and GH (40, 41). The heightened pulsatile secretion of GH during fasting contributes to a decrease in free Insulin-like Growth Factor-I (IGF-I), an increase in Insulin-like Growth Factor-Binding Protein 1, and a reduction in total IGF-I (42). Additionally, IF may lead to a decrease in GLP-1, a hormone crucial for insulin and glucose regulation (43). The collective findings from these studies suggest that intermittent fasting may contribute to enhanced glycemic control and increased insulin sensitivity.

Intermittent fasting has been reported to exhibit signs of influencing libido, mainly through changes in androgen markers. It may result in reduced levels of androgen in both men and women, which could suppress sex drive. In females with obesity, IF decreases androgens markers and increases in the levels of the sex hormone binding globulin, while in the case of lean males who are physically fit, it was revealed it to be responsible for lower testosterone levels (44). The available evidence is limited, and further research is necessary to confirm a direct influence on libido.

2.6. Impact on Cognitive Function:

Intermittent fasting has been shown to have potential benefits for brain health and cognitive function. IF, when combined with regular physical activity and exercise, can lead to improved physical and mental performance, especially in athletes (45). Numerous potential benefits are associated with brain-related disorders, including epilepsy, Alzheimer's disease, and multiple sclerosis. Insights from animal studies also suggest potential advantages of intermittent fasting (IF) for conditions such as Parkinson's disease, autism spectrum disorder, and mood and anxiety disorders. However, there is a need for further research to thoroughly investigate the impact of IF on neurological diseases, particularly in human individuals (6).

Critics express concerns about the potential negative impact on social relationships and mental well-being, highlighting the importance of considering the broader psychosocial aspects of IF. Some physical and mental health aspects are negatively affected by daylight fasting. Common potential drawbacks include hunger, irritability, and impaired cognition (9) . Eating-related thoughts, feelings of hunger, and fear of loss of control were significantly more frequent during fasting periods compared to days of normal eating (46). These symptoms may dissipate within a month of the fasting period (9) .

2.7. Impact on Sports Performance

Intermittent fasting has been shown to have a positive impact on body composition and lean muscle mass, without compromising physical performance (59). This is particularly relevant for athletes, as it can aid in weight management and improve cardiovascular health (60).

Intermittent fasting does not significantly impair strength and power in resistance-trained individuals, but may increase hunger and desire to eat (61). Research has shown its promising results in improving body composition and muscle oxidative capacity in overweight women (62); in active women, combining high-intensity interval training (HIIT) with IF can reduce fat mass and proved to increase jumping performance (63).

When combined with resistance training, intermittent fasting has been found to significantly reduce body mass, fat mass, body mass index, and body fat percentage, while maintaining fat-free mass (64). Various intermittent fasting patterns result in similar improvements in body composition, muscle quality, and strength (65). Despite promising results, still further research is needed to fully understand the mechanisms and energy pathways that allow athletes to maintain their performance capacities during intermittent fasting.

2.8. Sustainability and Adherence:

Critics and cautious observers raise concerns about sustainability of intermittent fasting, particularly concerning long-term adherence (47). The current state of knowledge underscores the necessity for personalized approaches that take into account individual preferences, lifestyles, and cultural factors to optimize adherence. While older adults generally tolerate time-restricted eating well, additional support may be essential to facilitate comprehension and adherence to the regimen (48), especially for individuals with metabolic syndrome and type 2 diabetes (49).

2.9. Effect on circadian rhythm

Intermittent fasting can lead to disruptions to sleep patterns. Studies have reported delays in bedtime and wake time during IF, as well as a reduction in the proportion of rapid eye movement (REM) stage sleep (50). Nevertheless, IF does not result in a feeling of excessive sleepiness during the daytime or any noticeable change of cognitive functions; it also has no adverse effect on circadian rhythms if the schedules of sleep/wake are properly controlled (51).

2.10. Diversity of Intermittent Fasting Protocols:

Though the literature does recognize the rich variety of intermittent fasting, they do not yet all have a centralized source of information. Scientists are investigating possible different approaches to fasting, as studies have shown that the particular type of fasting may affect the results. Comparative trials are designed to identify those periods of fasting which show superior therapeutic value for particular health targets and as such contribute to the puzzle lying in the proper caloric regimen.

The various intermittent fasting regimens comprise five distinct categories: time-restricted feeding, alternate-day fasting, periodic fasting (ex. 5:2 method), less well-defined IF (fast-mimicking diet and juice fasting) and religious fasts (6, 9).

Time-restricted eating (TRE) is a dietary approach that restricts calorie intake to a 6- to 10-hour period during the active phase of the day, as aligning food intake with circadian rhythms has been proven to decrease the risk of chronic diseases (5).

Alternate day fasting (ADF) is feeding pattern where one day of fasting (defined as zero-calorie or <800kcal intake per day) is followed by a day of normal feeding. (52, 53).

The 5:2 fasting method involves eating normally for five days a week and significantly reducing calorie intake for the remaining two days.

Time-restricted eating is being seen well-tolerated while long-term adherence to ADF can be challenging (17). Furthermore, research has demonstrated that fasting periods ranging from 4 to 21 days are safe and well-tolerated by individuals (54).

While all protocols has been shown to produce mild to moderate weight loss and improve markers of cardiometabolic health, such as blood pressure and insulin resistance is still unclear which pattern will fit the best to reach certain health goals. (55). ADF may be more effective for weight loss and cardiometabolic risk factors, particularly in people with insulin resistance, while TRE is well-tolerated and may have metabolic benefits, even without weight loss (47, 56, 57). Furthermore, the TRF pattern exhibits a lower dropout rate when compared to other IF

protocols (14). In terms of diabetes risk indicators, IF have been found to be equally effective as daily calorie restriction for weight loss and cardioprotection, but more research is needed to determine their comparative effects on glucose concentrations (58).

3. Summary:

Intermittent fasting has been found to extend both life and health span by positively impacting weight management, reducing the risk of cardiovascular incidents, promoting cellular repair, and exhibiting anti-inflammatory actions. It improves blood sugar levels, offers better control of diabetes, provides protection against hepatosteatosis, enhances lipid metabolism and has beneficial effects on the brain-gut-microbiome system. IF leads to improved mental performance and offers benefits for neurological disorders such as epilepsy, Alzheimer's, and multiple sclerosis. However, concerns about nutritional deficiencies, sustainability, and broader social implications are evident. Common drawbacks of IF include feelings of hunger, irritability, fatigue and hypoglycemia risk. IF is not recommended for pregnant woman and individuals suffering from eating disorders.

IF is as a promising tool alongside traditional therapeutic strategies, particularly for addressing obesity, diabetes, hepatosteatosis, and managing cardiovascular risk. However it is not recommended for certain groups such as pregnant woman and patients with eating disorders. The diverse landscape of IF patterns, coupled with drawbacks and controversies, underscores the necessity for long-term research before recommending IF for the prevention and treatment. Also, there is a need for further research to investigate its impact on ischemic stroke, libido and cancer as results in these areas remains unclear.

Disclosure:

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