

Beyond a Meal: The In-Depth Analysis of Breakfast and Its Impact on Obesity Prevention- A Comprehensive Review.

Rupal Kumar , Moattar Raza Rizvi .

Abstract:

Obesity has reached alarming proportions globally, with an estimated 1.9 billion adults classified as overweight and 650 million as obese. This health epidemic results in approximately 2.8 million annual deaths due to obesity-related complications. Women are more vulnerable to facing the adverse effects of being overweight. Consequently, Researchers are actively exploring various strategies for obesity prevention. One such strategy gaining significant attention is the key role of breakfast consumption in preventing obesity. Recent research has focused on examining the impact of breakfast on energy balance and weight regulation. This comprehensive review aims to evaluate current research on the relationship between breakfast intake and obesity prevention. The data for this review was acquired from a variety of sources such as Google Scholar, Research Gate, PubMed, and Science Direct, and was authored by a variety of researchers. The findings of this review underscore a growing consensus regarding the role of breakfast consumption in the prevention of obesity. Physiological and behavioural mechanisms suggest that regular breakfast consumption can exert a positive influence on weight management. Skipping breakfast has been associated with unusual metabolic effects, obesity-related type 2 diabetes, heart disease, as well as disruption to circadian rhythms. In light of these findings, it becomes apparent that embracing a nutrient-rich breakfast, adhering to regular meal timings, and implementing behaviour change strategies may prove helpful in preventing obesity and obesity-related health issues. Nevertheless, to establish a definitive causal relationship, further research is imperative, including well-designed randomized controlled trials.

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Introduction

Breakfast Consumption and Obesity Prevention

Breakfast plays a significant role in preventing obesity and promoting overall health. Numerous studies have shown the importance of regularly having a balanced breakfast. To investigate the association between consuming breakfast and obesity, it is important to define these terms distinctly. Obesity refers to the condition where an individual carries more than 20% of additional body fat compared to the typical accumulation based on their body mass index. This condition arises due to an unhealthy lifestyle combined

with improper nutrition. Obesity is a global concern, surging at an alarming rate and affecting the public well-being significantly. Statistics report that over 1.9 billion persons were classified as being overweight, with over 650 million being classified as obese. Notably, 39% of men and 40% of women were identified as overweight.[1] People in developing countries are more prone to get obese because of increased intake of calorie-rich food, sedentary lifestyles, and lack of access to health care services and

financial support. More than 135 million people in India experience obesity-related health issues from problems associated with obesity. Research has revealed that women are substantially prone to being overweight. The prevalence of obesity and central obesity spans 11.8% to 31.3% and 16.9% to 36.3%, respectively, according to a 2015 study by ICMR-INDIAB. Further, a major risk factor for a number of cardiovascular diseases (CVDs) is abdominal obesity. Obesity is one of the biggest financial and medical burdens in a nation's economy. [2]

According to Atlas, the global population living with obesity is projected to reach a staggering one billion by 2030. According to this estimate, 1 in 5 women and 1 in 7 men worldwide will be obese. These findings indicate that most countries are unlikely to achieve the 2025 goal established by the World Health Organization (WHO) to halt the rise in obesity rates and will be maintaining them at 2010 levels instead. The most pronounced impact of this trend is especially noticeable in low- and middle-income countries (LMICs), where the incidence of obesity is projected to more than double across all LMICs, with a threefold increase in low-income nations compared to statistics from 2010. [3] Other data show that worldwide obesity has grown, with more than 2 billion overweight persons accounting for 30% of the world's population. [4] Breakfast is one of the most

a king, lunch like a prince, and dinner like a pauper.”[5]

When to eat breakfast, lunch, and dinner. What we consume for breakfast has a significant impact on our overall well-being, and cognitive abilities.[6] From a physiological angle, “breakfast stands out from other meals as it follows the longest period of fasting after a meal, specifically the overnight fast”. Andersen, in his work titled "A History of Breakfast," outlines various characteristics of breakfast's role in the human diet throughout centuries.[7]_Also, research has shown that people who have breakfast consume more nutritious food than those who skip breakfast. Having breakfast presents a distinctive chance to intake essential micronutrients that might be less abundant in the succeeding meals.[8] A growing collection of scientific research increasingly substantiates the view that breakfast holds a significant importance. One of them is the potential adverse health outcomes for individuals who neglect to consume food at breakfast.[9]

The social norms, psychological aspects, and knowledge about breakfast in a culture are important and the scientific community should emphasize it more. [10] Breakfast consumption is essential to maintain a healthy body. It maintains a healthy weight, reduces insulin sensitivity, and lowers the likelihood of developing a number of diseases, including type 2



Figure 1: Benefits of eating breakfast. Eating breakfast offers numerous benefits for overall health and well-being. It can enhance mood, boost cognitive function, and reduce the risk of illnesses. A balanced breakfast provides essential energy for daily activities and can aid in weight management by curbing unhealthy snacking later in the day. Establishing a regular breakfast routine can contribute to a healthier and more productive lifestyle

essential meals of the day, providing nourishment and the essential calorie energy for the day to come. Renowned nutritionist Adelle Davis emphasised the importance of breakfast by quoting “Eat breakfast like

diabetes. Breakfast is essential as it breaks the overnight fast and offers multiple advantages, including improved memory recall, improved performance in children, improved mood, improved cognitive function, decreased weight, and improved menstrual health for

women. Despite this, many people across the world tend to miss breakfast owing to constraints on time, family relationships, and a lack of appetite in the morning, and false beliefs about breakfast, such as the idea that it contributes to an increase in weight. The trend of skipping breakfast has detrimental effects on one's health. [11] The risk of developing metabolic syndrome and an increase in the symptoms of cardiometabolic disease in children and teenagers are both linked to skipping breakfast. Advocating for the advantages of having breakfast could serve as a straightforward yet significant approach to mitigate these risk factors [12] Also, breakfast consumers feel less hunger and have increased satiety[13]

Reasons why breakfast is crucial in preventing obesity:

Improves metabolic syndrome: A properly functioning metabolism can help with weight management and prevent excessive fat accumulation. The importance of breakfast lies in its ability to initiate the body's daily metabolism. A 12-week study by Jakubowicz et al. (2013) studied the effects of breakfast on weight loss and overall health in women with metabolic syndrome. In the study, the two weight loss groups for overweight and obese women had different meal schedules but the same daily calorie intake (about 1400 kcal). Compared to the other group, the high-calorie breakfast group resulted in greater weight loss and a smaller waist size. Fasting insulin, ghrelin, and glucose levels improved in both groups. The high-calorie breakfast group, however, had higher reductions in triglyceride, insulin, fasting glucose, and insulin resistance levels. In addition, they responded to glucose and insulin more effectively during oral glucose tests and felt fuller sooner. This suggests that a high-calorie breakfast followed by a lighter dinner would be an effective strategy for treating obesity and metabolic syndrome.[14]=

Reduces overall calorie intake and controls cravings:

Skipping breakfast often leads to increased hunger later in the day, causing people to overcompensate by consuming larger portions and higher-calorie foods for other meals. A balanced breakfast can help satiate longer, reducing the likelihood of overeating later in the day. The findings indicate that having breakfast is helpful in decreasing food cravings and increasing the feeling of fullness [15] breakfast consumers feel less hunger and have increased satiety [16] Incorporating breakfast into the diet of overweight/obese young individuals reduces cravings for food after meals and increases levels of homovanillic acid. Further, breakfast options with higher protein content seem to elicit stronger effects in terms of reducing cravings and increasing HVA (homovanillic acid) concentrations.[17] There is also an association

between breakfast consumption and various measures of dietary intake, physiology, and biochemistry.[18] A high-calorie breakfast and reduced intake at dinner can lead to better weight loss outcomes in overweight and obese women.[19] In overweight/obese, adolescent girls, a higher-protein breakfast has been shown to have positive effects on hunger and the hormonal signals that control calorie intake [20]

Enhances physical activity: Individuals who regularly have breakfast tend to follow a healthy lifestyle, including maintaining a balanced diet and engaging in regular physical exercise. A cross-web survey involving 3395 Japanese workers investigated the connection between the type of breakfast consumed, an individual's chronotype (their preference for morning or evening activities), and their level of physical activity. It concluded that individuals who consume a traditional Japanese breakfast are more likely to have an early chronotype and engage in higher levels of physical activity.[21] Skipping breakfast has also been shown to reduce the amount of free-living physical activity performed over the period of a day. [22] From a sample of active females, eating breakfast before exercise can improve various aspects of mood temporarily while also leading to superior appetite management after exercise. Although additional research is required before this can be recommended, a pre-workout breakfast of about 118 kcal can enhance mood and appetite management after exercise. [23] Breakfast omission can also be used to reduce daily calorie consumption, although it may affect performance later in the day, even after eating lunch. [24]

Improves nutrient intake: It is important to choose foods that are high in nutrients, such as whole fruits, 100% fruit juice, low-fat milk, fortified cereals, and other nutritious grain products. This kind of nutrient-dense breakfast should be incorporated within a larger healthy eating strategy. [25] It is necessary as people who consume fruits, cereals, yogurt, and nuts have less belly fat. This connection was partially clarified by the fact that their more nutritious diet throughout the remaining part of the day played a role.[26] Consistently having breakfast and maintaining regular meal schedules are connected to adopting healthy lifestyle patterns and receiving sufficient nutrients. These factors play a role in promoting metabolic well-being, thus contributing to the prevention of obesity, and associated metabolic complications. [27]

The Link between Breakfast Skipping and Obesity Described as the most crucial meal of the day, breakfast gives the body the nourishment it needs after an overnight fast. In recent years, breakfast has been linked to weight control, risk factors for cardio-metabolic illness, and cognitive function, while the research is still inconclusive on the exact health advantages of breakfast

[28]. In a recent report, about 36% of the UK population either eat occasionally or always skip breakfast [29].

lipoprotein cholesterol (HDL-C) in their bloodstream.[36] Additionally, research has indicated



Figure 2: Harmful effects of skipping breakfast. Skipping breakfast can have many harmful effects on the body. It can lead to decreased metabolism, potentially contributing to weight gain. Additionally it may affect cardiovascular health, Cognitive function, and even lead to hair loss. Skipping breakfast can also worsen the symptoms of a hangover and increased the risk of developing type 2 diabetes. Therefore maintaining a healthy breakfast routine is essential for overall well-being.

that missing breakfast frequently increases the risk of developing type-2 diabetes associated with obesity and heart disease. [37]. Skipping breakfast may also disrupt circadian rhythms [38]. Increased inflammation in people who miss breakfast has been proposed as one potential mechanism linking breakfast intake and the risk of chronic diseases. [39,40]. A small number of published prospective cohort studies from the United States and Japan have connected skipping breakfast to an increased risk of cardiovascular disease morbidity and mortality, as well as all-cause death.[41]. According to research, Japanese women who had late meals or nighttime snacks skipped breakfast

Skipping breakfast is linked to unusual metabolic effects in Korean men, particularly among young employees. Furthermore, original concepts were presented to elucidate the ways in which the act of skipping breakfast influences metabolic results.[30]. Omitting breakfast has been shown to create deficiencies in vitamin and mineral intake, leading to an unfavorable dietary pattern [31]. Breakfast skipping is related to the inadequacy of vitamins. Furthermore, obesity and being overweight are also associated with skipping breakfast [32]. Skipping breakfast has a notable influence on body weight and metabolism. The association between not having breakfast and elevated body mass index (BMI) values has been extensively documented among Hong Kong children, European adolescents, and Fizi girls. [33,34,35] Several investigations have explored the connection between skipping breakfast and its consequences on metabolism. A cross-sectional study involving 5316 young adults in the United States discovered that those who consistently had breakfast were less prone to having elevated levels of low-density lipoprotein cholesterol (LDL-C), hypertension, and lower levels of high-density

more frequently. An increased likelihood of becoming overweight or obese was linked to eating a late meal or a snack before bed.[42].

Physiological mechanism of consuming breakfast: Breakfast Consumption and Metabolic Rate

Metabolic rate refers to the number of calories the body burns to maintain basic physiological functions and perform daily activities. Several studies have investigated the relationship between breakfast consumption and metabolic rate. The association between breakfast habits and several aspects of energy balance in people living independently was examined in a randomized controlled trial. In individuals with lower weight, the study discovered an association between daily breakfast consumption and increased physical activity thermogenesis. Eating breakfast helped to maintain more stable blood sugar levels in the afternoon and evening compared to fasting.[43]. Regularly eating breakfast establishes a consistent eating schedule, which is beneficial for metabolic health. Regular mealtimes can enhance metabolic health by regulating hormone levels. In one study, researchers analyzed the consistency of breakfast eating with respect to weight

status among 46,037 women from the Sister Study cohort using modified Poisson regression models. They looked at cross-sectional outcomes such as obesity, waist size, hip-to-waist ratio, and overweight. To estimate weight growth and incident overweight and obesity, they also used self-reported weight collected five years after the baseline. The results showed that women who consistently ate breakfast were 11% to 17% less likely to be obese compared to those who only did so sometimes (3 to 4 days/week). Prospective investigations showed that consistent breakfast eaters (those who always or never skipped breakfast) had a 21% and 28% lower risk of obesity over the course of five years than those who only occasionally had breakfast. Breakfast eating, however, was not significantly linked to gaining 5 kg of weight. According to the study, maintaining a regular breakfast eating routine—either by eating breakfast each day or not at all—might help to support a healthy weight [44]. It is important to note that individual responses to breakfast and metabolic rates can vary based on factors such as age, genetics, body composition, and overall lifestyle. While breakfast can positively impact metabolic rate in women, it is just one factor in a complex interplay of lifestyle and dietary habits that contribute to overall health and metabolism. Another study found a strong association between daily

sensitivity refers to how responsive the body's cells are to the hormone insulin, which helps regulate blood sugar levels. Here's how breakfast consumption can influence insulin sensitivity:

- **Stabilizing blood sugar level:** Consuming a balanced breakfast that includes complex carbohydrates, proteins, and healthy fats can help stabilize blood sugar levels throughout the morning. This prevents rapid spikes and crashes in blood sugar, reducing the strain on insulin production and maintaining insulin sensitivity. A healthy approach for the control of obesity and metabolic syndrome is a high-calorie breakfast with a lower intake in the evening. [46]. In comparison to a conventional daily diet, a low-calorie Mediterranean diet with a larger percentage of calories taken earlier in the day can result in more pronounced decreases in fat mass and enhanced insulin sensitivity.[47].
- **Regular meal timings:** Consistently having breakfast and adhering to regular meal schedules can promote improved insulin sensitivity. The timing of meals and the glycemic index (GI) of food both influenced how the body processed glucose and secreted insulin. It could be especially advantageous to



Figure 3: Effect of meal timings on different variables Incorporating a dietary routine of 2-3 well-balanced meals a day, with a consistent emphasis on consuming a regular breakfast and avoiding late-night meals, can yield numerous health benefits. This approach has been shown to significantly improve insulin sensitivity, reducing the risk of diabetes, and lower overall hunger levels, aiding in weight management. Additionally, it supports a healthier circadian rhythm, enhancing sleep quality and overall well-being. This dietary pattern is associated with lower fat mass and more stable blood sugar levels, promoting overall metabolic health.

breakfast intake and a reduced risk of various metabolic conditions, suggesting that regular breakfast consumption may have a protective effect on metabolic health.[45].

Breakfast consumption and insulin sensitivity

Breakfast consumption can have an impact on insulin sensitivity, a critical factor in metabolic health and the prevention of conditions like type 2 diabetes. Insulin

avoid consuming large, high-GI meals during the evening to enhance the way the body manages glucose after eating. This approach might also contribute to lowering the likelihood of developing type 2 diabetes [48]. A study on animals demonstrated that the timing of the initial daily meal influences the alignment of peripheral clocks, like those in

the liver. On the other hand, the timing of the last daily meal strongly influences processes related to lipid metabolism and the buildup of adipose tissue. This indicates distinct physiological effects and roles associated with these respective meal timings.[49]. Breakfast followed by many smaller meals on a regular basis has been demonstrated to help people with Type 1 diabetes maintain better glycaemic control. This, however, may increase blood glucose variability owing to the number of meals eaten. [50]. Consuming more calories earlier in the day and fewer calories later in the day seems to boost dietary-induced thermogenesis, improve cardiovascular health, and accelerate weight loss. [51].

high-fiber nondairy cultured product. Both breakfast options similarly suppress appetite and food intake after 2 hours, but overall cumulative intake is higher compared to skipping breakfast altogether.[54]. Additionally, it has been shown that healthy women who eat low-fat high-protein snacks like yogurt instead of high-fat snacks may be able to better manage their appetites, feel fuller longer, and consume fewer calories overall. [55].

Effects on circadian rhythm: Circadian rhythms regulate the functions of the human body. These rhythms are impacted by both the alternating pattern of light and darkness and by the intake of food, which serves as a metabolic signal. Conversely, the circadian control of metabolic genes has an impact on the results of various metabolic processes in the human body. This emphasizes the close connection between meal timing

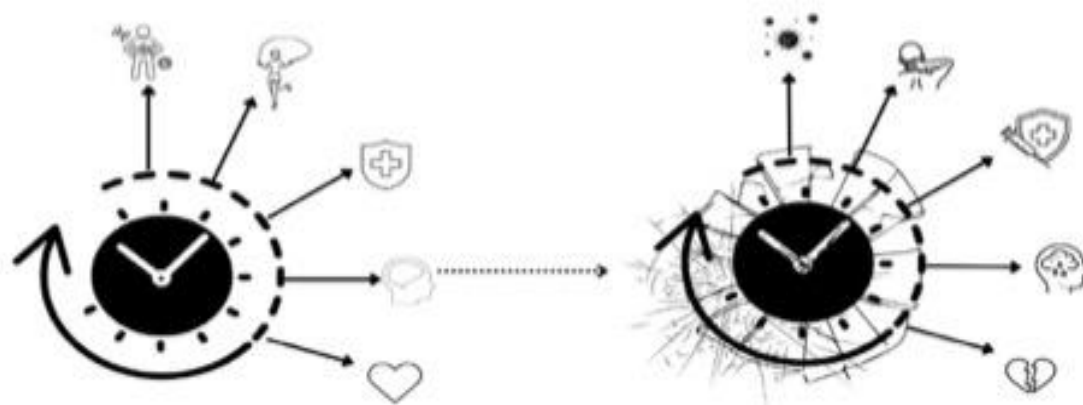


Figure 4: Effect of circadian misalignment on health

Circadian misalignment, often due to irregular eating habits, can disrupt the rhythmic functioning of the body. This disruption has the potential to contribute to the development of conditions like metabolic and cardiovascular disease, inflammation, depression, and the progression of cancer

Regulating appetite: Studies have shown that individuals who regularly eat a healthy breakfast tend to have a healthier body weight compared to those who skip breakfast or eat unhealthy options. By controlling appetite and reducing overeating, breakfast can contribute to better weight management in women. A breakfast that included ready-to-eat cereals was associated with a lower rate of overweight/obesity, abdominal obesity, and several other cardiometabolic risk factors in a sample of US young adults, in contrast to the potential detrimental metabolic effects that were found from skipping breakfast. [52]. Optimal management of satiety was achieved when the fruit salad was eaten during the mid-morning as a snack. Therefore, maintaining a regular breakfast schedule and incorporating whole fruits as mid-morning snacks could be an effective approach to regulating appetite.[53]. The findings suggest that in young females, a breakfast with granola combined with high-protein cultured dairy results in lower blood glucose levels compared to a

and the circadian clock.[56]

According to a study investigating how breakfast influences postprandial glycemic response, missing breakfast has an adverse effect on circadian gene expression and raises postprandial glucose response. [57]. The time-based context of eating, daily cycles in hormone profiles, and the metabolic reaction to food intake show how the circadian system is involved in controlling the homeostatic regulation of food intake. [58]. Data demonstrating that metabolic illnesses like obesity can affect the daily rhythms of the clock metabolic genes and endocrine components also emphasize the circadian effect on normal metabolic responses. [59] Maintaining circadian alignment seems to play a crucial role in managing overall well-being. When the body's internal clock desynchronizes with its surroundings a condition known as circadian misalignment, often due to irregular eating habits, can disrupt the rhythmic functioning of the body. this disruption has the potential to contribute to the

development of conditions like metabolic and cardiovascular disease, inflammation, depression, and the progression of cancer[60][61]. As a result of night shift employment, sleep difficulties, social jet lag, irregular eating patterns, and a lack of physical exercise, it has been suggested that this misalignment is frequently seen in modern lifestyles. This is why there remains a lot of interest in understanding the processes supporting clock synchronicity.[62][63],[64]. The circadian clock is crucial for regulating our eating patterns.. Eating in line with the circadian clock might enhance metabolic regulation and prevent metabolic changes caused by unhealthy (energy-dense, high-fat meals) and irregular eating habits (mistimed food intake). A growing amount of research in humans indicates that having breakfast early during the day is linked to better body weight management and metabolic homeostasis. [65]. Eating a nutritious breakfast in the morning can help regulate the body's internal clock and circadian rhythms. Disrupted circadian rhythms have been associated with metabolic disturbances, including insulin resistance. [66][67]. Both healthy individuals and those with type 2 diabetes can improve their blood sugar control by aligning their internal body clock, daily behaviors like sleep and eating, and exposure to light in a way that makes sense for their natural rhythms. There is also growing evidence that eating within specific time periods could be helpful for metabolic health and controlling blood sugar levels [68,69]. In another study, mice who were given a high-fat meal at the "correct" time to eat (during the rodents' dark phase) gained less weight than mice that were given the same high-fat diet at the "wrong" time (during the rodents' light period, when feeding is usually reduced). [70].

Behavioural mechanism of consuming breakfast:

Dietary Quality: Breakfast consumption has been associated with improved overall dietary quality, including a higher intake of essential nutrients and lower consumption of high-calorie, low-nutrient foods. Young Isfahanian women who ate breakfast had lower values for their body mass index and waist circumference as well as higher scores on the dietary quality indicators. Further studies should be performed to determine the relation between the kind of breakfast consumed and the dietary quality indices.[71]. Most of the UK population has breakfast regularly, contributing around 20-22% of daily energy intake across all age groups. Carbohydrate and added sugar intake are higher, while protein, total fat, and saturated fat intake are lower at breakfast compared to the entire day. The study reveals micronutrient-rich UK breakfasts, notably boosting vitamin D, calcium, and folate intake. Breakfast consumption improves overall diet quality, indicating potential for UK nutrient-based balanced breakfast recommendations for the first time.[72]. Regularly eating breakfast helps lower the risk of

vitamin deficiencies since it gives yet another meal to incorporate important nutrients into the diet. Missing breakfast can result in inadequate nutrient intake, particularly nutrients like calcium, vitamin D, and the B vitamins that are frequently found in breakfast dishes. The Arab region continues to have nutritional issues, especially when it comes to adolescent intake of junk food, fast food, and sugary beverages. These diets can result in fiber, niacin, and vitamin A deficiencies. The study's findings highlight the significance of a balanced diet for female adolescents and the necessity of health-promoting interventions that are successful in raising the knowledge of their own health.[73]. A study analyzed adults (N=18,988) from the National Health and Nutrition Examination Survey (2001-2008) to compare breakfast patterns and nutrient intake. Consumers of patterns including grains, cereals, lower-fat milk, and whole fruit/100% fruit juice exhibited higher nutrient intake, better diet quality, lower body mass indexes, and waist circumferences than breakfast skippers, highlighting the potential benefits of consuming a balanced breakfast.[74]. A cross-sectional study looked at 35 skippers and 40 breakfast eaters. women from Sacramento, CA, between the ages of 18 and 45 with BMIs under 40 were recruited (2009–2013). The Dietary

Guidelines' compliance was evaluated using 24-hour recalls using the Healthy Eating Index 2010 (HEI-2010). Through tests and questionnaires, stress and executive function were assessed. Breakfast eaters had superior diet quality, including whole grains, fruit, and nutrients like fiber, calcium, potassium, and folate, despite having identical energy intake. Skippers of breakfast had greater levels of added sugars and saturated fat in the evening. Skippers, not eaters, have been related to poor eating habits by stress. [75].

Portion control: Including a balanced breakfast may assist in portion control and prevent excessive calorie intake during later meals. Breakfast can play a significant role in supporting portion control throughout the day. Making thoughtful and balanced choices during breakfast can positively influence eating habits and help manage portion sizes for other meals and snacks. breakfast is known to have an impact on portion control while eating on a person. there is evidence that suggests that skipping breakfast or having irregular breakfast increases the appetite and reduces satiety in a person. this may lead to overcompensation in the next meals [76]. Skipping breakfast can also adversely impact glycaemic control in people with type 2 diabetes. evidence suggests that having a rich breakfast improves glycemic control in people with type -2 diabetes.[77].

Physical Activity: Breakfast consumption has been linked to increased physical activity levels, potentially contributing to weight management and energy balance. Consumption of breakfast can have a significant impact

on the physical activity of a person in comparison to omission of breakfast, Consumption of breakfast has been shown to provide more energy for physical activity thereby improving exercise performance [78].

Practical recommendations for consuming breakfast

1. Nutrient-rich breakfast: Having a nutrient-rich breakfast is important in preventing obesity and maintaining a healthy weight. A balanced and nutritious breakfast sets the tone for the day and provides essential nutrients that support overall health and well-being. Here are some ways a nutrient-rich breakfast helps in preventing obesity:

- **Satiety and appetite control:** A breakfast that includes a good balance of protein, fiber, and healthy fats promotes feelings of fullness and satisfaction. This helps control hunger and reduces the likelihood of overeating or snacking on unhealthy foods later in the day. Breakfast meals containing a larger amount of protein and energy increased the magnitude of satiety and appetite response.[79].
- **Encourages healthier food choices:** A healthy breakfast frequently sets a good tone for the rest of the day, increasing the likelihood that people will choose healthier foods for later meals and snacks. Individuals who ate fruit, natural cereal flakes, nuts/seeds, and yogurt for breakfast had a lower chance of developing abdominal obesity as a result of making healthy food decisions throughout the rest of the day. [80].
- **Supports physical activity:** A nutrient-rich breakfast provides the energy and nutrients needed to support physical activity and exercise. Regular physical activity is crucial for maintaining a healthy weight and preventing obesity. Breakfast omission decreases exercise performance throughout the day; thus, individuals hoping to optimize exercise performance should have breakfast. [81].

2. Regular Meal Timing:

The prevention of obesity and the promotion of general health can both benefit from maintaining regular mealtimes. Consistent eating habits encourage improved appetite management by regulating hunger hormones, enhancing metabolic health, and improving metabolic function. Regular mealtimes can help avoid obesity in the following ways: Eating at irregular times may hinder the effectiveness of obesity therapies, and eating late may have an obesogenic impact from several mechanisms. The timing of the three main meals of the day—breakfast, lunch, and dinner—was discussed in a review, along with the effects that eating during the biological night may have on factors associated with metabolism, glucose tolerance, and obesity.[82]. Given

the importance of meal patterns, dietary advice must also address nutrient timing in addition to the usual emphasis on nutrient amount and quality. Researchers have looked into a variety of food timing factors over the past decade and have discovered a number of practical methods for enhancing human health. [83]. Having set meal timings encourages mindful eating, where the focus is on the food that is being consumed and the body's hunger and fullness cues. This mindfulness can prevent mindless and emotional eating, which is a contributory factor to obesity. Greater weight reduction and improved glycemic control have been seen in obese women on calorie restriction who consume 1400 kcal per day and lessen their caloric intake from the morning to the evening (700, 500, and 200 kcal at breakfast, lunch, and dinner, respectively). [84].

3. Strategies to Change Behaviour:

Promoting the habit of regular breakfast consumption requires implementing changes in behaviour that encourage consistency and make breakfast a regular part of your daily routine. According to research, habit formation offers an acceptable, simply understood intervention technique with the ability to modify behaviour and produce good health outcomes, making a habit-based approach to behaviour change efforts more effective. Approaches, however, should be goal setting, and self-monitoring, and should come with social support in order for them to form healthy habits. [85]. The school setting is an ideal setting to encourage a healthy diet, favouring the introduction of food and nutrition education programs to educate teenagers on the significance of having breakfast every day. [86]. A 12-week text message intervention called LEAP Beep was given to overweight and obese persons who had started a weight-loss program. The participants received daily goals for their diet including fruit, vegetables, and breakfast. They received individualized feedback as they routinely reported their progress. Those receiving the text messages (the intervention group) showed significant decreases in body weight, waist circumference, and BMI compared to the control group who just received weight checks. The intervention group also noticed improvements in their quality of life and a decline in their levels of depression. With the help of text messaging, goal setting, self-monitoring, and encouragement were all effectively completed, leading to positive weight results. Such therapies may be more effective if automation continues to develop while individual support is maintained [87]. During the early phase of a weight loss treatment, self-monitoring is also linked positively to weight loss. [88]. Frequent self-monitoring also aids weight management by assisting participants in meeting daily calorie intake targets. [89][90]. Participating in online communities and forums focused on healthy eating and breakfast

habits can also be helpful in the formation of habits as supported by the social cognitive theory. [91,92].

Conclusion

Although the current evidence is not entirely conclusive, there is growing support for the idea that consuming breakfast may help prevent obesity. Physiological and behavioural mechanisms suggest that regular breakfast consumption can positively influence weight management. Additionally, it has also been demonstrated that those who eat breakfast have improved diet quality, portion control, and enhanced physical activity levels as compared to those who do not eat breakfast. On the other hand, skipping breakfast has a notable influence on body weight and metabolism. Obesity-related type 2 diabetes and heart disease can be the consequences of skipping breakfast. A balanced breakfast that includes complex carbohydrates, proteins, and healthy fats can help reduce blood sugar levels and may improve insulin sensitivity, which is crucial for metabolic health and helps prevent type 2 diabetes, heart disease, and obesity. To establish a definitive cause-and-effect relationship, further research is imperative, including well-designed randomized controlled trials. Nonetheless, promoting healthy breakfast habits is a practical and feasible strategy to support overall health and weight management efforts.

Abbreviations:

CVDs: cardiovascular diseases

WHO: World Health Organization

LMICs: low- and middle-income countries

HVA: Homovenallic acid

BMI: body mass index

LDL-C: low-density lipoprotein cholesterol

HDL-C: hypertension, and lower levels of high-density lipoprotein cholesterol



HEI: Healthy Eating Index

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