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Journal of Endocrinology and Disorders

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Review Article

Obesity and Chrono-Nutrition

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Received Date: 10 January 2022 | **Accepted Date:** 31 January 2022 | **Published Date:** 25 February 2022

Citation: A Nikkhah. (2022). Obesity and Chrono-Nutrition. Endocrinology and Disorders. 6(2): DOI:10.31579/2640-1045/115

Abstract

The objective of this article was to describe obesity mechanisms and why obesity and meal properties during a circadian phase are interrelated. Obesity remains a major challenge globally. The increasing rates of obesity and diabetes indicate that current perspectives on obesity etiology are not adequately explanatory. The common view on obesity is energy balance model (EBM), suggesting that energy is stored as fat when overconsumed. However, since EBM is driven by physics, biochemical pathways of fat storage are overlooked. Insulin is secreted by increased blood glucose which drives positive energy balance and thus fat deposition. Such pathways present an innovative concept known as carbohydrate insulin model (CIM). This model might offer a more mechanistic perception into obesity development. Considering that glucose metabolism possesses circadian rhythmicity, CIM and chrono-nutrition may be interconnected. Preventing glycemic load through limiting carbohydrate-rich diets intake and care of meal timing would benefit obesity and diabetes prevention strategies. In conclusion, energy source and chrono-nutrition should be contemplated together as key factors influencing energy partitioning and fat deposition in the modern human.

Key words: obesity; circadian phase; chrono-nutrition; etiology

Philosophy and Discussion

The objective of this review article was to describe the etiology of obesity and present an innovative nutritional view to highlight how chrono-nutrition may be related to and justify obesity development. Obesity and diabetes are a result of modern human eating habits and lifestyle. The intake of energy-rich fast foods has considerably increased. These foods cause positive energy balance and likely overweight/obesity [1]. Energy balance, a protruding model of obesity, suggests that when energy intake is greater than expenditure, the extra energy is stored as fat, thus gradually leading to obesity. Presumably, food source and composition, and not only/merely energy content, are involved in obesity development [2]. The carbohydrate-insulin model (CIM) suggests that glucose overload would elicit hormonal responses that alter nutrient partitioning and metabolism [2]. Insulin is secreted in response to increased glucose supply from the gut and plays a crucial role in partitioning glucose towards muscle, liver, and adipose tissue.

In addition, insulin interferes with glucagon action and stimulates lipogenesis simultaneously [3]. The postprandial insulin would depend on how different foods raise the postprandial blood glucose or glycemic index (GI) [4]. After eating a high GI meal, serum insulin levels would increase sharply, resulting in a sequence of metabolic events that cause excess food intake [5]. Persistent exposure to such anabolic conditions might increase cellular metabolite uptake and reduce blood metabolites levels. This would cause the brain to feel hunger signals. As a result, cravings would develop [2]. Subsequently, fuels might be stored as fat, thus causing positive energy balance [6].

In addition to food amount and quality, meal timing and energy distribution are also critical as far as glycemic index and obesity development are concerned. These may be strictly interconnected with CIM. Glucose metabolism possesses circadian rhythmicity. Disruption in such rhythms (e.g., by shifting from morning to evening eating) may cause unfavorable effects on metabolic health. The importance of chrono-nutrition (meal timing) on obesity epidemic and managing weight loss is a rising science [7, 8]. Glucose tolerance decreases as day ends and night begins. Hence, eating high GI foods in evening/overnight would likely result in greater glycemic load and disturbed insulin metabolism [8]. Apparently, human body does not require higher insulin levels overnight because of lower energy requirements for resting/sleeping [9]. Notable, insulin is responsible for glucose and fatty acids uptake and lipogenesis [9]. The elevated insulin may be related to obesity [9]. Overweight or obesity in 7 years old children was associated with eating high energy lunch and mid-afternoon meals when they were at 4 years of age [10]. Such a response is supported by CIM. Moreover, skipping breakfast may cause obesity in children. Furthermore, lowering glycemic index by moderate increase of protein intake has attenuated gestational weight gain in obese pregnant women, also suggesting advantageous effects of low glycemic index diets [11]. In accordance with the natural circadian metabolic rhythms, optimizing glucose metabolism is a necessity for reducing pregnancy issues. As such, large evening meal must be avoided in all, especially in pregnant women [12].

Besides timing, frequency, and source of meals; daily exercise is also synchronized with circadian rhythms and possesses a key role in glycemic control and management [13]. The optimal timing of eating and exercise

as well as lower intake of high glycemic index diets are amongst the most important guidelines that the public should take into consideration. Future research is warranted to further identify true metabolic pathways of obesity development. The association of chrono-nutrition and obesity development requires more pragmatic research.

Implication

Conventionally, obesity is described as a result of imbalance between energy intake and expenditure. In accordance with a more recent carbohydrate-insulin model, however, consuming energy-dense carbohydrate-rich foods leads to greater blood glucose, thus activating biochemical pathways of substrate partitioning for lipogenesis and fat storage. Obesity and diabetes are a consequence of disturbed circadian glucose and insulin metabolism. Consuming low glycemic index foods at optimal times of the circadian phase (e.g., morning rather than evening) may offer a workable eating framework for securing healthy nutrient metabolism and partitioning in the modern human.

Acknowledgments

Mountains for their inspirational nature

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DOI: 10.31579/2640-1045/115