

Review Article

The Origin of Obesity: Proportional Influence of Metabolic Factors, Dietary Choices, and Physical Activity

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Abstract

Three primary factors contribute to the regulation of body weight: metabolic factors, dietary habits, and physical activity, all of which are influenced to varying degrees by genetic traits. Despite recent advancements in our understanding of these factors, the prevalence of obesity in Westernized societies continues to rise. In contrast to instances seen in monogenic animal models and rare genetic syndromes in humans, the predisposition to common forms of obesity likely involves numerous susceptibility genes. These genes contribute to variations in energy requirements, fuel utilization, muscle metabolism, and taste preferences. While recent increases in obesity rates cannot be attributed to changes in the genetic makeup of populations, it is plausible that previously unnoticed genetic variations now play permissive roles in the context of modern societies. Available data indicates that variations in resting energy expenditure, the thermic effect of food, and fuel utilization exist but are unlikely, by themselves, to fully account for the onset of obesity. As for dietary patterns, the best available trend data suggests that fat and overall energy intake have decreased, not only in this region but in other Westernized countries as well. Paradoxically, the simultaneous trends of declining energy intake and increasing body weight point toward reduced physical activity as the most significant current factor contributing to the escalating prevalence of obesity. Modern existence necessitates a radical departure from previously beneficial energy-conserving dietary and exercise practices.

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Recognizing the inherent challenges in adhering to energy-restricted diets within an environment replete with fast food options and social indulgences, it is unlikely that the current trajectory of rising body weight can be reversed solely through recommendations for further reductions in energy intake. Rather, a substantial increase in physical activity levels is likely required in response to an environment that now encourages a more sedentary lifestyle."

Key words: Physical Activity, Health**Introduction**

"In recent decades, significant strides have been made in unraveling the complex factors that contribute to obesity. These advancements encompass the discovery of a mutant gene linked to obesity and the exploration of metabolic elements, such as variations in energy expenditure and fuel utilization patterns (Yadav et al., 2023). Despite these breakthroughs, the prevalence of obesity in the adult population of the United States has surged by 31% from 1976 to 1991, a trend that starkly contradicts the goal set by the U.S. Public Health Service to prevent any increase in obesity prevalence as outlined in Healthy People 2000 (Devi, 2023; Dhillon & Malik, 2023a).

The etiology of obesity is multifaceted, with three major factors at play: metabolic factors, dietary choices, and physical inactivity, each influenced by genetic factors. Numerous studies, including adoption and twin studies, (Nara et al., 2023; Nara, Kumar, Rathee, & Phogat, 2022) have demonstrated a hereditary component in human obesity. Both cross-sectional and longitudinal research has confirmed the existence of familial patterns in adiposity (Dhillon & Malik, 2023a; Taily & Bhat, 2023).

The purpose of this commentary is to delve into the relative contributions of metabolic factors, diet, and physical inactivity to the development of obesity, (Nara, Kumar, Rathee, & Kumar, 2022; Nara, Kumar, Rathee, Kumar, et al., 2022) all while considering the underlying role of genetic influences (Jadon & Kumar, 2023; H. Kumar & Sharma, 2023a; Lata, 2023). Our ultimate conclusion is that both research and intervention efforts should pivot their focus toward addressing physical inactivity as the primary contemporary factor driving the escalating prevalence of obesity in modern society."

The etiology of obesity is multifaceted, with various factors contributing to the condition. These factors include metabolic elements, dietary choices, and levels of physical activity, all of which are influenced by genetic traits. (Chauhan & Kumar, 2023; F. A. Kumar, 2023; H. Kumar & Sharma, 2023b, 2023c)

Energy Expenditure

Total energy expenditure consists of three components: resting energy expenditure, thermic effect of food, and activity-related energy expenditure. Genetic influences have been observed in resting energy expenditure, thermic effect of food, and the body's response to short-term overfeeding. Resting energy expenditure, which accounts for approximately 60% of daily energy expenditure, primarily depends on body mass, especially fat-free mass, which is metabolically more active than fat tissue. While absolute resting energy expenditure is usually higher in obese individuals due to their larger body size, when adjusted for differences in fat-free mass, resting energy expenditure tends to be comparable between obese and non-obese individuals. However, even after adjusting for body composition, there is variability in resting energy expenditure among individuals. Studies have investigated the association between resting energy expenditure and weight change, with varying results. It is suggested that relatively low resting energy expenditure values could be associated with weight gain, but the impact is generally small.

In contrast to resting energy expenditure, there is a strong correlation between a relatively low total daily energy expenditure and the rate of weight gain. This suggests that reduced nonresting (activity-related) energy expenditure may be a key component of daily energy expenditure that contributes to obesity. Spontaneous activity-related energy expenditure represents about 30% of total energy expenditure and is highly variable. Available evidence suggests that reduced activity-related energy expenditure is a significant contributor to the predisposition to obesity.

Fuel Utilization

Variations in fuel utilization, particularly a high respiratory quotient indicating reduced fat oxidation, have been proposed as factors that may predict weight gain. However, the role of fuel utilization in obesity is not well-established, and there is no clear evidence that variations in fuel utilization affect energy balance.

Role of Appetite and Dietary Factors

Leptin, a hormone that suppresses appetite and increases energy expenditure in animals, has been studied in relation to human obesity. Genetic linkage of the leptin gene with human obesity has been reported, but only in extremely obese individuals. Elevated fasting serum leptin levels are found in obese patients, possibly indicating leptin resistance. The relationship between dietary fat consumption as a percentage of total caloric intake and adiposity is variable. Secular trend surveys in the United States have shown that average fat and energy intake have decreased over time, yet obesity prevalence has increased. These findings suggest that dietary factors alone are not the primary drivers of obesity.

Role of Physical Inactivity

Physical activity is inversely related to adiposity, with sedentary individuals more likely to be overweight or obese. Exercise training generally leads to a decrease in body fat. The amount of energy expended during physical activity depends on factors such as the type of activity, intensity, and muscle groups engaged. The energy economy of different activities varies. Some individuals may be less predisposed to physical activity due to differences in muscle fiber types and metabolic characteristics. There is evidence to suggest that inherent differences in muscle characteristics may influence an individual's level of physical activity.

Systematic surveys have shown that leisure-time physical activity in the U.S. population has changed very little over time, with a significant portion of adults reporting inactivity. While there are no epidemiological data on total daily physical activity, survey data and research findings suggest that a reduction in daily physical activity may be the most significant factor contributing to the rising prevalence of obesity in Westernized countries.

Discussion

The article explores the multifaceted nature of obesity and the various factors contributing to its prevalence in contemporary society. It delves into metabolic factors, dietary choices, and physical activity, all within the context of genetic influences. The overarching message is that obesity is a complex interplay of these elements, but the article emphasizes the growing role of physical inactivity as the predominant driver of the obesity epidemic.

Genetic Predisposition

The article acknowledges that genetic factors play a substantial role in the predisposition to obesity. These genetic influences impact various aspects of an individual's metabolism, including resting energy expenditure, thermic effect of food, and fat utilization. This recognition is vital as it underscores the importance of personalized approaches to obesity management. It also calls for continued research into the identification of specific genetic markers associated with obesity and how they interact with environmental factors (Dhillon & Malik, 2023b; Nara et al., 2023; Nara & Kumar, 2023).

Metabolic Factors

The article investigates the role of metabolic factors in weight regulation. While variations in resting energy expenditure and thermic effect of food exist, they are not found to be the primary drivers of obesity. Instead, the focus shifts towards the effect of reduced nonresting energy expenditure or physical inactivity. However, the role of fuel utilization in obesity remains inconclusive, highlighting the need for further research in this area.

Dietary Factors

The relationship between dietary fat consumption and adiposity is examined. Despite variations in cross-sectional analyses, it is noted that dietary factors alone do not appear to be the primary determinants of the increasing prevalence of obesity. The article underscores the significance of long-term dietary trends over cross-sectional data, suggesting that the reduction in fat and calorie intake has not mitigated the rising prevalence of obesity. This might be attributed to dietary restraint and the availability of reduced-calorie food products.

Physical Inactivity

The primary focus of the article is on physical inactivity as a major contributor to the obesity epidemic. It discusses the correlation between a sedentary lifestyle and increased adiposity. Various studies and surveys are cited, demonstrating that reduced physical activity is consistently associated with weight gain, and these findings are more consistent than the relationship between excess energy intake and weight gain (Janra et al., 2023).

Environmental Influence

The article highlights the significant role of the environment in shaping physical activity levels. It argues that modern environments, characterized by increased sedentary behaviors and ready access to energy-dense foods, make it easier for individuals predisposed to obesity-prone behaviors to gain weight. This highlights the need for societal and governmental efforts to create environments that promote physical activity (D. Kumar et al., 2023).

Implications and Future Directions

The discussion underscores the need for a multifaceted approach to combat obesity. While genetics do play a role, it is the interaction between genetic predisposition and the obesogenic environment that drives the obesity epidemic. It calls for a shift in focus from simply reducing energy intake to increasing physical activity levels as a more effective means of addressing the issue. This necessitates broader community, industry, and government involvement in creating environments that encourage physical activity.

In conclusion, this article provides a comprehensive overview of the complex factors contributing to obesity and offers valuable insights into the relative contributions of each factor. By emphasizing physical inactivity as a primary driver of the obesity epidemic, it underscores the importance of promoting active lifestyles in modern society. This discussion sets the stage for future research, interventions, and policy changes aimed at tackling the growing global issue of obesity.

Conclusions

Common forms of obesity are influenced by genetics and are most likely to occur in individuals predisposed to energy-conserving behaviors, such as the preference for energy-dense foods and sedentary activities. These behaviors are not inherently maladaptive but have become challenging to manage in the modern environment that promotes a sedentary lifestyle and offers easy access to high-calorie foods. Although dietary adjustments have been made to some extent, simply reducing energy intake is unlikely to reverse the trend of increasing obesity. Instead, increasing daily physical activity levels is likely necessary to combat the environmental factors that contribute to obesity. Community, industry, and government involvement will be essential in creating environments that encourage physical activity in response to technological advances that have reduced energy expenditure in daily activities.

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