

ANALYSIS OF THE IMPACT OF CARBOHYDRATES ON HUMAN HEALTH AND DISEASE

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Abstract

The aim of this research is to comprehensively investigate the pivotal role of carbohydrate nutrition in supplying energy to the human body and its implications for health. Over recent decades, the surge in diseases like obesity and type II diabetes, often linked to carbohydrate consumption, has raised concerns. Drawing upon an extensive review of literature, this qualitative study goes beyond surface-level analysis to delve deeply into the intricate relationship between carbohydrate intake, gut microorganisms, and their impact on human well-being. By adopting a qualitative approach, this research aims to provide a nuanced understanding of the multifaceted effects of carbohydrates, particularly emphasizing their influence on the growth and equilibrium of gut microorganisms. The symbiotic relationship between carbohydrates and gut microbiota extends its reach to mental health and various organic systems. However, disruptions in this balance may yield adverse consequences, warranting a comprehensive exploration. The study uncovers a spectrum of diseases associated with carbohydrate-related factors, encompassing cardiovascular ailments, cancer, chronic kidney failure, and asthma. Additionally, the research highlights the negative influence of simple and refined carbohydrates on mood-related aspects such as alertness and fatigue. This research seeks to elucidate the complex interplay between carbohydrate nutrition, gut microbiota, and human health. By achieving this objective, the study contributes valuable insights that can guide healthcare professionals, policymakers, and individuals toward informed dietary choices and improved overall well-being.

Keywords: Carbohydrates, Disease, Fiber, Metabolism, Nutrition

1. INTRODUCTION

This century is marked by remarkable technological advancements that have facilitated social progress, yet not without disparities in human history. Recent decades have witnessed a surge in newly identified or emerging diseases, such as obesity and type II diabetes, despite the medical strides made in combating certain fatal illnesses (Hopkins, 2013). While these conditions remain shrouded in mystery, a myriad of factors come into play, including dietary habits and psychosocial contexts (Kopp, 2019). Past centuries have also seen the rise of global pandemics such as obesity and type II diabetes, with their causative triggers attributed to a sedentary lifestyle and shifting dietary behaviors (Ginsberg & MacCallum, 2009; Swinburn et al., 2011). The synergy between these factors has led to a substantial rise in pathologies like cardiovascular diseases, cancers, and diabetes, necessitating a deeper investigation into their root causes (Hjelm et al., 2003). Carbohydrates, as a significant component of nutrition, have emerged as a crucial focal point in understanding these pathologies and devising effective interventions. Thus, this study endeavors to analyze the impact of carbohydrates on health.

Over the past five decades, the perception of carbohydrates has undergone substantial changes. Far beyond their role as a mere energy source, carbohydrates have been found to play a pivotal role in human health, impacting risk factors for non-communicable diseases (NCDs) (Sarda et al., 2018). The exploration of carbohydrates, from a biological utilization perspective, particularly began with dietary fiber, and the subsequent interest in its physiological effects is evidenced by a surge in scientific publications. These advances underscore the significance of dietary fiber's involvement in human health, encompassing its composition, structural attributes, physicochemical properties, and physiological impacts. In contemporary times, dietary fiber is represented by various compounds and has emerged as a key component in functional foods.

Acknowledging the essential role of carbohydrate nutrition in providing energy to the human body, it is evident that carbohydrates encompass a diverse array of compounds, each with distinct compositions, structures, and biological utilization. Among these carbohydrates, variations in digestion rates have been recognized, contributing to varying glycemic responses contingent upon the type and amount of carbohydrates consumed (Blaak et al., 2012; Laville et al., 2013). Carbohydrates are broadly categorized into two main types: simple and complex. Simple carbohydrates consist of single or double sugar units, while complex carbohydrates are composed of multiple sugar units. These encompass monosaccharides, comprising individual sugars (glucose, fructose, and galactose); disaccharides, comprising two sugars (maltose, sucrose, and lactose); and complex carbohydrates with multiple sugars (starch, glycogen, and fiber) (Clemente-Suárez, Navarro-Jiménez, et al., 2022). The rapid progress of scientific knowledge, increasing specialization across various fields, and the continuous generation of new insights in increasingly specific domains highlight the need for a holistic approach that fosters interdisciplinary connections. By leveraging tools such as narrative reviews, the present organization of knowledge and cross-disciplinary relationships can facilitate efficient knowledge transmission within higher education institutions. This, in turn, enhances the comprehension of research areas for both researchers and academic professionals, promoting streamlined and multi-faceted research endeavors that contribute to the advancement of diverse fields.

The overarching objective of this study is to comprehensively analyze the intricate relationship between carbohydrate consumption and health. This research seeks to elucidate the multifaceted impact of carbohydrates, particularly their role in influencing pathologies, physiological responses, and dietary interventions. By addressing this research objective, the study aims to contribute valuable insights to the understanding of dietary influences on health and pave the way for future research endeavors that can inform public health initiatives and promote well-being on a global scale.

2. METHOD

The method employed was a critical narrative review, delving into both primary and secondary sources for a comprehensive grasp of the subject matter. Primary sources comprised academic studies, while secondary sources encompassed a variety of materials such as online databases, web pages, and bibliographic indexes (Clemente-Suárez et al., 2020, 2021; Clemente-Suárez, Navarro-Jiménez, et al., 2022). The study's foundation rested on synthesizing and analyzing existing literature, making it essentially a literature-based inquiry. By examining a wide array of sources, the researcher aimed to attain a holistic and well-rounded perspective on the topic.

Moreover, this research employed a thorough and comprehensive exploration of existing literature. Through integrating primary and secondary sources, an intricate understanding of the subject matter was achieved. By adopting a qualitative approach and closely examining carbohydrates' effects on the human body, the study aimed to offer meaningful insights into existing knowledge. Rigorously selecting international articles upheld the research foundation's reliability, while collaborative author efforts ensured a comprehensive, well-informed perspective on the topic.

3. RESULT AND DISCUSSION

The global upsurge in obesity and metabolic disorders arising from diet has sparked inquiries into the fundamental drivers behind these concerns (Kopp, 2019). This has, in turn, highlighted the need to establish connections with profound changes in the environment, driving shifts in human behavior, particularly in terms of dietary choices. These shifts in the environment and alterations in behavior have upset the equilibrium between human genetic composition and their surroundings (Simopoulos, 1999). Consequently, there has been a growing fascination with the dietary patterns of our ancestors, prompting extensive investigations into the foods consumed during that epoch and their role in shaping human evolution (Cordain et al., 2005; Eaton et al., 2016).

3.1. Evolution of Human Carbohydrate Consumption

The progression of hominins into modern humans has been propelled by the essential and interconnected roles played by carbohydrates sourced from both plants and meat. Another pivotal juncture in the saga of human evolution is the embrace of cooking, a distinctive behavior that sets humans apart, with no other species known to share this practice (Wrangham, 1999). While the exact timeline of the widespread adoption of cooking remains uncertain, evidence suggests that it spanned a considerable duration, driving biological changes such as reductions in tooth size and a diminished ability to digest raw and fibrous foods due to a smaller gut (Wrangham & Conklin-Brittain, 2003).

The human brain alone claims 20-25% of the body's baseline metabolic expenditure in adults (Fonseca-Azevedo & Herculano-Houzel, 2012). Beyond its substantial energy requirements, approximately 170g/day of glucose is imperative for the optimal functioning of the brain, kidney medulla, red blood cells, and reproductive tissues. The main supply route for glucose is through dietary consumption of carbohydrates, although alternative sources include gluconeogenesis and propionate derived from the fermentation of dietary carbohydrates in the colon (Wong, 2003).

However, the march of modern agriculture, animal husbandry, and more recently, industrialization, has reshaped dietary norms without a parallel genetic adaptation—a phenomenon labeled as evolutionary discordance. These shifts have been correlated with reduced energy expenditure in urban populations, contributing to the rise of health hazards linked to changed dietary habits, which in turn underpin the surge of chronic nutrition-related diseases (James et al., 2019). Hence, it is of paramount importance to contemplate adopting strategies that guide us back to a Paleolithic diet, harnessing the advantages presented by the diverse range of contemporary food technologies accessible today.

3.2. Carbohydrates and Disorders/Diseases

The connection between the human body and its surroundings is prominently established through the expansive interface of the digestive tract, a crucial gateway that exposes individuals to a multitude of microorganisms over their lifespan. This exposure, however, comes with potential risks to the integrity of the digestive system itself (Backhed et al., 2005). The presence of available carbohydrates plays a pivotal role in shaping the intricate tapestry of the microbial community. This influence reaches across communities engaged in breaking down fibrous materials and primary degradation, setting off a cascade of effects across interconnected microbial populations (Backhed et al., 2005). Moreover, resistant starch has been observed to uniquely bolster specific bacterial groups in particular individuals, contingent on the chemistry of the carbohydrate and the enzymatic capabilities of the microbes. Remarkably, these enriched species can constitute more than 30% of the total microbiota in some instances (Martínez et al., 2010; Venkataraman et al., 2016). Thus, a diverse microbiota becomes a hallmark of robust health, and the consumption of carbohydrates that support the growth of these microorganisms is heralded for its reciprocal benefits in nurturing the host.

In the realm of metabolic disorders, the intake of carbohydrates holds the power to significantly mold disease development and outlook. The unregulated consumption of refined carbohydrates heightens the risk of individuals falling prey to metabolic syndrome, a gateway to a realm of metabolic diseases. Consequently, a three-pronged approach—comprising physical activity, weight management, and a nourishing diet characterized by low glycemic index carbohydrates and those that defy digestion—stands as a cornerstone in the endeavor to forestall and manage metabolic ailments (Spadaro et al., 2015).

Within the realm of cardiovascular disorders, emerging evidence underscores that the quality of carbohydrates, rather than their sheer quantity, plays a pivotal role in either mitigating or exacerbating the risk of cardiovascular diseases. In this context, carbohydrates sourced from whole fruits, vegetables, legumes, grains, and a dietary plan that emphasizes low glycemic index options are generally endorsed. These choices are believed to reduce the risk of cardiovascular diseases due to their potential content of dietary fiber and components that promote heart health. However, it's important to note that certain food sources, particularly those rich in dietary fiber, might inadvertently elevate cardiovascular risk markers such as total cholesterol or low-density lipoprotein (Clemente-Suárez, Mielgo-Ayuso, et al., 2022).

In the landscape of conditions related to cancer, the protective effects attributed to fiber and complex carbohydrates in preventing cancer development can be attributed to a multitude of factors. Primarily, complex carbohydrates can influence the activity of insulin, including elements like insulin-like growth factor binding protein 3 (IGFBP-3), which disrupts the insulin/IGF-1 axis. This disruption effectively hampers cell proliferation and serves to inhibit the growth of tumors, as elucidated earlier. Secondly, complex carbohydrates and dietary fiber can exert an impact on the composition of gut microbiota, resulting in the production of short-chain fatty acids that contribute to the reduction of inflammation. This, in turn, has a positive influence on the progression of cancer. Lastly, the presence of these complex carbohydrates and fiber can facilitate the excretion of carcinogens through fecal matter, thereby enhancing their elimination and diminishing their adverse effects on the overall health of the organism (Maino Vieytes et al., 2019).

In the context of specific carbohydrate consumption, research findings indicate that an increased intake of dietary fiber can have a beneficial effect on the management of Chronic Kidney Disease (CKD) (Mirmiran et al., 2018). This positive impact can be attributed to the

fact that greater fiber consumption stimulates the activity of saccharolytic gut microbiota, leading to an enhanced production of short-chain fatty acids (Carrero et al., 2020). Furthermore, as mentioned earlier, these short-chain fatty acids are associated with the reduction of inflammatory processes, which can play a constructive role in controlling CKD, given the detrimental impact of inflammation on CKD progression (Dinh et al., 2014).

In conditions like allergies and asthma, gender-related disparities are evident in the manifestation of asthma symptoms and allergic sensitization. These conditions are more prevalent in boys compared to girls, and there's a notable regional difference between southern and northern France (Saadeh et al., 2015). However, it's important to account for other influencing factors. Allergic conditions such as allergic rhinitis, rhinoconjunctivitis, and eczema are commonly observed among children and are linked to factors including exposure to tobacco smoke, environmental pollutants, paracetamol usage, antibiotic consumption, screen time, and both indoor and outdoor air pollution (Singh et al., 2018). The unique characteristics and limitations of these studies underline the critical need for well-designed randomized controlled trials that specifically target the pediatric population, aiming to provide more robust and conclusive evidence.

4. CONCLUSION

Many statements underscore the beneficial role of carbohydrates, particularly fiber, in supporting the health and growth of microorganisms within the gut, thus establishing a symbiotic relationship that impacts our mental well-being and various organic systems negatively. Additionally, evidence highlights the adverse effects of simple and processed carbohydrates on our mood, including factors such as alertness and fatigue. On the front of physical health, sugar intake can influence the development and prognosis of metabolic diseases, with uncontrolled consumption of processed carbohydrates posing a risk of developing metabolic syndrome and subsequent metabolic disorders.

Moreover, carbohydrates, notably fiber, play a significant role in nurturing the well-being and growth of gut microorganisms, influencing our symbiotic relationship with them and resulting in cascading effects on mental health and diverse organic systems. Concurrently, the negative impact of simple and processed carbohydrates on mood, including elements like alertness and fatigue, further emphasizes the broader influence of carbohydrate consumption. In terms of physical health, the implications extend to metabolic disorders, where unregulated intake of processed carbohydrates contributes to the risk of metabolic syndrome and associated conditions.

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