



Dysbiosis and obesity: implications of the gut microbiota

Alexandre Carli Pinto ¹, Danilo Everton Cunha Cavalcante ², Etianne Andrade Araújo ^{3*}, Francione Moreira Cabral ⁴, Jhonatas Mota Santos ⁵, Kaline Viana Costa ⁶

¹ University of Pernambuco, Recife, Brazil.

² Federal University of Maranhão, General surgery and Medical Clinic, São Luís, Maranhão, Brazil.

³ Etianne Bartz Institute, Fortaleza, Ceará, Brazil.

⁴ Porto Velho Hospital, Rondônia, Brazil.

⁵ State University of Pará, Brazil

⁶ Medical diagnostics Center, São Luís, Maranhão, Brazil

Corresponding Author: Dra. Etianne Andrade Araújo. Etianne Bartz Institute, Fortaleza, Ceará, Brazil.

Email: address: etianneandrade@hotmail.com

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Abstract

Introduction: Obesity has been considered a public health crisis, contributing as a risk factor for several important chronic diseases and even death. Considering this fact, it is noteworthy that there is a fundamental relationship between the intestine and health, and this organ is considered by modern medicine as our second brain in the concept of intestinal permeability. Within the evaluation of the food process, effective nutritional absorption can be altered due to imbalances, such as malabsorption, drug-nutrient interaction, changes in mucosal permeability, and, consequently, an imbalance in the gut microbiota. Dysbiosis is characterized by these negative changes that occur in the intestine. In this sense, the present systematic review study sought to answer: What influences can the microbiota composition have on the metabolic syndrome and obesity process? **Objective:** To elucidate the relationship between the presence of intestinal dysbiosis in the pathogenesis of obesity. **Methods:** This is a bibliographic review work where the MEDLINE, PubMed, and SciELO databases were consulted using the following descriptors: Human gut microbiota, obesity, dysbiosis. **Results and Conclusion:** Based on the literature that supports this theme, it was possible to observe that in the obese population there is an increase in bacteria of the genus Firmicutes and a decrease in the genus Bacteroidetes, with the blocking of factors and proteins that regulate the homeostasis of the absorption of lipids and fatty acids

being observed thus being able to alter the energy metabolism leading to a greater accumulation of adipose tissue.

Keywords: Human gut microbiota. Obesity. Dysbiosis. Bowel changes.

Introduction

Food plays an important role in the proper functioning of the body. Changes in eating habits, such as high consumption of sodium, preservatives, and saturated fats, have contributed to the increased incidence of obesity, diabetes, and inflammatory bowel diseases [1]. Furthermore, these choices, when frequent, lead to an imbalance of the gut microbiota, influencing the maintenance of the physiology of the gastrointestinal tract (GIT) and immunological aspects [2]. This fact is justified due to the composition of the GIT, which, in turn, houses a complex and dynamic population of microorganisms called together the human gut microbiota (HIM), which exerts a marked influence on its host in the processes of homeostasis and disease. Several factors contribute to its formation and maintenance throughout life, with diet being one of the most important [4-5].

Any microbial imbalance in or on the body, including the gastrointestinal tract is referred to by the term dysbiosis [6], and these changes in the microbiota can result from factors internal and external to the host and trigger various diseases [7]. Thus, dietary imbalances can lead to changes in HIM populations (dysbiosis), contributes to immune chan-

ges, changes in the intestinal barrier, emergence of inflammatory diseases, metabolic syndrome, and obesity [5]. Obesity, in turn, is considered a disease that characterizes a public health problem and is defined by the increase in body mass index (BMI), constituting a metabolic syndrome with a multifactorial cause and is related to biological, environmental, and neuropsychological mechanisms. as being the accumulation of adipocytes in the tissues, due to the high BMI [8].

From this premise, it is observed that in recent decades there has been a rapid expansion in the proportion of obese individuals worldwide, and more recently, there has been an association with changes in the representation of the dominant phyla of bacteria in the intestine. HIM is highly individualized and involved with the quantity and quality of nutrients extracted from the diet, with direct implications for weight maintenance or obesity [3,9]. Kelly et al. [9], in their studies, carried out a projection in relation to the expansion of obesity and it is estimated that the numbers reported in 400 million in 2010, reached 700 million and could triple, according to the author, the intake of high-calorie foods and sedentary lifestyle that today's society has adopted. However, it can also be associated with the different compositions of the intestinal microbiome.

Specifically in Brazil, a survey carried out in 2016 with individuals over 18 years of age by the Surveillance of Risk and Protection Factors for Chronic Diseases by Telephone Survey (Vigitel), found that one in five Brazilians is overweight and that the prevalence of obesity had a significant increase, from 11.8% in 2006 to 18.9% in 2016 [10]. In this sense, given the attention highlighted in studies that show that the composition of the microbiota can be different in obese and thin humans, it is considered that the gut microbiota can participate in the pathology of obesity [11]. And so, given the increase in the number of obese people and consequently dysbiosis, the present study aimed to relate the significant role of the gut microbiota in obesity and point out a relevant alternative, aimed at intestinal integrity, while acting on the reestablishment of the microbiota in cases of intestinal dysbiosis due to this pathology [5,8].

Also, this study addressed analyzes of information that indicate the complex characteristics of the relationship between obesity and gut microbiota, considering the introduction of probiotics to maintain the integrity of the gut microbiota in obesity as a therapeutic approach. This work is justified by the great importance that HIM plays in the process of human health as a whole, especially in the genesis of obesity and how its

modulation can positively influence weight control, as well as the need to compile data on the subject and to analyze the quality of the productions, through a vast literature available and still in constant production in the current years.

Methods

The method used in this study was based on the research and analysis of published and available materials on the subject, considering articles in Portuguese and English, including books, reports, and specialized websites, highlighting the knowledge of Brazilian and foreign physicians in order to seek and integrate the various theoretical approaches in other areas of knowledge providing a convergence of knowledge. The databases of Pubmed, Google Scholar, and Scielo were consulted.

Results and Discussion

Obesity

In adults, the body mass index (BMI), obtained by calculating a person's weight (in kilograms) divided by the square of their height (in meters), is a simple measure used to classify nutritional status. Individuals with a BMI equal to or greater than 25.0 are considered overweight, while those with 30.0 or more are considered obese [12]. According to the World Health Organization (WHO), overweight and obesity are defined as a health accumulation. Approximately 3.4 million adults die each year as a result of this excess weight. In addition, 44% of the diabetes burden, 23% of the ischemic heart disease burden, and between 7% and 41% of certain cancers are attributed to it [3,12].

The global obesity pandemic is a public health crisis placing an enormous burden on economic resources [13]. This disease is influenced by genetic, environmental, socio-cultural, and behavioral factors. It is believed that inadequate eating habits and a sedentary lifestyle should be the main factors influencing the increase in obesity in genetically susceptible population groups [14-16]. The relationship between obesity and health complications is well established. The list of complications is long, highlighting type 2 diabetes mellitus (type 2 DM), dyslipidemia, sleep apnea, cardiovascular disease, and high mortality. The greater the excess weight, the greater the severity of the disease [11,13].

In Brazil, according to the study carried out by Vigitel, one in five people is overweight and the prevalence of obesity has grown significantly. Food patterns are changing rapidly in most countries and increasingly are on a critical path. Its main changes are replacements of fresh or minimally processed foods with processed foods [10,17]

This scenario is not just inherent to today. Hill and Peters [18] described the context of the 1990s as an environment where the unlimited supply of cheap, palatable, practical, and high-energy-concentrated foods predominated in all western countries or countries with westernized lifestyles. Obesity is a heterogeneous group of conditions with multiple causes. The genetic principles and the influence of genotype on the etiology of this disorder can be mitigated or aggravated by non-genetic conditions that act on physiological mediators of energy expenditure and consumption [5,6].

In a meta-analysis study carried out in eight centers around the world, with 1,399 individuals over 18 years of age, it was found that the energy flow, which is the energy expenditure in the same proportion as the energy intake, can increase body mass. The authors also came to the conclusion that a high energy intake is the main factor for the high body mass gain in populations [7]. Nutritional or lifestyle choices can turn obesity-triggering genes on or off [4,9]. Knowing that the adopted lifestyle also influences the development of obesity pathology, it is important that attitudes are taken that lead the population to a healthier life [11].

One of the issues that have arisen in recent years is the link between obesity and the composition and functionality of the gut microbiota [8]. Dysbiosis processes, that is, a disruption in a balance associated, in addition to obesity, with states of malnutrition, inflammatory bowel disease, neurological disorders, and cancer [13]. In this context, some studies have shown the association between the composition of the gut microbiota and body weight and the important role played by diet in these interactions [4,8].

Gut Microbiota

A healthy microbiota can be defined as one that promotes well-being and the absence of disease, especially in the gastrointestinal tract. The gut microbiota benefits the individual when there is a symbiosis of the host, that is, there is a balance, this balance has to be reciprocal, when the imbalance occurs, it can result in the proliferation of pathogens and, consequently, a bacterial infection. Also according to the studies by the aforementioned author, the microbiota has a strong influence on the appearance of diseases. This is because they participate in the regulation of metabolism [19].

Therefore, the observation that demonstrates the role of the gut microbiota in relation to the performance of an important role in the intestinal regulation of the individual is notorious. The microbiota,

also known as gut microbiota, is characterized by the set of micro-organisms that live in the intestine. These gut-dwelling bacteria are located between the mucosa and the intestinal lumen [17]. Huttenhower et al. [19] analyze the gut microbiota as the largest organic site of commensal microorganisms in the human body. Although each individual has its own bacterial composition defined by genetic and environmental characteristics, in general, there is a predominance of bacteria from the firmicute phyla, especially the order lactobacillus, and bacteroidetes.

Continuing the importance of this gut microbiota, Brandt et al. [20] state that these bacteria that are part of the microbiota act symbiotic with the colonic mucosa and evolve along with the development of GIT. In the adult population, the microbiota remains stable, but it can change due to the type of diet, hygiene, age, intestinal transit time, and use of medications. In this sense, according to the author, it is understood that for a good functioning of the GIT, a balance between the microorganisms is needed. As the microbiota species are unbalanced, with a proliferation of pathogenic bacteria, such as *Clostridium* sp., on commensal bacteria, firmicutes, and bacteroidetes, there is the establishment of intestinal dysbiosis. This fact affects an imbalance, and this phenomenon impairs the metabolism of nutrients and their proper absorption and causes a situation of hypovitaminosis due to a deficiency in the synthesis of vitamin K2. There is also a deficiency in the production of hydrochloric acid [8,21].

The Western diet is characterized by high fat and low fiber consumption and is one of the diets that most contribute to the proliferation of pathogenic bacteria in the gut microbiota, a process called intestinal dysbiosis [13]. A healthy and microbiologically balanced gut microbiota results in the normal performance of the physiological functions of the host, ensuring an improvement in the quality of life [9,15].

Implications of him in the obesity process

Obesity is a disease of complex etiology and high prevalence in different populations. Although some studies have reported differences in the composition of the gut microbiota associated with obesity in humans, there is a lack of consistency in the nature of the reported changes; this fact can be justified by the difference in the adopted methodologies or even by the studied populations [5,8]. However, most surveys of empirical studies with this thematic approach point to the association between intestinal dysbiosis and a wide variety of human diseases; however, in most cases, it has not yet been possible to establish its causality [11,17].

Among these diseases is obesity and also its comorbidities [23]. Thus, the modulation of the gut microbiota has been considered as a potential target in an attempt to treat obesity [21,23]. Nevertheless, a major challenge inherent in modulating the gut microbiota to correct dysbiosis still exists and resides in our ability to reliably alter the composition of bacterial communities to achieve the desired clinical results, avoiding unwanted or poorly perceived negative consequences [17]. Obese individuals have less diversity and richness in the intestinal bacterial component than eutrophic individuals. Populations of dominant species within HIM can potentially be modified by food intake with health consequences, including obesity [15].

Some mechanisms have been proposed to explain the role of HIM in the genesis of obesity. One of them is related to energy regulation and the ability to ferment dietary polysaccharides not digested by the microbiota. Fermentation of dietary fibers results in the generation of short-chain fatty acids (SCFA) which, after being absorbed, can induce lipogenesis and increase triglyceride stores through molecular pathways. It can induce the accumulation of triglycerides in host adipocytes [18].

High-fat, low-fiber diets increase the abundance of bile-tolerant *Alistipes*, *Bilophila*, and *Bacteroides* and reduce the abundance of plant polysaccharide-degrading microorganisms such as *Roseburia sp.*, *Eubacterium rectale*, and *Ruminococcus bromii*; while dietary fiber intake is correlated with the increase in *Prevotella* and *Xylanibacter* bacteria and the general richness of the microbiota. Current evidence supports the association of HIM composition and obesity, highlighting some bacterial populations most commonly found in obese individuals. Further studies of how population heterogeneity influences the relationship between gut microbiota and obesity are needed [3,6].

It is also highlighted the difficulty of studies in this field of knowledge due to the methods and complexity of in vivo interactions, which are not replicable in vitro, most studies are based on causal inferences in the changes in HIM populations with metabolic and metabolic disorders, and weight loss [20]. As an alternative to taking care of the gut microbiota, food stands out, that is, in most cases, the treatment of dysbiosis is done through changes in eating habits, however, in some cases it may be necessary to use probiotic supplements and, depending on the severity, performing a fecal transplant [23].

Conclusion

As exposed in this research, current evidence in humans makes it clear that there is in fact a relationship between the manipulation of the gut microbiota and obesity. In this sense, a healthy and balanced diet plays an extremely important role in gut microbiota. Functional foods are increasingly recommended by health professionals, acting in the field of preventive nutrition. However, treatment with probiotics stands out as an alternative in this process. Due to the increasing availability of probiotics and prebiotics on the market, it becomes more accessible to use them in the treatment of dysbiosis in obesity along with other tools knowing that they contribute to the balance of the gut microbiota. Thus, the combination of healthy eating habits with the use of prebiotics and/or probiotics becomes a good alternative in the treatment of individuals with this condition. However, caution should be exercised in its use, as there are still some disparities in some products offered.

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Data sharing statement

No additional data are available.

Conflict of interest

The authors declare no conflict of interest.

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