Bifidobacteria probiotic: prevention and treatment of obesity.

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Abstract

Obesity has become a severe public health problem in recent decades, impacting both children and adults. The most prevalent cause is an imbalance in energy intake and expenditure. Obesity is linked to changes in the function and makeup of the gut microbiota, according to scientific research. The gut microbiome of healthy persons differs from that of lean people. As a result, the gut microbiota can be adjusted to achieve optimum health. Obesity is linked to alterations in the Bacteriodetes and Formicates bacterial divisions. Formicates are a sign of obesity, but bifido is a sign of a healthy weight speciality. As a result, the gut microbiota, an important pathophysiological component, plays a key role in obesity development. Changing the gut flora has the ability to increase or reduce body weight and BMI (BMI). Probiotics have been found to alter the makeup of the gut microbiota, increase gut integrity, and reverse obesity-related microbial shifts. As a result, probiotics have been proposed as a potential approach for preventing and treating obesity. The greatest answer to the problem is to control the diet and lifestyle factors that promote obesity development. The goal of this study is to examine the huge amount of evidence available on the composition, function, and alternations of the gut microbiota in obesity, Bifidobacterium's antiobesity benefits, probiotics for treating obesity, and the field's future prospects.

Keywords: Gut microbiota, Bifidobacteria, Lactobacillus, Probiotic, Obesity, Visceral fat

Introduction

Obesity is connected with a greatly increased mortality rate and is a risk factor for numerous diseases, including diabetes, stroke, and cancer, and is defined as a BMI of more than 30 kg/m^{-2} and a huge expansion of fat (visceral fat) [1]. Obesity is on the rise among adults, adolescents, and children, and has more than doubled since 1960, when it was first recognised as a global epidemic. In the Global Obesity Index, India is ranked third [2]. In 2014, nearly 1.9 billion persons over the age of 18 were overweight, and by 2020, 39 million children under the age of five will be overweight or obese [3]. Despite major efforts over the last decade to reduce the prevalence of obesity, progress in understanding the aetiology and numerous processes regulating its development, which could lead to the development of effective therapeutic options for treatment, has been slow. New research suggests that the gut microbiota is a significant contributor to obesity, given the wide range of variables and their intricate interactions [4]. The gut microbiota is the collection of microorganisms found in the Gastrointestinal (GI) tract, beginning in the mouth cavity and growing in density as it travels down the small and large intestine. The gut microbiota has been identified as a potential predictor of obesity in recent human and animal research [5]. Several probable pathways by which the gut microbiota contributes to and/or influences obesity have been outlined by a significant body of evidence. Although much remains unknown and debated, there is a general consensus that the gut microbiota plays a role in obesity *via* dietary carbohydrate fermentation, lipogenesis, excess energy storage, and a variety of other pathways involving a wide range of metabolites, hormones, and neurotransmitters, some of which are known to regulate food intake and energy balance [6]. Furthermore, there is compelling evidence that the makeup and diversity of the gut microbiota in obese animals and humans differ from their lean counterparts [7]. Obesity is linked to alterations in the Bacteriodetes and Firmicutes bacterial divisions, respectively. When obese persons are compared to lean people, this proportion drops and increases with weight loss in two sorts. These results show that restoring the compositional profile and richness of the gut microbiota could help people lose weight [8]. The use of probiotics is one method of achieving this. By changing the number and functions of numerous intestinal microbiota, probiotics can help to prevent, treat, and manage obesity.

Literature Review

Gut microbiota

The microbiota in our gut determines our health. The human intestine contains 10-100 trillion microbes. Firmicutes (60-80%) and Bacteroidetes (20-30%) are the most common phyla and genera in human gut microbiota [9]. The gut

microbiota, which digests plant carbohydrates and milk products, increases the host's metabolic capacity (glycans). It contains vitamins B_2, B_{12}, K, and folic acid. Recent evidence, primarily from animal model studies, suggests that gut microbiota influence nutrient acquisition and energy regulation [10]. The stomach Microbiota contributes to energy homeostasis by extracting energy from food *via* fermentation processes and the formation of Short-Chain Fatty Acids (SCFAs). Furthermore, the microbiota modulates and inhibits the release of Fasting-Induced Adipse Factor (FIAF), an inhibitor of Lipoprotein Lipase (LPL) activity, resulting in triglyceride storage in adipose tissue and the liver [11]. Gut dysbiosis is linked to a number of pathologic conditions that affect the gastrointestinal tract (diarrhoea, irritable bowel syndrome), the immune system (allergy, multiple sclerosis, type 1 diabetes, rheumatoid arthritis, inflammatory bowel syndrome), the central nervous system (Alzheimer's disease, autism), and the host's energy metabolism (obesity, type 2 diabetes, atherosclerosis). The relationship between the two dominant phyla, expressed as the Firmicutes/Bacteriodetes ratio, has been linked to a number of pathological conditions [12]. Accordingly, the gut microbiota is emerging as a promising target for the nutritional or therapeutic prevention and management of these diseases.

Gut microbiota of obese vs. lean individual

The human gut microbiota is made up of trillions of bacteria that fall into two major bacterial groups: firmicutes and bacteroidetes. These two phyla are involved in the development of obesity and microbial dysbiosis. Several animal and human studies have revealed differences in the composition of gut microbiota and energy metabolism in obese and lean populations. When the gut microbiota of obese and lean people was compared, obesity was found to have higher proportions of firmicutes and lower proportions of bacterioidetes [13]. Obese subjects had a lower proportion of bacteria than people with a normal Body Mass Index (BMI). A subsequent large metagenomics study resolving the gut microbiome in obese and lean twins discovered lower bacterial diversity and bacteroidetes proportion in obese people than in lean people [14]. As a result, the relative abundance of firmicutes to bacterioidetes *(i.e.,* the F/B ratio) appeared to be a biomarker of obesity susceptibility [15]. Several animal and human studies have revealed differences in the composition of gut microbiota and energy metabolism in obese and lean populations. In a study examining the relationship between gut microbiota composition and body fat loss, 12 obese adult men and women randomly assigned to either a low-fat or low carbohydrate diet for one year had fewer bacteria and a higher ratio of firmicutes/bacteroidetes when compared to lean, normal-weight controls. However, in those who lost weight successfully and sustainably, the ratio returned to normal [16]. Based on these findings, it could be concluded that the F/B ratio is a marker of obesity and that efforts to restore this ratio to normal could aid in the prevention and treatment of obesity [17].

Some studies were unable to demonstrate this association, while others discovered the opposite trend. Evidence of a link between the prevalence of a particular bacterial genus and obesity or leanness does not explain whether the microorganism is truly the cause of obesity or normal weight [18]. The genera Bifidobacterium, Erwinia, Alistipes, and Oscillospira, on the other hand, were thought to be protective because they were found to be more abundant in subjects of normal weight than in obese subjects [19].

Antiobesity effects of bifidobacteria

There are trillions of bacteria on and inside your body, and they are critical to your health. Bifidobacteria is one of the most important types. Bifidobacteria are gram-positive, non-motile y-shaped bacteria that are extremely beneficial to your health. Low bifidobacteria counts have been linked to a variety of diseases, and their supplements may aid in the treatment of certain symptoms [20]. Nearly 50 species of these beneficial bacteria have been discovered by researchers, each of which is thought to have unique functions and health benefits. Despite their importance, they account for less than 10% of the bacteria in the adult gut microbiome. This bacteria's main function in humans is to digest fibre and other complex carbohydrates that your body cannot digest on its own. Fiber has been shown to aid in weight loss. Bifidobacteria may help reduce the risk of these diseases by digesting fibre [21]. This is due to the fact that when beneficial bacteria digest fibre, they produce important chemicals known as Short-Chain Fatty Acids (SCFAs). These compounds play a variety of important roles in gut health and may also aid in hunger control [22].

Experimental studies supporting the antiobesity effect

There was an overall favourable effect when bifidobacteria lactis HN019 was given to patients with metabolic syndrome, including a reduction in adiposity [23]. Higher levels of *B. animalis, L. paracasei, or L. plantrum* were linked to normal weight, implying a link between these species and lean and obese people [24]. Hyang Mi An discovered that a high-fat diet fed group gained considerable weight after 5 weeks, and that providing Bifidobacteria to that group reduced body weight gain and fat weight gain [25]. Body weight and epididymal fat accumulation were reduced in high-fat diet mice fed with *bifidobacterium breve* B-3 for 8 weeks. It improved total cholesterol, fasting glucose, and insulin levels in the blood, showing that the strain is helpful in lowering the risk of obesity [26]. When given to obese mice on a High-Fat Diet (HFD), *Bifidobacteria longum* counteracted the effects of obesity by lowering their BMI [27].

Use of bifidobacteria in probiotic to reduce visceral fat

Elie Metchikoff, a 28 years employee at the prestigious Pasteur Institute in Paris, was the first to suggest that lactic acid bacteria were advantageous to the gut microbiota. He was the one who initially discovered a probiotic strain. Probiotics are live microorganisms that are advertised with the premise that

when taken, they improve or restore gut flora, hence improving or restoring health [28]. In obesity, gut flora has a modulatory role. As a result, improving the status of obesity by regulating the gut by dietary or other measures, such as probiotics, is possible [29]. Probiotics can provide helpful microorganisms to your body directly, which has its own set of health benefits. The most often utilised probiotics are *Bifidobacterium* and *Lactobacillus* species. Bifidobacteria have been added as active ingredients in several functional meals due to their putative health-promoting characteristics [30]. The flora of the gut and visceral fat has a link. The proportion of bifidobacteria in the intestine is found to be adversely correlated with visceral fat [31]. It means that someone with a lot of bifidobacteria has a healthy weight and someone with less no. of Bifidobacteria has obesity. That is, if your body contains a lot of bifidobacteria, it can aid in the loss of visceral fat. This information is about a product that prevents the production of visceral fat by increasing the relative number of bifidobacteria in the intestines. Probiotics, particularly bifidobacteria, will raise the ratio of it in a person's body, resulting in decreased visceral fat and the prevention of obesity [32]. As a result, creating a probiotic product that may enhance the amount of probiotics in the body can directly reduce visceral fat and hence prevent the health risks connected with it. This can reduce the need for treatment expenditures as well as the danger of bariatric surgery [33].

Human probiotic studies

Probiotic strains from the genera *Bifidobacterium* and *Lactobacillus* have been studied extensively for their effects on weight gain and loss. Positive results have been recorded in the majority of them, in both adults and children [34]. In a 12 weeks double-blind, randomised, placebo-controlled experiment, Kadooka gave fermented milk containing Lactobacillus gasseri LG2055 to persons with a higher BMI and abdominal visceral fat regions. The visceral and subcutaneous fat regions of the subjects who received the probiotic both dropped by 4.6 percent and 3.3 percent, respectively [35]. Probiotic use was related with a significant reduction in all examined parameters, according to a total of 8099 studies identified, 21 randomised trials (*i.e.* body weight and fat mass). The amount of probiotic dose and its impact, on the other hand, are still unknown [36]. For example, a low dose of probiotic resulted in a lower BMI decrease but a bigger reduction in visceral fat, while a longer period of probiotic treatment with a low dose resulted in a reduction in both BMI and visceral fat. These investigations indicated that probiotics are an important therapy for treating obesity because they modulate the gut microbiome [37].

Probiotic limitations in obesity

The lack of human studies, heterogeneity among the studied subgroups in terms of age, gender, and lifestyle, and the use of different agents with potential therapeutic effects in different formulations, doses, ratios, and pharmacodynamics/ pharmacokinetics are some of the major limitations of probiotics in obesity research [38]. With the exception of the use of probiotics in immunocompromised patients, probiotic supplementation has not been linked to major side effects in immune-competent persons.

Discussion

Increased research in the last decade targeted at defining probiotic processes and determining clinical efficacy indicate to a bright future for bifidobacteria in the treatment of obesity and a number of other pathological disorders. Probiotic dietary supplements aid in the fermentation of both dairy and non-dairy foods, which is beneficial not only in the treatment of obesity but also cancer and diabetes [39]. The application, however, is still limited. Future research should focus on learning more about how changes in the gut microbiota cause obesity or how obesity affects microbiome makeup. This link, as well as the minute interactions between human and gut flora, could be the key to meaningful clinical translation [40].

The development of more customised and targeted probiotic medicines will be aided by a better understanding of this intricate interaction. Furthermore, the majority of research in this rapidly evolving field has focused on Lactobacillus and Bifidobacterium strains, necessitating the identification of new bacterial possibilities as well as their possible mechanistic effects on obesity [41]. Clinical cohorts have traditionally had small sample numbers and have concentrated on short-term physical characteristics or inflammatory markers,

Making long-term follow-up research in the future particularly desirable. Despite the fact that probiotics are considered safe for oral intake, there are currently no standard standards for probiotic administration in humans [42]. The effects of probiotics may vary based on the individual and the type of probiotic-containing diet. As a result, further research is needed to better understand the intricate interplay between intestinal and ingested microbiota [43].

Conclusion

Obesity has far-reaching and burdensome implications, not just in terms of individual health outcomes, but also in terms of having a huge financial impact on society as a whole. Because of the negative impacts and obese people's inability to maintain long-term weight loss, clinical treatment for obesity remains difficult. Although bariatric surgery is helpful in lowering weight, it is invasive and hazardous, and it necessitates a significant amount of effort in adopting a new lifestyle. These facts compel scientists and clinicians to devise fresh techniques to manage this ever-increasing problem, and probiotics, which are generally regarded safe for human health, have showed some promise among the prospective remedies. Evidence is mounting suggesting the gut microbiota is important in maintaining energy homeostasis and, as a result, in the development and progression of obesity and related metabolic diseases. In this context, a vast number of researches in both animals and humans have demonstrated that addressing the gut microbiota may be a useful method for preventing and managing obesity. By changing the makeup of the gut microbiota and restoring the physiological bacterial flora,

probiotics can provide significant health advantages. Despite the fact that a rising number of research have pointed to probiotics' therapeutic effects on obesity, there is still a scarcity of evidence in this field. The most significant effects of probiotics on host metabolism and obesity have been documented mostly for *Bifidobacterium/Lactobacillus* strains in human research. Bacterial strains such as *B. longum* SPM 1205, *B. longum* SPM 1207, and *B. pseudocatenulatum* SPM 1204 have anti-obesity properties. Because Bifidobacterium has a negative link with visceral fat, probiotics pills containing these bacterial strains can help people lose weight. More prospective bacterial candidates, as well as the mechanisms driving their anti-obesity benefits, should be found. Future study should concentrate on knowing more about how alterations in the gut microbiota create obesity or how obesity impacts microbiome makeup, as well as the complex interplay between intestinal and ingested bacteria.

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