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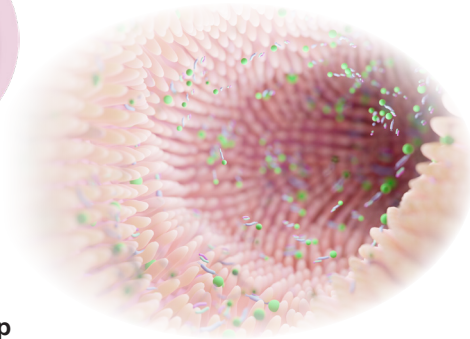

CAN PROBIOTICS INFLUENCE WEIGHT?

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This article explores the relationship between the gut microbiome and weight, and provides a summary of the research outlining the potential use of probiotics for weight management.

The connection between gut microbiota (GM) and health is well established, with the diversity of the gut being linked to immunity, digestion and even mental health.[1,2] Evidence is emerging that suggests that the GM may also play a role in influencing body weight,[3,4] and that alterations of the gut microbiome through the use of probiotics and/or dietary changes could promote changes in metabolism, risk of metabolic conditions and weight.

THE RELATIONSHIP BETWEEN THE GM AND BODY WEIGHT

Diet is considered one of the main influencers of the composition of the GM,[5,6] and studies have shown that there are two bacteria dominant in the gut: *Bacteroidetes* and *Firmicutes*.[7] Diets rich in processed foods that are high in fat and sugar are associated with an increase in the relative abundance of *Firmicutes*,[8,9] and the ratio of these bacteria has been correlated to an individual's weight, with lower concentrations of *Bacteroidetes* and a higher proportion of *Firmicutes* observed in individuals who are overweight or obese.[10,11]

It is evident that there is a close link between the GM, diet and weight, as studies have found that switching from a 'Western' style diet to one richer in plant foods has been shown to shift the composition of the GM.[12] Furthermore, a lower *Firmicutes* to *Bacteroidetes* ratio was observed in obese individuals who lost weight on a low-fat and low-sugar diet.[13]

It has been suggested that this imbalance of *Bacteroidetes* and *Firmicutes* in the gut can alter the amount of calories and nutrients extracted from foods consumed, which could impact body weight.[9] This unfavourable ratio of bacteria also leads to the reduced production of fasting-induced adipose factor, which leads to an increased storage of triglycerides in adipose tissue[14,15] and promotes a slow release of hormones, such as glucagon-like peptide 1 (GLP-1) and peptide YY, which regulate appetite, therefore promoting higher food intake.[16]

It is well established that fibre plays an important role in supporting overall health, and also in supporting the diversity of the GM. It has also been shown that dietary fibre supplementation can reduce body weight, insulin resistance and dyslipidaemia.[17]

Fibre cannot be broken down by digestive enzymes but can be metabolised by certain species of bacteria within the GM. This process is known as anaerobic fermentation and results in the production of short-chain fatty acids (SCFAs). SCFAs are involved in appetite regulation as they stimulate the production of satiety hormones and are involved in processes that slow gut motility[18] and regulate glucose and lipid

metabolism.[19,20] SCFAs are mostly associated with positive benefits, but high levels of SCFAs have been associated with gut dysbiosis, excess adiposity and cardiometabolic risk factors.[21,22]

As the GM has an ability to break down these typically indigestible polysaccharides, the amount of energy that can be extracted from the diet increases, with researchers expecting this to represent up to 10% of daily energy intake.[23,24] Studies have found higher SCFA concentrations in the faeces of individuals who are overweight and obese in comparison to those who have a BMI within the normal range,[25,26] and it is thought that the ratio of *Bacteroidetes* and *Firmicutes* plays a role in this.

Although *Bacteroidetes* have an ability to produce enzymes involved in lipid and carbohydrate metabolism, *Firmicutes* possess significantly more enzymes, which results in increased end products such as SCFAs.[27,28] These findings are in line with more recent evidence, with a systematic review and meta-analysis published in 2019 finding that obesity is associated with high levels of SCFAs.[29]

This evidence suggests that the GM of obese individuals may be able to obtain more calories from a given diet than the microbiota from lean individuals, which could play a role in weight regulation. However, the evidence is mixed, with some literature showing a negative correlation between faecal SCFA concentrations and obesity.[30] Additional high-quality studies are required to fully establish this link.

PROBIOTICS

With evidence suggesting that the composition of the GM may be associated with an indivi-dual's weight, studies have investigated the implications of altering the GM through the use of probiotics.

Probiotics are defined as live microorganisms which, when administered in adequate amounts, confer a health benefit on the host.[31] Probiotics can be taken as supplements or commercially added to foods, such as yoghurts or fermented milk drinks. Interestingly, studies have associated yoghurt-rich diets with lower amounts of weight gain over long-term periods,[32] as well as with a reduced risk of metabolic-related diseases.[33] However, it cannot be concluded that probiotics are solely responsible for these effects, as recent evidence from studies investigating the impact of saturated fat from dairy products has found associations between dairy intake and lower levels of body fat and cardiometabolic risk markers.[34-36]

1 Probiotics and weight loss

Evidence has suggested that probiotic supplementation can enhance weight loss with one of the proposed mechanisms for this being that probiotic supplementation could improve appetite regulation.

In a study investigating the effect of probiotic supplementation on weight loss in obese men and women, researchers found that women who received the probiotic supplement had a significant decrease in food cravings during both weight loss and maintenance periods.[37] The women in the intervention group had greater weight loss than those who took the placebo, which may have been attributable to the effects of the probiotic on satiety.

The probiotic administered was *Lactobacillus rhamnosus*, but this was combined with oligofructose and inulin, which are types of prebiotic fibre. Prebiotic fibre has the ability to stimulate the growth of different species of probiotic bacteria and can therefore enhance the function of a probiotic supplement, but fibre is also known to promote satiety. The researchers claimed that the quantity of the prebiotics in this formulation was not sufficient to promote improvements in satiety alone, and was included to support the resistance of the probiotic, indicating that the modulation of the GM by this supplement may have been responsible for these results.

A similar study was conducted by the same researchers using the same probiotic. This concluded that the formulation was effective in assisting weight loss via a calorie-controlled diet, but in obese women only.[38] What is interesting about this study is that women in the probiotic group continued to lose fat mass during the maintenance period, whilst the opposite occurred in the placebo group. This could indicate that the GM may have been altered throughout the weight-loss period and this alteration could potentially have led to the further weight loss. There was no significant difference between the male intervention group and the male control group, suggestive that the effects of this supplement may be sex-specific. Gender differences have

been observed in other studies,[39] however the explanation for different results between different genders has yet to be addressed.

Another probiotic which has illustrated an ability to promote weight loss in both mice and humans is *Bifidobacterium breve* B-3.[40-42] In one study, overweight individuals who took two capsules of this probiotic supplement per day exhibited a significant decrease in body fat mass, which was the opposite to what was observed in the placebo group where body fat mass had increased from baseline.[42] Interestingly, nutrition and energy intake did not differ between the groups and dietary changes were not suggested as part of the trial, which suggests that *Bifidobacterium breve* B-3 may have the ability to induce reductions in body fat without calorie restriction. However, it was disclosed that the physical activity of participants was not monitored, which may have influenced the results.

2 Probiotics and body composition changes

Not only have probiotics been demonstrated to assist weight loss, but changes to body composition have also been illustrated.

A randomised control trial found that *Lactobacillus gasseri* SBT2055 (*L. gasseri*) promoted a reduction in abdominal adiposity,[43] with greater results seen at higher dosages.[44] Other parameters, such as total body fat mass and BMI, also significantly decreased, which were not seen within the control group. It was also observed that the cessation of probiotic supplement attenuated the results, suggesting that in order to maintain effects, everyday consumption of *L. gasseri* may be required.

3 Probiotics and prevention of weight gain

There is evidence that suggests that probiotics may have a preventative effect on weight gain too.

Yakult Light is a commercially available fermented milk drink which provides a probiotic known as *Lactobacillus casei Shirota*. One study demonstrated that four weeks supplementation of Yakult Light resulted in less weight gain following a seven-day high-calorie (defined as 50% increase in energy intake) and high-fat diet (defined as 65% of energy).[45] The mean increase in body mass in those who had Yakult Light daily was 0.3kg, which was insignificant and half of that gained by the control group.

Similar results were seen in another study which was funded by VSL Pharmaceuticals.[46] The researchers established that VSL #3, a probiotic sold by the company, attenuated weight gain and fat accumulation during a hypercaloric and high-fat diet.

For four weeks, healthy young men consumed an additional 1000kcal above daily energy requirements, which were supplied in the form of a high-fat milkshake, which also served as the vehicle for the placebo or the probiotic. Body mass and fat mass increased in both groups, but the increase was substantially less in the probiotic group.

Both of these studies were small, which means the results cannot be translated into bigger population groups. It is also important to recognise the risk of bias in the study funded by VSL Pharmaceuticals, and the fact that their supplement contains nine different strains of probiotic, which means that it cannot be determined which probiotic or combination of probiotics were responsible for these effects.

CONCLUSION

The connection between the GM and weight is complex and an evolving area of research. Certain studies have shown that probiotics could enhance weight loss, but it is important to note that evidence is still emerging and more high-quality research is required to establish a definite link. Additionally, factors such as gender and baseline health could influence the response to probiotics and dosages, and formulations that are most effective are yet to be determined.

References
1 Cryan, J.F., O'Riordan, K.J., Cowan, C.S., Sandhu, K.V., Bastiaanssen, T.F., Boehme, M., Codagnone, M.G., Cussotto, S., Fulling, C., Golubeva, A.V. and Guzzetta, K.E., 2019. The microbiota-gut-brain axis. Physiological reviews.
2 Skonieczna-Żydecka, K., Marlicz, W., Misera, A., Koulaouzidis, A. and Łoniewski, I., 2018. Microbiome—the missing link in the gut-brain axis: focus on its role in gastrointestinal and mental health. Journal of clinical medicine, 7(12), p.521.
3 Kobyliak, N., Conte, C., Cammarota, G., Haley, A.P., Styriak, I., Gaspar, L., Fusek, J., Rodrigo, L. and Kruzliak, P., 2016. Probiotics in prevention and treatment of obesity: a critical view. Nutrition & metabolism, 13(1), pp.1-13.
4 Conlon, M.A. and Bird, A.R., 2014. The impact of diet and lifestyle on gut microbiota and human health. Nutrients, 7(1), pp.17-44
5 Thursby, E. and Juge, N., 2017. Introduction fo the human gut flora. Biochem J, 474(11), pp.1823-1836.

6 Donaldson, G.P., Lee, S.M. and Mazmanian, S.K., 2016. Gut biogeography of the bacterial microbiota. Nature Reviews Microbiology, 14(1), pp.20-32.
7 Kobyliak, N., Conte, C., Cammarota, G., Haley, A.P., Styriak, I., Gaspar, L., Fusek, J., Rodrigo, L. and Kruzliak, P., 2016. Probiotics in prevention and treatment of obesity: a critical view. Nutrition & metabolism, 13(1), pp.1-13.
8 Singh, R.K., Chang, H.W., Yan, D.I., Lee, K.M., Ucmak, D., Wong, K., Abrouk, M., Farahnik, B., Nakamura, M., Zhu, T.H. and Bhutani, T., 2017. Influence of diet on the gut microbiome and implications for human health. Journal of translational medicine, 15(1), pp.1-17.
9 Davis, C.D., 2016. The gut microbiome and its role in obesity. Nutrition today, 51(4), p.167.
10 Muscogiuri, G., Cantone, E., Cassarano, S., Tuccinardi, D., Barrea, L., Savastano, S., Colao, A. and Obesity Programs of nutrition, Education, Research and Assessment (OPERA) group, 2019.
11 Le Chatelier, E., Nielsen, T., Qin, J., Prifti, E., Hildebrand, F., Falony, G., Almeida, M., Arumugam, M., Batto, J.M., Kennedy, S. and Leonard, P., 2013. Richness of human gut microbiome correlates with metabolic markers. Nature, 500(7464), pp.541-546.Gut microbiota: a new path to treat obesity. International journal of obesity supplements, 9(1), pp.10-19
12 Turnbaugh, P.J., Ridaura, V.K., Faith, J.J., Rey, F.E., Knight, R. and Gordon, J.I., 2009. The effect of diet on the human gut microbiome: a metagenomic analysis in humanized gnotobiotic mice. Science translational medicine, 1(6), pp.6ra14-6ra14.
13 Ley, R.E., Turnbaugh, P.J., Klein, S. and Gordon, J.I., 2006. Human gut microbes associated with obesity. nature, 444(7122), pp.1022-1023.
14 Angelakis, E., Armougom, F., Million, M. and Raoult, D., 2012. The relationship between gut microbiota and weight gain in humans. Future microbiology, 7(1), pp.91-109.
15 Moreno-Navarrete, J.M., Serino, M., Blasco-Baque, V., Azalbert, V., Barton, R.H., Cardellini, M., Latorre, J., Ortega, F., Sabater-Masdeu, M., Burcelin, R. and Dumas, M.E., 2018. Gut microbiota interacts with markers of adipose tissue browning, insulin action and plasma acetate in morbid obesity. Molecular nutrition & food research, 62(3), p.1700721.
16 Parekh, P.J., Arusi, E., Vinik, A.I. and Johnson, D.A., 2014. The role and influence of gut microbiota in pathogenesis and management of obesity and metabolic syndrome. Frontiers in endocrinology, 5, p.47.
17 den Besten, G., Gerding, A., van Dijk, T.H., Ciapaite, J., Bleeker, A., van Eunen, K., Havinga, R., Groen, A.K., Reijngoud, D.J. and Bakker, B.M., 2015. Protection against the metabolic syndrome by guar gum-derived short-chain fatty acids depends on peroxisome proliferator-activated receptor γ and glucagon-like peptide-1. PLoS One, 10(8), p.e0136364.
18 Anachad, O., Taouil, A., Taha, W., Bennis, F. and Chegdani, F., 2023. the implication of short-chain Fatty acids in Obesity and Diabetes. Microbiology Insights, 16, p.11786361231162720.
19 Cronin, P., Joyce, S.A., O'Toole, P.W. and O'Connor, E.M., 2021. Dietary fibre modulates the gut microbiota. Nutrients, 13(5), p.1655.
20 Rocha-Gomes, A., Silva, J.D., Morais, T.A., da Costa Ferreira, A.R., Costa, V.C., Teixeira, A.E., Lessa, M.R., da Silva, A.A., Dessimoni-Pinto, N.A.V. and Riul, T.R., 2020. High-fat diets are detrimental of the lipid profile, glucose metabolism and body composition of Wistar rats: the role of fatty acid type and consumption duration. Nutrition & Food Science, 51(5), pp.781-791.
21 De la Cuesta-Zuluaga, J., Mueller, N.T., Álvarez-Quintero, R., Velásquez-Mejía, E.P., Sierra, J.A., Corrales-Agudelo, V., Carmona, J.A., Abad, J.M. and Escobar, J.S., 2018. Higher fecal short-chain fatty acid levels are associated with gut microbiome dysbiosis, obesity, hypertension and cardiometabolic disease risk factors. Nutrients, 11(1), p.51.
22 Kim, K.N., Yao, Y. and Ju, S.Y., 2019. Short chain fatty acids and fecal microbiota abundance in humans with obesity: a systematic review and meta-analysis. Nutrients, 11(10), p.2512
23 Bentsen, H. (2017). Dietary polyunsaturated fatty acids, brain function and mental health. Microbial ecology in health and disease, 28(sup1), 1281916.
24 Agregán, R., Popova, T., López-Pedrouso, M., Cantalapiedra, J., Lorenzo, J.M. and Franco, D., 2022. Fatty acids. In Food Lipids (pp. 257-286). Academic Press.
25 Rahat-Rozenbloom, S., Fernandes, J., Gloor, G.B. and Wolever, T.M., 2014. Evidence for greater production of colonic short-chain fatty acids in overweight than lean humans. International journal of obesity, 38(12), pp.1525-1531.
26 Schwiertz, A., Taras, D., Schäfer, K., Beijer, S., Bos, N.A., Donus, C. and Hardt, P.D., 2010. Microbiota and SCFA in lean and overweight healthy subjects. Obesity, 18(1), pp.190-195.
27 Duncan, S.H., Hold, G.L., Barcenilla, A., Stewart, C.S. and Flint, H.J., 2002. Roseburia intestinalis sp. nov., a novel saccharolytic, butyrate-producing bacterium from human faeces. International journal of systematic and evolutionary microbiology, 52(5), pp.1615-1620.
28 Pryde, S.E., Duncan, S.H., Hold, G.L., Stewart, C.S. and Flint, H.J., 2002. The microbiology of butyrate formation in the human colon. FEMS microbiology letters, 217(2), pp.133-139.
29 Kim, K.N., Yao, Y. and Ju, S.Y., 2019. Short chain fatty acids and fecal microbiota abundance in humans with obesity: a systematic review and meta-analysis. Nutrients, 11(10), p.2512.
30 Barczyńska, R., Litwin, M., Sliżewska, K., Szalecki, M., Berdowska, A., Bandurska, K., Libudzisz, Z. and Kapuśniak, J., 2018. Bacterial microbiota and fatty acids in the faeces of overweight and obese children. Polish Journal of Microbiology, 67(3), pp.339-345.
31 FAO, A.J., 2001. Report of a Joint FAO/WHO Expert Consultation on Evaluation of Health and Nutritional Properties of Probiotics in Food Including Powder Milk with Live Lactic Acid Bacteria. 2001;[updated 1-4 October 2001].
32 Mozaffarian, D., Hao, T., Rimm, E.B., Willett, W.C. and Hu, F.B., 2011. Changes in diet and lifestyle and long-term weight gain in women and men. New England journal of medicine, 364(25), pp.2392-2404.
33 Santiago, S., Sayón-Orea, C., Babio, N., Ruiz-Canela, M., Martí, A., Corella, D., Estruch, R., Fitó, M., Aros, F., Ros, E. and Gómez-García, E., 2016. Yogurt consumption and abdominal obesity reversion in the PREDIMED study. Nutrition, Metabolism and Cardiovascular Diseases, 26(6), pp.468-475.
34 Yuan, M., Singer, M.R., Pickering, R.T. and Moore, L.L., 2022. Saturated fat from dairy sources is associated with lower cardiometabolic risk in the Framingham Offspring Study. The American Journal of Clinical Nutrition, 116(6), pp.1682-1692.
35 Duarte, C., Boccardi, V., Amaro Andrade, P., Souza Lopes, A.C. and Jacques, P.F., 2021. Dairy versus other saturated fats source and cardiometabolic risk markers: Systematic review of randomized controlled trials. Critical Reviews in Food Science and Nutrition, 61(3), pp.450-461.
36 Unger, A.L., Torres-Gonzalez, M. and Kraft, J., 2019. Dairy fat consumption and the risk of metabolic syndrome: an examination of the saturated fatty acids in dairy. Nutrients, 11(9), p.2200.
37 Sanchez, M., Darimont, C., Drapeau, V., Emady-Azar, S., Lepage, M., Rezzonico, E., Ngom-Bru, C., Berger, B., Philippe, L., Ammon-Zuffrey, C. and Leone, P., 2014. Effect of Lactobacillus rhamnosus CGMCC1. 3724 supplementation on weight loss and maintenance in obese men and women. British Journal of Nutrition, 111(8), pp.1507-1519.
38 Sanchez, M., Darimont, C., Panahi, S., Drapeau, V., Marette, A., Taylor, V.H., Doré, J. and Tremblay, A., 2017. Effects of a diet-based weight-reducing program with probiotic supplementation on satiety efficiency, eating behaviour traits, and psychosocial behaviours in obese individuals. Nutrients, 9(3), p.284.
39 Floch, M.H., 2015. Gender in probiotic use. Journal of Clinical Gastroenterology, 49(2), pp.93-94.
40 Kondo, S., Xiao, J.Z., Satoh, T., Odamaki, T., Takahashi, S., Sugahara, H., Yaeshima, T., Iwatsuki, K., Kamei, A. and Abe, K., 2010. Antiobesity effects of Bifidobacterium breve strain B-3 supplementation in a mouse model with high-fat diet-induced obesity. Bioscience, biotechnology, and biochemistry, 74(8), pp.1656-1661.
41 Sung, H.K., Youn, S.J., Choi, Y., Eun, S.W. and Shin, S.M., 2022. Body Fat Reduction Effect of Bifidobacterium breve B-3: A Randomized, Double-Blind, Placebo Comparative Clinical Trial. Nutrients, 15(1), p.28.
42 Minami, J., Iwabuchi, N., Tanaka, M., Yamauchi, K., Xiao, J.Z., Abe, F. and Sakane, N., 2018. Effects of Bifidobacterium breve B-3 on body fat reductions in pre-obese adults: A randomized, double-blind, placebo-controlled trial. Bioscience of Microbiota, Food and Health, 37(3), pp.67-75.
43 Kadooka, Y., Sato, M., Imaizumi, K., Ogawa, A., Ikuyama, K., Akai, Y., Okano, M., Kagoshima, M. and Tsuchida, T., 2010. Regulation of abdominal adiposity by probiotics (Lactobacillus gasseri SBT2055) in adults with obese tendencies in a randomized controlled trial. European journal of clinical nutrition, 64(6), pp.636-643.
44 Kadooka, Y., Sato, M., Ogawa, A., Miyoshi, M., Uenishi, H., Ogawa, H., Ikuyama, K., Kagoshima, M. and Tsuchida, T., 2013. Effect of Lactobacillus gasseri SBT2055 in fermented milk on abdominal adiposity in adults in a randomised controlled trial. British Journal of Nutrition, 110(9), pp.1696-1703.
45 Hulston, C.J., Churnside, A.A. and Venables, M.C., 2015. Probiotic supplementation prevents high-fat, overfeeding-induced insulin resistance in human subjects. British Journal of Nutrition, 113(4), pp.596-602.
46 Osterberg, K.L., Boutagy, N.E., McMillan, R.P., Stevens, J.R., Frisard, M.I., Kavanaugh, J.W., Davy, B.M., Davy, K.P. and Hulver, M.W., 2015. Probiotic supplementation attenuates increases in body mass and fat mass during high-fat diet in healthy young adults. Obesity, 23(12), pp.2364-2370.

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NETWORK HEALTH DIGEST

Questions relating to: *Can probiotics influence weight?* Type your answers below, download and save or print for your records, or print and complete by hand.	
Q.1	What is the relationship between *Bacteroidetes, Firmicutes* and weight?
A	
Q.2	Explain how the ratio of these two gut bacteria can impact appetite.
A	
Q.3	What is anaerobic fermentation and how does it affect appetite regulation?
A	
Q.4	Why are probiotics considered a health benefit?
A	
Q.5	Outline one research study on the probiotic *Lactobacillus rhamnosus* and its effect on weight loss.
A	
Q.6	How can *Bifidobacterium breve* B-3 have an impact on body fat?
A	
Q.7	Explain research behind Lactobacillus casei Shirota and prevention of weight gain.
A	
Q.8	What are the issues with the two research studies quoted in the article around *Lactobacillus casei Shirota*?
A	
Please type additional notes here.	