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No causal link between obesity and probiotics

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We wish to counter the comments of Raoult (Probiotics and obesity: a link? *Nature Rev. Microbiol.* **7**, 616 (2009))[1] that probiotics increase the risk of obesity. The impact of probiotics in farm animals has been shown to include: an increase in size and weight but not in fat mass[2,3]; a reduction in fat mass in farm animals that are gaining weight[4,5]; or no impact on growth[6]. In the livestock industry, probiotics are used to promote growth and lean mass, not adiposity. These observations are consistent with weight gain resulting from improved gut function and resistance to infection rather than from a metabolic imbalance that causes obesity.

No human study cited by Raoult showed a statistically significant increase in weight gain for subjects who were given probiotics compared to those who were given a placebo[7,8]. In spite of the widespread use of probiotics in modern and traditional diets, there is no evidence that the consumption of probiotics leads to weight gain in healthy people. Most probiotics are delivered as dairy products, and in the USA, where levels of obesity are high, consumption of probiotic yogurt (4 kg per person per year) is substantially lower than that in countries such as France, Finland and Japan, where obesity rates are low.

The data showing an association between obesity and both a reduction in the levels of Gram-negative bacteria and an increase in the levels of Firmicutes in the gut are mainly based on statistical correlations that cannot distinguish between cause and consequence. Furthemore, these data have been partly contradicted by numerous other studies, including that of Turnbaugh *et al.*[9], which revealed a higher proportion of Actinobacteria and a lower proportion of Bacteroidetes among obese subjects but no significant difference in Firmicute levels. In other studies, comparisons of microbiota using real-time PCR revealed a higher Bacteroidetes/Firmicutes ratio among overweight and obese subjects than among lean ones[10]. At least one study has shown a resultant decrease in body weight and fat mass in obese individuals taking prebiotics[11].

The consumption of probiotics does not lead to any sustained compositional change in the gut microbiota, and there is no suggestion from a multitude of human studies that weight gain is a side effect of probiotic consumption. Probiotic-induced weight gain in ill or undernourished subjects, which might result from improved gut function, is not an adverse outcome.

Unfortunately, Raoult confuses probiotics (live microbes) and prebiotics (selectively fermented substrates for beneficial colonizing microbes) and is inaccurate with regard to the microbiological identity of different probiotics. Strains of the *Bifidobacterium* genus, commonly used as probiotics and indicted by Raoult as contributors to increased levels of Firmicutes, are in fact members of the phylum Actinobacteria. Furthermore, there are important strain-to-strain differences in probiotic effects, and one cannot generalize about a species. Targets also differ, such that the use of a probiotic in humans can lead to improved health whereas in animals it can lead to improved performance.

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