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A Meta-Analysis of the Therapeutic Effect of Probiotic Intervention in Obese or Overweight Adolescents

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ADMINISTRATIVE INFORMATION

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Conflicts of interest - None declared.

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Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 19 January 2024 and was last updated on 19 January 2024.

INTRODUCTION

Review question / Objective Existing evidence on the possible effects of probiotics on obese or overweight adolescents has not been fully established. Therefore, the aim of this study was to explore the effects of probiotic supplementation on anthropometric indices, inflammatory markers and metabolic indices in obese or overweight adolescents.

Condition being studied The prevalence of overweight and obesity in adolescents has risen dramatically in recent decades and has become one of the most important public health problems. Adolescence is a unique transition period accompanied by significant physiological and psychological changes. Obesity-related comorbidities may negatively impact adolescent growth and developmental trajectories, while the rising prevalence of obesity in adolescents is associated with an increase in adult-onset diseases (e.g., type 2 diabetes mellitus, hypertension, nonalcoholic fatty liver disease, obstructive sleep apnea, cancer, and dyslipidemia). As the importance of gut flora is further demonstrated, an increasing number of studies are focusing on the correlation between gut microbiota and obesity.
The gut microbiota is the most complex ecosystem in nature, possessing large bacterial populations in the gut. A significant correlation between obesity and the specific composition of the gut microbiota has been demonstrated.

The gut microbiota is not stationary, and short-term changes can occur through diet and lifestyle changes. Studies have shown that the microbial imbalances associated with obesity can be re-established with probiotics and a balanced dietary regimen. Currently, the number of studies on the effects of probiotics on obesity is small and mainly based on animal models. The effects of probiotics on human host metabolism, particularly on obesity, have been controversial because of the paucity of research data, inconsistent findings and lack of long-term follow-up results, as well as a serious lack of consistency in terms of strain type, sample size, dosage parameters, treatment duration, and mode of administration, which has hampered comparative analyses between studies and made their safety and efficacy for the treatment of obesity an ongoing controversy. Several studies have shown that probiotics not only lead to weight loss and improved obesity but also have a positive effect on metabolic parameters such as blood glucose, systemic inflammation and energy intake. Despite the existing data suggesting that probiotics have significant therapeutic potential in obesity, there are still many hurdles to overcome before probiotic therapy can be recognized in the medical practice of adolescent obesity, and there is controversy and uncertainty regarding the use of probiotics in adolescent obese patients.

METHODS

Participant or population Obese or overweight adolescents.

Intervention Probiotic treatment.

Comparator Placebo-controlled.

Study designs to be included 1.1Literature retrieval strategy.1.2Selection criteria.1.3Quality assessment.1.4Data extraction and management. 1.5Statistical analysis.

Eligibility criteria The inclusion criteria were as follows: ① The study participants were obese or overweight adolescents; ② The intervention was probiotic treatment; ③ Posttreatment means and standard deviations were directly available in the literature, or posttreatment-related means and standard deviations could be obtained by formula calculation; ④ The type of study was a randomized controlled trial.The exclusion criteria were as follows: ①The study participants were not adolescents; ②Noncontrolled trials, animal experiments or in vitro experiments; ③ Literature with incomplete data or where the original data statistics could not be extracted; ④Conference papers, abstracts, reviews or meta-analyses; ⑤Secondary obesity with a clear etiology; ⑥For duplicate reports or multiple publications targeting the same subject, the literature with the most recent publications and the most complete data was selected.

Information sources The PubMed, Embase, Cochrane Library, CNKI, Wanfang and CBM databases.

Main outcome(s) A total of 8 studies that met the inclusion criteria were included in this study. There were 201 cases in the experimental group (probiotic treatment) and 190 cases in the control group. Compared to the control group, probiotic intervention in adolescents resulted in a decrease in body mass index, fasting blood glucose and C-reactive protein with WMD (Weighted mean difference) and 95% CI of -2.53 (-4.8 to -0.26) kg/m2, -0.80 (-1.13 to -0.47) mol/L and -0.24 (-0.43 to -0.05) mg/L, respectively. No significant changes were found in weight, waist circumference, waist-to-hip ratio, insulin, Homeostatic Model Assessment of insulin resistance, interleukin 6, tumor necrosis factor alpha and so on; however, an unfavorable elevated effect in total cholesterol, triglycerides, and low-density lipoproteins was detected with WMD and 95% CI of 0.06 (0.02 to 0.09) mmol/L, 0.18 (0.14 to 0.21) mmol/L, and 0.19 (0.18 to 0.20) mmol/L, respectively.

Quality assessment / Risk of bias analysis All included studies were randomized controlled studies; therefore, the Cochrane Risk Assessment Tool was used to assess the quality of the included studies. The scale consists of six dimensions: (1) random sequence generation; (2) allocation concealment; (3) blinding; (4) incomplete outcome data; (5) selective reporting; and (6) other bias. If all of the above criteria are “adequate”, there is a low likelihood of bias; if one of the criteria is “unclear”, there is a moderate likelihood of bias; if one of the criteria is “inadequate” or “not used”, there is a high likelihood of bias.

Strategy of data synthesis Relevant data were extracted by 2 independent investigators through joint discussion to determine final inclusion, with a third investigator assisting in resolution if necessary. The relevant data were extracted, including author, year and country of publication, target population, number and mean age of participants, intervention duration and type. Additionally, the mean and standard deviation (SD)

of the effect indicators of concern at the end of the intervention were extracted.
For each parameter, we used the mean and SD of the postintervention values for the probiotics and control groups, as the study population was randomly grouped for inclusion in the literature after reviewing the references, and as the inclusion literature was clearly stated, we considered that there was no difference between the initial data for the experimental and control groups.

Subgroup analysis To further look for sources of interstudy heterogeneity, subgroup analyses based on the type of intervention (probiotic or synbiotic) and duration of intervention (8 weeks/12 weeks) were performed. When grouped by intervention type (Fig. 7C), two of the studies with intervention type of probiotic and two of the studies with intervention type of synbiotic were meta-merged separately, and there was no significant heterogeneity in either (I2=0), suggesting that the intervention type might be the source of heterogeneity, with WMD and 95% CI in the probiotic group of -0.24 (-0.43, 0.05) mmol/L and WMD and 95% CI in the synbiotic group of 0.03 (-0.03, 0.09) mmol/L, respectively. This suggests that probiotic treatment can reduce FBG levels, while synbiotic treatment has no effect on FBG. When grouped by intervention duration (Fig. 7D), three studies had an intervention duration of 12 weeks, one study had an intervention duration of 8 weeks, and there was no significant attenuation of heterogeneity after the merger, suggesting that interstudy heterogeneity was not related to intervention duration.

Sensitivity analysis e.g. Significant heterogeneity (I2=64%, P=0.04) was observed when meta-merging was performed (Fig. 7A), and a sensitivity analysis did not reveal a significant reduction in heterogeneity after excluding a particular piece of literature (Fig. 7B), suggesting that the results of the included studies were relatively robust.

Country(ies) involved The Second Affiliated Hospital of Shandong First Medical University, Taian, Shandong, 271000, China.

Keywords Probiotic, Overweight, Obesity, Adolescent, Meta-analysis.

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