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Original research

Influence of the intervention of exercise on obese type II diabetes mellitus: A meta-analysis

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ABSTRACT

Aim: The study aimed to assess the effect of exercise intervention on the management of obese T2DM patients.
Methods: The literature retrieval was conducted in relevant databases from their inception to 2015, with predefined searching strategy and selection criteria. The Cochrane Collaboration's tool was utilized to assess the quality of included studies. Weighted mean difference (WMD) with its corresponding 95% CI (confidence interval) was used as the effect size.
Results: A subset of 13 eligible studies was selected. Exercise significantly reduced the concentration of high sensitivity C reactive protein (4 months: WMD = −1.03, 95% CI: −1.77 to −0.29, $P < 0.01$), triglyceride (6 months: WMD = −24.75, 95% CI: −27.67 to −21.83, $P < 0.01$), diastolic blood pressure (6 months: WMD = −2.70, 95% CI: −4.12 to −1.28, $P = 0.0002$), systolic blood pressure (WMD = −7.98, 95% CI: −9.87 to −6.08, $P < 0.01$)), HbA_{1c} (4 months: WMD = −0.25, 95% CI: −0.49 to −0.02, $P = 0.04$) and homeostasis model assessment-insulin resistance (3 months: WMD = −0.19, 95% CI: −0.37 to −0.01, $P = 0.04$); and a pronounced increase of HDL-C (12 months: WMD = 3.57, 95% CI: 1.92 to 5.21, $P < 0.01$).
Conclusion: Exercise was beneficial to obese T2DM patients.

1. Introduction

Diabetes is a serious chronic disease that is the sixth leading cause for death [1]. The disease is divided into type I diabetes mellitus and type II diabetes mellitus (T2DM), which is known as non-insulin dependent diabetes and accounts for nearly 90% of the diabetic patients [2]. Incidence of T2DM keeps an increasing trend and 439,000,000 patients have been estimated to be diagnosed by 2030 [3]. T2DM is tightly associated with the risk factors for cardiovascular disease (CVD), the leading cause for death with high morbidity and mortality [4]. As the major causative factor for diabetes, obesity is characterized by high body mass index (BMI), which contributes to the development of CVD [5].

Exercise has been considered as a cornerstone for the treatment and prevention of diabetes. It is reported that an exercise intervention with 24-week program achieves a

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beneficial effect on the T2DM patients with increased cardiovascular fitness and reduced BMI [6]. At present, a subset of meta-analysis has been investigated to assess the effect of exercise training on the control of T2DM, however most of them put emphasis on the assessment of glycemic control; the comparison among different exercise modalities such as aerobic exercise, resistance exercise and the combination of them; or the comparison between the structured exercise training and physical activity [7,8]. The effect of exercise on obese T2DM patients is rarely reported. Though risk of CVD is involved in a meta-analysis evaluating the effect of exercise, assessments on indexes such as high sensitivity C reactive protein (hs-CRP) and homeostasis model assessment-insulin resistance (HOMA-IR) are not taken into consideration, neither the subgroup analysis by exercise time nor the relationship of obesity with CVD [9]. Therefore, with the restricted population of obese T2DM patients, we carried out this meta-analysis examining a spectrum of indexes such as hs-CRP, serum lipid, blood pressure, HbA_{1c} and HOMA-IR; and performing subgroup analysis stratified by distinct exercise time, to comprehensively assess the effect of exercise intervention on the improvement of obese T2DM patients.

2. Methods

2.1. Search strategy and literature selection

The literature retrieval was conducted using the databases such as PubMed, EMBASE and Cochrane library from their inception to May 5th, 2015, to search the randomized controlled trials (RCTs). The key searching terms were "type II diabetes" OR "T2DM" AND "exercise" AND "overweight" OR "obese". Then the preliminarily selected studies were subjected to title browsing, abstract reading and full text reading, to further identify the eligible studies. Two independent investigators conducted this retrieval and reached a consensus through discussion with a third investigator when disagreement presented.

2.2. Inclusion and exclusion criteria for eligible studies

Studies were included if they fulfilled with the following criteria: (1) studies were RCTs; (2) the research objects were obese T2DM patients; (3) the study compared the intervention group applying the prescribed exercise with the control group that did not apply this intervention; (4) at least one of the following outcomes were involved in the study: hs-CRP, serum lipid, diastolic blood pressure (DBP), systolic blood pressure (SBP), HbA_{1c} and HOMA-IR index; (5) the case numbers in the intervention group (exercise) and control group (without exercise) were both greater than 10; (6) the study was published in English. On the other hand, the studies were excluded if they met with the criteria: (1) the study was a letter, excerpt from a meeting or a review; (2) the study was a non-RCT; (3) the study involved the comparison between different modalities of exercise; (4) secondary analysis of the reported clinical experimental data.

2.3. Data abstraction and quality assessment

Like in the process of literature retrieval, two investigators independently extracted the data information and completed the quality assessment of the selected studies. Disagreements were resolved through the discussion with a third researcher. The following information were abstracted including first author name; publication time; follow up time; characteristics of the populations such as age composition, BMI and HbA_{1c}; diabetic duration; the detailed case numbers in the two groups; the specific intervention measures; and biochemical indexes including hs-CRP, total cholesterol (TG), triglyceride (TC), high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), DBP, SBP, HbA_{1c} and HOMA-IR, which were relevant to CVD risk factors. The Cochrane Collaboration's tool [10] was recruited to examine the risk of bias of the included RCTs.

2.4. Statistical analysis

Since the outcomes in the present study were all continuous variable, weighted mean difference (WMD) with its corresponding 95% confidence interval (CI) was used as the effect size. Subgroup analysis stratified by the time of exercise intervention was also conducted, to further compare the differences between the two groups on the above biochemical indexes. Cochran Q statistic and I^2-test [11] were applied to detect and quantify heterogeneity across the studies. Substantial heterogeneity was considered if $P < 0.05$ or $I^2 > 50\%$, and then a random effects model was applied to calculate the pooled results. On the other hand, if obvious heterogeneity was absent ($P > 0.05$, $I^2 < 50\%$), a fixed model was selected. All the statistical analyses were performed using the software of RevMan 5.3 (Cochrane Collaboration, http://ims.cochrane.org/revman).

2.5. Sensitive analysis

To examine the reliability of the results, the sensitive analysis using Stata 11.0 (STATA, College Station, TX, USA) was carried out. We compared the pooled results before and after removing a single study at one time, determining whether the combined result would be affected by a specific study.

3. Results

3.1. Eligible studies and the characteristics

Based on the aforementioned strategies, a set of 938 studies were retrieved after the preliminary selection (PubMed: 283; Embase: 477; Cochrane library: 178). Then 861 irrelevant studies and duplications were filtered out. After abstract reading, another elimination with 51 articles were conducted (17 taking T2DM patients without obesity as the study objects; 3 not aiming at T2DM patients; 2 were excerpts from meetings; 23 not taking exercise as the intervention; 6 aiming at the same population). Subsequently, the remaining 26 studies were subjected to full text reading, through which 13 studies were further excluded (4 involving two modalities of

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