

# NON-PHARMACOLOGICAL INTERVENTIONS FOR TREATING SYMPTOMS OF KNEE OSTEOARTHRITIS IN OVERWEIGHT OR OBESE PATIENTS; A REVIEW

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## ABSTRACT

**Objective:** To explore the current literature on the effects of non pharmacological interventions on weight reduction, knee pain and function in patients with knee osteoarthritis who are overweight or obese.

**Methodology:** Three databases; Web of Science, PubMed Central and ScienceDirect were searched using Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The search terms used were "overweight and obese knee OA Patients, Treatment, Strengthening exercises, Range of motion exercises, High intensity exercises or Mobile health (mHealth)". Only articles written in English language and published in peer reviewed journals from August, 2008 to September, 2018 were searched. Out of 2838 articles identified, only 10 were considered relevant.

**Results:** The most effective intervention that showed improvement of knee pain and function was strengthening exercise. The two most effective interventions for weight reduction, among patients with knee osteoarthritis who were overweight or obese, were caloric restriction alone and diet intervention combined with the exercise program. Dietary intervention alone also reported a loss of fat significantly, when compared to exercise group.

**Conclusion:** Strengthening exercise played a vital role in relieving knee pain and improving function. A caloric restriction diet was found helpful in reducing weight. Combination of diet and exercise was found effective in reducing weight and improving knee pain.

**Key Words:** Exercise, Knee osteoarthritis, Overweight, Pain, Randomized controlled trial

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## INTRODUCTION

The most common form of arthritis is osteoarthritis (OA). It is characterized by a progressive destruction of the articular cartilage, resulting in severe pain and disability<sup>1</sup>. OA of the knee is the most common joint condition that causes significant physical disability worldwide<sup>2,3</sup>. A recent study conducted on 320 patients with OA knee joints showed that obesity and advanced age were associated with an increased risk of OA knee joints<sup>4</sup>. Obesity is a significant as well as rapidly increasing global health issue. More than 39% and 13% of adults were considered overweight (body mass index > 25 kg/m<sup>2</sup>) and obese (body mass index > 30 kg/m<sup>2</sup>) respectively in 2014. This prevalence has doubled globally since 1980<sup>5</sup>. The high prevalence of overweight and obesity continues to be a public health concern in the United States<sup>6</sup>.

The incidence of obesity and its related diseases has dramatically increased worldwide in the last few decades, mainly as a result of physically inactive lifestyle and inappropriate dietary habits. Excessive joint loading in the knee OA patients can lead to an increased inflammatory response, joint pain, and swelling<sup>7</sup>.

A recent study concluded that the excess of weight and adiposity or obesity showed a negative impact in increasing pain perception among patients with osteoarthritis<sup>8</sup>. All international clinical practice guidelines recommend patients with knee OA, who are overweight or obese, to lose their weight. There is no treatment that can reverse or halt OA, other than pain-relief. It provides strong evidence that strengthening exercises and reduction of weight improve the quality of life for long-term care of these patients<sup>9</sup>. Patients with knee OA who were

obese had the worst performance in the six-minute walk test, brisk walking speed and timed up and go test. Also, the obese group reported more difficulty in performing the tasks of standing, getting on/off toilet, rising from a chair and going downstairs. The quality of life scores in both groups were reduced<sup>10</sup>.

By acquiring the habit of regular exercise, knee OA patients can reduce pain, improve the quality of life and enhance physical activity. One of the protecting activities to the knee such as reduction of body weight is useful for healthy aging<sup>4</sup>. It is hoped that the results of this review will guide clinicians, physiotherapists and health policy makers in the management of overweight and obese knee OA patients. The objective of this study was to identify and summarize the current literature on the effects of diet, exercise and mobile health (mHealth) technology on weight reduction, knee pain and functions among adult overweight and obese patients with knee OA.

## METHODOLOGY

Electronic search was performed using Web of Science, PubMed Central and ScienceDirect databases to search for relevant literature. Peer review articles published in English language from August 2008 to September 2018 were reviewed. The databases were searched following the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines. The search method used in the ScienceDirect, PubMed Central and Web of Science is shown in the table 1.

All studies related to the obese and overweight patients with knee OA were viewed from three database searches according to the inclusion criteria for the study. Initially, the title was used as a searching tool from three data bases, then the abstracts of the included research articles were viewed to find out the participants' characteristics, intervention methods and the main findings of the research articles. If the participant characteristics, intervention methods or the main findings of the research articles were difficult to find from the abstract, then the full text research article were viewed. Only peer reviewed articles with randomized controlled trials (RCTs) and quasi experimental articles were included. The Cochrane Handbook for Systematic Review of Interventions was used to evaluate the risk of bias of selected studies<sup>11</sup>.

Narrative synthesis was carried out based on the outcomes of this review. Patients' demographics and clinical settings differed among selected searched articles, so the random-effects model was used to pool the results. In three arms randomized control studies, each of the intervention group was analyzed independently and compared with the control group.

## RESULTS

Total 2838 articles were identified through Web of Science, PubMed Central and ScienceDirect. Out of them, 2828 articles were excluded because they did not fulfill the inclusion criteria. The flow chart of study is shown in Figure 1. Table 2 summarizes the characteristics of the selected articles.

Study setting differed in most of the articles; six studies were conducted in the community<sup>12,16-20</sup> and four in the clinical settings<sup>13,14,15,21</sup>. Majority of selected articles incorporated interventions separately or in combination with other strategies. Combination strategies were exercise plus diet induced weight loss<sup>13</sup>, diet plus quadriceps strengthening<sup>17</sup>, diet plus physical activity by telephone<sup>18</sup>, exercise plus Kinesiotaping and placebo taping technique<sup>19</sup>. Separate interventions were dietary support<sup>17,20</sup>, low energy diet<sup>14</sup>, exercise<sup>16</sup>, quadriceps strengthening<sup>17</sup>, advice leaflet<sup>17</sup> and isokinetic exercise<sup>21</sup>. Four out of eight RCTs showed reduction in weight loss in the intervention group compared to the control<sup>12-14,16</sup>. Three RCTs showed reduction in knee pain in the intervention group compared to the control<sup>16-18</sup>. One RCT that incorporated intensive lifestyle intervention showed improvement in physical function when compared to control group<sup>12</sup>. Another RCT that incorporated dietary intervention resulted loss of fat significantly when compared to exercise group<sup>15</sup>. One of these RCTs used intensive diet-induced weight loss plus exercise to improve knee function and resulted in significant improvement in knee function compared with intensive diet-induced weight loss or exercise alone<sup>16</sup>. The quasi experimental study found that dietary intervention alone lead to significant reduction in weight<sup>20</sup>. Another quasi experimental study found that isokinetic exercise intervention protocol of short duration did not led to significant reduction in knee pain and function<sup>21</sup>.

Two subgroups for change in weight were defined as diet only and diet plus exercise; while for change in pain, an additional group was made for exercise. The method applied was random effect model with Der Simonian and Laird method. The forest plot revealed that overall heterogeneity index  $I^2$  was 65.0% for change in weight (Figure 2). For change in pain the heterogeneity index  $I^2$  was 0.0 % for diet as well as exercise. For diet plus exercise, it was recorded 87.0 % with overall value of 77.0 % (Figure 3)

## DISCUSSION

The narrative synthesis of current review found articles that incorporated dietary intervention alone and dietary intervention combined with an exercise program and reported positive effects on weight related outcomes. Also the narrative synthesis of the current review found that strengthening exercise interventions

**Table 1: Search method for ScienceDirect, PubMed Central and Web of Science**

Filter	English language articles in humans	ScienceDirect	PubMed Central	Web of Science
1	[Overweight and obese knee OA patients] "[Treatment]"	592	2003	42
2	[Overweight and obese knee OA patients] "[Strengthening Exercise]"	35	123	1
3	[Overweight and obese knee OA patients] "[ROM exercise]"	11	24	0
4	[Overweight and obese knee OA patients] "[High intensity exercise]"	0	4	0
5	[Overweight and obese knee OA patients] "[mHealth T]"	0	3	0
Total Articles		638	2157	43

OA = Osteoarthritis; ROM = Range of motion; mHealth T = Mobile Health Technology

**Table 2: Characteristics of selected research articles**

Authors, Year, Country	Participants' Characteristics, Design	Intervention methods	Main findings or outcomes
Foy et al., 2011 <sup>12</sup> , United State of America	5,145 Adults, Overweight or Obese with knee OA, RCT, Recruited outpatient centers	1. ILLI condition 2. Diabetes Support and Education Condition	ILLI condition resulted in significant improvement in physical function and weight loss
Beavers et al., 2014, <sup>13</sup> United State of America	454 Older Adults, Average age 62 years, Overweight or Obese With knee OA, A Single Blinded, RCT, community-dwelling	1. Exercise, walking and strength training 2. Dietary-Induced Weight Loss 3. Dietary-Induced Weight Loss Plus Exercise	Weight loss is significant with an intensive dietary intervention, with or without exercise Weight loss with exercise intervention alone is not significant
Riecke et al., 2010 <sup>14</sup> , Denmark	192 both males and females obese knee osteoarthritis patients with a mean age 62.5 years, RCT, Recruitment from outpatient's clinic	1. A very low-energy diet (415 kcal/day diet) 2. A low-energy diet (810 kcal/day diet)	Significant weight loss with both groups. No clinically significant differences between both diets
Christensen et al., 2015 <sup>15</sup> , Denmark	192 obese participants with the knee OA, Both males and females mean age was 62.5 years, RCT, Department of rheumatology	1. Dietary support 2. A knee-exercise program 3. Control group	Loss of fat with dietary intervention group is significant as compared with the exercise group.
Messier et al., 2013 <sup>16</sup> , United State of America	454 overweight and obese knee OA adults, Age ≥ 55 years, Single-blind, 18 month, RCT, Community-dwelling	1. Intensive diet-induced weight loss plus exercise, 2. Intensive diet-induced weight loss, 3. Exercise.	Diet + Exercise and diet groups resulted in significant weight loss than those in the exercise group. Diet + Exercise group had less knee pain and better function than those in the Diet or Exercise groups

Jenkinson et al., 2010 <sup>17</sup> , England	389 participants with body mass index (BMI) of ≥28.0 Aged 45 year or more, RCT, Home based	1. Dietary intervention plus quadriceps strength- ening exercises 2. Dietary intervention 3. Quadriceps strength- ening exercises 4. Advice leaflet (control group).	Quadriceps strengthen- ing resulted in significant improvement in reduc- ing the knee pain and improving function. Dietary intervention was not associated with knee pain or function.
Leon-Ballesteros et al., 2018. <sup>18</sup> , Mexico	32 overweight or obesity women with the knee OA, Aged between 50 to 70 years, RCT, Home based	1. Exercise and Kinesio- taping 2. Exercise and placebo taping technique	No significant difference between two groups. Both groups have the same result for the im- provement of knee pain.
O'Brien et al., 2018. <sup>19</sup> , Australia	120 overweight or obese knee osteoarthritis pa- tients waiting for ortho- paedic consultancy, RCT, Community based	1. Intervention of diet and physical activity by telephone 2. Usual care of waiting list of orthopaedic consulta- tion or surgery	Intervention did not re- duce knee pain or weight significantly.
Aaboe et al., 2011. <sup>20</sup> , Denmark	157 obese knee OA pa- tients, Quasi experimen- tal, Community based	Dietary intervention study	Dietary intervention study resulted in significant reduction in weight.
Germanou et al., 2013. <sup>21</sup> , Greece	20 was sample size. Of them, 10 were obese women with the Knee OA and 10 age/weight matched control, Qua- si Experimental, Sports science department	Isokinetic exercise proto- col of short duration	Not significant on knee pain and function

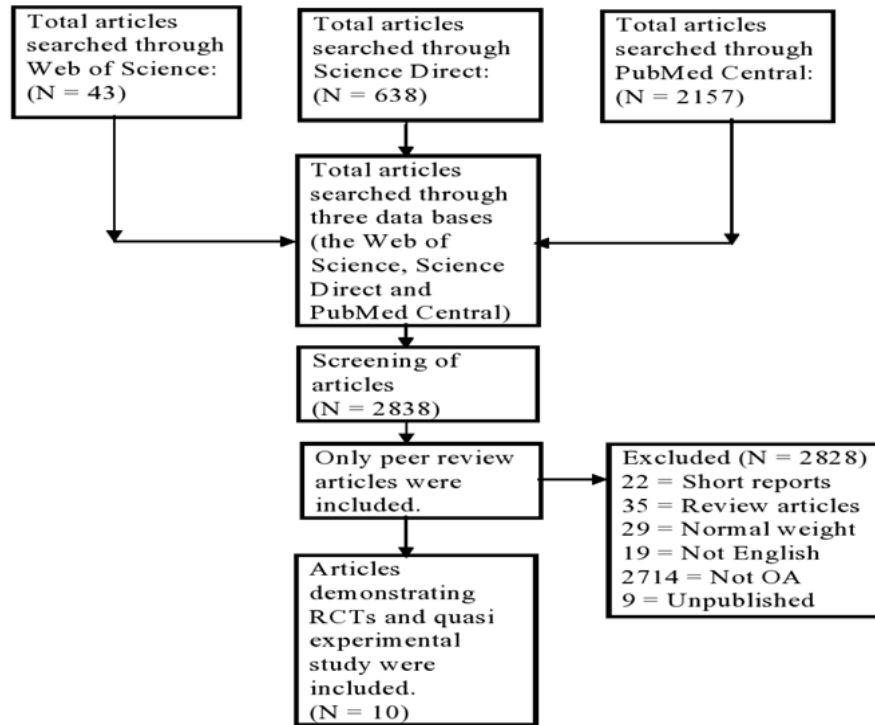
OA = Osteoarthritis; RCT = Randomized controlled trial; ILI = Intensive lifestyle intervention

reported positive effects on knee pain and function. Previous review and meta-analyses have reported that diet-only or combined diet and exercise interventions improved physical function, knee pain relief was moderately achieved with a combination of diet and exercise but not with diet only interventions<sup>22</sup>. A randomized controlled trial of 820, overweight and obese knee OA patients investigated that in a rigorously monitored environment, diet-induced weight loss combined with exercise was significantly more effective in reducing pain of knee OA than with the single intervention<sup>16</sup>. One of the studies concluded that dietary intervention group resulted in double loss of fat as compared with exercise group<sup>15</sup>. A study randomized 389 overweight participants, aged 45 years or more, into four groups named dietary intervention, quadriceps strengthening exercises, dietary intervention plus quadriceps strengthening exercises, and advice leaflet control group. Quadriceps strengthening in overweight and obese adults with knee pain had significant role in reducing the knee pain and improved the mobility. Dietary intervention was associated with an improvement in depression but did not have an effect on knee symptoms<sup>17</sup>. Another recent study randomized 32 obese or overweight women with

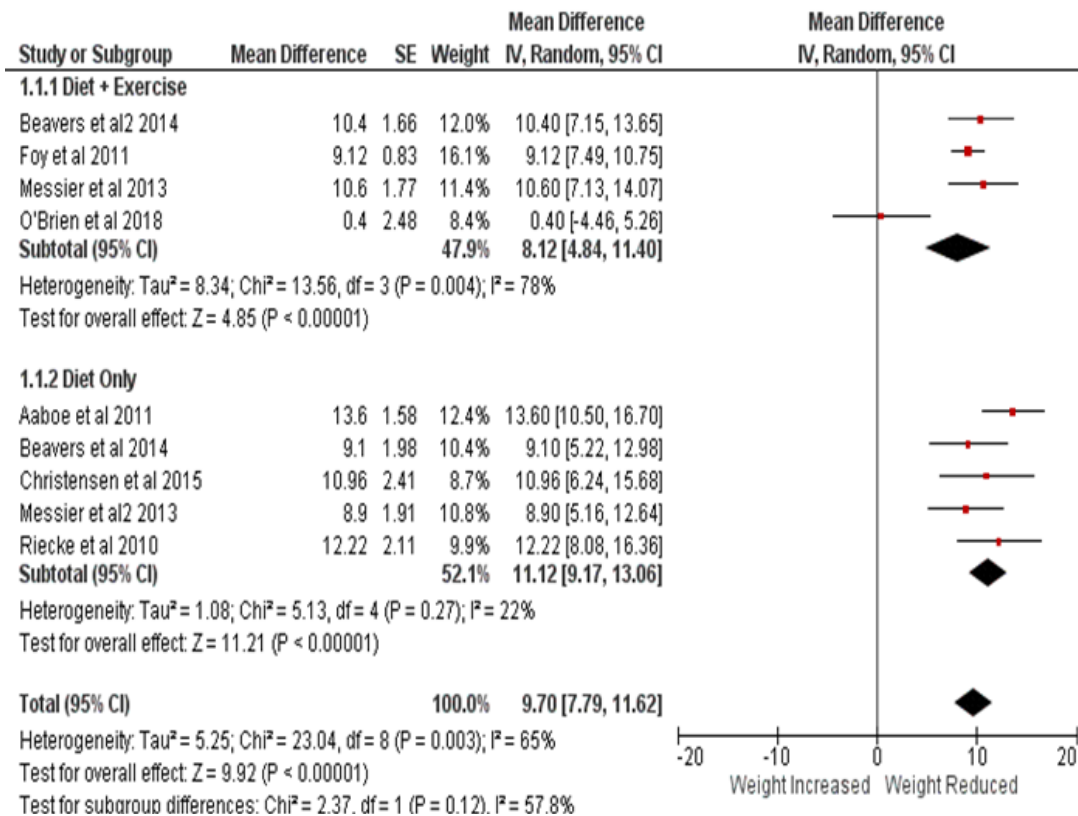
knee OA, aged 50–70 years, into two groups exercise and kinesiotaping, and exercise and placebo technique. Both groups had the same result for improvement of knee pain<sup>18</sup>.

The current systematic review included quasi experimental studies and RCTs from August, 2008 to September, 2018. The cohort research articles were not included. The cohort study design will explain a better reflection of clinical setting. This systematic review was specific for diet, exercise and mobile health technology interventions. But, there was no article that investigated the effectiveness of strengthening exercise using mHealth among knee OA patients who were overweight and obese. The inclusion criteria did not include unpublished articles, thus, publication bias is possible. The intervention methods discussed in the current review in overweight and obese knee OA patients were diet, exercise and a combination of diet plus exercise, but the most effectively used intervention methods for weight related outcomes were diet or diet combined with exercise. The strengthening exercise reported positive effects on knee pain and function.

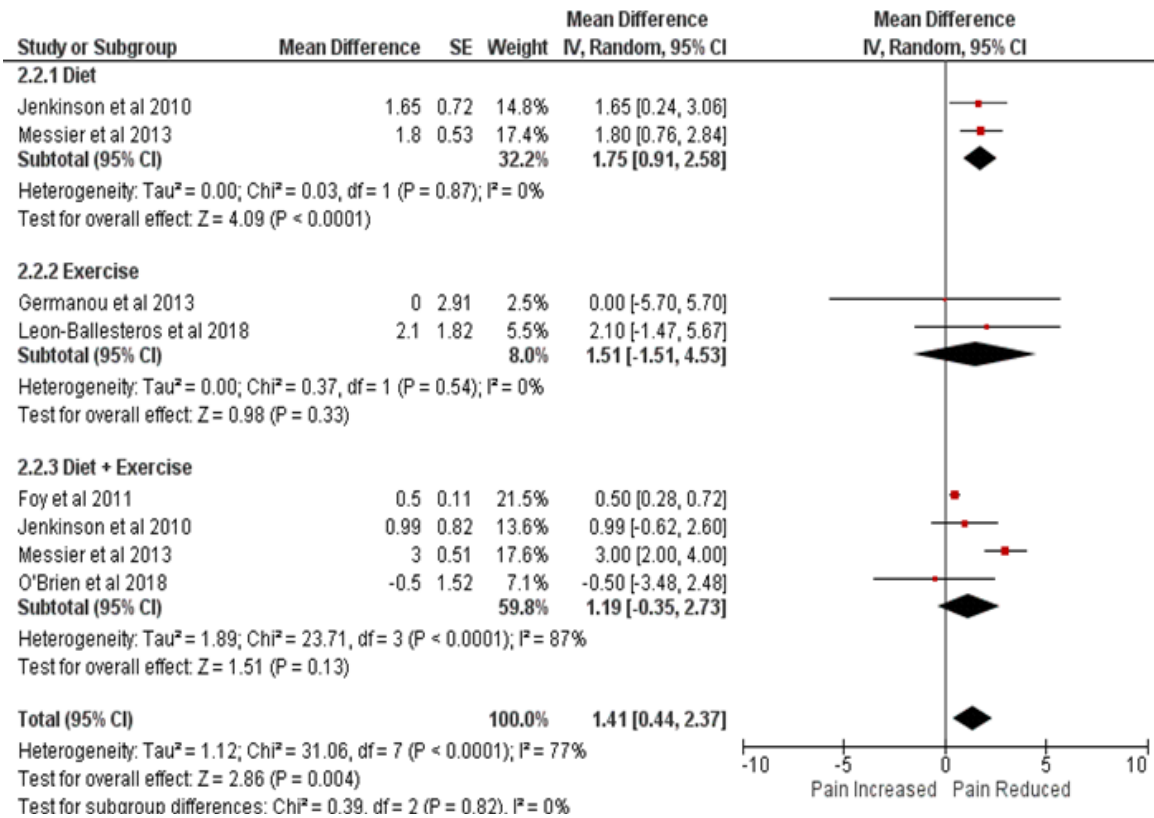
**Figure 1: The flow chart of study. RCT = Randomized controlled trial; OA = Osteoarthritis; N = Number**



**Figure 2: Forest plot presenting the effect size for change in weight after a specific management program of various studies with management methods taken as subgroups**



**Figure 3: Forest plot presenting the effect size for change in pain score after a specific management program of various studies with management methods taken as subgroups**



**CONCLUSION**

Strengthening exercise plays a vital role in relieving knee pain and improving function. A calorie restricted diet is helpful in reducing weight. Combination of diet and exercise is effective in reducing weight and improving knee pain. Future trials should investigate the effectiveness of strengthening exercise using mHealth in these patients.

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## CONTRIBUTORS

MTR conceived the idea, wrote initial manuscript, made plan for literature search and data collection and analyzed and interpreted data. MSAH and EH helped in defining key words for search after going through the research protocol, acquisition and interpretation of data and bibliography. All authors contributed significantly to the submitted manuscript.