

# Effects of balance training on functional outcomes after total knee arthroplasty: a systematic review and meta-analysis of randomized controlled studies

**Wang Chen**

Affiliated Hospital of Xuzhou Medical University

**Zheng-Hao Hu**

Affiliated Hospital of Xuzhou Medical University

**Jian-Ning Sun**

Affiliated Hospital of Xuzhou Medical University

**Ye Zhang**

Affiliated Hospital of Xuzhou Medical University

**Yu Zhang**

Affiliated Hospital of Xuzhou Medical University

**Xiang-yang Chen** (✉ [xzchenxiangyang@163.com](mailto:xzchenxiangyang@163.com))

Affiliated Hospital of Xuzhou Medical University <https://orcid.org/0000-0001-7376-6179>

**Shuo Feng**

Affiliated Hospital of Xuzhou Medical University

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## Research article

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# Abstract

**Background:** Many previous studies have compared the effects of preoperative balance training and non-balance training on daily performance and knee functional outcomes after surgery, however, whether preoperative balance training is more beneficial to patients is still a big debate. Comparing the postoperative joint and daily function of balance training and non-balance training is the main purpose of our study.

**Methods:** Cochrane library, Pubmed and Web of Science databases searched by us, and searched again before submitting our submission. This meta-analysis included 22 studies that directly compared postoperative performance and functional outcomes after training group (TG) and control group (CG). We used the software endnote X9 for data selection, and the software Review Manager 5.3 for data analysis to make funnel plots and forest plots.

**Results:** The pooled data indicated that balance training significantly improved 2/6 MWT (2/6-min walk test) (weighted mean difference (WMD) = 25.17, 95% confidence interval (CI) 12.88 to 37.46,  $P < 0.0001$ ), gait speed (WMD = 0.15, 95% CI 0.10 to 0.19,  $P < 0.00001$ ), TUG (timed up and go) (WMD = 1.02, 95% CI 0.75 to 1.29,  $P < 0.00001$ ), BBS (berg balance scale) (WMD = 1.79, 95% CI 0.50 to 3.08,  $P = 0.006$ ), FHR (ratio of functional reach distance to body height) (WMD = 9.34, 95% CI 6.69 to 11.98,  $P < 0.00001$ ), TCS (WMD = 1.20, 95% CI 0.86 to 1.53,  $P < 0.00001$ ), early stage vitality (WMD = 14.41, 95% CI 13.53 to 15.30,  $P < 0.00001$ ) and KOOS (Knee Injury and Osteoarthritis Score) symptoms (WMD = 6.34, 95% CI 2.07 to 10.60,  $P = 0.004$ ), middle stage function (WMD = 5.85, 95% CI 0.13 to 11.56,  $P = 0.04$ ).

**Conclusion:** Preoperative balance training improved partial postoperative daily performance and knee functional outcomes in patients with total knee arthroplasty.

## Background

The number of patients requiring total knee arthroplasty (TKA) for osteoarthritis of the knee continues to increase as the population ages.<sup>[1]</sup> This is mainly because TKA can improve joint mechanics, reduce pain, increase angle of joint motion, and improve function and balance.<sup>[2-4]</sup> However, studies show that about one in five patients still have chronic knee pain after surgery, and in 15% of the patients, no cause was found in the radiographic images of the joint.<sup>[5,6]</sup> Although total knee arthroplasty largely alleviates the adverse symptoms of the affected limb, patients may still have balance disorders,<sup>[7,8]</sup> long-distance walking and difficulty in climbing stairs for several months after the operation,<sup>[9,10]</sup> indicating that patients may not necessarily achieve the expected physiological function results after TKA.

Most patients were satisfied with total knee arthroplasty,<sup>[11]</sup> however, there were still some patients with persistent sensorimotor dysfunction.<sup>[12]</sup> Incomplete proprioceptive recovery of the knee joint, poor mobility and unstable dynamic balance are factors that increase the risk of falls in the elderly, and are also common factors that lead to difficulty in completing daily activities.<sup>[13,14]</sup> It has been reported that 25% of patients will fall within 2 years after total hip or total knee arthroplasty,<sup>[15]</sup> resulting in physical and psychological trauma and a high cost to the patient.<sup>[16]</sup> Therefore, limb balance is particularly important for the basic daily activities

and safety of patients with total knee arthroplasty. Balance training is proprioceptive or neuromuscular training, as well as overall sensorimotor training,<sup>[17]</sup> which aims to control pain, increase range of motion, restore deteriorating muscle strength, and improve functional performance and balance.

Recent studies have found that postoperative balance training appears to be effective in improving early stage postoperative outcomes<sup>[18]</sup> and supporting the use of balance training as a rehabilitation program during total knee arthroplasty.<sup>[18,19]</sup> However, there were few studies on preoperative intervention, and the evidence of results were uncertain, so the effectiveness of preoperative balance training remains to be determined. The purpose of this study was to evaluate the effects of preoperative balance training on early and middle stage postoperative functional outcomes in TKA patients.

## Methods

### Search Strategy

We conducted this study based on the reporting project of the systematic review and meta-analysis (PRISMA)<sup>[20]</sup>. The research plan of this systematic review and meta-analysis was determined by all co-author before the start of the document retrieval, research solutions have been posted online in PROSPERO International Prospective Register of Systematic Reviews.

Two authors searched for studies in MEDLINE (through PubMed), SCI (through Web of Science) and the CENTRAL (Cochrane Central Register of Controlled Trials, through the Cochrane-Library), without language restrictions. The time was set at nearly twenty years. Before submitting the manuscript, we searched again and found no new literature.

### Inclusion/Exclusion Criteria

The search results in this systematic review were assessed independently by scanning the title/abstract or the full text. Any dispute between the two authors was settled by the third author to reach the final consensus.

#### Inclusion criteria

1. Participants: patients who underwent primary TKA;
2. Interventions: the intervention group received balance training after TKA;
3. Comparisons: the control group received non-balance training after TKA;
4. Outcomes: Inclusion studies should include at least one of the following results: 2/6 MWT, gait speed, TUG, 10-m walk, BBS, SLST, FHR, TCS, vitality, stair up/down, KOOS symptoms, KOOS ADL, KOOS QOL, function, pain, ROM.
5. Study design: Randomized controlled trials (RCTs).

#### Exclusion criteria

1. The study simply reported the balance training or non-balance training, with no comparative analysis of the methods.

2. Research on obvious defects in experimental design.
3. Duplicate reports and reviews.
4. Animal experiments.

## **Study quality assessment**

We use the Cochrane risk of bias tool to evaluate the risk of bias in RCTs to determine whether bias might affect the outcome. These literatures were independently evaluated by the two authors. The differences between the two authors were settled through consult with the third author.

## **Data extraction**

The authors independently extracted data from all included literatures, including the following items: author, year of publication, country, age, number of patients, sex, body mass index(BMI), study type, type of surgery, follow-up time, and major outcomes (1. 2/6 MWT (2/6-min walk test); 2. gait speed; 3. TUG (timed up and go); 4. 10-m walk (timed walk of 10-m distance); 5. BBS (berg balance scale); 6. SLST (single leg stance test); 7. FHR (ratio of functional reach distance to body height); 8. TCS (timed chair stands); 9. vitality; 10. stair up/down; 11. KOOS (Knee Injury and Osteoarthritis Score) symptoms; 12. KOOS ADL (activities of daily living); 13. KOOS QOL (quality of life); 14. function; 15. pain; 16. ROM (range of motion)).

## **Statistical analysis**

Since there are no binary variables in the included literatures, odds ratio (OR) and 95% confidence interval (CI) are not required to estimate each study. Continuous variables were assessed using mean difference (MD) or standard mean difference (SMD) to assess the data included in the literature. For studies that present continuous data, such as mean and range values, statistical algorithms were used to estimate standard deviations(SD).<sup>[21]</sup> Only studies involving standard deviation and mean values can be included in the analysis. Heterogeneity was represented by P value and  $I^2$ . When  $P \leq 0.1$  or  $I^2 \geq 50\%$ , the random effect model was used instead of the fixed effect model for heterogeneity test.

Performed a sensitivity analysis by deleting one study every time and rebuilding the data from the remaining studies to identify possible high heterogeneity studies. The forest plot was used to present the results of each study and the respective effect sizes. Funnel plots were used to evaluate publication bias for any results. Review Manager 5.3 was used for all statistical analyses.

# **Result**

## **Study Selection**

We extracted 794 potentially relevant articles from 3 electronic databases (Pubmed, Cochrane library and Web of Science). By browsing the references in the literatures, we included 5 additional RCTs. After deleting the duplication and reviewing the titles and abstracts, 335 irrelevant references were excluded. We perused the remaining 43 articles, 4 of which were systematic reviews. We excluded another 17 articles for the following reasons: Not RCT (n = 9); No comparison (n = 5); No data required (n = 2); Others (n = 1). Finally, 22 studies

published between 2002 and 2019 met the selection criteria and were included in the meta-analysis. The detailed literature selection process was shown in Fig 1.

Of the 22 studies, 1000 patients treated with total knee arthroplasty were in the training group and 1000 were in the non-training group. The longest follow-up time was 1 year and the shortest was 3 weeks. The study characteristics, patient demographics, and clinical results of each study were shown in Table 1.

### **Risk of bias**

22 of these studies described the generation of random sequences, and 4 studies described allocation concealment. Attrition bias, reporting bias, and other biases in the literatures were reported in detail, and these were classified as low-risk deviations. The included studies were 22 RCTs with low risk of bias. The quality of the studies were shown in Fig 2 and 3.

### **Outcomes**

**2/6 MWT** The data was divided into two subgroups according to time after training: < 6 months (early stage) and > 6 months (middle stage). 5 studies (566 participants) were contained in this study. The results indicated that early stage MWT of balance training was well than non-balance training, with a statistically significant difference (WMD = 25.93, 95% CI 8.36 to 43.51, P = 0.004, Fig 4). The results indicated that there was statistically significant difference between the middle stage MWT of balance training and that of the non-balance training (WMD = 24.44, 95% CI 7.25 to 41.63, P = 0.005, Fig 4).

**Gait speed** The results of 4 studies (435 participants) indicated that early stage gait speed of balance training was well than non-balance training, with a statistically significant difference (WMD = 0.12, 95% CI 0.07 to 0.17, P < 0.00001, Fig 5). The results indicated that there was statistically significant difference between the gait speed of the middle stage balance training and that of the non-balance training (WMD = 0.20, 95% CI 0.13 to 0.28, P < 0.00001, Fig 5).

**TUG** 9 studies (669 participants) were contained. The results indicated that early stage TUG of balance training was well than non-balance training, with a statistically significant difference (WMD = 1.43, 95% CI 0.99 to 1.88, P < 0.00001, Fig 6). The results indicated that there was statistically significant difference between the TUG of the middle stage balance training and that of the non-balance training (WMD = 0.79, 95% CI 0.45 to 1.13, P < 0.00001, Fig 6). Funnel plot showed that the data included in the meta-analysis were basically symmetrical, which suggested that bias was minimal. Fig 7.

**10-m walk** 2 studies (including 157 participants) reported a comparison of 10-m walk (timed walk of 10-m distance) between the two approaches, and the results obtained can prove that there was no significant difference (WMD = 0.59, 95 % CI -1.13 to 2.30, P = 0.50, Fig 8).

**BBS** The results of 2 studies (including 140 participants) showed that there was statistically significant difference (WMD = 1.79, 95 % CI 0.50 to 3.08, P = 0.006, Fig 9).

**SLST** 3 studies (including 204 participants) reported a comparison of SLST (single leg stance test) between the two approaches, and the results obtained can prove that there was no statistically significant difference

(WMD = 0.44, 95 % CI -1.99 to 2.88, P = 0.72, Fig 10).

**FHR** 3 studies (539 participants) were contained. The results indicated that early stage FHR of balance training was well than non-balance training, with a statistically significant difference (WMD = 8.27, 95% CI 4.37 to 12.17, P < 0.0001, Fig 11). The results indicated that there was statistically significant difference between the FHR of the middle stage balance training and that of the non-balance training (WMD = 11.23, 95% CI 6.65 to 15.82, P < 0.00001, Fig 11).

**TCS** The results of 6 studies (521 participants) obtained can prove that early stage TCS of balance training was well than non-balance training, with a statistically significant difference (WMD = 0.65, 95% CI 0.01 to 1.28, P = 0.05, Fig 12). The results indicated that there was statistically significant difference between the TCS of the middle stage balance training and that of the non-balance training (WMD = 1.41, 95% CI 1.02 to 1.80, P < 0.00001, Fig 12).

**Vitality** 3 studies (331 participants) were contained. The results indicated that early stage TCS of balance training was well than non-balance training, with a statistically significant difference (WMD = 14.41, 95% CI 13.53 to 15.30, P < 0.00001, Fig 13). The results indicated that there was statistically significant difference between the vitality of the middle stage balance training and that of the non-balance training (WMD = 10.96, 95% CI -5.16 to 27.08, P < 0.0001, Fig 13).

**Stair up/down** 3 studies (231 participants) were contained. The results indicated that early stage stair up/down of balance training was well than non-balance training, with a statistically significant difference (WMD = 0.20, 95% CI -2.56 to 2.96, P = 0.89, Fig 14), and indicated that there was no statistically significant difference between the stair up/down of the middle stage balance training and that of the non-balance training (WMD = 0.21, 95% CI -1.70 to 2.13, P = 0.83, Fig 14).

**KOOS sysptoms** The results of 4 studies (470 participants) indicated that early stage KOOS sysptoms of balance training was well than non-balance training, with a statistically significant difference (WMD = 6.34, 95% CI 2.07 to 10.60, P = 0.004, Fig 15), and indicated that there was statistically significant difference between the TUG of the middle stage balance training and that of the non-balance training (WMD = 3.07, 95% CI -1.07 to 7.20, P = 0.15, Fig 15).

**KOOS ADL** 5 studies (363 participants) were contained. The results indicated that early stage KOOS sysptoms of balance training was well than non-balance training, with a statistically significant difference (WMD = 4.91, 95% CI -0.26 to 10.08, P = 0.06, Fig 16). There was statistically significant difference between the KOOS ADL of the middle stage balance training and that of the non-balance training (WMD = 3.65, 95% CI -0.14 to 7.44, P = 0.06, Fig 16).

**KOOS QOL** 4 studies (467 participants) were contained in this study. The results indicated that early stage KOOS QOL of balance training was well than non-balance training, with a statistically significant difference (WMD = -0.28, 95% CI -9.52 to 8.95, P = 0.95, Fig 17), and the results indicated that there was statistically significant difference between the KOOS QOL of the middle stage balance training and that of the non-balance training (WMD = 4.43, 95% CI -1.63 to 10.48, P = 0.15, Fig 17).

**Function** The results of 6 studies (467 participants) obtained can prove that early stage function of balance training was well than non-balance training, with a statistically significant difference (WMD = 3.20, 95% CI -0.18 to 6.59, P = 0.06, Fig 18). The results indicated that there was statistically significant difference between the function of the middle stage balance training and that of the non-balance training (WMD = 5.85, 95% CI 0.13 to 11.56, P = 0.04, Fig 18).

**Pain** 13 studies (1098 participants) were contained. The results indicated that early stage pain of balance training was well than non-balance training, with a statistically significant difference (WMD = 0.29, 95% CI -0.10 to 0.67, P = 0.15, Fig 19) and there was statistically significant difference between the pain of the middle stage balance training and that of the non-balance training (WMD = 0.12, 95% CI -0.20 to 0.45, P = 0.46, Fig 19).

**ROM** The results of 9 studies (1225 participants) obtained can prove that early stage ROM of balance training was well than non-balance training, with a statistically significant difference (WMD = 0.36, 95% CI -0.38 to 1.10, P = 0.34, Fig 20). The results indicated that there was statistically significant difference between the ROM of the middle stage balance training and that of the non-balance training (WMD = 0.46, 95% CI -0.07 to 0.99, P = 0.09, Fig 20).

## Discussion

### Main findings

The meta-analysis included 22 randomized controlled studies (RCTs) that evaluated 1,333 patients and directly compared the clinical efficacy of the training and non-training groups. The pooled data indicated no difference between balance training group and non-balance training group in terms of 10-m walk, SLST, stair up/down, KOOS ADL, KOOS QOL, pain, ROM, early stage function, middle stage vitality and KOOS symptoms, but balance training significantly improved 2/6 MWT, gait speed, TUG, BBS, FHR, TCS, early stage vitality and KOOS symptoms, middle stage function.

### Comparison with other meta-analyses

Compared to previous systematic reviews,<sup>[43]</sup> we included a larger number of high-quality, up-to-date randomized controlled studies with a larger number of patients (1333 patients (TG = 675, CG = 658)). The research project content were also more comprehensive. As can be seen from the tree diagram, the heterogeneity of the two groups of data in this study were very low, and the information extraction were relatively rigorous, so the results were more reliable.

### Implications for clinical practice

The study showed that the TG was superior to the CG after total knee arthroplasty in regards to 2/6 MWT, gait speed, TUG, BBS, FHR, TCS, early stage vitality and KOOS symptoms, middle stage function. Therefore, we believe that postoperative training may be a better approach, and the effect appears to be positive in patients undergoing total knee arthroplasty. In contrast, comprehensive studies have shown that balance and proprioceptive training have no additional benefits in 10-m walk, SLST, stair up/down, KOOS ADL, KOOS QOL,

pain, ROM, early stage function, middle stage vitality and KOOS symptoms. The degree of pain affects the patient's function and quality of life. One of the greatest benefits of total knee arthroplasty is the ability to reduce or even eliminate pain. Kosek's study found that balance training and neuromuscular intervention did not reduce pain intensity, function, and quality of life in patients with osteoarthritis of knee, consistent with our findings.

### **Innovation and uniqueness**

The studies included in this study were all randomized controlled studies, so the literature quality were high. We excluded studies that resulted in higher heterogeneity to reduce heterogeneity between data, thus making the results more reliable. The evaluation of the included literature was relatively strict and the possibility of bias was small. This study has a large amount of data and a large number of participants, so it was highly reliable.

### **Limitations**

In this study, since there was no blind method of participants, there was a great risk of bias in most of the literature, so the subjective impression will affect the result. There was publication bias in this study, but the degree of bias was acceptable. And the number of patients included in the RCT literatures were less than 50. In addition, study follow-up was short and data collection may be incomplete, which may have an impact on the results.

## **Conclusions**

The pooled data indicated that balance training significantly improved 2/6 MWT, gait speed, TUG, BBS, FHR, TCS, early stage vitality and KOOS symptoms, middle stage function, so balance training has many positive effects in total knee arthroplasty. There was no significant difference in the middle stage vitality and KOOS symptoms between the balanced training group and the non-balanced training group, while the training group had better early stage vitality and KOOS symptoms than the non-training group, showed that the training group had a good effect on early stage vitality and KOOS symptoms. For the function, the early results of the balance training did not show a benefit to function, but by the middle of the postoperative period, the training group had better function results than the non-training group. These findings may help guide clinical decision-making on recovery after joint arthroplasty.

## **Abbreviations**

TKA: total knee arthroplasty; RCT: Randomized controlled trial; WMD: Weighted mean difference; CI: Confidence interval; OR: Odds ratio; BMI: Body mass index; 2/6 MWT: 2/6-min walk test; TUG: timed up and go; 10-m walk: timed walk of 10-m distance; BBS: berg balance scale; SLST: single leg stance test; FHR: ratio of functional reach distance to body height; TCS: timed chair stands; KOOS: Knee Injury and Osteoarthritis Score; KOOS ADL: activities of daily living; KOOS QOL: quality of life; ROM: range of motion; PRISMA: Preferred Reporting Items for Systematic Reviews and Meta-Analyses.

# Declarations

## Ethics approval and consent to participate

All findings in the study are based on published research and therefore do not require moral approval.

## Consent for publication

The co-authors agreed to publish.

## Availability of data and material

The text and charts in the article contain all the data.

## Competing interests

No competition.

## Funding

None.

## Authors' contributions

WC, SF and XYZ designed the research ideas, analyzed the data and wrote out the original manuscript. ZHH, JNS, YZ, YZ took part in the design of the study. The co-authors read and authorized the final manuscript for publication.

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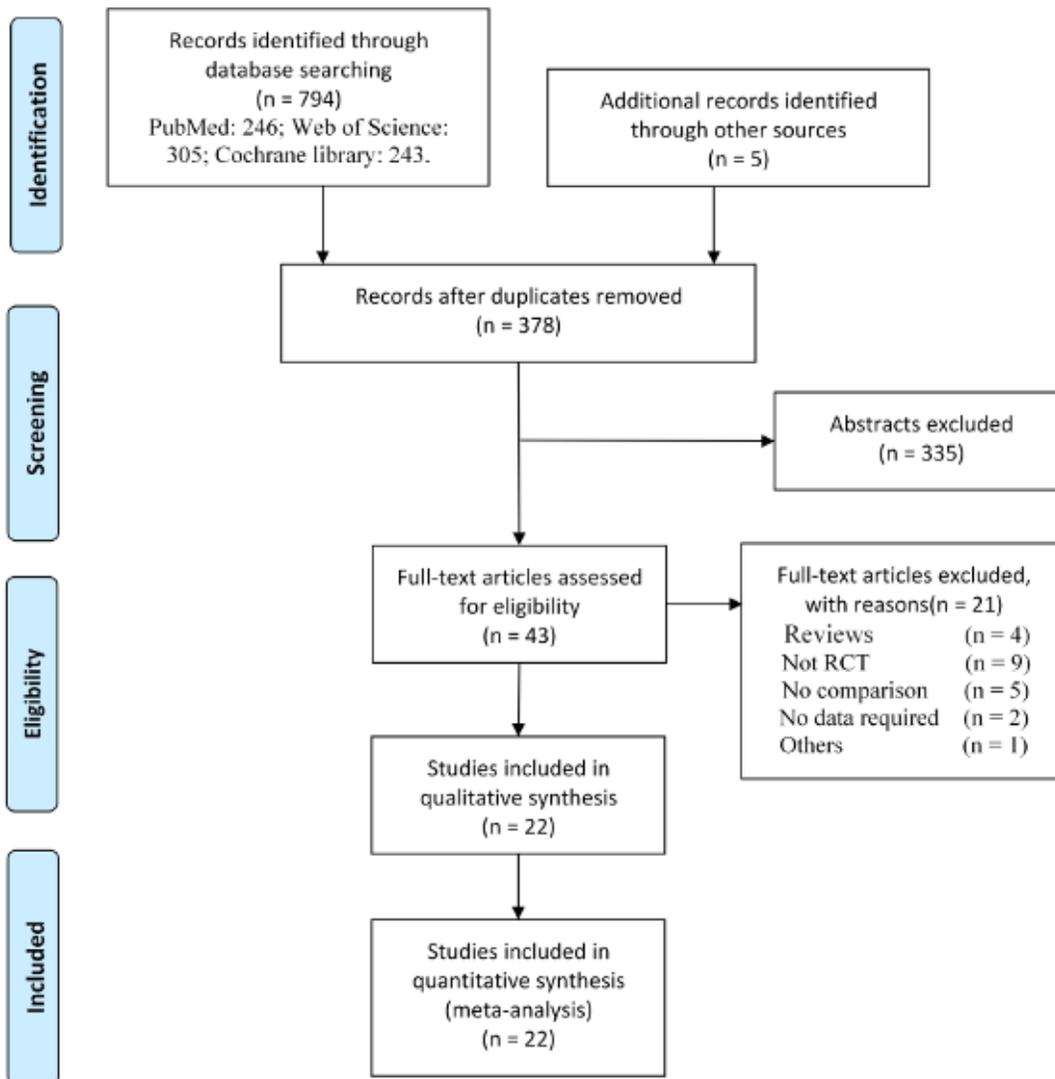
## Table

Table 1: General characteristic of the included studies

1. 2/6 MWT (2/6-min walk test); 2. gait speed; 3. TUG (timed up and go); 4. 10-m walk (timed walk of 10-m distance); 5. BBS (berg balance scale); 6. SLST (single leg stance test); 7. FHR (ratio of functional reach distance to body height); 8. TCS (timed chair stands); 9. vitality; 10. stair up/down; 11. KOOS (Knee Injury and Osteoarthritis Score) symptoms; 12. KOOS ADL (activities of daily living); 13. KOOS QOL (quality of life); 14. function; 15. pain; 16. ROM (range of motion). NC, not clear

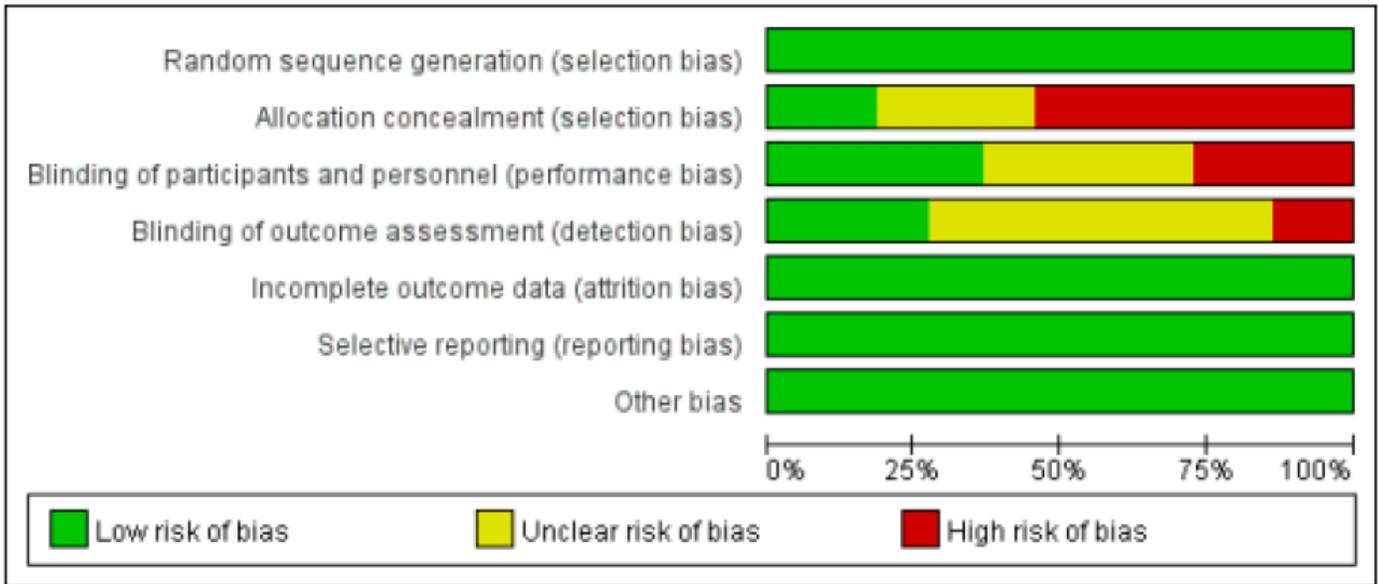
Author/year	Country	Training/Non-training				Study	Follow-up	Outcomes
		Mean age (years)†	No. of patients (n)	Female	BMI			
Frost <sup>22</sup> 2002	UK	71.5/71.1	23/24	11/12	NC	RCT	12m	2,15,16
Moffet <sup>23</sup> 2004	Canada	66.7/68.7	38/39	24/22	NC	RCT	2,8M	1,9,14,15
Piva <sup>24</sup> 2010	USA	67/70	18/17	13/12	30.5/5-31/5	RCT	2,8M	2,8,14,15
Johnson <sup>25</sup> 2010	USA	67/68.2	8/8	2/4	33.3/34.2	RCT	4W	3,15,16
Gstoettner <sup>26</sup> 2011	Austria	66.9/72.8	20/18	14/16	28.2/27.4	RCT	6 W	10,14,15
Fung <sup>27</sup> 2012	Canada	67.9/68.2	27/23	19/14	NC	RCT	> 6W	1,14,15,16
Bruun <sup>28</sup> 2013	Norway	68/69	29/28	18/14	28/6-29/5	RCT	9m	1,3,8,10,11,12,14,15,16
Liao <sup>29</sup> 2013	Taiwan	71.4/72.94	58/55	46/37	28.43/26.91	RCT	8W	3,4,8
Monticone <sup>30</sup> 2013	Italy	67/68	55/55	36/34	28/28.3	RCT	6M	9,11,12,13,15
Liao <sup>31</sup> 2014	Taiwan	71.43/73.4	65/65	49/42	27.88/26.97	RCT	8M	2,3,7,8,14,15
Jogi <sup>32</sup> 2015	Canada	66/67	28/26	NC	NC	RCT	5W	3,5,14
Karaman <sup>33</sup> 2017	Turkey	67.9-70.1	17/17	NC	30.4/31.1	RCT	6W	5,9,14,15
Piva <sup>34</sup> 2017	USA	68.3/68.1	22/22	13/18	29.3/31.2	RCT	6M	1,2,6,8,10,14
Roig <sup>35</sup> 2017	Spain	74.8/72.1	17/20	12/13	NC	RCT	6W	3,5,7
Sano <sup>36</sup> 2018	Japan	75.0/75.8	37/38	30/30	25.9/26.6	RCT	3W	2,3,15,16
Jaczevska <sup>37</sup> 2018	Poland	68.7/68.1	28/28	19/23	31.7/31.5	RCT	6M	2,15
Moutzouri <sup>38</sup> 2018	Greece	71.3/72.3	26/25	NC	NC	RCT	14W	3,12,15
Moutzouri <sup>14</sup> 2019	Greece	71.3/72.3	26/25	NC	NC	RCT	14W	16
Liao <sup>39</sup> 2019	Taiwan	72.2/69.8	30/30	NC	28.54/27.25	RCT	12W	2,3,6,7,15
Blasco <sup>40</sup> 2019	Spain	70.2/72.3/70.9	25/26/26	19/19/15	32.5/30.8/31.2	RCT	6W	3,5,6,7,11,12,13,15,16
Skoffer <sup>41</sup> 2019	Denmark	72.9/70.9	24/20	16/11	30.5/32.2	RCT	12m	1,3,4,11,12,13,15,16
Schache <sup>42</sup> 2019	Australia	70/69	54/51	39/30	30/31	RCT	6, 26W	1,3,8,11,12,13,15,16

## Figures



**Figure 1**

The flow diagram of study selection



**Figure 2**

Risk of bias graph: review authors' judgments about each risk of bias item presented as percentages across all included studies

	Random sequence generation (selection bias)	Allocation concealment (selection bias)	Blinding of participants and personnel (performance bias)	Blinding of outcome assessment (detection bias)	Incomplete outcome data (attrition bias)	Selective reporting (reporting bias)	Other bias
Blasco 2019	+	-	-	+	+	+	+
Bruun 2013	+	+	+	+	+	+	+
Frost 2002	+	-	-	+	+	+	+
Fung 2012	+	-	+	?	+	+	+
Gstoettner 2011	+	?	?	?	+	+	+
Jaczevska 2018	+	-	?	?	+	+	+
Jogi 2015	+	-	+	?	+	+	+
Johnson 2010	+	-	-	?	+	+	+
Karaman 2017	+	-	-	-	+	+	+
Liao 2013	+	+	+	?	+	+	+
Liao 2014	+	-	?	-	+	+	+
Liao 2019	+	?	?	?	+	+	+
Moffet 2004	+	-	?	-	+	+	+
Monticone 2013	+	+	+	+	+	+	+
Moutzouri 2018	+	+	-	?	+	+	+
Moutzouri 2019	+	?	?	?	+	+	+
Piva 2010	+	?	+	+	+	+	+
piva 2017	+	-	+	+	+	+	+
Roig 2017	+	-	-	?	+	+	+
Sano 2018	+	?	?	?	+	+	+
Schache 2019	+	-	+	?	+	+	+
Skoffer 2019	+	?	?	?	+	+	+

**Figure 3**

Risk of bias summary for included studies. +, no bias; -, bias; ?, bias unknown

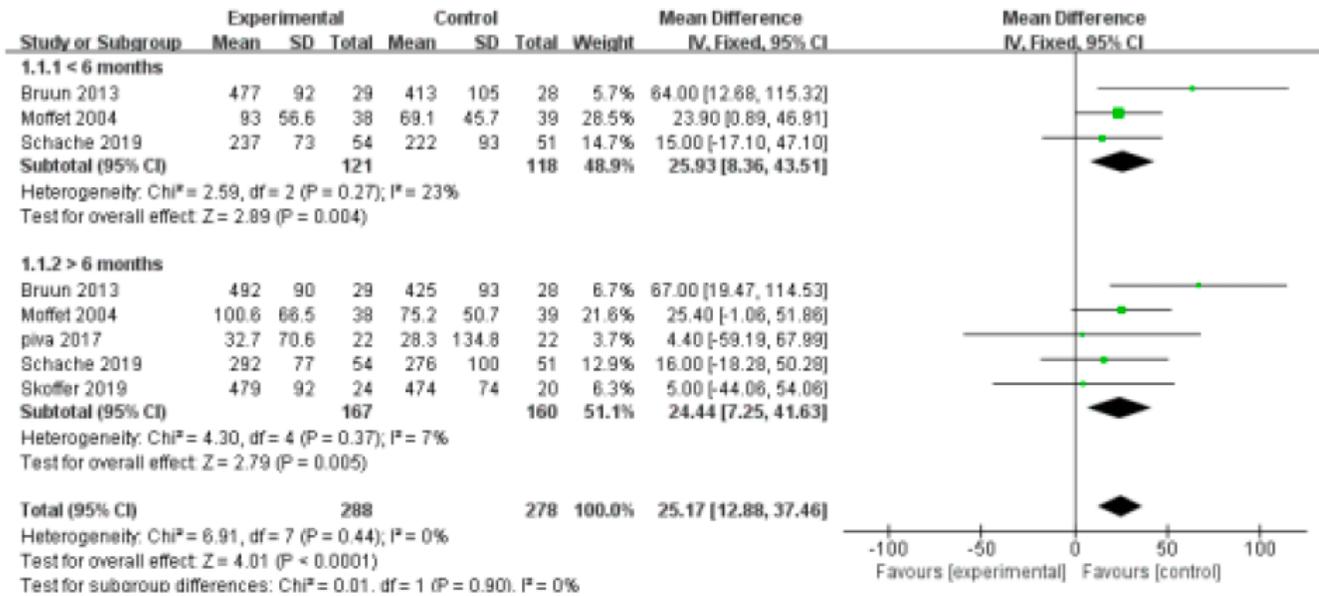


Figure 4

Comparison of 2/6 MWT between TG and CG.

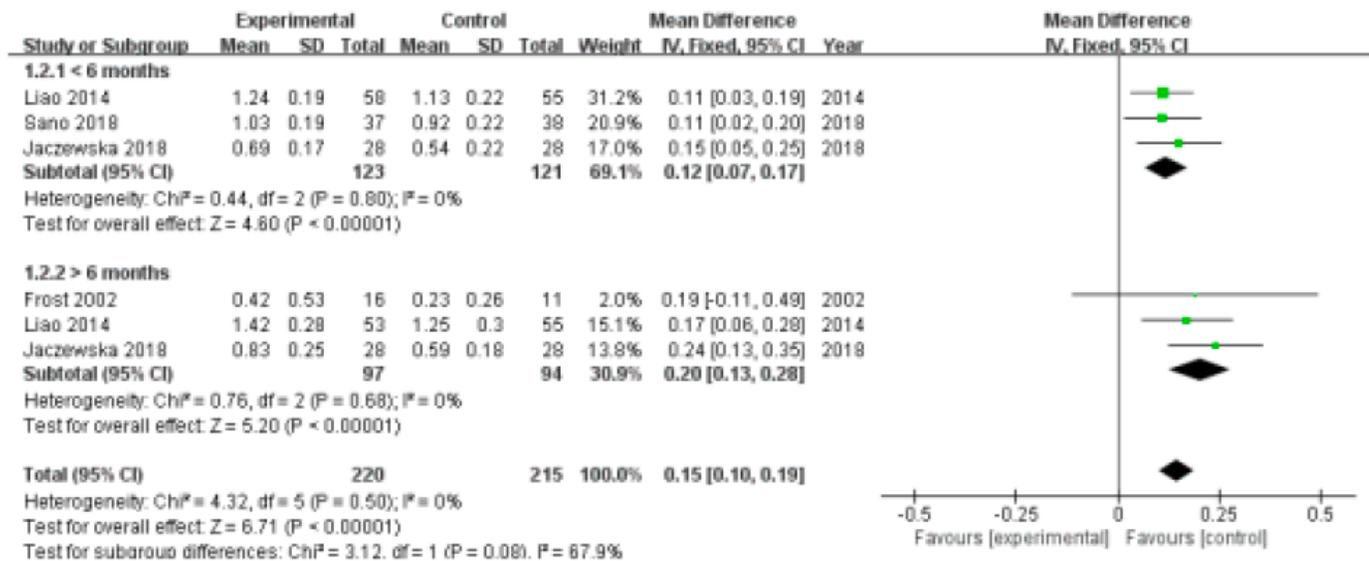


Figure 5

Comparison of gait speed between TG and CG.

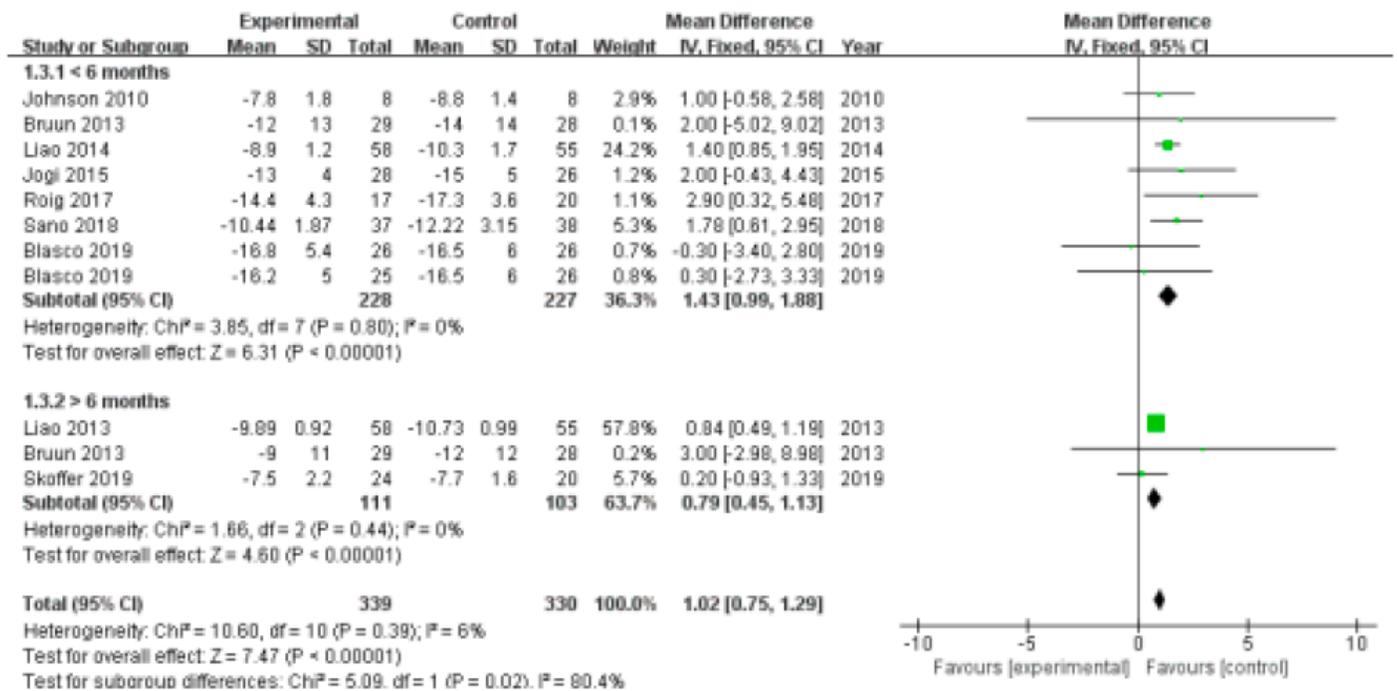


Figure 6

Comparison of TUG between TG and CG.

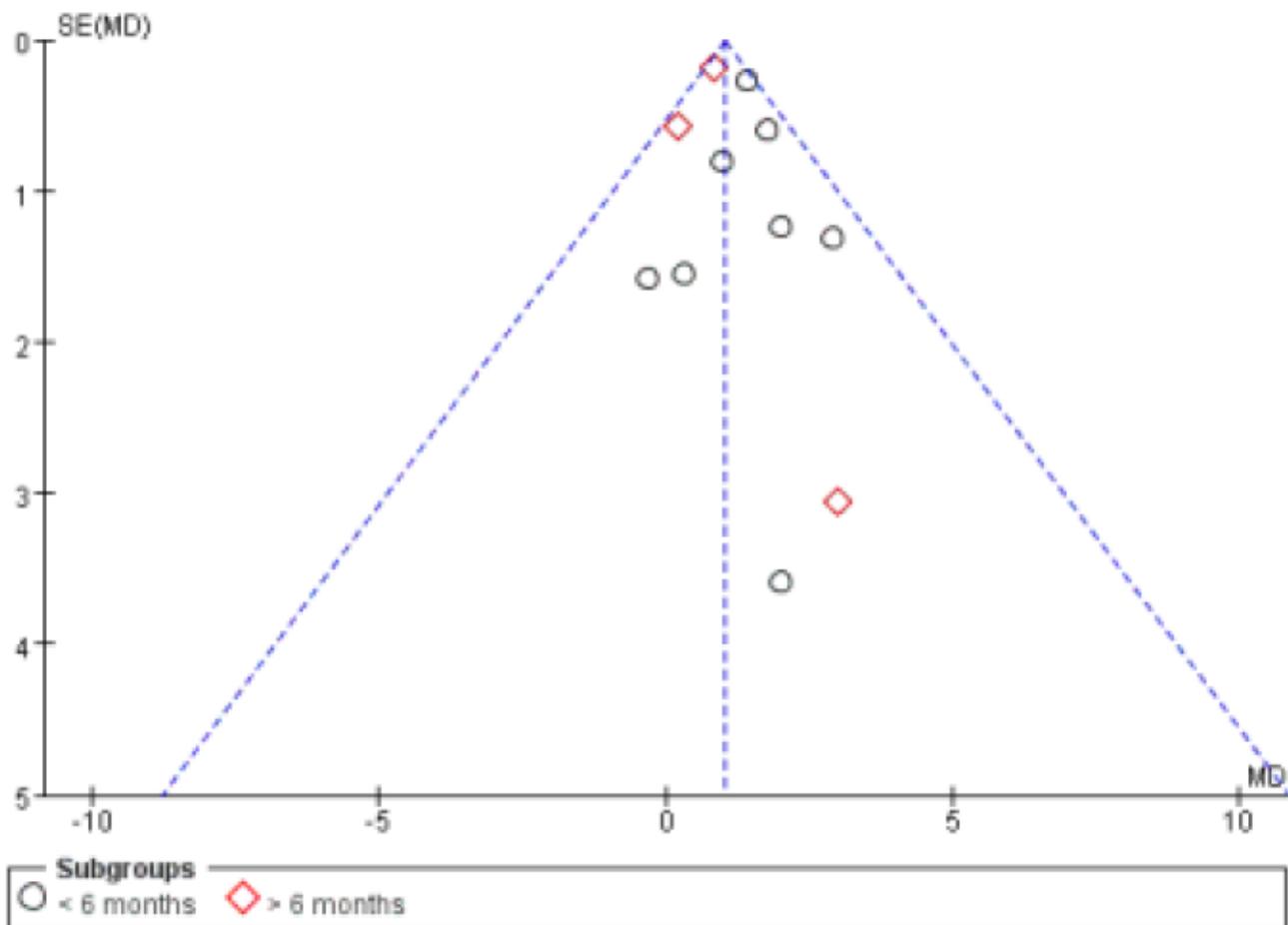


Figure 7

Funnel plot assessing publication bias.

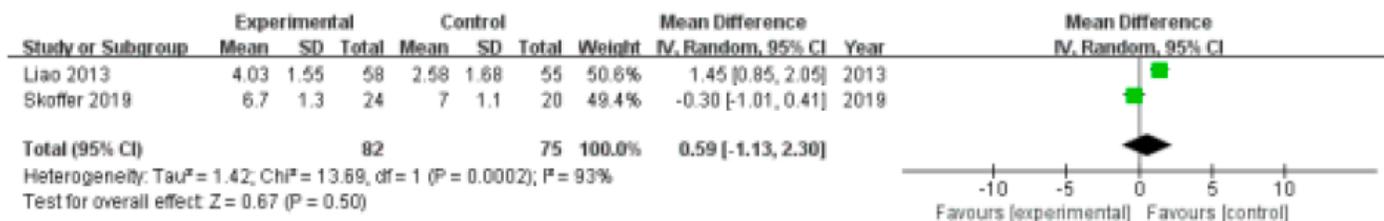


Figure 8

Comparison of 10-m walk between TG and CG.

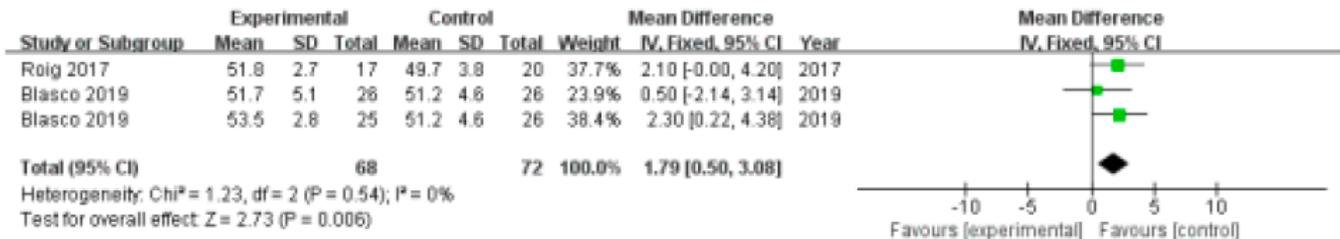


Figure 9

Comparison of BBS between TG and CG.

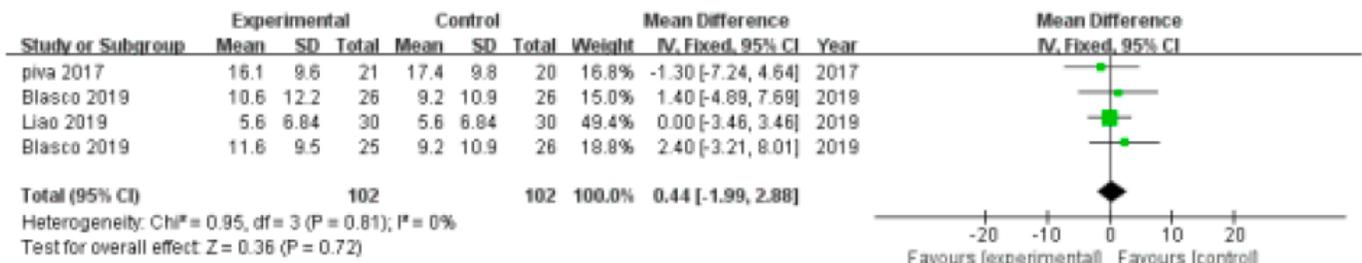


Figure 10

Comparison of SLST between TG and CG.

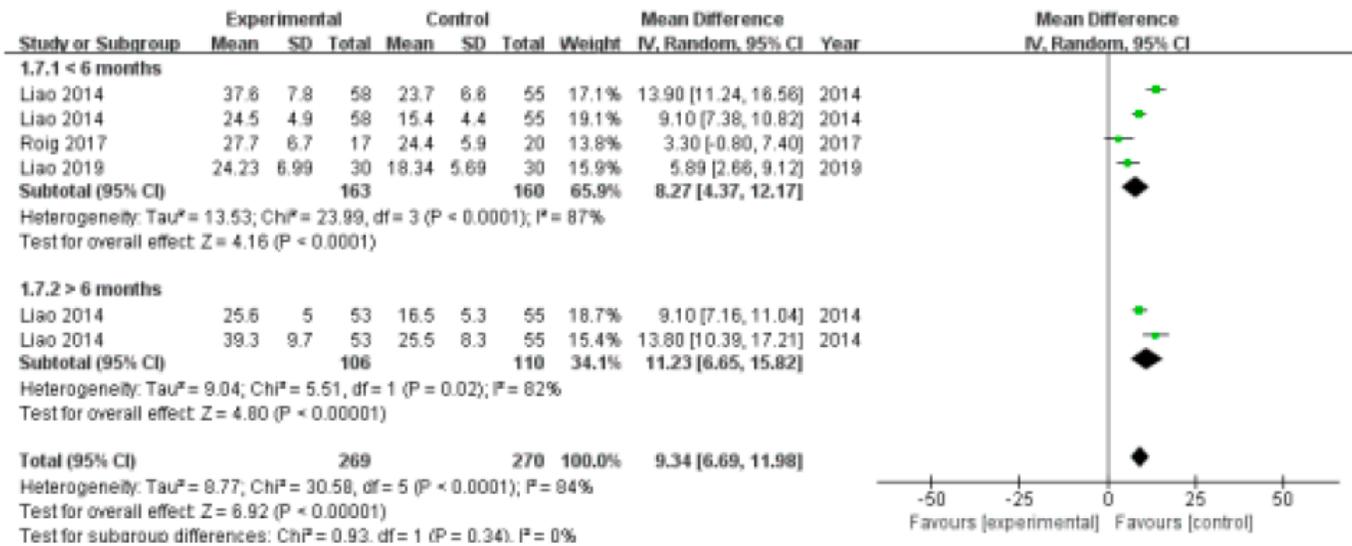


Figure 11

Comparison of FHR between TG and CG.

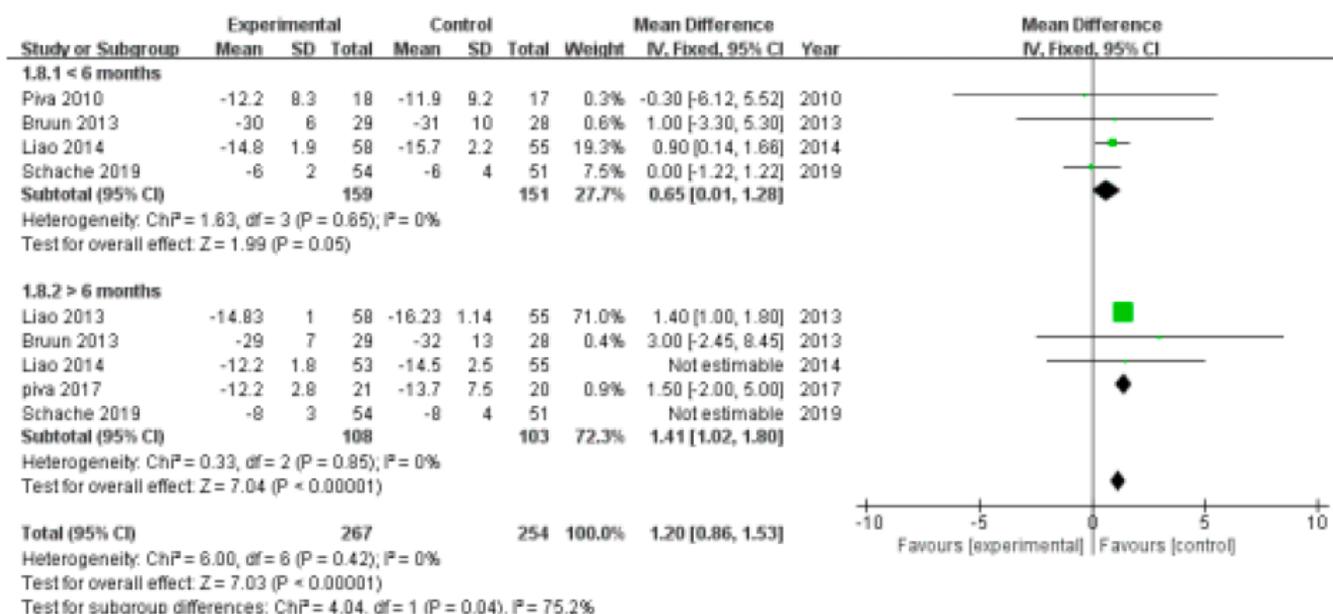


Figure 12

Comparison of TCS between TG and CG.

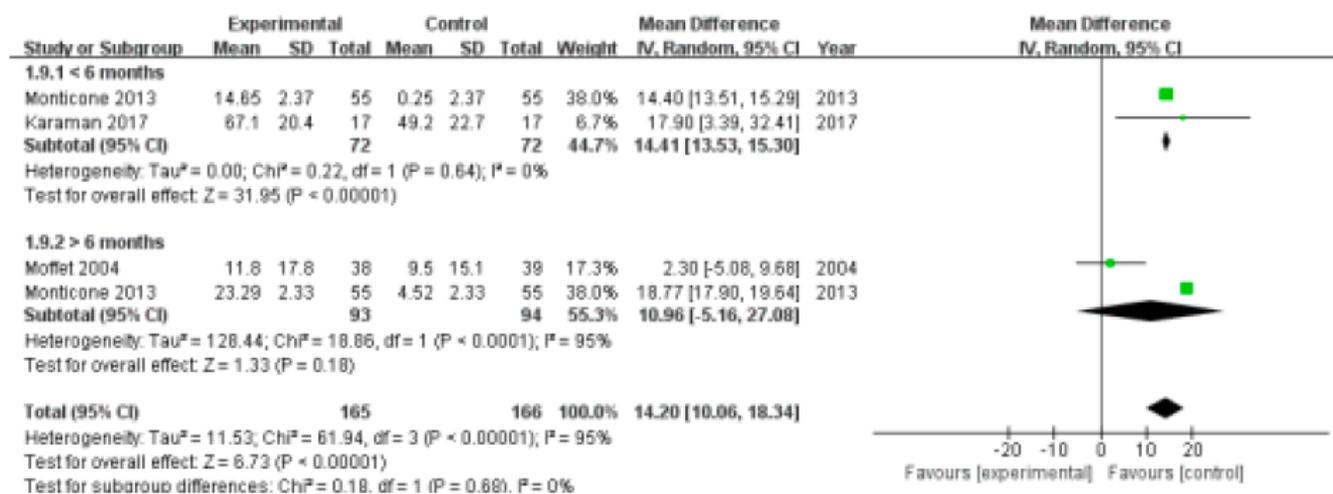


Figure 13

Comparison of vitality between TG and CG.

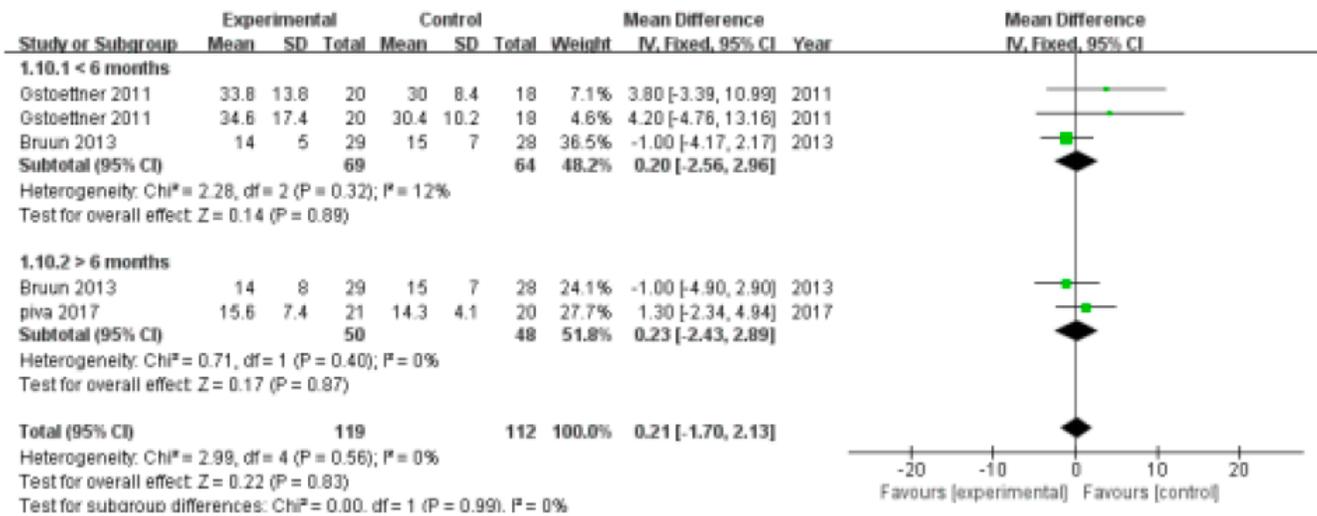


Figure 14

Comparison of stair up/down between TG and CG.

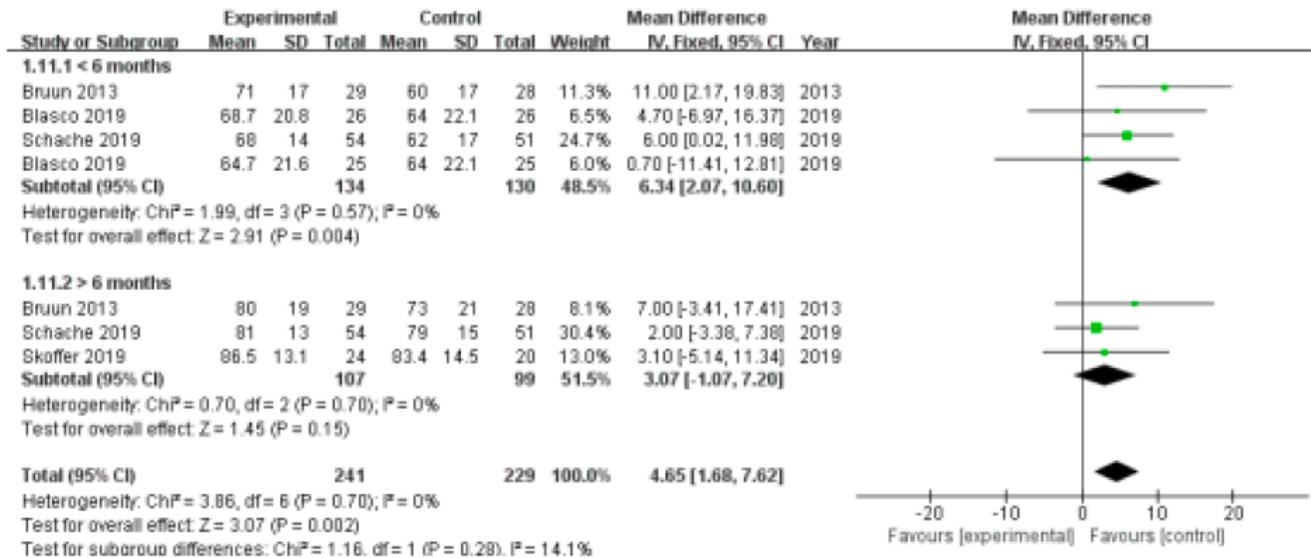


Figure 15

Comparison of KOOS symptoms between TG and CG.

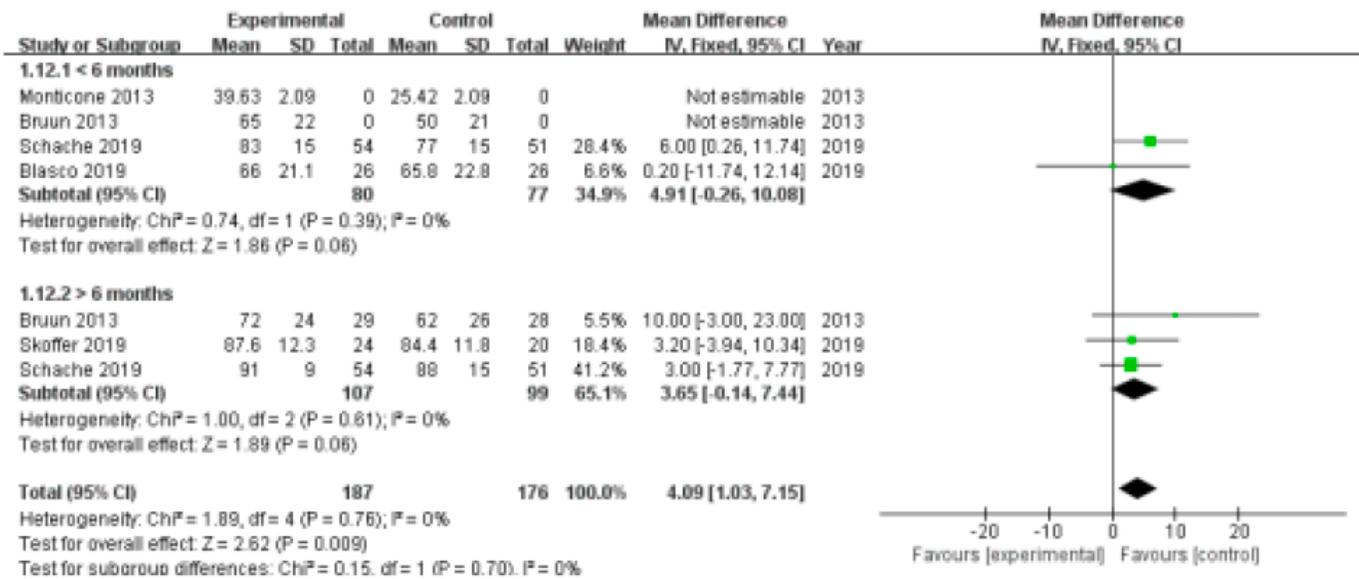


Figure 16

Comparison of KOOS ADL between TG and CG.

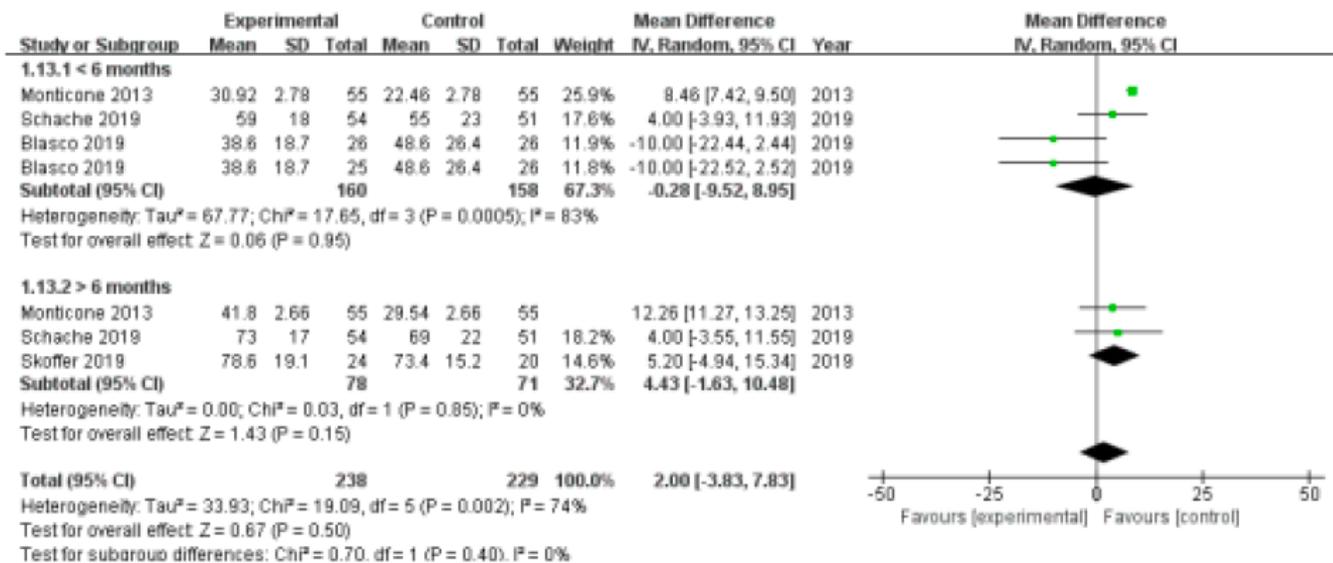


Figure 17

Comparison of KOOS QOL between TG and CG.

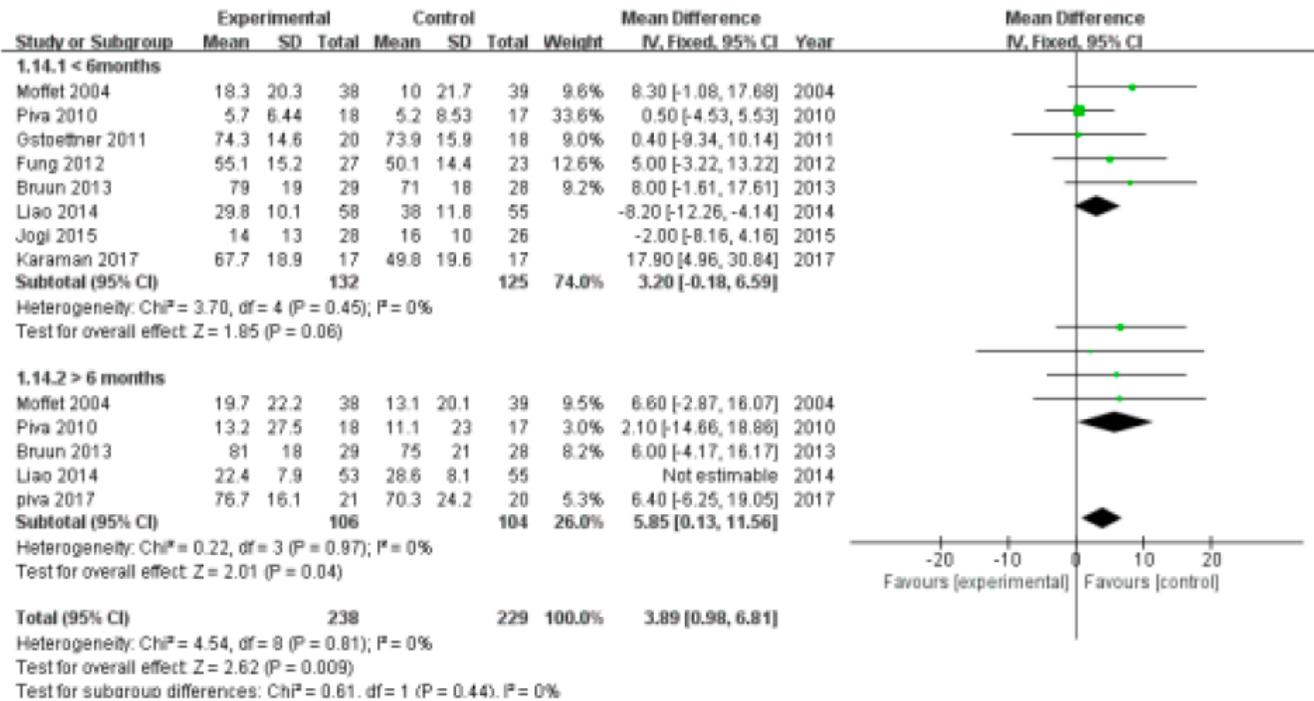


Figure 18

Comparison of function between TG and CG.

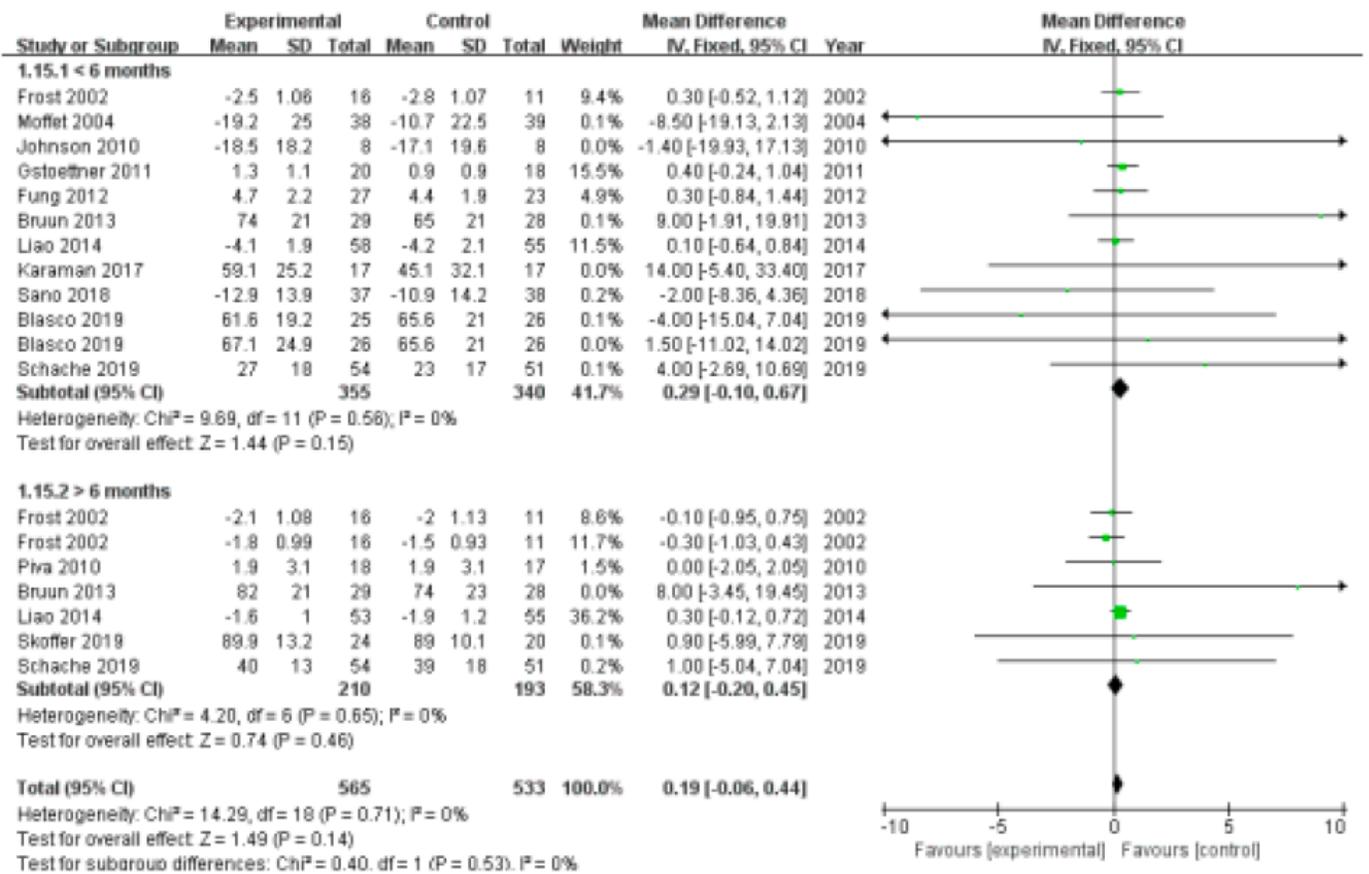


Figure 19

Comparison of pain between TG and CG.

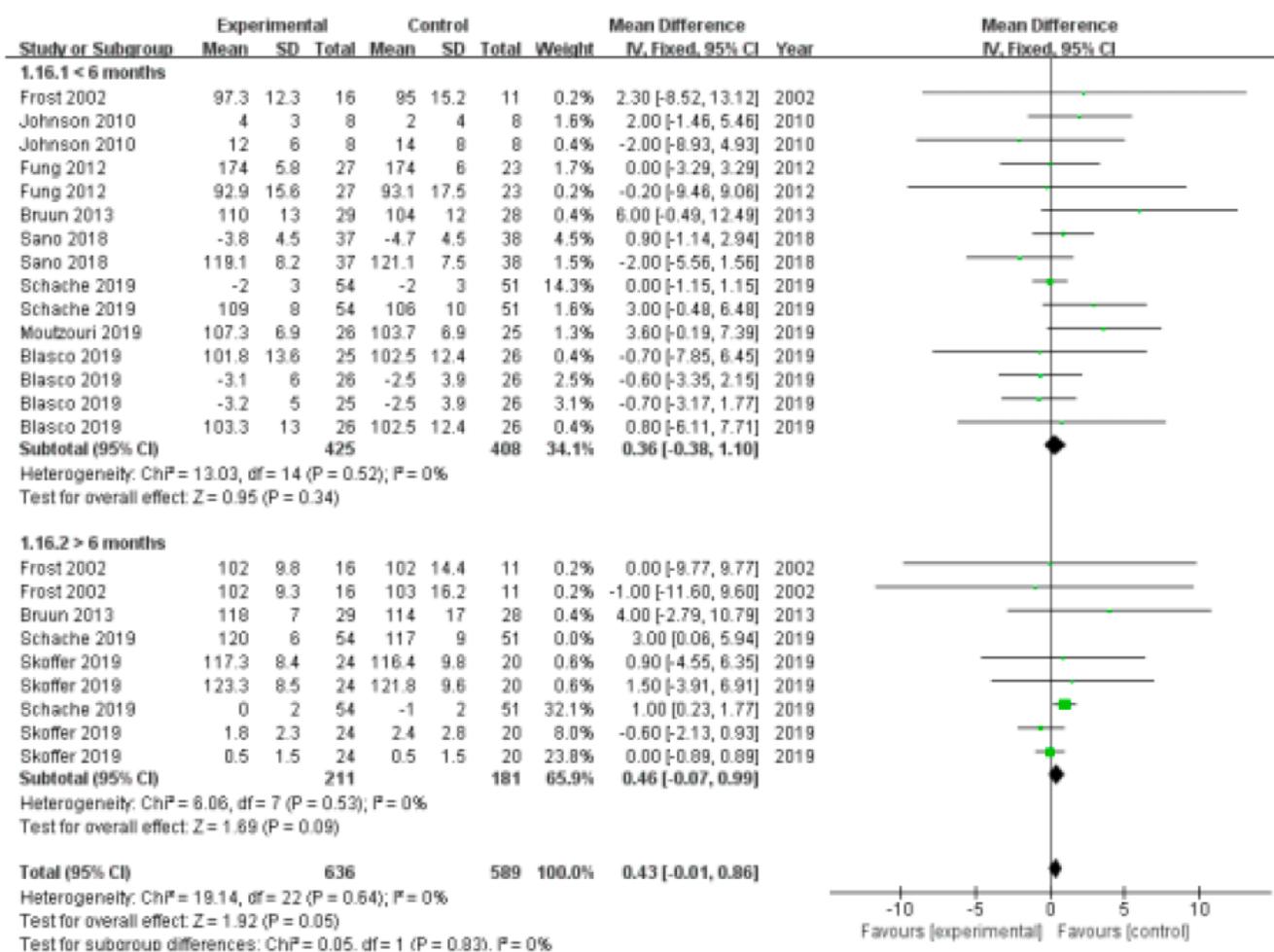


Figure 20

Comparison of ROM between TG and CG.

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