

## Abstract

**Clinical Scenario:** Increasing popularity in long-distance running and a greater focus on running economy (RE) has led to many runners experimenting with minimalist footwear (MFW).

**Focused Clinical Question:** What are the effects of a transition period with MFW on RE in recreationally trained runners?

**Summary of Key Findings:** The studies indicated that MFW does not improve RE in a statistically significant way. They did find, however, that RE was improved in both groups, potentially indicating that RE improves by running consistently.

**Clinical Bottom Line:** It was found that MFW does not improve RE, although more research is needed to determine a more conclusive outcome. **Strength of Recommendation:** Grade B evidence is available to suggest that there is no significant change in RE during a transition period to MFW.

## Introduction and Research Question

Running faster for longer seems to be the goal of many runners today. To achieve this goal, runners are now using new technology and training to improve running economy (RE). RE is a combination of metabolic, cardiorespiratory, biomechanical, and neuromuscular factors that affect oxygen uptake during submaximal running.<sup>1</sup> Two variables that affect several of these listed factors are running form and footwear. To improve RE, many runners have begun transitioning into minimalist footwear (MFW). Minimalist footwear is defined as a shoe that has a 0-6mm drop from the heel to the forefoot<sup>2</sup>. It is hypothesized that MFW can improve RE by creating a more natural movement that utilizes the elasticity of the triceps surae to improve RE.

As of this writing, researchers have only examined/filtered the literature regarding the RE in previously experienced minimalist or barefoot runners. There has never been an investigation into the transition from traditional footwear (TFW) to MFW<sup>3</sup>. Several studies have evaluated the effect of transitioning from TFW to MFW over an 8-10-week transition period on RE in recreational runners. Therefore, the purpose of our research is to examine the impact of MFW versus TFW on RE.

## RQ, PICO format, and levels of evidence

### Evidence Quality Assessment

The validity of the selected studies<sup>4-6</sup> was identified using the PEDro scale<sup>7</sup> for RCT. This scale contains 10 questions that can be answered as “yes”, or “no” (Table 1). This checklist is designed to assess the quality of each study by checking for clear inclusion criteria, valid methods, appropriate statistical analyses, and transparent reporting of outcomes and participants.<sup>7</sup> Each researcher independently reviewed the articles before discussing the selected consensus for each item on the checklist.

### Results of Evidence Quality Assessment

Each of the articles chosen: Lindlein et al.<sup>5</sup>, Ridge et al.<sup>4</sup>, and Warne et al.<sup>6</sup>, all scored a 5/10 on the PEDro scale. Lindlein et al.<sup>5</sup>, Ridge et al.<sup>4</sup>, and Warne et al.<sup>6</sup>, were unable to blind the subjects from the group that they were placed in as this would be nearly impossible with the study design. Additionally, all studies were unable to blind testers or evaluators. Each study also did not specify whether allocation was concealed. Due to the lack of clarity of the concealment of allocation “No” was assumed for all studies. Warne et al.<sup>6</sup> did not have similar groups, which may have affected the strength of comparison between groups at the conclusion of the study.

### Clinical Bottom Line: Strength of Recommendation

After evaluation of the articles, it was concluded that there is a Grade B<sup>8</sup> level of evidence that assessed the effects of MFW on RE in recreationally trained runners, but the difference between MFW and conventional footwear was not significant. All three included studies were RCT, which helps with clinical applicability to the specific group of recreationally trained runners, but not to the population as a whole. The studies used were not of the highest RCT quality and could be improved upon in the future. However, further research should be conducted using RCTs that utilize blinding to better decrease the risk of bias in future research.

## Search strategy

### Sources of Evidence Searched

- Trip Database
- Ebsco Host
- Health Source: Nursing/Academic Edition
- SportsDiscus
- Sports Medicine & Education Index

### Inclusion Criteria

- Participants must be human
- Studies must be written in English
- Studies must be peer-reviewed
- Studies must have been published within the previous ten years
- Studies must be randomized control trials
- Studies must have used recreationally trained runners
- Must evaluate RE through relative submaximal VO<sub>2</sub>
- Subjects must have no previous experience with minimalist running.

### Exclusion Criteria

- Studies that reported results on non-physically active patients
- Studies that reported the immediate effect of MFW on RE
- Studies which did not report pre and post-outcome measures
- Studies that did not statistically analyze RE

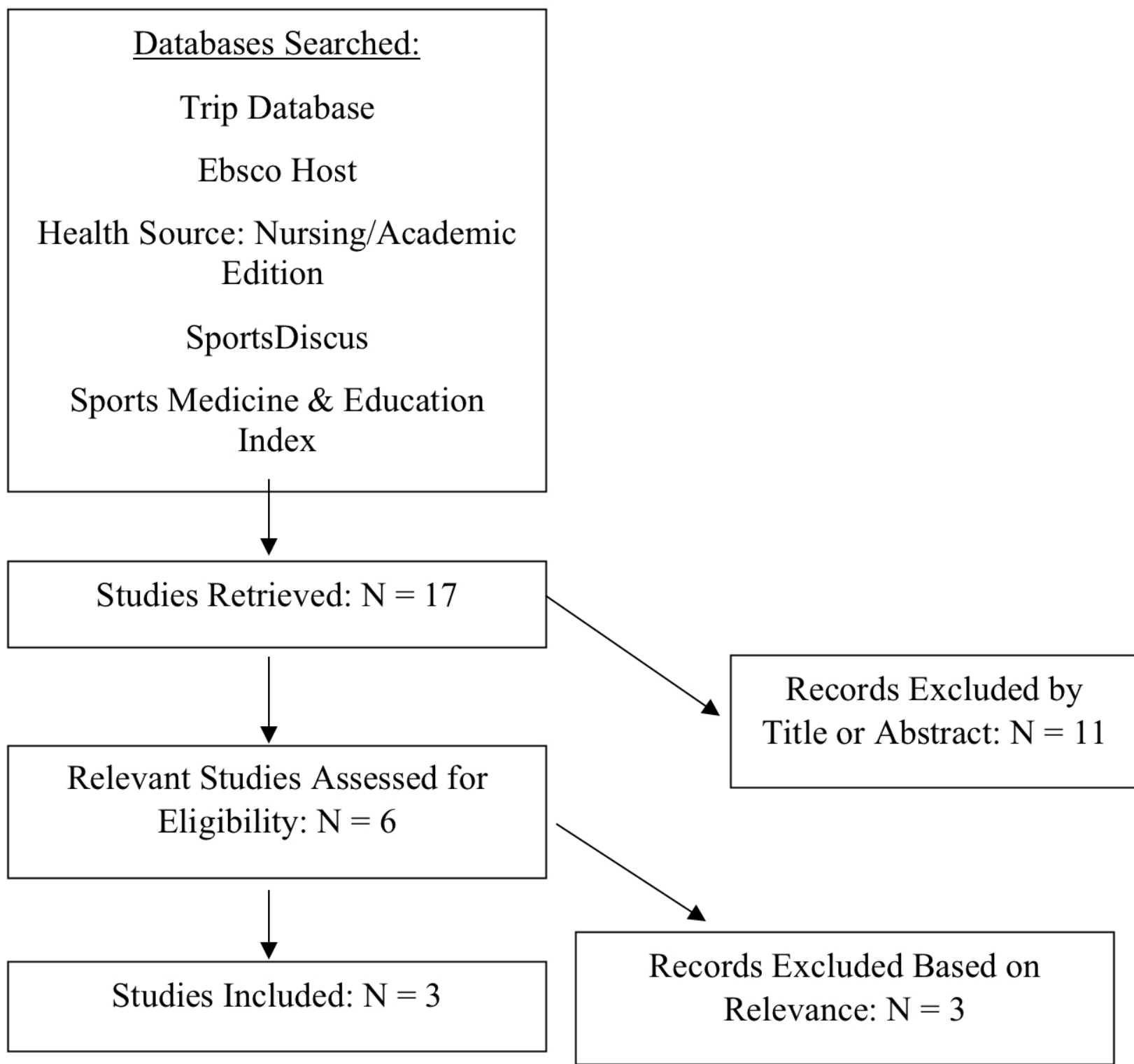


Figure 1 - Search Strategy



Figure 3 – Image obtained from <https://www.rei.com/learn/expert-advice/basics-of-barefoot-minimalist-running.html>



Figure 2 – Image obtained from <https://www.rei.com/learn/expert-advice/basics-of-barefoot-minimalist-running.html>

Table 2 Characteristics of Included Studies

	Ridge et al. <sup>4</sup>	Lindlein et al. <sup>5</sup>	Warne et al. <sup>6</sup>
Title	The Effect of Training in Minimalist Running Shoes on Running Economy	Improving RE by Transitioning to Minimalist Footwear: A Randomized Controlled Trial	Eight Weeks Gait Retraining in Minimalist Footwear has no Effect on Running Economy
Study Design	Randomized Control Trial	Randomized Controlled Trial	Randomized Controlled Trial
Participants	25 experienced runners, (11 women, 14 Men) Control group age 28.3±6.7, experiential group 24.1±5.5	32 male recreational runners, ages 38.3±8.5 years old	23 moderately trained male runners, age 43±10 were chosen who typically ran a weekly average of 52 km per week 4-6 days per week
Inclusion and Exclusion Criteria	Inclusion: Injury free for the past 6 months, ran 15-30 miles per week in traditional running shoes Exclusion: Participants had any experience with MFW running	Inclusion: Ran more than 3 hours per week and finished a 10k in less than 50 minutes in the past 6 months Exclusion: Participants with lower extremity injuries within the 3 months prior to study	Inclusion: Experience with treadmill running Exclusion: Running related injury within the last 3 months, experience with barefoot or minimalist running
Interventions Investigated	10-week transition period from traditional shoes to MFW	8-week transition period of MFW on RE	8-week gait retraining to assess the effect of MFW on RE
Outcomes Measures	VO <sub>2</sub>	VO <sub>2</sub> , vVO <sub>2</sub>	VO <sub>2</sub> , footfall pattern, step frequency
Main Findings	There was a significant improvement of 6.15% regardless of shoes type after the test	There were small improvements in RE that were not statistically significant, decrease in VO <sub>2</sub> (7.43 and 6.58 (ml km <sup>-1</sup> kg <sup>-1</sup> ))	After treatment RE was significantly better in MFW when compared to conventional. There was a 25% decrease in rear foot strikes after treatment in control and a 42% drop in rear foot strikes in the intervention group.
Level of Evidence Conclusion	Level 2b Both groups improved in terms of RE after 10 weeks regardless of shoe type. MFW did show more improvement, however, it was not statistically significant	Level 2b Running in MFW can improve your RE in multiple forms of shoes	Level 2b Gait-retraining and a MFW transition period showed no improvement in RE.

Note. VO<sub>2</sub>Max: Maximum Oxygen Consumption (ml/min/kg), vVO<sub>2</sub>: Velocity at Maximum Oxygen Consumption, MFW: Minimalist Footwear, RE: Running Economy



Figure 4 – Image obtained from <https://www.rei.com/learn/expert-advice/basics-of-barefoot-minimalist-running.html>

## Summary of Key Evidence

Each of the studies chosen had different protocols for the transition from conventional running shoes to MFW. Ridge et al.<sup>4</sup> utilized a 10-week transition period where runners ran 1-2 miles in MFW the first week, 2-4 miles in the second week, 3-6 miles in the third week, and were told to increase as they felt comfortable the remaining 7 weeks. Lindlein et al.<sup>5</sup> utilized an 8 week transition period where participants increased MFW usage by 5% after week 2. Warne et al.<sup>6</sup> utilized an 8-week transition period, but included gait retraining in the transition period.

Ridge et al.<sup>4</sup> only evaluated submaximal VO<sub>2</sub> as a measure of RE. Lindlein et al.<sup>5</sup> evaluated submaximal VO<sub>2</sub>, but also evaluated RE in a change in VO<sub>2</sub> Max. Warne et al.<sup>6</sup> evaluated RE using three different measures: submaximal VO<sub>2</sub>, step frequency, and footfall pattern.

Each of the studies evaluated RE over previously selected transition periods, but conflicted in the methods utilized to test the hypothesis. Warne et al.<sup>6</sup> and Lindlein et al.<sup>5</sup> utilized an 8-week transition period for the intervention group. The transition period for this study was controlled through the time and surface that each participant spent in the MFW. Warne et al.<sup>6</sup> differed, however, by including gait retraining in their study. Ridge et al.<sup>4</sup> varied from the other 2 studies by using a 10-week progression into a MFW shoe and only controlling the first 3 weeks of the subjects' transition into MFW.

Each study selected in this CAT utilized a different methodology, but each transitioned subjects into MFW finding no difference in RE when compared to conventional footwear. This leads to the question of what future changes methodology may be more effective in eliciting a significant change in RE.

## Results and Discussion

### Results

All studies selected measured RE by measuring VO<sub>2</sub> at a preset workload. Studies through the evaluation of submaximal VO<sub>2</sub> looked for a decrease in its value to signify an increase in RE. Ridge et al.<sup>4</sup> found a 10.4% ±6.88% decrease in VO<sub>2</sub> in participants who transitioned into MFW. This was found to be a significant improvement in RE over the course of the 10-week transition period. Lindlein et al.<sup>5</sup> found a decrease of 7.43± 13.57 ml/km/kg. This was not found to be a significant difference in RE in a 8-week transition period. Warne et al.<sup>6</sup> found a 0.02±2.3 mL/min/kg decrease in RE after post testing in the intervention group. This value was not significant and was concluded that MFW had no effect on RE after an 8-week gait retraining period.

### Discussion

While the three included studies were the best of what was available in the current literature, they all have a plethora of limitations. The topic of MFW as whole is severely lacking in current literature and even more so when its effects on RE are taken into consideration. Minimalist footwear may not affect RE one way or the other, and this could be due to several reasons. One reason for the lack of effect may be explained by MFW taking all the potential mechanical advantage out of the shoe such as a heel-to-toe drop or the carbon plate that is now present in many running shoes. Instead MFW relies on the runners intrinsic and extrinsic muscles of their feet to provide support and force to the ground. While this may be more “natural” it does not inherently increase RE. Instead, it may be more beneficial to use MFW as a tool to strengthen the feet and create a more stable base than to use MFW to improve RE. Therefore, MFW may be beneficial to improve running mechanics and prevent future injury. More research is certainly needed to determine the effectiveness of MFW on RE as well as many other variables. While MFW does not appear to improve RE it may be beneficial for improving foot strength, balance, stability, proprioception, and may even reduce falls in the elderly or increase motor skills in youth.<sup>10-12</sup>

## Future Work

1. Determine the effect of MFW on injury prevention through he strengthening of intrinsic foot muscles.
2. Determine the effect of MFW on RE over a longer transition period.
3. Determine the effect of MFW in a blinded RCT to prevent the possibility of bias in subject and researchers.

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