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## SYSTEMATIC REVIEW

# The influence of dosing on effect size of exercise therapy for musculoskeletal foot and ankle disorders: a systematic review

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### Abstract

**Objective:** The purpose of this review was to identify doses of exercise therapy associated with greater treatment effect sizes in individuals with common musculoskeletal disorders of the foot and ankle, namely, achilles tendinopathy, ankle sprains and plantar heel pain.

**Methods:** AMED, EMBASE and MEDLINE were searched from 2005 to August 2017 for randomized controlled trials related to exercise for these three diagnoses. The Physiotherapy Evidence Database scale was used for methodological quality assessment. Exercise dosing variables and outcome measures related to pain and function were extracted from the studies, and standardized mean differences were calculated for the exercise groups.

**Results:** Fourteen studies met the final inclusion. A majority of the studies showed large effects and two small trends were identified. Patients with plantar heel pain may benefit more from a daily home exercise program than two supervised visits per week (SMD = 3.82), but this recommendation is based on weak evidence. In achilles tendinopathy, a relationship was also seen when sets and repetitions of eccentric exercise were performed as tolerated (SMD = 1.08 for function, -1.29 for pain).

**Conclusions:** Session duration, frequency, total number of visits, and overall length of care may all be dosing variables with limited value for determining effective exercise prescription. However, the limited number of studies prevents any definitive conclusions. Further investigation

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is warranted to improve our understanding of the influence exercise dosing has on treatment effect sizes. Future randomized controlled trials comparing specific exercise dose variables should be conducted to clarify the impact of these variables.

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## Introduction

Exercise therapy is often prescribed to treat musculoskeletal disorders of the lower extremity, and recommended in many clinical practice guidelines and systematic reviews.<sup>1-19</sup> However, the amount of exercise performed and the specific relationship between dosing parameters and health benefits has not yet been determined. Therapeutic exercise for musculoskeletal disorders is the most commonly used intervention by physical therapists, above manual therapy, neuromuscular re-education and even modalities. However, the specific dosing varies greatly, and the definition of dose is poorly defined.<sup>20,21</sup> Dose can refer to the total number of exercise sessions over a given period of time, the frequency of those sessions, or the time spent in each of those sessions. It is more frequently thought of as the repetitions, sets, number of total exercises, and progression of exercise. While there is evidence that exercise therapy is effective for many of these lower extremity disorders,<sup>22-24</sup> there are few studies investigating the optimal dosing parameters associated with the best outcomes.

The American College of Sports Medicine (ACSM) has provided some general guidelines for exercise prescription, but they are clear in stating that it should be personalized for each individual.<sup>25</sup> Little work has been done to determine if these guidelines align with the exercise prescribed in clinical trials for patients with lower extremity musculoskeletal disorders, or if the use of these guidelines results in favorable outcomes. Although the authors of the ACSM guidelines state that these recommendations may also apply to individuals with disabilities or chronic diseases, the guidelines were targeted to individuals looking to improve their overall health instead of those recovering from a musculoskeletal injury.<sup>25</sup> Identification of optimal exercise dosing has the potential to improve outcomes and accelerate recovery during physical rehabilitation. In addition, identification of optimal dosing can help physical therapists provide efficient treatments, align with clinical practice guidelines and standardize dose in clinical trials.

In the lower extremity, the majority of research related to exercise dose is for hip and knee osteoarthritis.<sup>23,26,27</sup> To the knowledge of the authors, there are no studies investigating the impact of specific dosing variables on foot and ankle disorders. Three common disorders of the foot and ankle, achilles tendinopathy (AT), ankle sprains, and plantar heel pain, are frequently managed with exercise.<sup>1,28-31</sup> A recent editorial on AT and eccentric exercise highlighted the need for further trials investigating optimal exercise dosage.<sup>32</sup> A common dose prescribed for patients with AT is three sets of 15 repetitions two times per day seven days per

week with eccentric exercise as a home exercise program (HEP).<sup>6,8-10,12</sup> Beyer and colleagues used this same prescription, and saw large effects related to pain and function.<sup>6</sup> Yu et al.,<sup>13</sup> on the other hand, used eccentric exercise three times per week and showed only medium effect sizes. These groups had different frequencies of intervention and total number of overall sessions. Hence, optimal outcomes may be related more to dosing of an exercise rather than the type of exercise. For patients with ankle sprains, there have been a wide variety of different exercise programs showing favorable results, but none of these have measured the impact of dosing on outcomes.<sup>28</sup> Lastly, plantar heel pain has very limited evidence for the use of exercise as an effective intervention, and dosing information is highly lacking.<sup>30</sup>

When determining the value of exercise, it is important that clinicians understand the influence that effect size may have on clinical decision making. Traditionally, results are provided based on statistical significance, using *p*-values, which do not quantify the magnitude of difference between interventions like effect sizes do.<sup>33-35</sup> Statistically significant improvement does not always mean there have been clinically important changes, and therefore results from clinical trials are often difficult to integrate into practice.<sup>33</sup> Using effect sizes, clinicians can determine which interventions have the greatest impact on improving patient outcomes.<sup>36</sup> For example, using the same type of eccentric exercises, Rompe and colleagues<sup>10</sup> showed large effects on the Victorian Institute of Sports Assessment (VISA), whereas Stevens and Tan<sup>12</sup> exhibited a medium effect size on the VISA. Although both were shown to be significantly effective, the magnitude of the effectiveness was higher in one group, and the dosing of exercise was different between groups. It would be valuable for clinicians to know which dosing variables are associated with larger treatment effect sizes.

There is much variation in the dosing of prescribed exercise for foot and ankle disorders; hence, the purpose of this systematic review was to identify specific exercise dosing variables that were related to improved outcomes in pain and/or function in patients with foot and ankle disorders. The secondary purpose was to categorize the dosing variables based on their effect size.

## Materials and methods

### Search strategy

The Allied and Complementary Database (AMED), EMBASE and MEDLINE databases were used to identify relevant clinical trials that utilized therapeutic exercise in managing

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