Review Article

Is the Intensity or Duration of Treadmill Training Important for Stroke Patients? A Meta-Analysis

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Background: Stroke, the third highest cause of death after cancer and cardiac diseases, is a strong cause of adult disability in most countries. Therefore, the aim of the current meta-analysis was to examine the most effective intensity and duration of treadmill training on motor performance in stroke subjects. *Methods:* Suitable studies were recognized from January 1980 to July 2015 using PubMed as the main search engine. There were noticeable biases such as training intensity, training duration (≥2 weeks), relative training intensity, and Vo2max, which were controlled. Subgroup classifications for human studies were prepared based on previous studies and were determined as follows: low intensity (≤.6 m/s)–low volume/duration (≤500 minutes), low intensity (≤.6 m/s)–high volume/duration (>500 minutes), high intensity (>.6 m/s)–low volume/duration (≤500 minutes), and high intensity (>.6 m/s)–high volume/duration (>500 minutes). *Results:* Forty-nine articles were identified for human studies. This meta-analysis exhibited treadmill training regardless if intensity and volume/duration had a significantly greater recovery of motor function than did no training (standard mean difference [SMD] = .601; 95% confidence interval [CI] = .546-.657; P = .0001). Also, for the low-intensity, low-volume/-duration strategy, training on a treadmill displayed a significantly greater motor function rehabilitation than did no training (SMD = .75; 95% CI = .64-.85; P = .0001). *Conclusions:* The current meta-analysis showed that low-intensity (≤.6 m/s)–high-duration/-volume (>500 minutes) treadmill training as a rehabilitation strategy had the highest SMD to ameliorate stroke-induced dysfunctions compared with the other strategies. **Key Words:** Duration—intensity—rehabilitation—treadmill training—stroke.

Introduction

Stroke, the third highest cause of death after cancer and cardiac diseases, is a strong cause of adult disability in the most countries.[1,2] More than 130,000 people in the United Kingdom undergo a stroke; that means 1 person every 5 minutes.[3] Also, the stroke mortality rate is about 147 per 100,000 person-years in the north of Iran, and almost 780,000 new and recurred strokes happen every year in the United States.[4,5] Stroke is also the third cause of mortality in the UK, US and in the north of Iran.[3,5,6] Moreover, the financial cost of stroke is incredible because the annual cost of stroke is about US$30 billion in the United States.[5] Furthermore, stroke is a primary reason

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of disabilities in Western populations, with up to 40% of survivors not expected to recuperate independence from severe disablements. So, there are numerous forms of treatment for stroke-associated disabilities. Nearly 80% of stroke-associated happenings could be ameliorated by the creation of simple lifestyle alterations.[3,7-10] In this regard, there are various types of treatment for stroke-associated disabilities. One of this well-distinguished treatments is treadmill training.[11]

Training on a treadmill as an operative intervention to fight the stroke-related disabilities results in valuable results such as fatigue resistance,[8] endurance performance improvement,[9] the development of motor function,[7] infarct volume recovery,[10] and the elevation of mitochondrial biogenesis in the brain. Training on a treadmill has commonly been employed in clinical and laboratory studies to enhance revival after stroke for more than 20 years.[12-17] As a result, training on a treadmill has been considered in various studies and constantly used in human rehabilitation.[15,17-48] There are 2 prominent factors in training on a treadmill: intensity and volume. Previous studies have illustrated the value of intensity in stroke recuperation programs.[2,12,13,15,49,50] As some studies exhibited, progressive intensities can crop useful motor function convalescence contrast to low- or high-intensity training.[2,7,50,51] In opposite, some studies displayed that a high-intensity training had greater motor function than a low-intensity training[10,52,53] and a low-intensity treadmill training.[49,54,55]

Besides, there are differences in training duration (volume) between human studies. According to the ACSM and the Germany guidelines, exercise-associated adaptations are supposed to be disclosed after 2-6 weeks with 1-3 sessions per week.[37,56] In this regard, some studies exhibited that training with a low volume (duration) could harvest greater motor function recuperation,[2,7,14,18,49,57-64] and others displayed that a high volume (duration) of training on a treadmill led to greater motor performance.[13,30,34,37,38,40-46,65-71] Commonly, neither the effectiveness of treadmill training intensity nor the volume has been absolutely elucidated.[2]

Although training on a treadmill is a common method for stroke convalescence, the intensity and volume (duration) of this training as important mediators in human studies were not fully illuminated.[2,10,28,37] Given enough evidence about the consequences of treadmill training on stroke-induced disabilities, however, the effectiveness of current training protocols on stroke induced-disabilities requires much clarification. In particular, it is crucial to evaluate treadmill intensity, duration (volume), and their combination in human studies, whether they could improve motor function. Therefore, we have studied the published literature on the effects of various intensities and durations (volumes) of training on a treadmill in stroke subjects from 1980 up to 2015 using PubMed. We also evaluated studies with less risk of bias (as mentioned below). Therefore, the current meta-analysis aim was to examine the most effective intensity and duration of treadmill training on motor performance in stroke subjects, which could assist physicians and lab researchers to choose the most effective intensity and duration of treadmill training for stroke subjects.

Materials and Methods

Study Search Identification

Suitable studies were recognized from January 1980 to July 2015 using PubMed[1] as the main search engine, and the medical topic headlines and their keywords were searched according to Table 1.

Study Collection

Elucidation of Inclusion Criteria

We considered all related articles that met our inclusion criteria (Table 2) and classified 49 published human studies. We also considered studies with 1 or more independent variables (e.g., intensity and/or duration of training) with only 1 dependent variable (e.g., motor function) and studies with 1 or more independent variables with more than 1 dependent variable. Besides the given independent variables, body-weight support during training on a treadmill (10%-40% of body mass) was also considered for collected studies. We have considered only studies that satisfactorily clarified the training intensity as m/min, cm/s, m/s, or km/h, which were all converted to m/s. Also, training duration (volume) has been considered based on minute per session, session(s) per week, and training week(s), which were all converted to minutes.[80] Recovery of motor function was also measured by common assessment tests and other motor behavior tests that authors did not mention the exact names of in the motor function tests in their studies (Table 2).[80,81]

Meta-Analysis Biases

There were noticeable biases such as training intensity, training duration (≥2 weeks), relative training intensity, and Vo2max, which were controlled. Generally, any such studies were counted in data pooling that met or enclosed at least half of the above biases.[82,83]

Data Extraction

Studies were distinctly summarized by 1 author (S.A). The researcher extracted certain details from each study that involved (1) the publication year and the first author's name; (2) practical data for each study such as the number of subjects, sessions, days, and weeks of training; (3) treatment details such as training intensity and duration (volume) in each week or in the whole training

[1] http://www.ncbi.nlm.nih.gov/pmc/advanced/