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Review Article

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The Effect of High-Intensity Treadmill Training on Motor Function in Patients with a Stroke

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ABSTRACT

The current study's aim was to investigate the properties of treadmill training on the stroke-induced neurological deficit in both human and animal studies. Our searches identified 87 potentially suitable studies, of which 34 met our inclusion criteria for inclusion. Four were studies on humans and 30 on animals. We also considered studies with one or more independent variables (intensity and/or duration of treadmill training) and neurological scale as the dependent variable as well as studies with one or more independent variables and more than one dependent variable. Besides the given independent variables, body-weight support (BWS) during treadmill training (10 to 40% of body mass) was also regarded as an important bias for collected studies. This study displayed treadmill training regardless of intensity and volume/duration had significant greater recovery of motor function than did no-training (SMD= 0.601; 95% CI= 0.546 to 0.657; P=0.0001). The current study exhibited that low intensity (≤ 0.6 m/s) - high duration/volume (>500 minutes) treadmill training as a rehabilitation strategy had the highest SMD to ameliorate stroke-induced dysfunctions compared to the other strategies.

Keywords: High-intensity training, Stroke, Treadmill

Introduction

Stroke is an important and largest reason for patients mortality and one of the leading causes of disabilities worldwide [1,2]. Regarding stroke-related outcomes, previous studies have shown that subjective facial, arm and leg weakness, arm and leg paresis, eye movement abnormality, neurological deficit, and gait ataxia are dominant symptoms and sings of post-stroke events [3]. In this case, the neurological assessment is a time-honored physician skill that is enhanced by practitioners and it is a dominant part of the medical evaluation of a stroke patient [4]. While treadmill training is a usual stroke rehabilitation method, the intensity or duration of this training as imperative factors in human studies were not fully brightened [5]. About the strong literature, previously published investigations have explained the importance of exercise intensity in stroke restoration programs. As some studies unveiled, a gradual intensity elevation in workouts regimes can harvest higher neurological recovery compare to low- or high-intensity regimes following stroke [6-8]. In contradiction, other studies exhibited that high-intensity managements had greater neurological recovery than either low-intensity protocols or low-intensity treadmill training [7,9]. Although low-intensity strategy may have a negligible effect on promotion of recovery after stroke, than the other strategies, it is important to note that we previously disclosed that there were no training differences in stroke-related motor function recoveries from our pooled studies [5]. The current study's aim was to investigate the properties of treadmill training on the stroke-induced neurological deficit in both human and animal studies.

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Materials and Methods

Our searches identified 87 potentially suitable studies, of which 34 met our inclusion criteria for inclusion. Four were studies on humans and 30 on animals. We also considered studies with one or more independent variables (intensity and/or duration of treadmill training) and neurological scale as the dependent variable as well as studies with one or more independent variables and more than one dependent variable. Besides the given independent variables, body-weight support (BWS) during treadmill training (10 to 40% of body mass) was also regarded as an important bias for collected studies. We have considered only investigations that satisfactory illuminated the training intensity as m/min, cm/s, m/s or km/h, which all were converted to m/s and m/min for human and animal studies, respectively. Subgroup categorizations for human studies were equipped based on past investigations and defined as follow [5, 10-13]: Low intensity (≤ 0.6 m/s)-low duration (≤ 500 minutes) training protocol, Low intensity (≤ 0.6 m/s)-high duration (> 500 minutes) training protocol, High intensity (> 0.6 m/s)-low duration (≤ 500 minutes) training protocol, and High intensity (> 0.6 m/s)-high duration/duration (> 500 minutes) training.

Results

Our data analysis showed that there was a high degree of heterogeneity between the six included human studies ($I^2 = 96.6\ \%$; $p < 0.0001$). Though, a negative SMD was demonstrated a decrease in neurological deficit in favor of the low intensity-low duration and low intensity-high duration protocols, but, it was not statistically significant in these strategies ($p = 0.277$ and $p = 0.615$, respectively). Conversely, a positive SMD in high intensity-high duration protocol showed that with increasing intensity there is a general trend toward increased neurological deficit (SMD= 1.792; 95% CI= 0.566 to 3.02; p=0.004). However, there was no statistically significant difference in overall SMD among the current study subgroups ($p = 0.109$; Fig 2). In the current study, Egger's funnel plot and the Egger's test with 95% of CI also demonstrated no biases in all study subgroups ($t = 2.09$, p=0.104).Also, some heterogeneity was indicated for high intensity-low volume/duration subgroups up to 40.6 %. Moreover, for high intensity-low volume/duration strategy, training on a treadmill revealed a significantly greater motor performance than did no-training (SMD= 0.4; 95% CI= 0.22 to 0.59; p=0.0001). In the current study, Egger's funnel plot and the Egger's test with 95% of CI confirmed no biases in high intensity-low volume/duration strategy ($t = 0.31$, p=0.76).There was also a considerable heterogeneity for high intensity-high volume/duration subgroups up to 74.8 %. Besides, for high intensity-high volume/duration strategy, training on a treadmill demonstrated a significantly greater motor function convalescence than did no-training (SMD= 0.57; 95% CI= 0.48 to 0.67; p=0.0001). In this study, Egger's funnel plot and the Egger's test with 95% of CI demonstrated no biases in high intensity-high volume/duration strategy ($t = -1.47$, p=0.158).

Conclusion

For a large proportion of the stroke-related training studies there is robust evidence that treadmill training studies achieve same results when compared to 'conventional therapy', proposing that the equal results can be attained with the control intervention, while no contrary reports were described. It should also be emphasized that although there were negative SMDs in the neurological deficit on behalf of the low intensity-low duration and low intensity-high duration protocols, the SMDs were not statistically significant in these strategies. We additionally revealed that there was only one significant study which showed a negative SMD [14], suggesting that low intensity-high duration protocol has shown beneficial effect on neurological deficit. However, we did not see a significant difference in overall SMD among the studies subgroups. Conversely, there was a positive SMD in high intensity-high duration protocol, proposing that with increasing treadmill intensity there is a general trend toward increased neurological deficit. It has been also demonstrated that intensity is a crucial stress-inducing factor. Indeed, high training intensity causes significantly high stress levels and high stress levels is related to decreased levels of hippocampal BDNF, as a unique indicator of neural activity [15]. Therefore, we recommend that when practitioners select the high intensity-high duration protocol, they should regularly monitor the neurological outcomes which are at risk for being adversely affected by the protocol. Regarding the subgroups of animal studies, there is strong research evidence to show that exercise training frankly influences the neurological recovery process by elevating neural progenitor cell count via activation of the IGF-1/Akt and BDNF signaling pathways [16, 17]. The findings of our meta-analysis also presented that there were significant improvements (negative SMDs) in neurological deficit for all four treadmill training protocols, suggesting that the current training protocols indicating good feasibility and acceptability for neurological recovery in animal models of stroke.

However, the study for all these neurological outcomes indicated insufficient statistical power or Summary Effect Sizes (SESs), suggesting that more human studies are needed (SESs = 0.496). Furthermore, although a significantly negative SMD was not found for low intensity-related training protocols, these

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strategies also show advantageous effects on motor functional recovery.

References

1. Agulla J, Brea D, Campos F, Sobrino T, Argibay B, Al-Soufi W, et al. In vivo theranostics at the peri-infarct region in cerebral ischemia. *Theranostic.* 2013; 4: 90-105.
2. Sun J, Ke Z, Yip SP, Hu XL, Zheng XX, Tong KY. Gradually increased training intensity benefits rehabilitation outcome after stroke by BDNF upregulation and stress suppression. *Biomed Res Int.* 2014; 19.
3. Yew KS, Cheng EM. Diagnosis of acute stroke. American family physician. 2015; 91.
4. Adams Jr HP, Lyden P. Assessment of a patient with stroke: neurological examination and clinical rating scales. *Handbook Clin Neurol.* 2008; 94: 971-1009.
5. Abbasian S, MM MR. Is the intensity or duration of treadmill training important for stroke patients? A Meta-Analysis. *J Stroke Cerebrovasc Dis.* 2018; 27: 32-43.
6. Matsuda F, Sakakima H, Yoshida Y. The effects of early exercise on brain damage and recovery after focal cerebral infarction in rats. *Acta Physiol.* 2011; 201: 275-287.
7. Rezaei R, Nourshahi M, Khodagholi F, Haghparast A, Nasoohi S, Bigdeli M, et al. Differential impact of treadmill training on stroke-induced neurological disorders. *Brain Inj.* 2017; 31: 1910-7.
8. Zhang A, Bai Y, Hu Y, Zhang F, Wu Y, Wang Y, et al. The effects of exercise intensity on p-NR2B expression in cerebral ischemic rats. *Can J Neurol Sci.* 2012; 39: 613-8.
9. Liu P, Wang Y, Hu H, Mao Y, Huang D, Li L. Change of muscle architecture following body weight support treadmill training for persons after subacute stroke: evidence from ultrasonography. *BioMed Res Int.* 2014.
10. Westlake KP, Patten C. Pilot study of Lokomat versus manual-assisted treadmill training for locomotor recovery post-stroke. *J Neuroeng Rehabil.* 2009; 6: 1743-0003.
11. Moore JL, Roth EJ, Killian C, Hornby TG. Locomotor training improves daily stepping activity and gait efficiency in individuals poststroke who have reached a "plateau" in recovery. *Stroke.* 2010; 41: 129-135.
12. Sullivan KJ, Knowlton BJ, Dobkin BH. Step training with body weight support: effect of treadmill speed and practice paradigms on poststroke locomotor recovery. *Arch Phys Med Rehabil.* 2002; 83: 683-691.
13. Hesse S, Bertelt C, Jahnke MT, Schaffrin A, Baake P, Malezic M, et al. Treadmill training with partial body weight support compared with physiotherapy in nonambulatory hemiparetic patients. *Stroke.* 1995; 26: 976-981.
14. Calabrò RS, Maria C, Leo A, Reitano S, Balletta T, Trombetta G, et al. Robotic neurorehabilitation in patients with chronic stroke: psychological well-being beyond motor improvement. *Int J Rehabil Res.* 2015; 38: 219-225.
15. Sun J, Ke Z, Yip SP, Hu X-l, Zheng X-x, Tong K-Y. Gradually increased training intensity benefits rehabilitation outcome after stroke by BDNF upregulation and stress suppression. *BioMed Res Int.* 2014.
16. Chen BY, Wang X, Wang ZY, Wang YZ, Chen LW, Luo ZJ. Brain-derived neurotrophic factor stimulates proliferation and differentiation of neural stem cells, possibly by triggering the Wnt/β-catenin signaling pathway. *J Neurosci Res.* 2013; 91: 30-41.
17. Zheng H-Q, Zhang L-Y, Luo J, Li L-L, Li M, Zhang Q, et al. Physical exercise promotes recovery of neurological function after ischemic stroke in rats. *Int J Mol Sci.* 2014; 15: 10974-10988.

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