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SYSTEMATIC REVIEW

Effects of interventions with therapeutic suits (clothing) on impairments and functional limitations of children with cerebral palsy: a systematic review

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Abstract
Background: Therapeutic suits or clothing whether associated with intensive protocols or not, became popular in the rehabilitation of children with cerebral palsy. Studies have reported positive effects of these suits on children's posture, balance, motor function and gait. A summary of current literature may help guide therapeutic actions.
Objective: To evaluate the available evidence on the effects of interventions based on the use of therapeutic suits in the treatment of impairments and functional limitations of children with cerebral palsy.
Method: Three independent reviewers searched for experimental studies on MEDLINE, SciELO, BIREME, LILACS, PEDro and CENTRAL databases, between October and December 2015 and updated in May 2016. The reviewers evaluated the methodological quality of selected studies using the *Checklist for Measuring Quality*. The *Grading of Recommendations Assessment, Development and Evaluation* was used to synthesize the quality of evidence and strength of recommendation.
Results: From the 13 studies, two evaluated the *Full Body Suit*, two tested the *Dynamic Elastomeric Fabric Orthose*, three evaluated *TheraTogs* and six tested the *TheraSuit/AdeliSuit* protocols. The quality of evidence for the *Full Body Suit*, the *Dynamic Elastomeric Fabric Orthose* and the *TheraSuit/AdeliSuit* protocols was very low for body structure and function outcomes, while the evidence for *TheraTogs* was low quality. Regarding the activity outcomes,

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the *Full Body Suit* and *TheraSuit* showed very low quality evidence while the evidence for *TheraSuit/AdeliSuit* protocols were of low quality.
Conclusion: Enthusiasm with new therapeutic approaches that argue modifications in the neuromusculoskeletal impairments and functional limitations of children with cerebral palsy need to be guided by scientific evaluation. The low quality of evidence suggests caution in recommending the use of these therapeutic suits. New studies could change the findings of this review.
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Introduction

Rehabilitation of children with cerebral palsy (CP) has focused on minimizing impairments and disabilities, promoting functioning in patients' body structures and functions, activity and participation,[1] in addition to improving their quality of life.[2] New technologies have been used to support and/or enhance the engagement of these children in activities and tasks in different environments.[2] One example is the use of rigid and dynamic orthoses. These devices are intended to improve posture and movement, prevent deformities, and facilitate functional performance.[3]

Since the 1990s, different types of therapeutic suits have been used for children with CP.[4–6] These suits are dynamic orthoses available in various models. Body suit type orthoses are custom manufactured, made of Lycra, fit tight to the body and may cover the trunk and limbs, exerting a compressive force on the body.[4,7] TheraTogs are elastic straps attached by Velcro onto a vest, onto shorts and onto anchors on the legs and feet. These technologies are intended to improve postural alignment, joint stability and movement efficiency.[8]

TheraSuit, AdeliSuit and PediaSuit were created from a prototype developed for Russian astronauts so they could perform counter-resistance exercises in zero gravity situations.[5,9,10] These models have hooks that anchor a system of individually fixed elastic tubes that exert traction between the trunk and pelvis and between the pelvis and lower limbs.[9] They have become popular in many countries and are often associated with specific treatment protocols. The TheraSuit Method (TSM) and AdeliSuit Therapy (AST) protocols[9,11,12] consist of intensive treatments, including vigorous strengthening and stretching exercises and training of specific motor activities, during which the child wears the suits.[9,13]

Therapeutic suits have gained popularity in pediatric rehabilitation and are widely commercialized. Families of children with CP have made efforts to acquire these suits and submit their children to these very expensive supplementary treatments.[12–16] There are clinical claims that the use of these dynamic orthoses can modify joint alignment and contribute to the strengthening and/or stretching of certain muscle groups, thereby affecting posture, balance, coordination, gross motor function, hand function and gait of children with CP and other health conditions.[4–11] The mechanisms of action proposed to explain such functional changes are the compression and/or continuous tension exerted by the suits' elastic elements on the child's musculoskeletal system. These elastic elements are systematically adjusted based on individual needs and limitations.[5,8] In addition to the clinical claims and families' positive expectations, studies have provided scientific evidence on the effects of these suits regarding posture and movement of children with CP.[13,16]

A recent systematic review with meta-analysis showed that the effect of TSM and AST protocols on the functioning of children with CP was of small magnitude.[13] As this review focused on specific intensive training protocols, which involved elements other than suit wearing, no conclusions regarding the effects of alternative types of therapeutic suits (e.g., *TheraTogs*) worn by children with CP irrespectively of intensive training can be drawn. Moreover, given that the commercially available interventions include therapeutic suits associated or not with intensive protocols, it is necessary to evaluate the isolated and combined effects of these two elements (i.e., intensive training and suit wearing). It is possible that positive evidence of one element does not reflect the effect of the other, nor the combination of both. Therefore, the objective of this systematic review was to evaluate the available evidence regarding the effects of interventions based on the use of therapeutic suits (combined or not with intensive protocols) on the treatment of functional limitations and disabilities in children with CP. The summary and critical analysis of this literature may guide clinical decision making regarding these resources and provide scientific evidence to enable rehabilitation services to make judicious choices about the provision of these types of treatment.

Methods

Three independent examiners performed literature searches on MEDLINE, SciELO, BIREME, LILACS, PEDro and Cochrane Central Register of Controlled Trials databases. The searches were conducted between October and December 2015 and updated in May 2016. These searchers were standardized and involved no restrictions of year of publication. The search strategy, along with the inclusion and exclusion criteria, is shown in Table 1. As the use of therapeutic suits in child rehabilitation is a relatively new modality of treatment, studies with different experimental designs were included.

After reading the titles and abstracts, duplicate studies or studies that did not meet the inclusion criteria were excluded. The remainder were selected for full reading. An

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