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Research Article

## Daily Physical Activity And Exercise For People With Long Term Neurological Conditions; A Delicate Balance Between Training And Recovery

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### Abstract

**Objective:** In this paper we aim to provide insight, based on a comprehensive review of the literature, that may be helpful when enrolling people with long term neurological conditions (LTNC) into daily physical activity or exercise programs. We will discuss the following issues: 1) balance between training and recovery; 2) intensities of common physical activities like walking; and 3) consequences for daily physical activity and exercise prescription.

**Material and Methods:** A comprehensive review of studies up to July 2017 was performed. Databases searched were PubMed, EMBASE, SPORTDiscus, and PsychINFO.

**Results:** Five papers, that provided useful data on relative intensity of walking (i.e., the oxygen consumption of the activity relative to the maximal capacity) in people with LTNC, were identified and analysed. For stroke survivors the relative intensity of walking was between 62.3 and 69.8%. For children with cerebral palsy (CP) these values ranged from 52 to 78%, and for adults with CP an average relative intensity of 52% was found. These levels of relative intensity are considerably higher compared to those experienced by able-bodied children (36±8.4%) and adults (27±6%).

**Conclusion:** For a group of people with LTNC, walking can be categorized as a moderate physical activity while for others it might be a vigorous physical activity. When developing a physical activity or exercise program, insight into the intensity of physical activities is important.

**Keywords:** Stroke; Cerebral Palsy; Walking, Exercise; Physical Activity

## Introduction

Rehabilitation is a common treatment modality for people with long term neurological conditions (LTNC), and is often focused on increasing physical activity levels to assist each patient in achieving the highest possible degree of individual physical behavior. Physical behavior is an umbrella term, which includes the behavior of a person in terms of body postures, movements, and/or daily activities in his/her own environment [1]. It can be divided into physical activity at light to vigorous intensities and sedentary behavior. Recognition of the importance of physical activity, both exercise and daily physical activity, and the avoidance of prolonged sedentary periods for people with LTNC is growing. Most studies related to this topic are performed in the two populations that are most common in neurological rehabilitation: people with stroke and people with cerebral palsy (CP). In this paper we will therefore focus on these two groups. People with stroke and people with CP generally have low levels of physical activity, reduced aerobic capacity, and are often severely deconditioned and predisposed to high levels of sedentary behaviour [2,3]. This leads to various physical and psychosocial consequences [2].

Daily physical activity (defined as any bodily movement produced by skeletal muscles that results in energy expenditure [4] and exercise (a subset of physical activity that is planned, structured, and repetitive and has as a final or an intermediate objective the improvement or maintenance of physical fitness) have the potential to positively influence these consequences in people with LTNC [2, 3]. Therefore, it is not surprising that there is an increasing interest to improve physical activity levels through physical activity and exercise programs. However, in people with LTNC the balance between training and recovery can be delicate due to increased energy expenditure during daily activities due to a lower economy of movement. In this paper, we aim to provide some insight that may be helpful to direct future research in this area. In the first part of the paper we will discuss the balance between training and recovery. In the second part we will present the data from a comprehensive literature review, with studies related to intensities of a common activity like walking for people with LTNC. Hereafter, we will discuss the consequences for daily physical activity and exercise prescription.

## Training and Recovery

The health benefits of physical activity are so many that health

care providers often call exercise the “miracle” or “wonder” drug - pointing to the wide variety of proven benefits that it provides. But, as with other medications, too much of it may be harmful. There is an optimal drug dose for patients; when they take less, their condition may not improve and when they overdose, they may suffer serious consequences. Exercise acts in a similar fashion. Too little exercise or physical activity is harmful to the body, and the benefits increase as individuals start to exercise until a point is reached when the benefits are maximized. However, beyond this point, more intense exercise, or exercise with longer duration or higher frequency may have negative effects [5]. The goal of an effective program to improve physical activity is an optimal balance between appropriate training stress (at the right dose with appropriate progression) and adequate recovery [5]. When the intensity of a physical activity is above a certain threshold (overload), the individual's body adapts to the demands placed upon it (supercompensation). However, little is known about the optimal doses of exercise and possible consequences of unbalanced training doses in rehabilitation of people with LTNC.

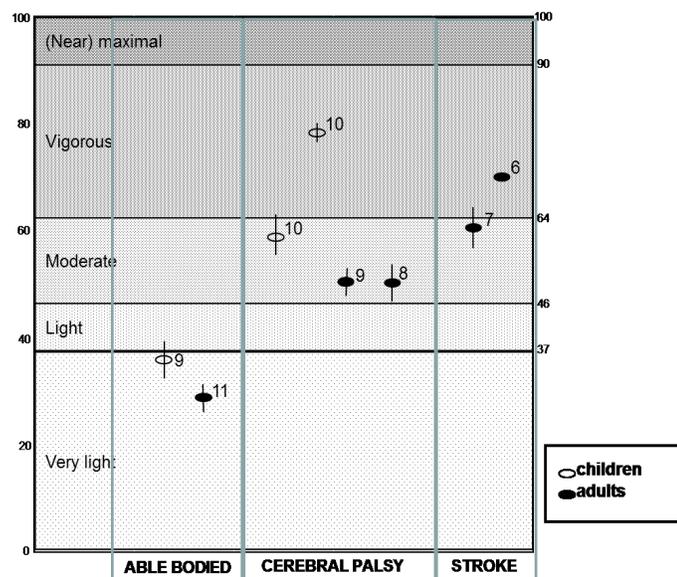
Importantly, any physiological improvement occurs during the rest period following training. Once the balance between training and recovery has been disrupted, the physiological system is not able to adapt and performance will deteriorate. An abnormal training response may occur and various physical and psychosocial consequences may develop [5]. For athletes, 24-36 hours of relative rest between vigorous intensity training sessions are usually recommended. Therefore, a training program with careful focus on appropriate dose as well as recovery time into the training program is important [5]. But what do we know about the intensity of common daily physical activities in people with LTNC? Can a daily physical activity like walking be seen as exercise, and what are the consequences for recovery and advice related to daily physical activity?

## Relative intensity of walking

Walking, with or without assistive devices, is an important and common daily physical activity and is often the primary way of moving around for people with LTNC. It is therefore important to consider the intensity of this activity. Motor impairments including an asymmetrical or impaired gait pattern, balance problems, low muscle strength and hypertonia, are associated with many LTNC and may cause an increased oxygen consumption during walking. Combined with the lower aerobic capacity ( $VO_{2max}$ ) that is often found in people with stroke and people with CP [2,3], this can result in a higher relative intensity (i.e., the oxygen consumption of the activity relative to the maximal capacity) for walking. The relative intensity of walking can therefore be expressed as a percentage of  $VO_{2max}$ . We performed a comprehensive literature search in four databases (PubMed, EMBASE, SPORTDiscus, and PsychINFO) up to July 2017 to identify papers that provided data that could be used to provide insight in the relative intensity of walking for stroke survivors and people with CP. Search terms included

subject headings and text words based on (I) cerebral palsy; (II) stroke; (III) oxygen consumption (in combination with aerobic capacity, aerobic power, cardiorespiratory strain); and (IV) walking.

For people with CP and people with stroke five papers that provide useful data on relative intensity of walking were identified.[6-10] For people with chronic stroke (>6 months post stroke) the relative intensity of walking at preferred walking speed was between  $62.3 \pm 17.2\%$  [7] and  $69.8\%$  (no SD provided)[6] of  $VO_{2max}$ . For children with CP these values ranged from  $52 \pm 7.7\%$  for children with mild CP[9] (classified at Gross Motor Function Classification System (GMFCS) level I) to  $78 \pm 3\%$  in children with more severe CP (classified at GMFCS levels III).[10] For adults with CP who were classified at GMFCS level I-III a relative intensity of  $52 \pm 17\%$  of their  $VO_{2peak}$  was found.[8] These levels of relative intensity are considerably higher compared to that experienced by able-bodied children ( $36 \pm 8.4\%$ ) and adults ( $27 \pm 6\%$ ) walking at preferred walking speed [9,11].



**Figure 1.** ACSM training guidelines presented as a percentage of  $VO_{2max}$  and relative walking intensities from included studies.

According to the American College of Sports Medicine guidelines[12], people are exercising at moderate intensity when their oxygen consumption is between 46% and 63% of  $VO_{2max}$  and at vigorous intensity when their oxygen consumption is between 64% and 90% of  $VO_{2max}$ . Thus, in accordance with these guidelines, for people with stroke and people with CP, walking in daily life may represent an activity at moderate- or even vigorous intensity. The large standard deviations show large variability between individuals. Therefore, the relative intensity of walking needs to be assessed individually.

## Consequences for exercise and physical activity prescription

Physical activity and exercise prescription are increasingly being incorporated into the management of people with LTNC. The promotion of physical activity should emphasize light- to moderate-intensity aerobic activity, and a reduction of sedentary behavior [2,3]. The recommended exercise volume for people with neurological conditions is 30 to 60 min/day of moderate-intensity physical activities for 3-5 days/week or more[2,3]. For some patients walking can be categorized as a moderate physical activity while for others it might be a vigorous physical activity (with a relative intensity above 64% of  $VO_{2max}$ ). Therefore, when developing a physical activity or exercise program it is important to have insight into the intensity of physical activities and respect the balance between training and recovery for each individual. In people with LTNC this balance can be delicate due to the increased energy demands of their daily activities. So, despite the fact that several clinical guidelines recommend increased lifestyle physical activity and a structured exercise program for people with LTNC, we suggest that a structured physical activity and exercise program should begin, where possible and appropriate, with an individual exercise assessment, including  $VO_{2max}$ , energy demands of walking, and the calculation of the relative intensity of walking. The results from this individual assessment have two important implications. First, when advising people with LTNC to be physically active at moderate intensity for 30 to 60 minutes/day, one must have information about the intensity and the amount of common activities like walking. Second, for the group of individuals who have a relative intensity above 64% during walking, the balance between training stress and recovery might be very important. So, a training and recovery program should consist of appropriate training stress and progression. We suggest, based on the existing evidence and expert opinion, to train 2-5 times a week (including sets of 20-60 minutes at 46-90%  $VO_{2max}$  or 40%-70%  $VO_{2-reserve}$ ) and allow adequate recovery (24-36 hours after vigorous exercise). [2,3,5] Based on the results of the assessment, a tailored day-to-day-program warranting these physiological principles can be developed helping to optimize the balance between training and recovery time in LNTC.

## Conclusion

An exercise or physical activity program with careful focus on appropriate training dose as well as recovery time is important for all individuals. This also applies to people with LTNC. Knowledge about individual fitness levels and relative intensity of common activities such as walking is essential for developing an individualized well-balanced training schedule. Further scientific investigation is required to assess the possible consequences of too much moderate/vigorous physical activity or not having enough time for recovery in this population. Evidence indicates that physical activity can deliver meaning-

ful benefits for people with LTNC such as stroke and CP; balancing appropriate training stress with adequate recovery is therefore imperative.

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