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Original Research

Muscle Weakness and Perceived Disability of Upper Limbs in Persons With Late Effects of Polio

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Abstract

Background: Muscle weakness in one or both upper limbs is common in persons with previous polio, but there is very limited knowledge how it influences daily life.
Objective: To assess muscle weakness and self-perceived disability of the upper limbs in persons with late effects of polio and evaluate their association.
Design: Cross-sectional study.
Settings: University hospital outpatient clinic.
Participants: Twenty-eight persons (mean age 67, SD 16 years) with late effects of polio in their upper limbs.
Main Outcome Measures: A fixed dynamometer (Biodex System 3 PRO dynamometer (Biodex Medical Systems Inc., Shirley, NY) was used to measure isometric shoulder abduction and elbow flexion, as well as isokinetic concentric elbow flexion and extension. A hand-held dynamometer (Grippit, Hägersten, Sweden) was used to measure isometric grip strength. The Disabilities of Arm, Shoulder and Hand (DASH) questionnaire was used to assess self-perceived disability of the upper limbs. The relationships between the measures were analyzed with the Spearman rank correlation coefficients (rho).
Results: The participants were 20%-31% weaker in their more-affected upper limb compared with their less-affected limb. The DASH score was on average 33.5 (SD 18.6), indicating a mild-to-moderate disability of their upper limbs. Changing a lightbulb overhead, carrying a heavy object, and performing recreational activities that required muscle force with the arms were perceived as most difficult. The correlations (rho) between the muscle strength measurements and DASH scores ranged from −0.46 (95% confidence interval [95% CI] −0.10 to −0.71) to −0.61 (95% CI −0.31 to −0.80) for the more affected upper limb, and from −0.54 (95% CI −0.21 to −0.76) to −0.68 (95% CI −0.41 to −0.84) for the less affected upper limb ($P < .05$-.01).
Conclusions: Persons with previous polio and muscle weakness in their upper limbs perceive difficulties to use their arms in daily life, especially when performing activities above their head and strenuous household or leisure activities. The fair-to-moderate correlations of muscle strength with self-perceived disability imply that the weakness can only partially explain the perceived disabilities of arm, shoulder and hand. Other factors are therefore important to consider in the rehabilitation of persons with late effects of polio and upper limb disability.

Introduction

Many persons afflicted by a poliomyelitis infection in their childhood or youth perceive new or increased impairments several decades later, the so-called late effects of polio or postpolio syndrome [1]. The most common impairments are muscle weakness, muscle fatigue, and musculoskeletal pain [2-4]. The muscle weakness often affects the lower limbs, but in many persons with previous polio muscle weakness also occurs in the upper limbs [5]. Studies have shown that these persons have significantly reduced grip strength [5,6] and elbow muscle strength compared with healthy individuals [7,8] and that the decline in upper limb muscle strength is related to increasing age [9]. The muscle weakness in the arm and hand can lead to difficulties in using the upper limbs in daily activities [5] and thereby impact on perceived participation in life situations. To be able to plan individually targeted rehabilitation interventions, a better understanding is needed of the association between muscle weakness in the upper limbs and performance of daily activities.

To the best of our knowledge, only 1 study has investigated how muscle weakness affects the ability to

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perform daily activities in persons with late effects of polio. Sunnerhagen et al [5] assessed grip strength and perceived ability to perform daily unilateral or bimanual activities by using the ABILHAND questionnaire. Bimanual activities often were more difficult to perform than unilateral hand activities, and the reduced grip strength was significantly correlated with the amount of perceived difficulties.

It is clinically well known, however, that the muscle groups in the upper limbs of persons with late effects of polio are affected to various extents. Therefore, it is not sufficient to measure only grip strength when the muscle weakness in the upper limbs is evaluated. To fully assess how muscle weakness influences the ability to perform daily arm and hand activities, muscle strength has to be measured in several muscle groups of the upper limbs. Furthermore, outcome measures that evaluate the ability to perform daily activities have to capture personal and instrumental activities, as well as work and leisure activities. One outcome measure that covers these aspects is the Disabilities of the Arm, Hand, and Shoulder (DASH) questionnaire. The DASH has been used in persons with different musculoskeletal disorders [10-14] and in persons with multiple sclerosis [15], but, to the best of our knowledge, not in persons with late effects of polio. Thus, the aim of this study was to assess muscle weakness and self-perceived disability of upper limbs by using the DASH in persons with late effects of polio and to evaluate their association.

Materials and Methods

Participants

This study is based on a purposive sample of 28 persons (of 30 contacted) from a postpolio outpatient rehabilitation clinic at a university hospital in the south of Sweden. The participants had taken part in the clinic's rehabilitation program and were included in the life-long follow-up. At the time of the study (September 2012 to March 2013), approximately 600 persons were registered in the database and approximately 20% met the following inclusion criteria: (1) a confirmed history of acute poliomyelitis affecting their upper limbs; (2) a period of recovery and functional stability of at least 15 years; and (3) new symptoms that had persisted for at least a year, such as muscle weakness and/or loss of functioning, in one or both upper limbs. In addition, the participants needed to understand Swedish to be able to respond to the DASH questionnaire. Exclusion criteria included other diseases, such as stroke, Parkinson disease, osteoarthritis, that could impact on muscle strength in the upper limbs. As part of the initial routine clinical examination and verification of previous polio in their upper limbs, an electromyogram had been recorded in the deltoid, biceps brachii, and first dorsal interosseus muscles in both upper limbs. One upper limb was defined as the "less affected" and the other as the "more affected," according to the National Rehabilitation Hospital Post-Polio Limb Classification [16] and the individuals' own descriptions. All persons had postpolio National Rehabilitation Hospital class II-V (indicating subclinical, clinically stable, clinically unstable or severe atrophic polio) in at least 1 upper limb.

Ethics

Verbal and written information about the purpose of the study was provided before inclusion, and each individual gave their written informed consent to participate. The principles of the Declaration of Helsinki were followed.

Procedure

The assessments were performed at the university hospital via a standardized protocol. When the individuals participated in a test–retest reliability study of upper limb isometric and isokinetic muscle strength measurements [17], data about self-perceived disability of upper limbs also were collected to relate to the strength measurements. In the present study, data from the second test occasion are presented. All measurements were performed in a quiet, separate room of the hospital. The strength measurements were performed first and thereafter the ratings of self-perceived disability of the upper limbs. In total, the entire test session lasted about 1.5 hours.

Muscle Strength Measurements

In our previous study, we showed that isometric and isokinetic muscle strength in the upper limbs can be measured reliably in persons with late effects of polio. Details about the test protocol and test procedures can be found therein [17]. In summary, the less-affected upper limb was measured first and thereafter the more affected, and the arm strength measurements were performed before the grip strength measurements. Before the tests, the dynamometer was calibrated and positioned according to the test protocol [17].

Arm Strength Measurements

Arm strength (isometric shoulder abduction and elbow flexion as well as isokinetic elbow extension and flexion) was measured with a Biodex System 3 PRO dynamometer (Biodex Medical Systems Inc., Shirley, NY; http://www.biodex.com). The participants were seated in the Biodex chair (hip flexion 70°-85° depending on their height) and were stabilized with straps across the shoulders and waist and support for their feet. The chair and dynamometer were adjusted (in height, rotation, and tilt) so the joint lines of the participants became aligned with the dynamometer movement axis. For measurement of isometric abductor strength, the