The mediation effect of lower limb strength on subjective and objective walking as it relates to health-related quality of life in multiple sclerosis

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Background

Multiple sclerosis (MS) is a chronic demyelinating disease characterized by lesions in the central nervous system (CNS) causing neuronal damage and resulting in physical and/or cognitive impairments.[1] Common impairments include, but are not limited to, spasticity, coordination deficits, gait impairments, ataxia, sensory disturbances, and strength deficits.[2] Each of these symptoms, to some capacity, have been known to impact quality of life (QoL).[3] Health related quality of life (HR-QoL) helps distinguish the impact a given disease, injury, or disability has on a person's ability to participate in their daily life and their perception of themselves.[4] When considering the strength deficits associated with MS, there are several muscle groups that are commonly weak in persons with MS (PwMS), including the hip extensors, knee extensors, knee flexors and ankle dorsiflexors.[5]

The literature supports that lower limb (LL) muscle weakness and gait impairments contribute significantly to decreased QoL in PwMS.[5] In one study, 70% of participants indicated difficulty walking was the most challenging aspect of having MS in their day-to-day life.[6] Approximately half of PwMS experience a form of gait dysfunction, with reduced speed and walking distance being the primary limitations secondary to deconditioning and loss of mobility.[5, 6, 7] Although current literature highlights that both gait and strength affect QoL in PwMS, to the best of our knowledge, no studies have evaluated if strength has an indirect effect through walking on QoL.

Purpose

The aim of this study was to determine if LL strength (hip extension: HE, knee extension: KE, knee flexion: KF, and ankle dorsiflexion: ADF) has an indirect effect on HR-QoL through objective (gait speed) or subjective (perceived impact) walking in PwMS.

Hypothesis: There will be a significant indirect effect between strength deficits and both Physical and Psychological HR-QoL through subjective and objective walking in PwMS.

Instruments

- The Timed 25-foot walk (T25FW) was used to measure objective walking as gait speed.
- The 12-Item Multiple Sclerosis Walking Scale (MSWS-12) was used to measure subjective walking as the impact of MS on walking
- The Biodex System 4 Pro Dynamometer was used to measure isometric LL strength as Peak torque in Newton-meters (Nm)

Figure 1. Biodex Dynamometer

Methods

Participants:

•A convenience sample (n= 175: 40 males, 135 females) of PwMS

Variables Collected:

•Demographics: age, gender, ethnicity, and race
- Mean age = 53 years; 7.4% Hispanic or Latino, 86.3% White or Caucasian

•Disease characteristics: Disease duration (median: 12.3 yrs)

•Disability: Patient Determined Disease Steps (PDDS) (median: 2..0 [moderate disability], range: 0-7 [no disability-wheelchair/scooter]

•Objective Walking; T25FW (gait speed)

•Subjective Walking: MSWS-12 (perceived impact)

•LL strength: Isometric peak torque (Nm) of HE, KE, KF and ADF

•HR-QoL: Multiple Sclerosis Impact Scale (MSIS-29) Physical and Psychological subscales

•Covariates: (1) Pain: Visual Analogue Scale (VAS-P), and (2) Fatigue: Modified Fatigue Impact Scale-5 item scale (MFIS-5)

Statistical Analysis:

- Bivariate analysis (Spearman rank coefficient) to examine relationships between strength, walking and MS impact variables.
- Mediation analyses were preformed using Hayes PROCESS. Statistics were performed using SPSS 26.0

Results

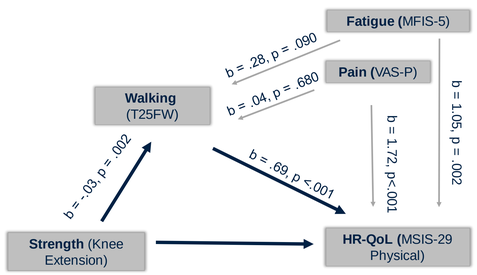

Figure 2. Mediation model of Knee Extension through the T25FW on the MSIS-29 Physical

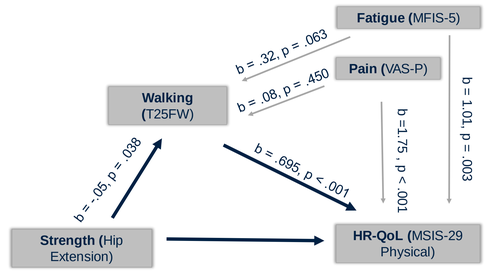

Figure 3. Mediation model of Hip Extension through the T25FW on the MSIS-29 Physical

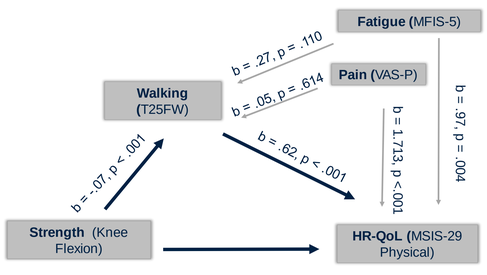

Figure 4. Mediation model of Knee Flexion through the T25FW on the MSIS-29 Physical

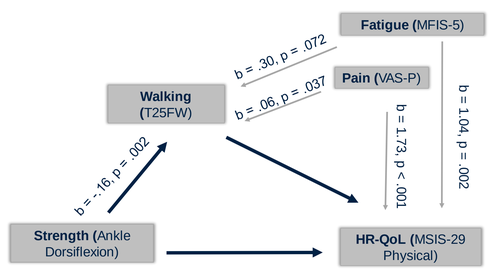

Figure 5. Mediation model of Ankle Dorsiflexion through the T25FW on the MSIS-29 Physical

Results (cont.)

- All LL strength measures had a significant indirect effect on the Physical HR-QoL through both gait speed and perceived walking, while controlling for fatigue and pain (Figures 2-5).
- HE, KF and ADF all had direct effects on Physical HR-QoL in only the T25FW models (Figures 3-5).
- LL strength does not impact the psychological HR-QoL through gait speed or perceived walking ability, while controlling for fatigue and pain.

Conclusion

The findings indicate that HE, KE, KF, and ADF affect both subjective and objective walking, which in turn affects Physical HR-QoL, but not Psychological HR-QoL. Results of this data provide a guide for physical therapists to focus rehabilitation programs on physical strengthening of the HE, KE, KF, and ADF and education on the importance of exercise to promote favorable outcomes improving HR-QoL in PwMS.[2]

This study is the first to examine the mediation effect of strength through perceived walking and gait speed on HR-QoL, which improves the understanding of mobility and how it impacts HR-QoL in PwMS.

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