Effects of Holding an External Load on the Standing Balance of Older and Younger Adults With and Without Chronic Low Back Pain

Leonardo Shigaki, PT, MSc,[a] Edgar Ramos Vieira, PT, PhD,[b] André Wilson de Oliveira Gil, PT,[c] Cynthia Gobbi Alves Araújo, PT, MSc,[a] Mariana Zingari Carmargo, PT, MSc,[c] Leandro Amaral Sturion, PT, MSc,[a] Marcio Rogério de Oliveira, PT, PhD,[c] and Rubens A. da Silva, PT, PhD[c]

Abstract

Objective: The purpose of this study was to assess the effect of holding an external load on the standing balance of younger and older adults with and without chronic low back pain (CLBP).

Methods: Twenty participants with and 20 without CLBP participated in the study. Each group contained 10 younger (50% men) and 10 older adults (50% men). Participants were instructed to look straight ahead while standing on a force platform during two 120-second trials with and without holding an external load (10% of body mass). The center of pressure area, mean velocity, and mean frequency in the anteroposterior and mediolateral directions were measured.

Results: Older adults had worse standing balance than younger adults did ($P < .001$, $d = 0.20$). There were no significant balance differences between participants with and without CLBP within age groups during standing balance condition. However, holding the external load significantly increased postural instability for both age groups and CLBP status, with mean effect size across center of pressure variables of $d = 0.82$ for older participants without CLBP and $d = 2.65$ for younger participants without CLBP. These effects for people with CLBP were $d = 1.65$ for subgroup of older and $d = 1.60$ for subgroup of younger participants.

Conclusion: Holding an external load of 10% of body mass increased postural instability of both younger and older adults with and without CLBP. (J Manipulative Physiol Ther 2017;xx:1-9)

Key Indexing Terms: *Postural Balance; Low Back Pain; Aging*

Introduction

Workplaces and occupational tasks often expose workers to risks for musculoskeletal disorders such as chronic low back pain (CLBP).[1,2] Chronic low back pain can be defined as lumbar or lumbosacral pain daily or almost daily for a minimum of 3 months with or without proximal radicular pain.[3] The main physical risk factors for CLBP are excessive or repetitive spine compressive forces during lifting, trunk flexion, repetitive movements, and awkward postures.[4,5] Prolonged static postures can also overload the passive structures of the spine, causing discomfort, physical stress, and inflammatory responses, resulting in low back pain.[6-8] There is a cause-effect relationship between excessive back physical exertion during work and acute low back pain as well as CLBP.[9,10]

Chronic low back pain is a common health problem worldwide,[11] with a higher prevalence in older adults (aged 60+).[12] Chronic low back pain can be associated with motor control impairment, altered lumbosacral proprioception, increased postural instability, and older adult falls when the postural demands are increased.[13-16] Some studies have found poorer postural control in participants with CLBP compared with participants without CLBP in various standing conditions.[17,18] Regarding increases in

[a] Laboratory of Functional Evaluation and Human Motor Performance (LAFUP), Londrina, Brazil.

[b] Physical Therapy & Neuroscience Departments, Wertheims' Colleges of Nursing and Health Sciences & Medicine, Florida International University, Miami, FL.

[c] Universidade Norte do Paraná, Laboratory of Functional Evaluation and Human Motor Performance (LAFUP), Londrina, Brazil.

Corresponding author: Rubens Alexandre da Silva, PhD, Universidade Norte do Paraná (UNOPAR), 675 Paris Av, Londrina-PR, Brazil, CEP 86041-120. Tel.: + 55 43 3371 7700x7990; fax: +55 43 3371 7721. (e-mail: *rubens@unopar.br*).

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postural demands, Hendershot et al[19] evaluated the postural control of 12 healthy young adults in different trunk flexion positions with external loads and found a significant dose-response relationship between increased trunk flexion and decreased balance.

Good postural control is essential for performing activities of daily living; therefore, it is important to assess postural control in people with and without CLBP.[18] Holding and lifting external objects are tasks that younger and older adults perform daily. However, few studies have investigated the effects of holding an external load on the standing postural control of older adults with CLBP.

Back injuries during occupational and recreational activities commonly involve cumulative trauma from repetitive or prolonged spinal loading.[20-22] Repetitive and prolonged loading of the posterior passive tissues of the spine result in time-dependent changes in intervertebral disc mechanics that slowly deform and creep because of its viscoelastic characteristics.[22] Sustained loading and resultant creep can cause progressive reduction in viscoelastic tissue strength with decline of the margin of safety until injury occurs as a result of tissue strain.[21,22] This occurs even when people are not lifting heavy loads but simply staying in a posture for a prolonged period, resulting in injury, instability, and back pain.[20-22] To prevent the incidence or aggravation of back pain and falls caused by balance impairments as a result of repetitive or prolonged spinal loading, we need to understand the effects of holding external loads on younger and older adults with and without back pain.

Therefore, the present study aimed to assess the effects of holding an external load on the standing balance of younger and older adults with and without CLBP. The hypothesis was that younger adults would present better standing balance than older adults and that holding an external load would impair postural control in both younger and older adults with and without CLBP.

Methods

Participants

Twenty participants with and 20 without nonspecific CLBP (multifactorial and/or mechanical back problems)[20] were recruited from universities, rehabilitation centers, and the community in Londrina, Brazil. The younger participants were students and workers between 18 and 45 years old, and the older participants were aged 60 years and older. Both groups were matched by age and sex (50% men and 50% women). All participants signed an informed consent form before participation. The protocol and consent form were approved by the Universidade Norte do Paraná research ethics committee (#250.551).

The inclusion criteria for the participants with CLBP were having lumbar or lumbosacral pain daily or almost daily for a minimum of 3 months with or without proximal radicular pain. The inclusion criteria for participants without CLBP were not having back pain for more than 1 week in the previous year. All participants had to have no history of foot, knee, and hip disorders; pelvic or spinal surgery; congenital spinal malformation or scoliosis; degenerative neurologic disease; severe labyrinthitis; chronic cardiovascular or respiratory diseases; falls in the past year; and Mini–Mental State Examination score <21.[23] In addition, no participant could be enrolled in any regular physical activity program or back treatment during the study period. A physiotherapist (MR Oliveira) performed all evaluations and determined CLBP status for all participants.

Questionnaires and Equipment

The participants with CLBP completed the Portuguese versions of the following questionnaires and tools:

1 The Roland–Morris Disability Questionnaire (RDQ)—score range: 0 = no disability to 24 = severe disability[24]
2 The Fear-Avoidance Beliefs Questionnaires for physical activities (FABQp)—score range: 0 to 24 with higher scores meaning more fear[25]
3 The Fear-Avoidance Beliefs Questionnaires for work activities (FABQw)—score range: 0 to 42 with higher scores meaning more fear[25]; for the retired older adults, the term *work* was changed to *social or home activities*
4 A 10-cm visual analog scale (VAS)—score range: 0 = no pain, 10 = worst pain you can imagine[26]

Standing balance of all participants was assessed using a force platform (BIOMEC400, EMG System do Brasil, Ltda, SP).

Experimental Protocol

After familiarization, the participants performed two 2-minute trials of barefoot bipedal standing with eyes open on a force platform holding and not holding a load in random order. The participants took a 3-minute rest break between each of the 4 trials.[26] The participants were instructed to stand looking at a target (15 × 15 cm) at eye level on a wall 2 m away while holding an external load (load condition; Fig 1A), and with the arms alongside the body (no load condition). A landmark on the force platform was used to standardize the feet position. An investigator stood close to the participants during testing to prevent falls.

The magnitude of the external load was 10% of total body mass. The load level established was submaximal and comparable to loads handled during activities of daily living.[27] The load was placed in a grocery basket (38 × 19 × 25 cm), which was handled as close to the body as possible