# Comparison Between Elderly and Young Males' Lumbopelvic Extensor Muscle Endurance Assessed During a Clinical Isometric Back Extension Test

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## Abstract

**Objective:** Endurance of the back extensor muscles has become important for clinical decisions that guide interventions, particularly for chronic low back pain patients. Very little information is available regarding back muscle endurance in the elderly. The aim of this study was to investigate back extensor muscle endurance in healthy elderly subjects during a modified Sorensen test.

**Methods:** Sixteen elderly and 20 young male adults participated in our cross-sectional study. The subjects performed a modified Sorensen test (on a 45° Roman chair) to quantify lumbopelvic extensor muscle endurance. Pre and postfatigue back extension maximal voluntary force was assessed according to an isometric lift test in a semicrouched position. Endurance time, perceived exertion (Borg CR10 scale), and postfatigue reduction of lifting force were recorded and compared among groups.

**Results:** Elderly subjects showed a trend toward decreased endurance time compared to young adults, but the difference was not significant. Similar perceived exertion and diminished maximal force after the fatiguing protocol were observed in both young and elderly subjects. Maximal isometric lift force was significantly associated with endurance time in young but not in elderly subjects.

**Conclusions:** Lumbopelvic extensor muscle endurance and perceived exertion do not differ between young and healthy elderly individuals. However, back muscle endurance seems to be modulated by different neurophysiologic factors in the elderly. Normative data on young adults should be interpreted with caution in assessing back fitness in elderly subjects. (J Manipulative Physiol Ther 2009;32:521-526)

**Key Indexing Terms:** *Physical Endurance; Isometric Contraction; Muscles; Physical Exertion; Aged; Diagnosis; Chiropractic*


Low back pain (LBP) is one of the leading causes of disability, contributing to 40% of all workdays lost in the United States of America.[1] Because of the cost associated with work-related LBP disabilities, most published studies have focused on the working-aged population. However, back pain and neck pain are also common musculoskeletal disorders affecting, each month, approximately one third of adults older than 70 years.[2] The annual prevalence of chronic low back pain (CLBP) ranges from 44% to 84% in adults older than 65 years.[3,4] In Canada, CLBP is the third and fourth most important chronic health problem in women and men, respectively, older than 65 years.[5] Women with severe CLBP are 3 to 4 times more likely than other women to have difficulty with light housework tasks and 2 times more likely to encounter problems with mobility tasks, such as climbing stairs, walking, or lifting.[6] In Canada, it is estimated that approximately 25% of the population will be older than 65 years by 2031.[7] Anticipating the growing impact of the ageing population, a better understanding of CLBP's impact on physical capabilities in elderly people is important.

In working-aged adults, CLBP has been associated with increased fatigability of the lumbopelvic extensor muscles, as demonstrated by shorter back endurance test duration.[8-11] In all back endurance protocols reported in the literature, isometric testing procedures with the trunk positioned in a weight-dependent position, such as the Sorensen test,[12] may be most suitable in clinical settings. Weight-dependent position tests of muscle endurance are cost-effective, easy to perform in a clinical context, and require no special equipment. The Sorensen test is conducted with subjects

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**Table 1.** *Study subject characteristics*

| | Young subjects | Elderly subjects | *P* |
|---|---|---|---|
| Age | 22.8 (3.1) | 72.8 (4.7) | .000 * |
| Weight (kg) | 77.3 (10.8) | 79 (6.7) | .630 |
| Height (m) | 1.79 (0.1) | 1.71 (0.1) | .001 * |
| BMI (kg/m$^2$) | 24.1 (2.5) | 27.1 (2.6) | .002 * |

BMI indicates body mass index. Data are presented as means ± SD and their relative *P* values.
* $P < .05$.

lying prone, the upper body unsupported in a horizontal position relative to the ground, and the lower limbs fixed by straps. This procedure has been found to be a reliable measure of position-holding time and can discriminate between subjects with and without LBP.[13,14]

Ageing has been related to changes in the neuromuscular system. Among these changes, loss of muscle force generation capacity,[15,16] a slower firing rate of motor units,[17] and a reduction in motor unit and muscle fiber number have been observed.[18] Together with the loss of muscle fibers, a selective decrease in fast twitch fibers has been demonstrated with advancing age, leading to alteration of muscle fiber type proportion.[15] This shift in fiber-type proportion appears to contribute to changes in muscle fatigability in healthy elderly individuals.

To our knowledge, very few studies have assessed back muscle endurance in elderly subjects. The current investigation aims to evaluate back extensor muscle fatigability in healthy elderly adults by quantifying endurance time during a clinical isometric back endurance test and the posttest decrease of lumbopelvic extensor maximal force. We hypothesized that elderly subjects will experience greater fatigability of lumbopelvic extensor muscles than young subjects.

## Methods

### Participants

Sixteen community-dwelling elderly males and 20 young male adults were recruited from local and university communities. All subjects gave their informed written consent to participate according to Université du Québec à Trois-Rivières Ethics Committee guidelines. Descriptive data on the study participants are presented in Table 1. All subjects were free of LBP, defined as no pain or pain occurring less than once a week at low intensity, without limitation of functional tasks or daily living activities. The exclusion criteria were acute illness or pain and medical conditions that could make physical effort unsafe, such as, but not limited to, hypertension, cardiac or respiratory disease, neurologic symptoms, and musculoskeletal disorders. The elderly subjects completed the Mini-Mental State Examination—a brief screening test for dementia and general cognitive impairment covering several aspects of cognition.[19] They were excluded from the study if their Mini-Mental State Examination scores were lower than 21.

### Instrumentation and Procedures

All subjects performed 2 sessions in laboratory settings, separated by a week. Each session was conducted by the same investigator. The first session allowed subjects to become accustomed to the laboratory settings and with the experimental procedures. In the first session, all participants completed a modified physical activity readiness questionnaire to screen for contraindications to physical efforts, and arterial blood pressure was measured. They were also instructed to perform 4 trials of maximum voluntary static lifts in a semicrouched position separated by a 2-minute rest period. A resistive load cell (Model LSB350, Futek Advanced Sensor Technology Inc, Irvine, Calif) attached to a platform measured peak force during each trial of maximum voluntary static lifting. The subjects assumed a bilateral symmetrical leg lift position with forearms in pronation and the handle adjusted to knee height. They were then instructed to pull steadily and maximally in a back extension effort on the load cell for 5 seconds. Instructions regarding neutral posture of the lumbar spine were carefully provided.

A week later, the subjects were asked to perform 2 blocks of 4 trials of maximal voluntary static lifting, according to the same experimental protocol used in the first session. Between blocks of static lifts, they undertook a body weight-dependent isometric back extension endurance test. A modified version of the Sorensen endurance test was undertaken in a prone position on a 45° Roman chair, the iliac crests aligned with the edge of the chair cushion. Their body was maintained unsupported (head, arms, and trunk) as long as possible in a horizontal position relative to the ground. They were also instructed to maintain lumbar lordosis as stable as possible and to keep their torso in contact with a static reference providing tactile proprioceptive feedback over the left scapula. The investigator (AC) gave similar verbal encouragement to all subjects who were required to rate their perceived effort throughout the back endurance test on the Borg CR10 scale (range, 0-10).[20] Before the fatiguing protocol, they were informed that the upper limit of the rate of perceived exertion (RPE = 10) scale should correspond to the most strenuous effort they had ever experienced in their lumbopelvic extensor muscles.

### Data Analysis

Endurance time was calculated in seconds. Average maximal force was calculated for each of the two 4-trial blocks of maximal static lifting (pre and postfatigue) and normalized to each subject's weight (relative lift strength). To assess the reduction of muscle force induced by the fatiguing task, the postfatigue values were expressed as a