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Research Article

Work-Related Differences in Postural Control and Habitual Physical Activity of Older Adults

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Abstract

Physical Activity (PA) is highly recommended to improve balance, prevent falls and maintain physical function in older adults. Unfortunately, for some people, engagement in PA tends to decline following retirement. The aim of this study was to investigate the differences in postural control and in the level of Habitual PA (HPA), between older workers and non-workers. Forty-one (41) older adults, aged 65 and over, were enrolled in two groups: Workers (n=25) and non-workers (n=16). The assessment included: Demographic and anthropometric measures (ex: Sex, age, work status, back status: Pain or not, retirement, mass, height, body mass index), postural control trials under platform during a semi-tandem posture, habitual physical activity by the Baecke Physical Activity Questionnaire (BPAQ) and fear of falling self-reported (Modified-Falls Efficacy Scale).Unexpectedly, no significant difference between groups was found for postural control measures. Significant differences were however found for work index by BPAQ (p=0.03) and PA level related to main occupation (p=0.03). Workers have slightly higher scores in work index associated with physical activity (2.9 points±0.6) than non-workers (2.5 points±0.5), while 17% of workers had a middle level of occupation such as factory work, plumbing, carpentry, and farming, as compared to non-workers. Older workers reported comparable postural control to non-workers, being even more active related to work index and showing a middle-level of occupation compared to non-workers. These results have implications for fall prevention and work rehabilitation when associated with the aging process or age effects on work.

Keywords: Aging; Habitual physical activity; Occupation; Older worker; Postural control

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Introduction

The proportion of Canadians over the age of 65 is increasing (19% as of 2021) [1,2], with more older adults remaining active in the workforce [3]. Work status can impact the levels of Physical Activity (PA) in older adults [4-7], while age-related changes in the musculoskeletal, neural and sensory systems (e.g., decreased strength and mobility; decline in physical function and motor control) added to lower PA levels, can lead to altered postural control mechanisms and increased risk of falls, disability and mortality [8-11]. Developing a better understanding of how retirement from the workforce is related to postural stability and Habitual Physical Activity (HPA) can help in the development of healthy aging strategies, both for older adults who remain in the workforce and for those who choose to retire.

In short, HPA refers to any activity that people do in their daily life and natural environment, and covers three distinct dimensions: PA at work, sports during leisure time, and other PA during leisure-time [10-12]. While HPA is a measure of performance rather than capacity, it clearly has beneficial links to quality of life [10,13]. However, retirement from the workforce may lead to changes in both the type and volume of HPA. Loss of occupational and travel-linked PA contributes to reductions in overall PA volume after retirement [4], although recreational and household PA tends to increase, at least during the first few years after retirement [4,6]. According to Brainard et al., [4], retired people have distinctive perceptions of their time and availability to do PA [4,7] that cause changes regarding maintenance and sustainability of viable forms of PA, motivations, personal mobility and perceived benefits of PA [4,14]. Regardless of employment status, HPA can help to maintain and improve balance and physical function in older adults, and prevent falls and fall-related injuries [15-17]. Current recommendations are to undertake at least 150 minutes of moderate-intensity PA, or 75 minutes of vigorous-intensity aerobic PA, per week. Older adults should also engage in PA that emphasizes functional balance and strength training, at a moderate or greater intensity, for three or more days a week, to enhance functional capacity and prevent falls [15,18]. In this sense, understanding and quantifying the level of HPA of older adults, and how it is affected by retirement, can provide key information to prevent future functional limitations and fall-related injuries [6,8,9,14,19,20]. Few studies have compared older workers and non-workers based on a set of variables for physical capacity, occupation, and balance performance regarding fall prevention.

The purpose of the present study was thus to compare postural control and HPA between older workers and non-workers. We expected that non-workers would present poor postural control as well as lower HPA scores (work, sports, leisure time and global) with the potential for more fall risks than older adults who were still active in their occupation.

Materials and Methods

Participants

This cross-sectional study took place between June 2020 and March 2022 at the Université du Québec à Chicoutimi-UQAC (Quebec, QC, Canada) in its Physiotherapy Clinic. A convenience sample of forty-one (41) older adults were recruited voluntarily for the study. As we did not find a specific study comparing working and non-working adults aged 65 and over mainly in relation to postural control and PA within a fall prevention perspective, we opted for a study that differentiated active and non-active older adults, based on each individual's capacity for physical exercise or activity. The power sample calculation based on this study [21] allowed us to give a minimal idea that our sample was, at least, adequate to test comparisons with a significant level of 0.05 and a power of 0.80 (more conservative). This previous comparison was performed by means of the postural control variable of the pressure center displacement area (a power and sensible parameter of postural control using a force platform), differentiating the two groups: Low (9.95±3 cm^2) versus normal (7.85±2 cm^2) physical capacity during balance performance, using a force platform. From this analysis, forty-six (46) (23 in each group) would be needed to compare two groups: Older workers and non-workers from a simple unpaired t-test (95% CI) with a power of 0.80 related to postural control. Our study was then approved by the local ethics committee (CER: #602.605.01) and all participants read and signed an approved consent form.

The inclusion criteria were: a) Age 65 years+; b) being physically independent and c) a good cognitive status (higher than 22 points on the Mini-Mental State Examination) [22]. Participants were excluded if they had a history of: a) Musculoskeletal surgery; b) scoliosis or congenital malformation of the spine (e.g., spondylolysis, intervertebral fusions, 4 lumbar vertebrae); c) severe systemic or degenerative syndrome(s) or disease(s) involving the musculoskeletal, cardiovascular, respiratory or nervous system; d) neurological (e.g., stroke) and vestibular impairment (e.g., vertigo); e) treatment with anxiolytic, anticonvulsant or antidepressant medication or other medications that may influence neuronal excitability; f) occurrence of a fall within the last six months.

Procedures

All the procedures were performed by two trained investigators (physiotherapy and kinesiology students). Data collection for each participant was completed in one session lasting approximately one hour.

Measurements

Participant profiles

Semi-structured questionnaires, regarding sex, age, work status (worker, non-worker) and self-reported nonspecific Low Back Pain (LBP), were collected. Participants were then assigned to one of two groups, based on work status: Workers (n=25) and non-workers (n=16). Unfortunately, we were not able to equalize the groups, due to the timeframe of the project.

Body Mass Index (BMI)

The BMI was calculated according to the National Institutes of Health protocol by dividing participant weight, in kilograms, by the square of their height, in meters (kg/m^2). Participants were classified as: Underweight (BMI<18.5); Normal weight (18.5-24.9); Overweight (25.0-29.9); Obese class I (30.0-34.9); Obese class II (35.0-39.9) and Obese class III (>=40.0) [23].

Postural control measurement

Postural oscillations and reactions when keeping a semi-tandem posture (Figure 1) were measured with a force platform (BIOMEC 400, EMG System do Brasil, Ltda, SP) [20,24]. Each participant was allowed to practice the semi-tandem posture before testing and to choose their preferred forward leg for the upcoming evaluation, since only one stance position was tested. For data acquisition, participants stood barefoot (Figure 1A), with their arms alongside their body, and with eyes open looking at an eye-level target on a wall, 2 meters away. An investigator stood close to the participant during testing to prevent falls and injuries [20,24]. All subjects performed two trials with a 30-second rest interval between them [25].

The force feedback data on the platform was collected with a sampling rate of 100 Hz and converted into stabilographic data (Figure 1B) to calculate Center of Pressure (CoP) parameters [20,24]: Antero-Posterior (AP) and Medio-Lateral (ML) amplitudes (cm); area (cm^2); AP and ML frequencies (Hz); AP and ML velocities (cm/s). The mean of these parameters was used for statistical analyses.

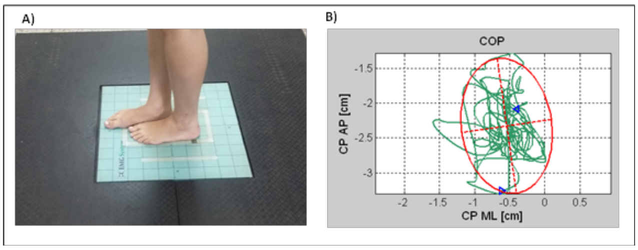

Figure 1: 1A). Illustration of participant's position on a force platform during the semi-tandem posture (BIOMEC 400, EMG System do Brasil, Ltda, SP); 1B. Demonstration of the stabilographic analyses output related here to the parameter of the center of pressure of the feet on the platform (CoP). The derivates of CoP were further calculated (velocity, frequency and amplitude) from this typical analysis.

Habitual Physical Activity (HPA)

The Baecke Physical Activity Questionnaire (BPAQ) was used to measure HPA. Self-reported questionnaires, such as the BPAQ, are accessible, low-cost and easy to apply options for epidemiologic studies [10-12]. The BPAQ includes 16 questions, leading to four HPA scores for the past 12 months: 1) Work index (8 questions); 2) Sport index (4 questions) and 3) Leisure-time index (4 questions), as well as Global index of HPA (the sum of the three scores) [11,12,16]. The score of each index was calculated using the codes and formulas in the questionnaire's appendix [11,16].

Three levels of occupational PA were further defined according to The Netherlands Nutrition Council [11]: 1) Low level, for occupations such as clerical work, driving, shopkeeping, teaching, studying, housework, medical practice, and all other academic-related occupations; 2) middle level, for occupations such as factory work, plumbing, carpentry, and farming; 3) high level, for occupations such as dock work, construction work, and sports [11]. For non-worker participants, the dimension 'main occupation' was adapted to the principal or most frequent social or home maintenance activities, as proposed by previous studies [20,23]. The sports index was calculated by the code and formula according to a multiplication of the intensity of the sport which was played, the amount of time per week playing that sport, and the proportion of the year in which the sport was played regularly [11].

Sports were subdivided into three levels of PA according to Durnin and Passmore [11,26]: 1) Low level, for sports such as, billiards, sailing, bowling, and golf (average energy expenditure 0.76 MI/h); 2) middle level, for sports such as, badminton, cycling, dancing, swimming, and tennis (average energy expenditure 1.26 MI/h); and 3) high level, for sports such as, boxing, basketball, football, rugby, and rowing (average energy expenditure 1.76 MI/h) [11,26].

Falls efficacy scale

The validated French version of the Modified-Falls Efficacy Scale (M-FES Fr), was used to assess fear of falling [27]. The M-FES Fr consists of an 11-point response scale (from 0 "not at all confident" to 11 "completely confident") assessing how confident older adults are to undertake 14 daily activities within the past 12 months. Higher scores reflect more confidence and less fear of falling, while lower scores reflect less confidence and a greater fear of falling [27].

Data analysis

CoP parameters and HPA were compared between the two participant groups: Workers and non-workers. The Shapiro-Wilk test was first used to confirm data normality and determine the appropriate statistical tests for comparison. To describe the sample profile, variables were also described in terms of frequency, mean and standard deviation. An unpaired student's t-test was used to compare the two groups for age, BMI, all CoP parameters, HPA, time of sports practice and fear of falling when normality was accepted. The percentage (Δ%) from mean values differences between groups as well as the effect size, were calculated for clinical overview of data [28,29]. The effect size was calculated to accord with Glass and Hopkins, using Hedge's coefficient g: Small (g = 0.20-0.49), moderate (g = 0.50-0.79) and large (g ≥ 0.80) [28,29]. All statistical analyses were performed with an alpha level of 0.05, using IBM SPSS version 28.0 software (IBM, Armonk, NY, USA).

Results

Participants' general characteristics (n=41) were mostly female (23/41), aged 65-74 years (28/41) and overweight or obese (24/41). Based in work status, 61% (n=25) were still workers, while 39% (n=16) were non-workers. The PA level associated with the main occupation varied from low (83% of sample) to middle level (17% of sample), while 60% of sample declared not to suffer from nonspecific low back pain or any back pain. Unexpectedly, no significant differences were found between the groups for CoP parameters related to postural control assessment. Figure 2 shows the differences between groups for each CoP variable analyzed. In addition, table 1 presents a perspective view of data related to the percentage of mean differences, as well as the effect size from the magnitude of changes between the two groups for the CoP parameters, with some of these results showing no significant difference between them, based on their t-test results.

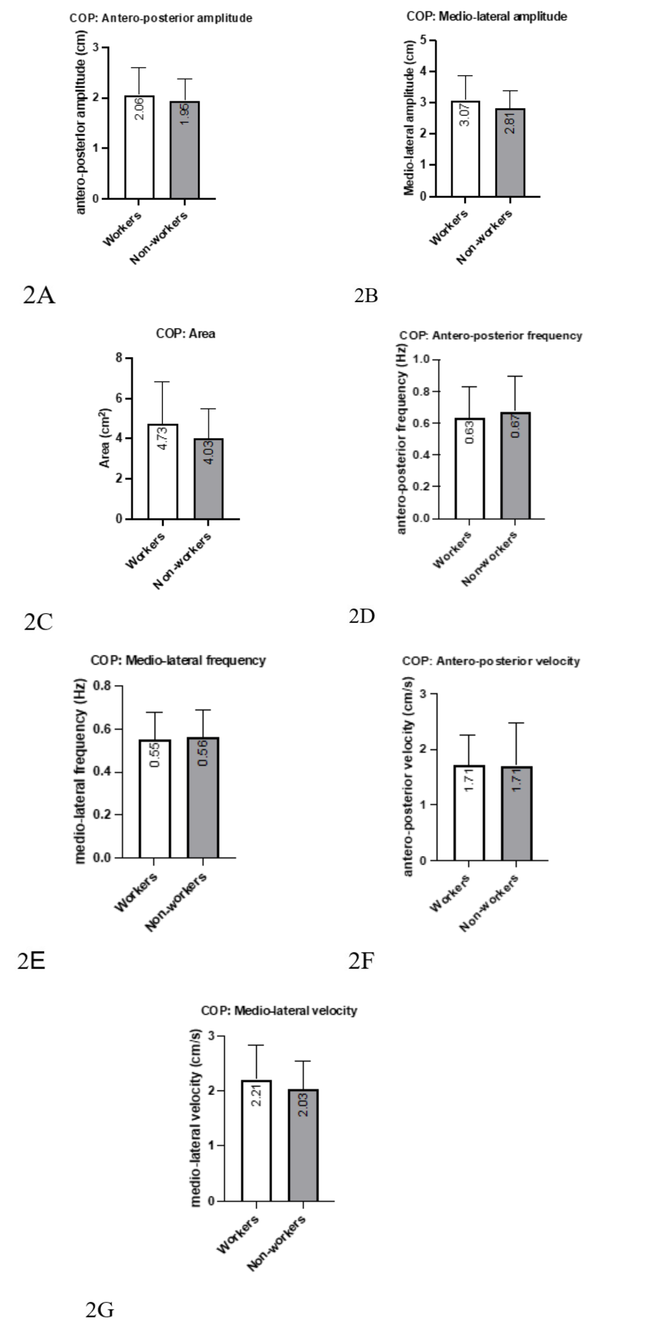

Figure 2: Means values of the parameters of the center of pressure (error bars = standard deviations) during postural control performance between older workers and non-workers. 2A. antero-posterior amplitude (cm); 2B. medio-lateral amplitude (cm); 2C. Area (cm^2); 2D. antero-posterior frequency (Hz); 2E. medio-lateral frequency (HZ); 2F. antero-posterior velocity (cm/s); 2G. medio-lateral velocity (cm/S).

Variables	Workers (n=25) Mean ± SD	Non-workers (n=16) Mean ± SD	Differences	%	Hedge's g	p-Value
CoP						
AP ampl. (cm)	2.05 ± 0.5	1.95 ± 0.4	-0.10	5.1	-0.21	0.50
ML ampl. (cm)	3.07 ± 0.7	2.81 ± 0.5	-0.26	9.2	-0.35	0.26
Area (cm²)	4.73 ± 2.0	4.03 ± 1.4	-0.70	17.3	-0.36	0.24
AP freq. (Hz)	0.63 ± 0.2	0.67 ± 0.2	+0.04	5.9	0.19	0.54
ML freq. (Hz)	0.55 ± 0.1	0.56 ± 0.1	+0.01	1.7	0.07	0.81
AP vel. (cm/s)	1.71 ± 0.5	1.71 ± 0.7	-0.00	0.0	-0.005	0.98
ML vel. (cm/s)	2.21 ± 0.6	2.03 ± 0.5	-0.18	8.8	-0.30	0.34

Table 1: The percentage of mean differences from CoP results between workers and non-workers (mean ± SD), including effect size-based Hedge's analysis.

*CoP= Center of pressure. AP= antero-posterior. ML= medio-lateral. ampl= amplitude. freq=frequency. vel=velocity

The results of the comparison between workers (25/41) and non-workers (16/41) are reported in table 2. No differences were found for age or BMI. Significant differences were found for work index by BPAQ (p=0.03, higher HPA for workers) and PA level - main occupation (p=0.03, higher PA level for workers).

Variables	Workers (n=25)	Non-workers (n=16)	Differences	%	Hedge's g	p-Value
Age (years)	71.9 ± 4.5	71.6 ± 4.9				0.85
BMI (kg/m2)	28.4 ± 6.1	26.2 ± 5.4				0.24
HPA (BPAQ)						
Work index	2.9 ± 0.6	2.5 ± 0.5	-0.45	16.0	-0.69	0.03
Sport index	2.8 ± 0.9	3.2 ± 0.7	+0.40	12.5	0.40	0.21
Leisure-time index	3.3 ± 0.7	3.2 ± 0.7	-0.06	3.1	-0.08	0.79
Global index	9.4 ± 2.6	8.9 ± 1.9	-0.47	5.6	-0.19	0.53
Sports practice time (min/week)	168.0 ± 102.4	175.6 ± 89.8	+7.62	4.3	0.07	0.80
M-FES Fr (/140 points)	137.6 ± 9.3	135.8 ± 8.2	-1.78	1.3	-0.19	0.53
PA level - main occupation						**0.03**
Low level	18 (43.9%)	16 (39.0%)				
Middle level	7 (17.1%)	0 (0.0%)				
High level	0	0				
Presence of nonspecific LBP						**0.46**
No	14 (34.1%)	10 (24.4%)				
Yes	11 (26.8%)	6 (14.6%)				
Sports practice						**0.44**
No	6 (14.6%)	2 (4.9%)				
Yes	19 (46.3%)	14 (34.1%)				

Table 2: General characteristics of the sample and comparison between the two groups (older workers and non-workers) for demographic, anthropometric, HPA and main occupation.

*Age, BMI and BPAQ are expressed as mean ± SD (standard derivation). Other data are expressed as n (%). BMI = body mass index. BPAQ= Baecke physical activity questionnaire. M-FES Fr= French version of the Modified-Falls Efficacy Scale. LBP= low back pain.

Discussion

The purpose of this study was to compare measures of postural control and HPA between older workers and non-workers. We expected better postural control and high HPA scores among the workers. In line with the first of these expectations, no differences were found between the two groups for any measures of postural control (CoP parameters). Regarding our second expectation, two measures of HPA (work index of the BPAQ; PA level - main occupation) were higher for the workers than for the non-workers. This could be explained by the size sample for group comparison in our analysis (25 workers vs. 16 non-workers), despite our preliminary calculation (prevision of 23 in each). From the CoP area data of postural control, we observed a real difference between them of 17% (effect size of 0.36; table 1), which could suggest a type II error in our power analysis.

For the BPAQ, only the work index was significantly different between the two groups (p=0.03), with no difference on the sport or leisure-time indices. Additionally, while none of our participants had 'high' PA level main occupations, only participants in the workers group had main occupations (p=0.03) classified as 'moderate' PA level (7/25 workers vs. 0/16 non-workers) such as factory work, plumbing, carpentry, and farming. According our procedure, for non-worker participants, the dimension 'main occupation' was adapted to the principal or most frequent social or home maintenance activities, as proposed by previous studies [19]. Few other studies [30] have investigated these variables from a similar sample, which makes it difficult to generalize our findings, discuss and conclude further.

Our findings do however suggest that efforts should be made to encourage older adults to increase their levels of sports and leisure PA upon retirement, particularly if their jobs provided a large part of their PA. The health benefits of PA are clear, from the standpoint of preventing weight gain, maintaining normal blood pressure, reducing systemic inflammation, decreasing stress, and stimulating the production of neurotransmitters and neurotrophins that maintain neurons and improve mood [15,18,30-33]. Regular PA reduces the risk of sedentary behavior, significantly increases quality-adjusted life years, and reduces disability-adjusted life years [31,32]. In older adults, PA also helps to prevent falls and fall-related injuries and a decline in bone density and functional ability [15-18]. There are strong recommendations to the effect that multicomponent PA focusing on functional balance and strength training enhance functional capacity and prevent falls [15,18].

According to Barnett et al., [6], retirement is associated with life changes including those involving social networks, income, and time flexibility that may affect physical activity behaviors. In retirement age, walking was the most popular leisure PA for persons aged 55-74 [4,34]. Walking was also the most frequent activity in our study. There are ''favourable and unfavourable lifestyle changes'' at retirement that can influence total PA [4,35]. Retirees presented significantly greater PA, particularly in walking and moderate-intensity activities, compared with pre-retirement [4], this is for those who retired at a younger age, who had better baseline physical function, and/or who worked full-time prior to retirement [4,30]. In our study, our participants tended to be quite physically active.

The fact that our sample population was generally physically active and independent may also explain the lack of significant differences between groups on our measures of postural control. Both groups reported more than 150 min of sports practice per week, on average, which is in line with the WHO 2020 guidelines for older adults [15,17]. Both groups also had high scores on the M-FES Fr (with no difference between the groups), which reflects a low fear of falling [27].

Our data did not, however, compare the postural control of our older adult population with healthy younger adults. Postural control generally decreases with age, due to biological changes such as decreased strength, mobility, and motor control, which increases fall risk [20]. This can be somewhat offset with PA, however, so older adults, whether working or retired, should be encouraged to engage in multicomponent exercise programs for fall prevention and to preserve or improve physical function, balance and mobility. This could also provide benefits for workers who want, or need, to continue working over the age of 65 [5,6,14-18,36]. According to Scott et al., [30], among workers aged 65 years and older, falls (non-injurious and injurious) are associated with subsequent health-related work limitations.

On the other hand, we did not evaluate other factors that might impact HPA, such as older age (75+ years) and muscular strength. The interpretation of our data is also somewhat limited by a lack of objectively measured PA (e.g., using activity tracking technology), measures of physical performance (e.g., exercise capacity), or measures of health, mood, quality of life, and social support. Finally, the sample size could explain our results for postural control (type II error for some comparisons), even with a previously calculated power analysis from an estimated study, due to the fact that there were no other studies of this type in the literature. More studies are necessary, as well as a longitudinal overview from new data to better understand the changes in HPA patterns along the three distinct dimensions of work, sport, and leisure time. These future directions for research could help to target specific PA intervention strategies, including balance for the transition period from working to retirement [4], to promote continued or increased HPA in the retirement years and consequently prevent falls and injuries with age. These study results have implications for fall prevention and work rehabilitation associated with age factors.

Conclusion

Our results demonstrated no differences in postural control between older workers and non-workers. However, older workers were more physically active than their age-matched non-workers. These differences were specific to the work index of the BPAQ and PA levels in the participants' main occupation, suggesting that work cessation is associated with a decrease in HPA. Further research is needed to identify the effect of retiring on engaging in PA and the obstacles associated with balance and fall risks/injuries in older adults.

Statements and Declarations

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Competing interest

The authors certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Authors' contributions

Conceptualization, R.A.d.S.; methodology, L.VN., R.A.d.S., and L.D.B.; data and formal analysis, M.d.C.C.d.L., R.M.L.d.A., L.D.B., and R.A.d.S; investigation, R.A.d.S., M.d.C.C.d.L., and R.M.L.d.A; writing—original draft preparation, M.d.C.C.d.L., M.B.C; writing-review and editing, R.A.d.S., M.d.C.C.d.L., L.D.B., M.B.C.; L.V.N., H.M.A., and R.P; supervision, R.A.d.S.; project administration, R.A.d.S., funding acquisition, R.A.d.S. All authors have participated to drafting the manuscript. All authors read and approved the final version of the manuscript.

Data availability

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.

Ethics approval

This study was approved by the local ethics committee (CER: #602.605.01).

Consent to participate

All participants read and signed an approved consent form.

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