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The work ability index and functional capacity among older workers

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ABSTRACT | Background: Decreases in functional ability due to aging can impair work capacity and productivity among older workers. **Objective:** This study compares the sociodemographics, health conditions, and physical functioning abilities of young and old workers as well as correlates of physical functioning capacity with the work ability index (WAI). **Method:** This exploratory, cross-sectional study examined employees of a higher education institution (HEI) and those of a metallurgical industry. Older workers (50 years old or above) were matched for gender and occupation type with younger workers (less than 50 years old). The following evaluations were applied: the multidimensional assessment questionnaire (which included sociodemographic, clinical, health perception, and physical health indices), the WAI, and a battery of physical functional tests. **Results:** Diseases and regularly used medications were more common among the group of aging workers. The WAI did not differ between groups (p=0.237). Both groups showed similar physical functional capacity performances with regard to walking speed, muscle strength, and lower limb physical functioning. Aging workers showed a poorer performance on a test of right-leg support (p=0.004). The WAI was moderately correlated with the sit-to-stand test among older female workers (r=0.573, p=0.051). **Conclusions:** Unfavorable general health conditions did not affect the assessment of work ability or most of the tests of physical functional capacity in the aging group.

Keywords: aging; work; occupational health; work ability; functional capacity; physical therapy.

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Introduction

The modern workforce is aging, and older people represent a growing proportion of the population[1]. The segment of workers 50 years old or older is estimated to increase quickly over the next decades[2,3]. In 2000, 3.3 million people over the age of 60 worked, and this number rose to 5.4 million in 2010[4]. In 2006, 54% of all Brazilian workers were 60 years old or older, and approximately 70% of the elderly had some occupational activity in 2009[4].

Aging is characterized by a reduction in the functional reserve of several physiological systems[5], and its effect on functionality depends on numerous factors such as genetics, lifestyle habits, and the presence of chronic diseases[6]. A decline in work ability of approximately 12% per year[7] is estimated to occur after 45 years of age, in particular after 50 years of age[8]. This decline can compromise productivity and the ability to work[9]. In general, this effect is greater among employees of jobs with high physical demands than jobs with higher mental demands[5]. The prevalence of work ability impairment varies between 5.7% and 46.4% depending on the population and the type of work performed[10].

Socioeconomic conditions are important predictors of health and work ability. However, these models are complex and influenced by factors related to the work itself, living conditions, and health habits[11]. The presence of psychological symptoms, chronic diseases, and poor health perceptions are negatively correlated with work ability[12].

Studies have shown that workers who are involved in occupational physical activities (whether moderate or vigorous) maintain their levels of work ability, especially when these activities involve specific tasks. The "healthy worker effect" has been emphasized because these workers tend to continue working,

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whereas workers in poorer health tend to retire early or are transferred to occupations with fewer physical demands[13].

Despite these findings, the general health conditions of older workers compared with younger workers and the correlation between work ability and physical functional capacity have been seldom explored. Thus, this study compared the sociodemographic profiles, health conditions, and physical functional capacities of young and old workers and correlated physical functional capacity measurements with the work ability index (WAI).

Method

Study design

This exploratory, cross-sectional study examined employees from a higher education institution (HEI) and those from a factory related to the metallurgical industry.

This study is part of a larger project entitled, “Influência do Envelhecimento e da Experiência Profissional no Desempenho Físico, Aspectos Biopsicossociais e Estratégias Motoras de Trabalhadores” (“The Influence of Aging and Professional Experience on the Physical Performance, Biopsychological Aspects, and Motor Strategies of Workers”) and was approved by MCT/CNPQ/CT (Health Public Notice 58/2009; Aging, Work, and Health; case number 557752/2009-4). The “Rede de estudos sobre envelhecimento, trabalho e saúde” (“Study Network on Aging, Work, and Health”) developed this project.

Participants

A convenience sample was recruited in which all older workers (at least 50 years old) were invited to participate in the study and were matched with younger workers with respect to gender and occupation (under 50 years old).

All participants were informed about the study objectives and procedures and were invited to volunteer by signing a consent form approved by the Ethics Committee of the Universidade Cidade de São Paulo (UNICID), São Paulo, SP, Brazil (protocol number 0048.1.186.000-10).

Group characteristics

Higher Education Institution (HEI)

The participants of this group belonged to a private HEI located in São Paulo, SP, Brazil. Their common job activities were academic or administrative, with 8-hour workdays. These employees commuted to and from work via public transportation (i.e., subway, train, or bus).

Metallurgical factory

Over 80% of these workers performed tasks that required the use of force, load handling, quality control, and production. These employees commuted to and from work via bicycle or walking; only those who lived far away used the bus provided by the metallurgical company.

Data collection

Instruments

The following measures were used: a multidimensional questionnaire that evaluated sociodemographic, clinical (i.e., the number of illnesses and medications), health perception, and physical health data; the WAI; and a battery of physical functional tests. A physical therapist and final-year students performed these evaluations; they also discussed the study and received training concerning evaluation and the study criteria.

Physical Health. Physical health was evaluated using the Subjective Health or Self-rated Health. The individual uses this measure to rank their perceptions of and care for their own health as “very good”, “good”, “regular”, “poor”, or “very poor”. Next, they rank their health compared with that of their same-age peers 1 year ago as “equal to”, “better than”, or “worse”.

WAI. The WAI measures worker ability using questions that consider the physical and mental demands of their work, health conditions, and resources. Work ability is classified into four categories: Scores ranging from 7 to 27 denote poor ability; 28 to 36 represent fair ability; 37 to 43 represent good ability; and 44 to 49 denote excellent ability[14].

Physical functioning tests

The physical functioning tests measured normal and maximum gait speed as well as included the sit-to-stand, five-step, right and left unipedal stance, and handgrip strength (HGS) tests. All tests were measured using a digital chronometer (Cronobio model SW2018).

Usual and Maximum Gait Speed. An 8.6-m flat surface with no irregularities was used. The initial 2 meters were used for acceleration, and the final 2 meters were used for deceleration; the time spent traveling the remaining 4.6 meters was recorded. All participants wore shoes. For the usual gait speed test, the participants were told to "Walk at your normal pace, as if walking down the street to purchase something at the bakery. Walk to the last mark on the floor". For the maximum gait speed test, the participants were told to "Walk as fast as possible without running". These procedures were repeated three times, and the mean was computed.

Unipedal Stance Test. This test records the time a participant spends standing on one foot with their eyes open[15]. The individuals were instructed to keep their feet parallel, with a 10-cm distance between their heels, and their arms parallel to their bodies while looking straight ahead. Next, they lifted a specific leg without altering their base or touching their support leg. The time that the participants were able to remain in this unipedal stance was recorded (maximum=30 seconds). The timer was stopped when older workers displaced their support foot, touched their other leg, or returned their raised foot to the ground. This test was performed for each leg, and the mean of three trials was used.

Five-Step Test. This test measures the time that it takes individuals to climb a 10-cm step five times while facing forward and return while facing backward[16]. The participants begin with the verbal command "go". Time was only recorded when the participants performed the task as specified.

Hand Grip Strength Test. This isometric strength test measures the maximum effort maintained for 6 seconds of the dominant upper limb. To identify the dominant limb, the participants were asked which hand had greater dexterity. Individuals were positioned according to the recommendations of the *American Society of Hand Therapy*[17]. Grip strength was measured using the second handle position of a dynamometer (SAEHAN® model - SH 5001). Strength scores (kgf) were calculated using the mean of three trials, with a 60-second rest between each trial. Verbal encouragement was provided to ensure maximum effort when tightening the handle[18].

Sit-to-Stand Test. The participants were instructed to stand up and sit down in an armless chair of normal height (approximately 46 cm) while keeping their arms crossed over their chest as quickly as possible. The time was recorded, and the timer stopped when individuals returned to a sitting position.

Anthropometric data

The anthropometric data were measured using a standardized digital scale (G-Tech, model GLASS 3S) and a standard measuring tape (Inmetro). To record body mass, the participants wore light clothing without shoes, preferably with empty stomachs and bladders.

Height was measured using a wall-mounted ruler. The participants stood upright and looked straight ahead, with their bare feet together. Waist circumference was measured in the supine position at the midpoint between the anterior-superior iliac spine, and the coastal margin was determined on the lateral side of the abdomen. The measuring tape was placed next to the umbilical scar[19]. Hip circumference was measured at the widest part of the hips.

The waist-to-hip ratio (WHR) was obtained by dividing the perimeter of the waist and the hips. Body mass index (BMI) was calculated by dividing body mass by height squared (BMI=weight/height^2). The ranges established by the Pan American Health Organization for BMI cut-off points of underweight, normal weight, overweight, and obese were <23, 23-27.99, 28-29.99, and >30, respectively. These cut-off points were used to interpret the results.

Procedure

The researchers contacted the human resources department at the HEI, and all employees were invited to participate in the study. Those who volunteered gathered in a private room in groups of up to twenty. Workers who were unable to attend were provided the questionnaire in a sealed envelope, along with information about the study and the consent form. After reading and signing the form, the material was returned to the researchers. Employees of the metallurgical industry were invited by the Department of Occupational Health to attend the health unit to answer the questionnaire at work.

Afterwards, all older workers were identified. Younger workers from both companies were randomly selected and stratified by gender and occupation type as a comparison group.

Data analyses

Descriptive analyses were performed using frequencies for categorical variables and measures of central tendency for each age group, WAI score, and physical functioning capacity. Normality was tested using the Kolmogorov-Smirnov test and histograms with normal distribution curves.

The older workers were compared with the younger workers with respect to the variables of interest using the chi-square test or Fisher's exact test (categorical variables) and Student's t-test or Mann-Whitney U test (continuous variables).

The relationship between the WAI and the physical functioning tests was measured using Pearson's correlation. The level of significance was $p<0.05$. All tests were performed using SPSS version 19.0 (IBM).

Results

The means ± standard deviations of age for the younger and older groups were 31.9±8.1 years and 54.4±4.3 years, respectively. Table 1 displays the sociodemographic characteristics of the two groups. Of the variables analyzed, the groups differed with regard to marital status, years of education, monthly income, and self-reports of overall health ($p<0.05$).

The clinical characteristics, and anthropometric measures (Table 2) significantly differed between groups ($p<0.05$). Diseases and regularly used medications were more frequent among the older group. The WHR measurements were inversely proportional between the groups, such that the older group had greater values in the upper quartile. Significant differences were not found with regard to BMI ($p>0.05$).

In general, work ability and physical functioning did not significantly differ between groups. Only the right unipedal stance was significantly different, with the younger group able to stand in that position for a longer time on average (Table 3).

Figure 1 shows the distribution of WAI scores. Although the mean WAI score was greater for the younger group, this difference was not significant. Most workers had fair (28 to 36) or good work abilities (37 to 42), regardless of group.

Overall, the relationship between physical functioning capacity and work ability was not significant, with the exception of a weak correlation of HGS for the younger group ($r=-0.368$), and the Five-Step test for the older group ($r=-0.304$) (Table 4). Regarding gender, a moderate correlation ($r=0.573$) was observed between the WAI and the sit-to-stand test among older females ($p=0.051$).

Discussion

This study compared young and older workers with regard to their sociodemographic profiles, health conditions, and physical functional capacities and correlated physical functioning measurements with the WAI. This study was justified given the dearth of studies that have investigated the relationship between the changes that result from aging and maintaining the ability to work.

In general, older workers were married, had more education and more income, and held poorer global health perceptions compared with the younger workers. Approximately 80% of the participants in the older group reported having a global health of normal, poor, or very poor, and they reported more diseases and regular medication use than younger workers. Older workers had greater BMIs and significantly larger waist circumferences. Most older workers (73.9%) were classified in the upper half of WHR.

Differences in WAI were not observed between younger and older workers. The physical functional capacity of younger and older workers was similar with regard to gait speed, muscle strength, and the physical functioning of their legs. Older workers performed worse on the unipedal stance test. WAI scores were only correlated with the sit-to-stand test among older women.

Education and income were directly related, and both were positively correlated with work ability. This result occurred because a higher educational level creates an access to more qualified positions with higher wages and a greater possibility of continuity at an older age. In turn, these aspects positively influence health conditions and maintain the ability to work for longer periods[10,20]. Studies of older workers[6,21] have shown that those with more education, higher incomes, and exposure to richer professional experiences demonstrate better intellectual performance and health compared with

Table 1. Sociodemographic characteristics and health perceptions of the 79 workers by age.

Variables	Group 1 (N=37) Less than 50 years old % (N)	Group 2 (N=42) 50 years old or older % (N)	p-value
Sociodemographic			
Gender			
Female	54.1 (20)	71.4 (30)	0.11
Male	45.9 (17)	28.6 (12)	
Marital Status			
Married	45.9 (17)	76.2 (32)	<0.001
Single	45.9 (17)	4.8 (2)	
Widowed	8.1 (3)	9.5 (4)	
Separated	0.0 (0)	9.5 (4)	
Education Level			
0 to 4 years	0.0 (0)	9.5 (4)	0.007
5 to 8 years	5.4 (2)	23.8 (10)	
9 to 12 years	27.0 (10)	28.6 (12)	
13 to 16 years	51.4 (19)	11.9 (5)	
17 to 20 years	16.2 (6)	21.4 (9)	
> 20 years	0.0 (0)	4.8 (2)	
Monthly Income			
Up to 1 MW	5.4 (2)	2.4 (1)	0.004
1.1-3.0 MW	62.2 (23)	21.4 (9)	
3.1-5.0 MW	13.5 (5)	33.3 (14)	
5.1-10.0 MW	8.1 (3)	16.7 (7)	
Over 10 MW	10.8 (4)	26.2 (11)	
Self-rated health			
Good and Very Good	45.9 (17)	19.0 (8)	0.035
Regular	40.5 (15)	64.3 (27)	
Poor and Very Poor	13.5 (5)	16.7 (7)	
Comparative Health			
Equal to	18.9 (7)	16.7 (7)	0.749
Better than	10.8 (4)	16.7 (7)	
Worse	70.3 (26)	66.7 (28)	
Comparative Activity			
Better than	51.4 (19)	28.6 (12)	0.057
Worse	13.5 (5)	9.5 (4)	
Equal to	35.1 (13)	61.9 (26)	
Type of Work			
Administrative	29.7 (11)	26.2 (11)	0.93
Technical	13.5 (5)	16.7 (7)	
General	10.8 (4)	14.3 (6)	
Physical	45.9 (17)	42.9 (18)	

MW = minimum wage in Brazilian Reals (R$)

Table 2. Clinical and anthropometric characteristics of the 79 workers by age.

Variables	Group 1 (N=37) Less than 50 years old % (N)	Group 2 (N=42) 50 years old or older % (N)	p-value
Number of diseases			0.001
No disease	78.4 (29)	38.1 (16)	
1 to 2	21.6 (8)	54.8 (23)	
3 or more	0.0 (0)	7.1 (3)	
Number of Medications			0.011
No medication	64.9 (24)	31.0 (13)	
1 to 3	32.4 (12)	64.3 (27)	
4 or more	2.7 (1)	4.8 (2)	
BMI (mean, SD)	25.4 (4.1)	27.2 (3.5)	0.046
BMI Category			
Underweight	2.7 (1)	0.0 (0)	0.332
Normal	43.2 (16)	28.6 (12)	
Overweight	40.5 (15)	50.0 (21)	
Obese	13.5 (5)	21.4 (9)	
WHR			
1st Quartile (<0.81)	43.2 (16)	9.5 (4)	<0.001
2nd Quartile (0.81-0.88)	32.4 (12)	16.7 (7)	
3rd Quartile (0.88-0.94)	18.9 (7)	31.0 (13)	
4th Quartile (>0.94)	5.4 (2)	42.9 (18)	
Waist Circumference (mean, SD)	82.7 (8.9)	91.0 (13.1)	0.002

Table 3. Means and standard deviations of the WAI and physical functioning variables by age.

Variables	Group 1 (N=37) Less than 50 years old M (SD)	Group 2 (N=42) 50 years old or older M (SD)	p-value
WAI total	38.7 (36.7)	37.3 (35.9)	0.237
Usual Gait Speed	0.56 (0.08)	0.55 (0.08)	0.959
Maximum Gait Speed	1.87 (0.26)	1.88 (0.28)	0.891
Five-Step Test	9.05 (1.90)	9.33 (1.75)	0.498
Hand Grip Strength	40.3 (14.71)	38.8 (11.3)	0.398
Sit-to-Stand Test	10.6 (2.4)	10.6 (1.6)	0.866
Right Unipedal Stance Time	87.5 (6.4)	76.9 (21.0)	0.004
Left Unipedal Stance Time	62.7 (16.6)	62.25 (16.0)	0.398

Table 4. Correlations between work ability and physical functioning capacities in younger and older workers.

Variables	Group 1 Less than 50 years old (N=37)	Group 2 50 years old or older (N=42)
Hand Grip Strength (kg/f)	r=–.368	r=.116
	p=0.027	p=0.463
Usual Gait Speed (m/s)	r=–.262	r=.069
	p=0.123	p=0.664
Maximum Gait Speed (m/s)	r=–.251	r=.089
	p=0.140	p=0.573
Right Unipedal Stance Time (s)	r=.103	r=-.072
	p=0.549	p=0.651
Left Unipedal Stance Time (s)	r=–.186	r=–.045
	p=0.277	p=0.775
Sit-to-Stand Test (s)	r=.026	r=.101
	p=0.882	p=0.526
Five-Step Test (s)	r=.029	r=–.304
	p=0.865	p=0.050

Pearson's correlation: one missing value in the group of younger workers.

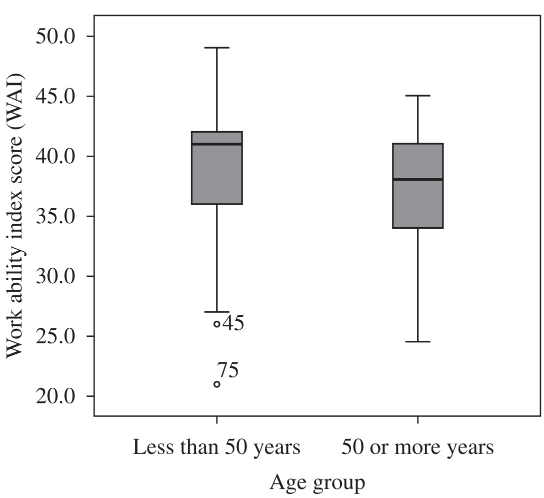

Figure 1. Distribution of the WAI scores for younger (n=37) and older workers (n=42).

those who are poorer and less educated, regardless of age. Furthermore, this latter group is more likely to become physically and psychologically frail with age[6].

Although older workers assessed their ability to work as moderate or good (similar to younger workers), importantly, their self-assessment of health was significantly worse than that of the younger workers. Health self-assessments are broader representations of the health conditions of older people, and they are more representative of global health than functional disabilities or physical and mental symptoms[22]. In addition, a self-assessment of poor health is related to a higher mortality rate among individuals with cardiovascular disease[23]; in turn, this disease was related to poor body compositions, higher BMIs, greater waist circumferences, and greater WHR among older workers. These indicators are associated with higher mortality rates among different populations of middle-aged individuals and older workers[24].

Most workers had fair to good work ability evaluations, regardless of age. The results revealed that older workers with better qualifications and higher monthly incomes tended to maintain their ability to work, even in the presence of disease. However, the mediating effect of income and education on work ability remains inconclusive. A previous study followed a group of educators for 2 years and did not find an association between work ability and sociodemographic variables[25]. In that study, other internal (i.e., functional capacity, knowledge, skills, values, and attitudes) and external factors (i.e., environment, context, and work demands) influenced work ability[20].

In general, physical functioning capacity did not significantly differ between groups. The older workers only demonstrated a worse performance on the right unipedal stance test; however, this result was not correlated with work ability. Performance on the unipedal stance test declines with age, and it is an important early marker of the loss of balance and muscle strength[8]. The finding that the older workers were relatively younger than those of studies that involved an elderly population (i.e., 60 years or older) might also explain the lack of differences between the performance of younger and older workers. According to the Committee for Economic Development's New Opportunities for Older Workers, an older worker is anyone who is at least 45 years old. This proposition is mostly based on demographics and socioeconomic factors, but also reflects the decline in the physiological systems due to age, which might have influenced the unipedal stance test that requires a good neuromuscular functional reserve. In addition, our results support the healthy worker effect, which states that older workers tend to maintain acceptable levels of functionality[26].

An association between physical functioning capacity and WAI was not observed. This result differs from Nygard et al.[27] who found an association between functional capacity and work ability among municipal workers and older workers in Finland. In our study, we observed a moderate correlation between WAI and sit-to-stand test among older female workers. This specific test is strongly correlated with leg functionality, plantar cutaneous sensation, speed, body stability, and psychological variables. In addition to muscle strength, several of these parameters decline with age[28]; however, no significant differences have been observed between males and females with regard to the sit-to-stand test[29].

The strong influence of the type of work activity with regard to physical functioning capacity and work ability must also be considered. The physical and psychological demands of an activity greatly influence the psychophysiological responses of workers and the perceptions of their abilities[25,30].

The results of our study suggest that although older workers positively assess their ability to work, they show health indicators that are worse than those of the younger group, especially with regard to body composition and self-health perceptions both of which are related to higher mortality rates. In addition, older workers exhibited poorer unipedal stances, which indicates a deficit in balance and muscle strength. Thus, an early physical activity intervention might prevent long-term global health issues for this group by increasing or maintaining work ability, thereby providing a more active and healthy life in old age. Interventions that are aimed at changing work structure and the organization can also influence the WAI, given that they reduce physical and mental workloads and engender greater satisfaction and a higher quality of life[25].

Some methodological limitations exist with regard to the results of this study. This study was cross-sectional, which precludes the establishment of causal relationships between the analyzed factors. In addition, the influence of the healthy worker effect must be considered with regard to the results. This effect arises from the selection and retention of workers with better health and greater productivity in the work environment[31]; as such, this effect is a caveat of other studies on work ability[32].

Conclusions

Older workers had a poorer self-rated health, a higher BMI, waist circumference and waist-hip ratio, a lower unipedal stance time, also reported more diseases and used more medications compared with younger workers. The poor self-perception of health did not affect did not affect the assessment of work ability or most of the physical functioning capacity tests in older workers. Early preventive interventions are suggested for workers who are at least 50 years old to provide them with an active and healthy life in old age.

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