

Comparison of dual-task performance in healthy geriatric individuals from different age groups

Dual task performance in geriatrics

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Abstract

Aim: The aim of this study was to compare the dual-task performance of healthy geriatric individuals in different age groups.

Material and Methods: One hundred and two healthy geriatric individuals were included in our study (Group 1: aged 65-75 years, Group 2: aged 75-84 years). In single-task, Montreal Cognitive Assessment Scale was used to evaluate cognitive performance; Timed Up and Go Test, 30 Seconds Sit-to-Stand Test and 10 Meter Walking Test were applied to evaluate motor performance. Dual-task performance was evaluated as motor-motor and motor-cognitive. The Dual-Task Questionnaire was applied to determine how difficult it was for the individuals during the dual-task.

Results: In single-task comparisons, a significant difference was found in favor of Group 1 in all assessments. While there was a significant difference in favor of Group 1 in motor-motor dual-task performance duration and motor-cognitive dual task performance duration ($p = .000$), there was no statistically significant difference in motor-motor dual-task performance ($p = 0.791$) and motor-cognitive dual task performance ($p = 0.475$) between groups. For Dual-Task Questionnaire, a significant difference was found between the two groups in favor of Group 1 ($p = .000$).

Discussion: Correspondingly with the decrease in physical and cognitive functions that occur with aging, a decrease in dual-task performance and performance durations were observed. Analyzing the studies conducted in the literature and more comprehensive studies on this subject will guide authors and clinicians.

Keywords

Aging, Cognition, Geriatrics, Rehabilitation

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Introduction

Aging begins with childhood and progresses with adulthood, and as time passes, the physical and mental independence of a person decreases, these all are structural and functional changes that negatively affect the musculoskeletal, cognitive and motor functions of living beings. [1]. According to the new age range list of the World Health Organization (WHO), which updates age groups to reflect changing and developing technology, 66 and 79 age range is defined as middle-age and age over 80 is defined as elderly [2]. On the other hand, gerontologists classified old age as 'young-old' between 65-74 years, 'middle-old' between 75-84 years, and 'advanced-old' over 85 years [3].

A dual-task is the measurement of two (sometimes more) information sources that are often processed simultaneously, as a result of sharing attention with dual-task performance [4]. On the dual-task scale, while the capacity of attention is used extensively in dual tasks performed simultaneously, attention can be divided according to the priority and degree of difficulty of the given tasks. Accordingly, changes in attention capacity and difficulty level may create problems in performing either or both of the tasks. Individuals are often asked to maintain a certain level of performance in the primary task under dual-task conditions. When the demands of concurrent tasks exceed the available processing capacity, one or two jobs are expected to deteriorate in performance [5].

Brustio et al. reported in their study on women in the young, middle, and old age groups that older women showed worse physical performance under dual-task performance compared to young and middle-aged groups [6]. In parallel with this, in another study investigating dual task performance among young adults, middle-aged and older adults, it was reported that dual task performance was affected by age, therefore mobility and cognitive tasks were negatively affected by age [7]. In addition to all these, there is no study in the literature comparing dual-task performance in geriatric individuals of different age ranges.

The aim of this study was to examine the motor-motor and motor-cognitive performances that affect dual-task performance in healthy geriatric individuals in different age groups. We hypothesized that, in parallel with the decrease in physical and cognitive functions that occur with aging, 'advanced-old' geriatric individuals had a greater decrease in dual-task performance.

Material and Methods

Participants and Study Setting

This is a cross-sectional study, which included participants during their evaluation at an orthopedic clinic in Turkey during the study recruitment period (March 2019- January 2020). All participants were informed about the study prior to the study and written informed consent was obtained.

The study was approved by the Pamukkale University Institutional Review Board (25.12.2018/24). Informed consent was obtained from volunteers who wanted to participate in the study.

The sample size calculation was based on effect size strength (d:0.5), assuming a 95% confidence interval and power of 80%,

when at least 102 people (Group 1: 51 individuals between 65-74 years of age, Group 2: 51 individuals between 75-84 years of age) were included in the study. Taking into account the estimated dropout rate, 110 participants needed to be recruited [8,9].

A total of 110 healthy geriatric individuals aged between 65-85 years were included in the study. The demographic characteristics of all participants are presented in Table 1. The Hodkinson Mental Test (HMT) was applied to the patients under the guidance of a physiotherapist [10]. Healthy elderly people with an HMT score of 8 and above, divided into two groups (ratio 1:1) according to gerontologists, were classified as [3]; Group 1: 65-74 years old (n= 51) and Group 2: 75-84 years old (n= 51) (Figure 1).

The inclusion criteria were as follows:

- Agreement to participate in the study;
- age 65-85 years;
- Being healthy;
- Getting a score of 8 and above on the Hodkinson Mental Test (HMT)
- Absence of any motor dysfunction that would prevent performing tests on the lower and upper extremities.

Healthy geriatrics who used more than 3 drugs that could affect motor or cognitive levels and had a diagnosed orthopedic or neurological problem were excluded from the study.

Outcome Measurement

HMT is a test that is used for the assessment of memory and orientation in the elderly. Each correct answer is scored with 1 point in the 10-question form. Scores from 6 and above indicate normal functions, 4-6: moderate impairment, 0-3: severe impairment [10]. Subjects who received 8 or higher scores were included in the study.

The Montreal Cognitive Assessment Scale (MoCA) was applied to evaluate the cognitive functions of the participants. This test measures 8 different cognitive functions: attention and concentration, executive functions, memory or delayed memory, language, visual spatial function, isolation, calculation and orientation. The highest score that can be obtained on the test is 30 in total. A score of 21 points or more is considered normal [11,12].

Timed Up and Go Test (TUG) is a test that evaluates fall risk and mobility in individuals. The test is carried out using a 40 cm high chair and a stopwatch are used to conduct the test. An area of 3 meters is determined in front of the chair. The patient is asked to stand up from the chair, walk at a normal speed, sit down and lean on the chair, and this time displays the duration of the test in seconds. For adult individuals, if they complete this test in more than 12 seconds, it is defined as a falling risk [13].

The 30-second Sit-to-Stand Test (30s-CST) is a test that evaluates the sit-to-stand activity, lower extremity strength, and dynamic balance of the subject. A chair with a seat height of around 44 cm and a recline (no arms if possible) and a stopwatch are needed. Once the person has settled comfortably in the chair in full contact, he crosses his arms and holds his shoulders freely. It is necessary to ensure that the individual gets up completely upright and sits back on the chair. The stopwatch starts from the moment of first start, and the number of times a person sits and stands up within 30 seconds

is recorded. If the number of times a patient is able to stand from a sitting position in 30 seconds is less than 10, this result indicates lower extremity weakness [14].

The 10- Meter Walking Test (10MWT) is used to evaluate normal gait. In this test, the individual is asked to walk at a daily walking speed in an area of 10 meters whose limits are determined. Timing starts when the foot reaches the start line and ends when it crosses the finish line. Two attempts are made and the best value is recorded as the result in meters/second [15].

In order to evaluate the motor-motor dual-task performance (MMDTP) of the participants in this study, the task of carrying 2 glasses on the tray was given during the 10-meter walking test. At the starting point of the predetermined 10-meter distance, individuals were asked to hold a standard-sized tray that they could hold, and two standard glasses were left on it. The stopwatch was started by giving the start command to the individuals, and they were asked to complete the 10 m distance without dropping the glasses [16].

In order to evaluate the motor-cognitive dual-task performance (MCDTP), participants were assigned the task of counting down the days of the week from Sunday during the 10-meter walking test. The participant who came to the starting point was asked to start on Sunday and walk at the same time to count down. Although he stopped to think about the days, time passed and he was expected to complete the 10-meter distance [17].

Dual-Task Performances are calculated separately for motor-motor and motor-cognitive tasks [18];

- MMDTP = $100 \times [(dual\ task\ score - walking\ single\ task) / single\ task\ walking]$

- MCDTP= $100 \times [(dual\ task\ score - walking\ single\ task) / single\ task\ walking]$

The Dual Task Questionnaire (DTQ) was used to obtain information about the difficulties experienced by individuals in their daily life in situations requiring dual tasks while performing these tasks. The dual-task questionnaire consists of 10 questions. Each question is scored as very frequent (4), frequent (3), occasionally (2), rarely (1), and never (0). The total score is calculated by adding the answers given to all questions and divided into 10 [19].

Statistical Analysis

The study data were evaluated using the Statistical Package for Social Sciences 20.0 program for Windows and through the analysis of the descriptive statistics. Before the statistical analysis, the Kolmogorov–Smirnov test was used to assess the normality of the data. Differences between the groups were compared using the parametric test (T-test) for data conforming to the normal distribution, and the non-parametric (Mann-Whitney U) statistical tests for the data that did not comply with the normal distribution. The Chi-square analysis was used to analyze differences between categorical data. In all statistics, $p < 0.05$ was considered significant [20].

Results

The flow of participants is shown in the flowchart in Figure 1. Among the 110 individuals who consented to participate, four were not included, and four of them were excluded from the study because they scored less than 8 on the HMT. The

102 participants were allocated to Group 1: Individuals between 65-74 years of age (n=51) and Group 2: Individuals between 75-84 years of age (n=51). There was a statistically significant difference between the groups in terms of education levels ($p=0.001$) and hobby habits ($p=0.013$). The baseline characteristics of the participants are shown in Table 1. There was a statistically significant difference between Group 1 and Group 2 in favor of Group 1, in both motor-motor dual task time (MMDTT) ($z=4.89, p=0.000$) and motor-cognitive dual task time (MCDTT) ($z=5.54, p=0.000$). There was no statistical difference in DTMMMP ($z=0.26, p= 0.791$) and DTMCMP ($z=2.04, p=0.475$) in between the two groups (Table 3). Additionally, there was a statistically significant difference for DTQ ($z=3.65, p=0.000$) between two groups in favor of Group 1 (Table 3).

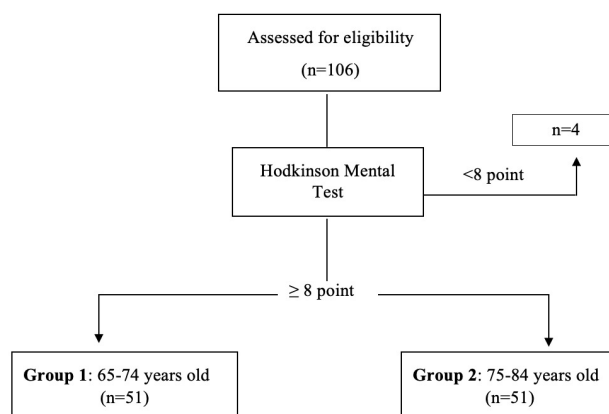


Figure 1. Flowchart of the participants

Table 1. Baseline Characteristics for Group 1 and Group 2

Baseline Characteristic	Group 1 (n=51) Mean±SD	Group 2 (n=51) Mean±SD	P
Age (years)	68.51±3.24	80.86±3.25	0.000*
Height (cm)	156.90±14.41	154.71±8.67	0.410
Weight (kg)	71.67±11.22	69.39±2.09	0.324
Body Mass Index (kg/m)	27.81±5.58	28.98±5.28	0.725
Sex of participants	n (%)	n (%)	
Women	28 (45.1)	26 (51)	0.421**
Men	23 (54.9)	25 (49)	
Hobby habit of participants	n (%)	n (%)	
None	25 (49)	21 (41)	0.013**
Solving puzzle	6 (12)	1 (2)	
Playing chess	1 (2)	5 (10)	
Playing okey-playing card etc.	4 (8)	0 (0)	
Others	15 (29)	24 (47)	
Level of education of participants	n (%)	n (%)	
Illiterate	3 (6)	0 (0)	0.001**
Literate	15 (29)	0 (0)	
Primary school	27 (53)	15 (29)	
Secondary school	5 (10)	19 (37)	
High-school	1 (2)	17 (33)	
Exercise habits of participants	n (%)	n (%)	
Yes	21 (41)	22 (43)	0.841**
No	30 (59)	29 (57)	

*: Mann-Whitney U Test, **: Chi-square test, SD: Standard deviation, kg: kilogram, cm: centimeter, Significance level: $p < 0.05$.

Table 2. A comparison of the Single Task Performance Score between two groups

Outcome Measure	Group 1 (n=51) Mean ±SD	Group 2 (n=51) Mean ±SD	Z	p
Cognitive Performance				
MoCA	23.27±2.12	21.98±1.24	-3.18	0.001*
Motor Performance				
TUG/rep.	11.67±3.26	9.53±6.38	-4.72	0.000*
30s-CST/sn.	11.24±3.41	14.85±4.53	-4.47	0.000*
10 MWT/sn.	11.91±4.00	16.15±4.73	-4.91	0.000*

*Mann-Whitney U testi, MoCA: Montreal Cognitive Assessment Scale, TUG: Time up and Go Test, 30s-CST: 30 Seconds Sit-to-Stand Test, 10 MWT:10 Meter Walking Test

Table 3. A comparison of the Dual Task Performance Score between two groups

Outcome Measure	Group 1 (n=51) Mean ± SD	Group 2 (n=51) Mean ±SD	Z	p
MMDTT/sn.	12.84±5.01	17.46±5.81	-4.89	0.000*
MMDTP	7.41±8.00	7.84±9.84	-0.26	0.791
MCDTT/sn.	15.11±5.39	22.31±8.34	-5.54	0.000*
MCDTP	27.95±20.87	36.82±22.94	-2.04	0.475**
DTQ	0.85±0.69	1.27±0.68	-3.65	0.000*

*Mann-Whitney U testi, ** Independent Samples t Test, MMDTT: Motor-Motor Dual Task Test, MMFTP: Motor-Motor Dual-Task Performance, MCDTT: Motor-Cognitive Dual Task Test, MCDTP: Motor-Cognitive Dual Task Performance, DTQ: Dual Task Questionnaire

Discussion

This cross-sectional study aimed to compare the dual task performance in healthy geriatric individuals in different age groups. The results demonstrated that Group 1 showed better scores than Group 2 in terms of MoCA, TUG, 30s-CST and 10MWT in single task performance. Additionally, the results demonstrated that Group 1 showed better scores than Group 2 in terms of MMDTP, MCDTP, MMDTT, MCDTT and DTQ scores. In our study, MoCA was used for cognitive performance evaluation in a single performance evaluation. Gluhm et al. applied MoCA on 254 healthy individuals aged 20-89 years and reported that the MoCA score decreased with increasing age [21]. Similarly, Malek-Ahmadi et al. on the other hand, divided geriatric individuals between the ages of 70 and 99 into 3 groups, each with a 10-year age range, and examined the MoCA score; they reported higher MoCA performance in the younger group [22]. In parallel with these studies, our study found that healthy geriatrics in Group 1 showed statistically higher MoCA performance than in Group 2. In our study, TUG, 30sCST, and 10 MWT were used for motor performance evaluation in a single performance evaluation. Yüksek and Cicioğlu divided healthy geriatric individuals aged 65-75 years into 3 groups and examined their 30sCST performance and reported that the younger group performed better [23]. In parallel with this study, in our study, healthy geriatric individuals in Group 1 showed statistically better TUG, 30sCST and 10 MWT performances than individuals in Group 2. Considering the studies examining the effect of age on dual task performance, Olivier et al. examined whether postural control is affected by cognitive tasks in children and adults aged 7-11 years. It has been reported that 8-11-year-old children perform better than 7-year-old children in dual task performance, but

they cannot reach the level of adults. The reason for this is thought to be related to the increase in attention capacity in children around the age of 8 years [24]. Brustio et al. examined dual task performance on elderly (72.74 ± 5.95), middle-aged (47.82 ± 5.06) and young (25.12 ± 3.00) adult women. Cognitive dual-task performance with timed get-up-and-go test while counting down from three; manual dual-task performance was evaluated with the timed get-up-and-go test while carrying a glass of water. At the end of the study, older women showed worse mobility performance under the dual-task condition compared to younger and middle-aged groups [6]. In another study by Brustio et al., age-related differences in dual-task performance in both mobility and cognitive tasks were investigated in a sample of the elderly (72.63±5.57), middle-aged (46.69±4.68) and young (25.34±3.00) male and female adults. According to the results of the study, physical and cognitive performance, and hence dual task performance were affected in older adults [7]. According to these results obtained from the studies, while the dual-task performance continues to increase from the age of 8 to adulthood and begins to decrease with aging [6,7,24]. In parallel, in our study, a decrease was observed in single-task performances, dual-task performance times and dual-task performances. In our study, we also questioned how much difficulty individuals have while performing dual-task performance with the Dual-Task questionnaire, and we found that individuals have more difficulty in tasks that require dual-task performance as they get older.

The fact that our study was conducted only on geriatric individuals who applied to an orthopedic clinic may be considered as a limitation of our study. Different results may be obtained in studies to be conducted in more than one clinic or in different provinces with more cases with different sociodemographic histories. Another limitation is that the basic tasks of the individuals participating in our study and the additional tasks given to the basic tasks are applied to all individuals in the same order. In addition, in our study, we did not identify any limitations in terms of education level. We think that the fact that there was no restriction according to education level may have affected the results of MoCA and thus the results of dual-task performance.

Future studies are required to investigate dual-task performance with more participants by making changes in the order of tasks in geriatric individuals where sociodemographic characteristics and cognitive functions are more clearly determined.

In summary, in parallel with the decrease in physical and cognitive functions that occur with the advancement of age, a decrease in dual task performances and performance times have been observed in geriatric individuals.

Conclusion

In summary, in parallel with the decrease in physical and cognitive functions that occur with aging, a decrease in dual task performances and performance times was observed in geriatric individuals.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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