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Differences in Cognitive Function Among Hellenic Folk Dancers, Exercisers and Non-exercisers

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Abstract

Cognitive function is an important parameter of psychological health and affects every day functioning. **Purpose**: The purpose of this study was to determine whether participation in Greek traditional dance affects the differentiation of cognitive function, as opposed to other forms of exercise. **Methods:** The survey involved 262 participants divided into two age categories (young adults: 24-35 years old, seniors> 60 years). They were randomly selected, but in such a way so that they should fall into one of the following groups: a) Greek folk dance classes, b) group - non-dance exercise programs, c) sedentary. Cognitive function was assessed using the paper and pencil test, Digit Symbol Substitution (WAIS – R). **Results**: According to the 2-way ANOVA, senior Greek folk dancers had better cognitive function than exercisers and sedentary participants of the same age ($p<.05$). Young adults scored better than seniors ($p<.05$), but there were no significant differences among the three physical activity groups ($p>.05$). **Conclusion**: The higher cognitive function of senior folk dancers as opposed to exercisers and nonexercisers, shown from the above results might be attributed to the complexity of the Hellenic folk dance as a motor task but it might also linked to other characteristics of this dance, such as the circular form and the haptic connection among the participants.

Keywords: *physical activity; Hellenic dance; young adults; older adults.*

1 Introduction

Cognitive function and the mechanisms that support it (e.g. memory, reaction time, etc.) are an important aspect of mental health (McAuley & Rudolph, 1995; Mihalko & McAuley, 1996) and are closely linked with quality of life (Wood, Reyes-Alvarez, Maraj, Metoyer & Welsch, 1999). Cognitive function is important for the successful response to most of the activities of daily life - if not all - since processes such as memory, attention, information processing speed, have a significant role in any task with either small or large demands on motor control. Cognitive function is particularly important for older people because maintaining it in good levels contributes not only to successfully meet the demands of everyday life but also to the preservation of their social roles (Herzog & Wallace, 1997; Spirduso & Asplund, 1995). Social activity on the other is important for mental and social well-being, two characteristics that together with the absence of disease complete the concept of health (WHO, 1947).

There is no doubt that older population is the main growth part of the population in our society, since increased life expectancy is linked with aging. Aging is a progressive process and its results are obvious in morphological, functional and psychological parameters deterioration (Roubenoff, 2000). Aging is associated with health problems and declines in several aspects, including cognitive function (Salthouse, 1995; Seshadri & Wolf, 2007). Studies have shown that aging inhibits cognitive function parameters, such

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as attention, reasoning, information-processing speed (Budson & Price, 2005; Park & Reuter-Lorenz, 2009). Preserving cognitive function in old age thus, is an important research quest.

Physical activity and exercise seem to have a positive influence on several aspects of cognitive function and the positive exercise-physical activity relationship is proved throughout lifespan, according to literature reviews and meta-analysis (Etnier et al., 1997; Paterson & Warburton, 2010). The results of the meta-analysis by Sofi et al. (2010) suggested a significant and consistent protection for all levels of physical activity against the occurrence of cognitive decline in non demented population. These results suggest that exercise can be used as a preventative tool for cognitive function in older adults.

Indeed, research has shown the positive relationship between exercise and reduction in the decline of cognitive function associated with aging (Brisswalter, Collardeau, & Arcelin, 2002; Colcombe & Kramer, 2003; Liu-Ambrose et al., 2008). Carral and Perez (2007) proved that older women can take part in high-frequency, high-intensity training programs with no risk to their health while experiencing improvements not only to their physical fitness but also to their quality of life and cognitive function. Brown, LiuAmbrose, Tate, and Lord (2009) found that a general group-based exercise program significantly improved cognitive performance of fluid intelligence in seniors, aged 62 to 95 years, compared to a flexibility exercise and relaxation technique program or a noexercise control group. Voss et al. (2010) found that in a group of healthy elderly adults, improved aerobic fitness was associated with a better cognitive function. Using FMRI techniques, they proved that almost half of the age-related neural disconnections showed increased functional connectivity as a function of aerobic fitness level. Kamijo et al. (2009) suggested that light and moderate exercises improve cognitive function across the adult lifespan, although the mechanisms underlying the effects of observed acute aerobic exercise on cognitive function may be age dependent.

The above studies indicate the benefits of physical activity in old age, regarding cognitive function. Zisi, Gikoudi and Kioumourtzoglou (2003) however, underlined in their review, the disadvantages in cognitive function of seniors with low levels of physical activity in most aspects of cognitive function. People who lead a sedentary life, because of their low physical and cognitive functional status, face difficulties in joining an exercise program. Thus, it is important to find a way to improve the physical and mental abilities that contribute in the performance of activities of daily living and in learning new skills in order to provide more opportunities for seniors to increase their daily physical activity. As suggested by Zisi et al. (2003), if seniors are preserved in participating in exercise programs, then the physical activity opportunities may be offered in the form of recreational activities.

Dance is a recreational activity combining very well and in a pleasant way, physical and social activity. It seems that the dance has certain characteristics that contribute to stress management, increasing interest in physical activity and life satisfaction (Olvera, 2008). The music that accompanies the dance influences our feelings (Krumhans, 2002), while the music and dancing included in a physical activity helps in one's commitment to this activity (Andrijasevic, 2010). Beyond these dance features however, there are many studies showing that dance contributes to physiological adaptations similar to those of aerobic exercise. For example, it has been shown that most of the Greek traditional dances may lead to adjustments in the oxygen transport and consumption system and it was

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suggested that they may be used as an alternative form of aerobic exercise (Pitsi, Smilios, Tokmakidis, Serbezis, & Goulimaris, 2008).

Studies in the literature show that a high level of physical activity has a positive effect on the cognitive function of seniors, especially in tasks with increased attention demands, such as the choice reaction time (Abourezk & Toole, 1995; Lupinacci, Rikli, Jones & Ross, 1993) and the Digit Symbols Substitution Test (Meyer, Goggin & Jackson, 1995), which together with the Digit Span are among the most common tests used to evaluate the speed of perceptual - motor processes, coding and working- memory in seniors (Spirduso, 1995). The purpose of the present study was to examine the differences in cognitive performance, as measured by the Digit Symbols Substitution Test, in young adults and seniors that participate in different forms of exercise, and specifically in Hellenic folk dance and non-dance aerobic exercise.

2 Method

2.1 Participants

The participants were 262 individuals from two age groups: a) young adults (25-34 yrs) and b) older adults (>= 60 yrs). In each age group, the participants were randomly selected, but in a way to fall into one of the following groups: a) dancers, who systematically participated in Greek folk dance, at least the last 15 months, b) exercisers, who used to participate regularly in aerobic exercise, but did not participate in any form of dance activity (i.e. bicycling, running, kalisthenics), and c) sedentary individuals, that did not participate in any form of physical activity, dance or exercise. The number of the participants in each group is presented in Table 1.

2.2 Participants selection procedure

In the first phase of participants' selection, the dance group participants were selected from dance clubs that: a) the folk dances taught were coming all over Greece, without a specific focus on local dances, b) the dance instructor was a Physical education teacher with a specialization on Greek folk dance. Following the above criteria, 12 clubs were located, 6 of them were in Athens – a major urban area in Greece – and 6 of them were in regional areas of central and northern Greece. All the participants of the above clubs, that depicted in the age range of the study were asked to take part in the study. The dancers that gave their informed consent to participate in the study entered the testing procedure. The exercisers were selected from the same regional areas with the dancers, mainly from major sport centers, so that to match the age, gender, physical activity METs and other sociocultural characteristics. The sedentary individuals were also selected from the same regional areas and matching age, gender, and other sociocultural characteristics with the dancers.

Before entering the study, participants were cleared for health problems and noncorrectable visual or auditory impairments which could interfere with cognitive function. Along with typical demographic characteristics (age, gender), their systematic participation in the particular physical activity (dance or exercise) was recorded as their experience years. As shown in Table 1, exercisers and dancers in both age groups, had similar years of experience in the particular activity. It was also used a simple physical activity questionnaire (Godin & Shephard, 1985), to make sure that the amount of physical activity did not interfere with the type of physical activity, dance or exercise (Table 1).

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Ethical approval for the study was given by the Ethics Committee of the Department of physical education and sport science, University of Thessaly, Greece (2-4/10-102012).

2.3 Instruments

Cognitive Function was assessed using the Digit Symbol Substitution Test (DSST), a paper and pencil test of the WAIS test battery, which is considered to measure speed of processing newly presented information (Wechsler, 1981). Participants are presented with nine symbols, each representing one of nine (1–9) digits. A series of digits with a blank space for drawing the symbol underneath is presented on the same sheet of paper. Subjects are asked to assign as many symbols as possible to the respective digits. The number of correctly assigned and written symbols was used as performance measure.

Table 1. Participants number and characteristics (Mean, *SD*).

		N	Age		Experience years		Physical activity (MET)	
			M	SD	M	SD	M	SD
young adults **N=141**	Greek folk dancers	47	31.25	*3.27*	7.52	*5.42*	29.89	*18.39*
	Exercisers	50	30.95	*4.51*	6.19	*5.37*	29.65	*15.58*
	Sedentary	44	30.13	*4.31*	-	-	19.02	*13.60*
older adults **N=121**	Greek folk dancers	41	61.85	*5.95*	7.74	*6.27*	27.60	*15.70*
	Exercisers	36	61.50	*3.60*	6.28	*4.32*	27.85	*14.54*
	Sedentary	44	69.09	*10.64*	-	-	16.02	*12.12*

2.4 Data Analysis

Two separate two-way 2X3 between groups ANOVA was conducted to assess the impact of the type of physical activity participation and age on participants' cognitive function as measured by the DSST and on the amount of physical activity, as measured by questionnaire. The between subjects factor was the age group (young adults, older adults) and type of physical activity participation intervention (Greek folk dancers, exercisers, non exercisers). The Sidak test was used for post-hoc analysis.

3 Results

3.1 Physical activity

The means and standard deviations for the physical activity score as a function of age and group are presented in Table 1. The results for the ANOVA indicated a significant main effect for the physical activity group ($F_{2,256}$= 15.43, p< .001, η^2= .11). There were no significant effects of age group ($F_{1,256}$= 1.43, p> .05) and no significant interaction age group X physical activity ($F_{2,256}$= 0.03, p> .05). As shown in Table 1, dancers had a quite similar amount of physical activity with exercisers in both age groups while the sedentary group show a remarkably lower score. The Sidak post-hoc tests show that sedentary individuals had a significantly lower physical activity amount than both dancers (MD= 11.31, p< .001) and exercisers (MD= 11.31, p< .001).

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3.2 Cognitive performance

The means and standard deviations for cognitive function differences as a function of the two factors are presented in Table 2. The results for the ANOVA indicated a significant main effect for age ($F_{1,256}$= 127.11, p< .001, η^2= 3.33), with the younger adults outperforming the older adults. There was also a significant main effect for the type of physical activity ($F_{2,256}$=4.99, p <.01, η^2=0.38) and a significant interaction between physical activity group and age ($F_{2,256}$= 3.88, p < .05, η^2= 0.26, Figure 1).

Table 2. Means and standard deviations for the performance on Digit Symbol Substitution Test across the three physical activity groups, in younger and older adults.

	Greek folk dancers		Exercisers		Non exercisers		Total	
Age group	**M**	**SD**	**M**	**SD**	**M**	**SD**	**M**	**SD**
Young adults	52.51	*17.86*	45.58	*17.49*	50.70	*18.87*	*49.49**	*18.17*
Older adults	33.76*	*12.07*	28.58*	*10.94*	22.57*	*9.55*	*28.15**	*11.76*
Total	43.77	*18.01*	38.47	*17.22*	36.64	*20.52*	*39.63*	*18.82*

* p<.05

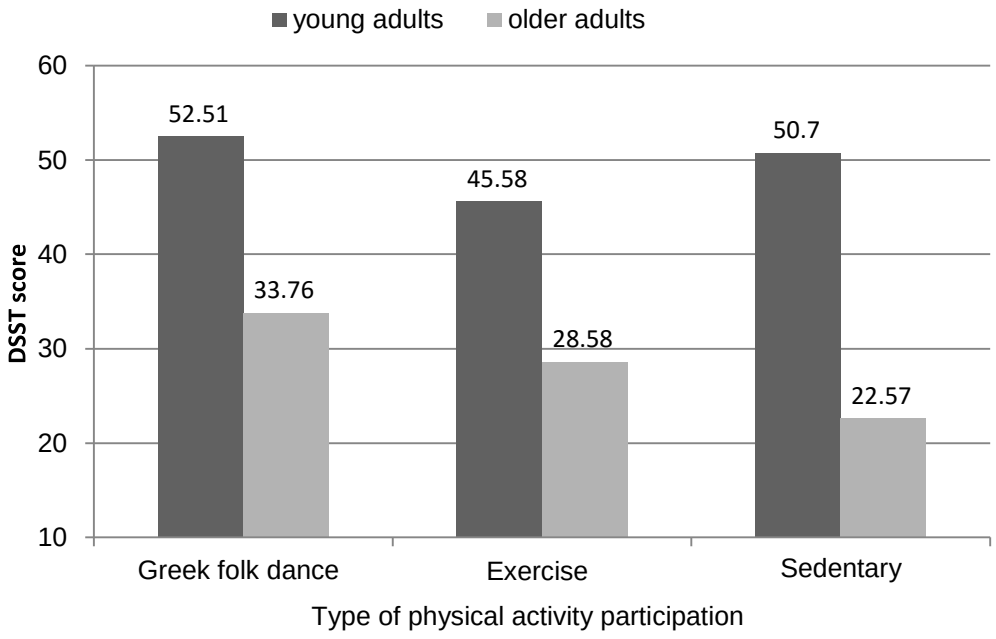

Figure 1. The significant physical activity group X age interaction for cognitive function.

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Breaking down the significant interaction, the simple main effects of age was examined, that is the differences among the different types of physical activity groups were examined separately in younger and older adults. To control for type I error across the two simple main effects, we set alpha for each at .025. There were no significant differences among the three physical activity type groups for young adults ($F_{2,138}$= 1.93, p> .05, η^2= 0.25), but there were significant differences for older adults ($F_{2,118}$= 11.29, p< .001, η^2= 1.61).

The Sidak post-hoc tests show a superior performance against the sedentary group, of both dancers (MD= 11.19, *p*< .001) and exercisers (MD= 6.02, *p*= .045). Dancers had a better performance than exercisers in the cognitive performance test, but these differences were not significant (MD= 5.17, *p*= .113).

4 Discussion

The purpose of the present study was to examine if participation in different types of physical activity, and specifically Hellenic folk dance and non-dance aerobic exercise, was associated with the differences in performance at a certain cognitive task, the Digit Symbols Substitution Test, in young adults and seniors. According to the results, young adults had a better performance than seniors. Differences among the three physical activity groups were noted only in the older age group, where Hellenic folk dancers had the best performance. Significant differences however were noted only for the lowest performance of the sedentary participants as opposed to the senior dancers and exercisers.

Younger participants had better scores than seniors on the cognitive function test. These findings are linked with the common findings in the literature about the cognitive decline associated with aging (i.e. Spirduso, Francis, & MacRae, 2005). The cognitive problems seem to be more pronounced and presented more and more with increasing age (Park, O'Connell, & Thomson, 2003). Declines in cognition are linked with changes in brain structure and also age-related functional differences in certain brain processes (Ballesteros, Mayas, & Reales, 2012; Kramer, Fabiani, & Colcombe, 2006). These changes accompany a general slowing of motor behavior and physical movements, characterized as the landmark of aging (Spirduso et al., 2005). Physical activity has a significant contribution in compensating the cognitive decline and the slowing of motor behavior (Zisi et al., 2003), it seems however that seniors do have a lower cognitive function level than younger adults, even though they participate in exercise programs (Kamijo et al., 2009; Voss et al., 2010).

The results of this research showed that both older participants in Greek traditional dance classes and participants in formal exercise programs had better cognitive levels than those individuals who did not participate in any form of exercise. There are similar findings in the literature. Rehfeld, Hökelmann, Lehmann and Blaser, (2014), also found that three types of intervention: dance, sport, dance and sport, had similar effects on the fluid intelligence, general intelligence and working memory of older individuals and they concluded that any physical activity contributes to successful aging. It is known that participation in exercise improves cognitive function (Paterson & Warburton, 2010), with greater frequency and intensity exercise leading to higher levels of cognition (Brown et al., 2009). The duration of the participation in the exercise programs seems to be another important factor for the exercise – cognition relationship. Findings in the literature indicate that some aspects of cognitive function, such as reaction time, are improved only after

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long systematic exercise participation, however improvements in working memory and increased complexity tasks are reported after four months of exercise (Zisi et al., 2003). The participants in the present study, the way they were selected, had a systematic participation history in dance or exercise of more than one year, so their cognitive function was probably positively influenced by their physical activity.

Older dancers seemed to have quite larger scores in the cognitive test, although not significantly different from the exercisers of the same age group. In the literature, there are several studies that show the beneficial effects of dance on seniors' cognitive function. Merom et al. (2013) found that a typical social dance program which included traditional dance from America, England, France, Italy, Israel and Greece, Latin dances like salsa and rumba, and also Rock and Roll, Foxtrot, Waltz, can reduce falls accident rate and improve cognitive factors associated with the risk of falling in seniors. Dennis Hamacher, Daniel Hamacher, Rehfeld, Hökelmann, and Schega (2015) suggested that dancing lowers gait variability to a higher extent than conventional health-related exercise, since they found that dancing improves minimum foot clearance variability and cognitive performance in a dual-task situation.

Dance programs have significant beneficial effects on cognitive functioning of older adults with health problems, like metabolic syndrome (Kim et al., 2011), while the circular dance helped people with dementia to improve their cognitive function (Hamill, Smith, & Rohricht, 2011). Persons 61-94 years, who participated in European dance lessons for 1.5 hours a week, for 16.5 years, had better cognitive performance and better reaction time than non-dancers (Kattenstroth, Kalisch, Holt, Tegenthoff, & Dinse, 2013). It seems however, that the type of dance is important to show effects on cognitive function, since such improvements are not apparent in some interventional studies with dance, such as Turkish folk dances (Eyigor, Karapolat, Durmaz, Ibisoglu, & Cakir, 2009), and types of jazz dance (Alpert et al., 2009). Brown, Martinez and Parsons (2006), investigated human dance, using positron emission tomography confirmed an interacting network of brain areas active during spatially patterned, bipedal, rhythmic movements that are integrated in dance. The activation of these areas is probably affected of the type and complexity of the movements, but also on the cognitive demands of the task and the memory load required. Kimura and Hozumi (2012), show that there is a positive acute effect of dance exercise on cognition in the elderly, but cognitive function improves when participants perform extended session of choreography and no effect is seen on cognition when participants simply repeat dance elements.

The Greek traditional dance seems that combines features that provide the stimulus to maintain and improve cognitive function. The wide variety of motor patterns and movements, the coordination of every participant with the music and the co-dancers might be some of the reasons of higher cognitive levels of participants in Greek dancing, compared with those following exercise program or leading a sedentary life.

In conclusion, the Greek traditional dance is an enjoyable form of physical activity and has an important role in improving aspects of mental health such as cognition. Participation in Greek traditional dance improves parameters of cognitive function at the same or maybe a higher level than participation in exercise programs. Greek traditional dance thus, emerges as an alternative type of exercise with aspects suitable for improving cognitive function and attracts more research interest, regarding its role in improving quality of life, especially in seniors. In an aging society with senior citizens being the majority of the population, successful aging becomes a priority and Greek dance seems to contribute in

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this priority. Since the object of this study is fairly new, additional research would be useful for further information in this regard.

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