

Assessment of Physical Activity Using Pedometers in a Structured Greek Traditional Dance Session in Adults: A Pilot Study

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DOI: [10.36348/jaspe.2022.v05i02.002](https://doi.org/10.36348/jaspe.2022.v05i02.002)

| Received: 07.01.2022 | Accepted: 12.02.2022 | Published: 16.02.2022

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Abstract

The aim of the present study was twofold: a) to test pedometers' reliability of measuring physical activity level and recording steps, and b) to record the level of physical activity using pedometers in adult participants, in a structured 60-minute Greek traditional dance session. Twenty adult members of a dance club aged 20-55 years old (7 men and 13 women) participated in the study. Pedometers were placed above the right hip of the individuals and recorded steps, distance, time of participation, calories, burnt fat during a structured 60-minute Greek traditional dance session. Steps per minute were, also, calculated. The measurement was performed twice for each individual, with the same dancing protocol, with an interval of one week between measurements. The results for reliability showed that intraclass correlation coefficient (ICC) was significantly high for all variables, ranged from .91 to .99. Paired sample t-test analysis showed no significant differences between measurements, in all variables ($p > .05$). Moreover, according to results regarding the level of physical activity during participation in this session, participants recorded an average of 5,231.25 (± 468.86) steps and they covered an average of 125.01 (± 7.81) steps per minute, meeting the needs based on the daily recommended number of steps, contributing to health benefits. In conclusion, pedometers were found to be an easy and reliable way of assessing physical activity in an hourly structured Greek traditional dance session. Thus, Greek traditional dance sessions may be planned and structured based on the principles for organizing an exercise session, and following the official physical activity guidelines. As a result, Greek traditional dance can be a means for participants in different age groups not only to obtain recreational benefits, but also, to achieve psychological and physiological health benefits, as well.

Keywords: physical activity, pedometers, Greek traditional dance

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INTRODUCTION

The benefits of participation in physical activity are both physical and psychological. Exercise can also have a therapeutic effect (ACSM, 2011). Physical activity and exercise, is the greatest preventive and therapeutic factor for many health issues and chronic diseases. People who participate in exercise programs have better functional capacity in their daily lives with more energy and efficiency than those who do not participate, and also have greater resistance to infections, diseases and aging (WHO, 2010; ACSM, 2011). According to the World Health Organization (WHO, 2010) physical inactivity was identified as the fourth leading risk factor for global mortality. Moreover, its levels are rising in many countries

leading in the prevalence of non-communicable diseases, such as cardiovascular disease, hypertension, type-2 diabetes and mental health, cognition and sleep disorders, affecting negatively general health of the population, worldwide. It is recommended that adults should participate in moderate-intensity aerobic physical activity for at least 150-300 minutes, or in vigorous-intensity aerobic physical activity for at least 75-150 minutes, or in an equivalent combination of moderate and vigorous-intensity physical activity throughout the week, for substantial health benefits. Furthermore, adults should also be engaged in muscle-strengthening activities of moderate, or greater intensity that involve all major muscle groups two, or more days per week (WHO, 2018; Bull *et al.*, 2020). Healthy adults performed 4,000 to 18,000 steps per day. However,

10,000 steps per day have been suggested as a reasonable and realistic goal for everyone leading to health benefits (Yamanouchi *et al.*, 1995; Tudor-Locke & Bassett, 2004; Tudor-Locke *et al.*, 2011). According to Tudor-Locke *et al.* (2011), 100 steps per minute represented a reasonable minimum floor value that can be useful as a public health heuristic value indicative of moderate intensity walking. Multiplying this cadence by 30 minutes, for instance the characteristics of a daily exercise - a recommendation according to WHO (2010) produced a minimum of 3,000 steps which was a percentage of steps used as the wider value for physical activity. Preliminary evidence suggested that communicating federal-physical activity guidelines using step-based metrics could facilitate individuals' ability to comprehend and achieve a physically active lifestyle (Tudor-Locke & Aguiar, 2019). Daily step counting was considered to be an easily accessible means by which one can record, monitor and set physical activity goals. Recent scientific data supported the results of previous studies regarding the existence of an inversed relationship-effect of daily steps with significant effects in health, such as rates of mortality, cardiovascular diseases and type II diabetes (Kraus *et al.*, 2019). In line with previous studies, data of patients' participation in a cardiac rehabilitation intervention program were also important. The continuous monitoring of their walking activity by themselves, watching their steps, allowed patients to choose the desired type of activity and to make continuous adjustments to their walking activities. Direct feedback on stepping activity and expectations for health benefits had led to increased motivation to participate in walking. Finally, pedometer monitoring gave patients a sense of care and support (Thorup *et al.*, 2016).

The use and validity of pedometers in physical activity research has been systematically evaluated (Tudor-Locke *et al.*, 2002), as well as the comparison of different manufacturers (Tudor-Locke, 2002; Crouter *et al.*, 2003; Schneider *et al.*, 2003; LeMasurier, Lee & Tudor-Locke, 2004; Schneider, 2004). The results regarding each type of pedometer differed depending on the manufacturer (Schneider *et al.*, 2003; Melanson *et al.*, 2004). Eight out of ten electronic pedometers in comparison were considered to be accurate, with the recorded number of steps which were performed not to have been significantly different from the actual number of steps (Schneider *et al.*, 2003). However, three manufacturers (Kenz-Lifecorder, NewLifestylesNL-2000 and YamaxDigiwalker SW-701) were rated as the best, with $\pm 3\%$ accuracy of the step test (Schneider *et al.*, 2003). Moreover, pedometers have been used to record steps in children (Michalopoulou *et al.*, 2011) and adults, mainly in the walking skill (Tudor-Locke *et al.*, 2011), and there is very limited scientific evidence regarding their use to monitor steps in various motor skills, or physical activities. However, as far as we know, there has been

only one reference in the literature, for the use of pedometers in a Greek traditional dance's session of one hour duration in middle-aged people (Argiriadou *et al.*, 2013).

Dance has been treated as an interesting and effective form of physical activity (Judge, 2003). When in the form of regular aerobic exercise, it contributes significantly to general physical and mental health of both adults (Fentem, 1992) and the elderly (Krawczynski & Olszewski, 2000). Dancing, especially for the elderly, is an effective form of physical activity, as it carries less risk of injury than many other types of exercise. Research shows that dancing provides older participants with benefits similar to those of exercise programs, helping them to improve balance and preventing falls (Shigematsu *et al.*, 2002; Federici *et al.*, 2005; Esther, Lopez & Fernandez-Arguelles, 2015). Furthermore, dancing can help young athletes to improve strength, speed, agility and flexibility (Alricsson, Harms-Ringdahl, Eriksson & Werner, 2003).

Thus, Greek traditional dance is inextricably linked to the Greek tradition, as it is an integral part of its tangible and intangible cultural heritage. It seems to be particularly beneficial, both for physical and mental well-being, since it was found to be a form of exercise, with its intensity being placed within the predetermined limits of an aerobic exercise routine (Pitsi *et al.*, 2008). According to literature, it seemed that not only had positive effects on motor function, as it contributed to the improvement of dynamic and static balance (Sofianidis *et al.*, 2009), increased mental well-being, reduced stress and depression in the elderly (Mavrovouniotis *et al.*, 2010), but it affected positively children's motor and balance skills, as well (Argiriadou *et al.*, 2018). Further research has shown that a combination of Greek traditional dance and Pilate's programs could be used as an alternative form of physical activity, in order to bring benefits, both in static and dynamic balance, in individuals with blindness (Mavrovouniotis *et al.*, 2013). Moreover, the inclusion of Greek traditional dances in rehabilitation programs, in patients with chronic heart failure were safe and effective in improving lower limb function (Vordos *et al.*, 2016) and similarly contributed to the improvement of physical function in women with breast cancer, their life satisfaction and the reduction of the symptoms of depression (Kaltsatou *et al.*, 2010). To sum up, Greek traditional dance could be a form of exercise, which is not expensive, does not require specific equipment and it is applicable to all ages. In addition, not only it contributed to the creation of cultural identity and preservation of national customs, but was also found to be a pleasant type of exercise that contributed significantly to the improvement of health-related quality of life, not only in the elderly (Bougiesi, 2011) but, in young and middle-aged adults, too (Zisi *et al.*, 2014). Furthermore, Greek traditional dance, both

as a means of relaxation and as a form of a pleasant physical activity in leisure time, contributes to participants' fun and entertainment, giving opportunities for expression of emotions and development of social interactions (Goulmaris *et al.*, 2008).

Conclusively, it seemed that Greek traditional dance contributed significantly to improvement in physical and mental health of the participants at different age groups. However, although research using pedometers included walking and to the best of our knowledge Greek traditional dance (Argiriadou *et al.*, 2013), given that pedometers could be a source of motivation for individuals to participate in physical activity, there has been very limited research, for the use of pedometers in dancing activities. It could be said that such a measurement could give valuable information about the contribution of these interesting and recreational physical activities in the increase of daily number of steps, in line with the global recommendations for improving physical and mental health of the participants. Thus, it was, firstly, hypothesized that pedometers would be reliable in

monitoring steps and physical activity in a structured 60-minute Greek traditional dance session. Secondly, it was hypothesized that steps and physical activity level monitored in a structured 60-minute lesson would be in line with official guidelines for health benefits in adults.

So, the purpose of the study was twofold: a) to test pedometers' reliability of measuring physical activity level and recording steps, and b) to record the level of physical activity using pedometers in adult participants, in a structured 60-minute Greek traditional dance session.

MATERIAL & METHODS

Sample

The sample in this study was a convenient sample of twenty (N=20) dancers (13 women and 7 men) from 20 to 55 years old who were members of an official Greek traditional dance club. Participants were informed about the purpose of the study and assigned informed consents. Participants' demographics are depicted in Table 1.

Table-1: Descriptive characteristics of the sample

<i>N=20</i>	<i>Mean</i>	<i>sd</i>
dancing experience (years)	14.10	6.91
weekly frequency participation (times/week)	2.80	4.67
session duration (hours/session)	1.70	1.59
stride length (cm)	69.45	9.63
body height (m)	1.69	0.09
body weight (kg)	74.80	14.47

Instruments

Yamax Power Walker EX-510 pedometers were used in the present study. The variables that were evaluated for each individual were the number of steps and the distance traveled in kilometers (km), the calories in kilocalories (kcal), the fat burnt in grams (gr), the total duration of physical activity (active participation time) in minutes, that is the time the individuals were active during the 60-minute lesson of Greek traditional dances, as well as the number of steps per minute. Pedometers were placed on the right hip pelvis in a special belt-case for safer recording. Research has shown that motion sensors can be placed on the hip, back, thigh, ankle, wrist, or legs, but the right pelvic floor is the predominant position of choice for a single recorder (Troost *et al.*, 2005; Ward *et al.*, 2005). This type of pedometer enables the recording of movement on three axes. The technical characteristics of the pedometers as given by the manufacturer are: Name: Power Walker, Model: EX-510. Display: 6-digit dual series liquid crystals. Sensor: 3D Accelerometer (Steps, calories, fat). Measurements: distance, activity time, 24-hour clock. Size: about 76x33.5x10 mm. Weight: 24 grams.

Procedure

The protocol included a standard session for teaching Greek traditional dances organized and structured according to the standards of an exercise program with: Introductory part (warm-up), Main part, Final part (recovery). The session was consisted of a variety of Greek traditional dances from different areas of Greece (Table 2). In order to start dancing, the participants were holding each other using a variety of handgrips, creating a semicircle. The pedometers were adjusted according to the instructions of their manufacturer and were placed on the right pelvic floor of the dancers in a special belt-case. The measurement was performed twice in each adult under the same conditions (time, place, music and dance protocol), while the interval between the first and second measurement was one week. For assessing the level of physical activity, the mean values of both measurements recorded by pedometers and the average of both measures was calculated for all pedometer variables (steps, fat, etc.).

Table-2: Protocol of the 60-minute Greek traditional dance session

Traditional dance name	Duration
Introductory Part	
Syrtos (Peloponnese)	2:20 min
Brostopisinos (Lemnos)	2:25 min
Mais	2:34 min
Main part	
Syghathistos	2:34 min
Tsourapia	2:15 min
Xesyrtos	2:20 min
Baintouska	2:30 min
Gaida (Serres)	2:54 min
Raikos	2:50 min
Litos	2:40 min
Sofka	3:00 min
Rantile	3:20 min
Kalamatianos (Naxos)	2:20 min
Pidihtos (Rhodes)	2:18 min
Ballos (Kefalonia)	2:00 min
Zacharoula	2:00 min
Zonaradiko	4:04 min
Final Part	
Zagorisio	3:00 min

STATISTICAL ANALYSIS

The SPSS/PC Version 20.0 for windows was used for all statistical analyses, and statistical significance was set at the $p < .05$ level. For testing pedometers' reliability in recording physical activity in a structured 60-minute Greek traditional dance session,

an Intraclass Correlation Coefficient (ICC) analysis was applied. In addition, a paired samples t-test analysis was performed, between the first and second measurement, for all variables (steps, calories, fat, distance, active participation time, and steps per minute). Descriptive statistics were performed for better representation of the means through data tables regarding level of physical activity recorded by pedometers.

RESULTS

Pedometer's reliability

Regarding reliability of pedometers in a structured 60-minute Greek traditional dance session the results showed:

a) Intraclass Correlation Coefficient (ICC) analysis was statistically significant, for all variables examined and values ranged from .91 to .99. ICC results are shown in Table 3.

Table-3: ICC for pedometer variables

Pedometer variables (N=20)	ICC
steps	.962
distance	.987
active participation time	.913
calories	.996
fat	.996
steps/min	.947

b) Paired samples t-test analysis showed no significant difference between the 1st and 2nd measurement in all variables ($p > .05$). The results are shown in Table 4.

Table-4: Means and standard deviations in 1st and 2nd measurement and paired samples t-test of the pedometer variables

Pedometer Variables (N=20)	Mean	sd	t	df	p
steps1 (number)	5,228.65	454.94	-.12	19	.89
steps 2 (number)	5,233.85	482.79			
calories1(kcal)	203.80	58.31	.22	19	.82
calories2 (kcal)	203.45	55.56			
fat 1 (gr)	28.27	8.10	.13	19	.89
fat2 (gr)	28.24	7.72			
distance1 (km)	3.60	.57	-.67	19	.50
distance2 (km)	3.62	.55			
active participation time1 (min)	41.90	1.68	.89	19	.38
active participation time 2 (min)	41.70	1.86			
Steps/min	124.66	7.72	-.88	19	.38
steps/min 2	125.36	7.90			

Recorded level of physical activity in a structured 60-minute Greek traditional dance session

The level of physical activity, which was recorded in both measurements regarding average steps were $5,231.5 \pm 468.86$, and regarding the average steps/minute were 125.01 ± 7.81 showed that, in both

structured 60-minute traditional dance sessions the participants met the needs based on the daily recommended number of steps with all the health benefits this may have. In detail, the means and standard deviations for each variable recorded by pedometers are shown in Table 5.

Table-5: Means and standard deviations of the average values derived from 1st and 2nd measurement using pedometers

<i>Pedometer variables (N=20)</i>	<i>Mean*</i>	<i>sd</i>
Steps (number)	5,231.25	468.86
calories(kcal)	203.63	56.94
fat (gr)	28.25	7.91
distance(km)	3.61	.56
active participation time(min)	41.80	1.77
Steps/min	125.01	7.81

*Average value from 1st and 2nd measurement

DISCUSSION

The purpose of this study was, firstly, to test the pedometers' reliability in recording physical activity in a structured 60-minute Greek traditional dance session in adults and, secondly, to record the level of physical activity with the use of pedometers during this session.

Regarding the first research hypothesis, the results showed that pedometers were a reliable instrument for recording physical activity in a structured Greek traditional dance session and these findings are in agreement with the existing literature for different types of skills and pedometers (Tudor-Locke, 2002; Schneider *et al.*, 2003). The type of pedometer used in the present study showed high reliability measuring an hourly program of Greek traditional dances, including motor skills, such as, the gait, a fundamental motor skill that has been evaluated in most surveys with pedometers. Importantly, the specific type of pedometer used to record the level of physical activity in the present study provides the ability to record at three dimensions. Movement, in the form of a motor pattern in each dance, is the fundamental component of the Greek traditional dance and is characterized by a complexity as a result of the emphasis given by the Greek tradition, mainly in combinations of lower limb movements, such as single- or double-leg bounces, dynamic supports on all or half the foot, squats, slidings, single, or double swings, twists and various other movements (Zografou, 2003). Preliminary evidence suggested that communicating federal physical activity guidelines using step-based metrics could facilitate individuals' ability to comprehend and achieve a physically active lifestyle (Tudor-Locke & Aguiar, 2019). Moreover, if daily measurement of steps is done with easily accessible technological equipment, appropriate for specific movements, individuals can record, monitor and set their personal goals for physical activity. Immediate feedback from activity-based pedometers and expectations for health benefits increase motivation to participate in research regarding the walking skill (Kraus *et al.*, 2019). Therefore, due to the complexity and the variety of movements the Greek traditional dance has to show, the possibility of three-dimensional recording offered by pedometers is important, so that the level of physical activity could be recorded. Moreover, scientists of physical education as teachers

of Greek traditional dances can record and check in this way daily, or weekly the goals of physical activity for health that they have been set in collaboration with the participants, given that pedometers may increase their motivation for participation (Kraus *et al.*, 2019).

According to the second research hypothesis, the results showed that the average of steps recorded during an hourly structured Greek traditional dance session was 5,231.25 (sd 468.86). Our results are in agreement with the results of Argiriadou *et al.* (2013) who found that the middle-aged people (M=56.53, sd=5.52 years old), that participated in a Greek traditional dances session of one hour duration, performed 4,721.29 (sd 469.094) steps. It is worth mentioning that the recorded steps, in the present study exceeded the required values given as the recommended level of daily physical activity for adults, according to the World Health Organization. Furthermore, 100 steps per minute found to represent a value of moderate-intensity walking steps (Tudor-Locke *et al.*, 2011; Tudor-Locke *et al.*, 2019), and if it is multiplied by 30 minutes, daily exercise - a recommendation according to WHO (2010) - produces the minimum 3,000 steps which is the minimum percentage of steps used as the wider value for physical activity, during exercise (Tudor-Locke *et al.*, 2011). Individual physical activity is defined as 4,999 steps - as a sedentary lifestyle, 5,000 - 7,499 as inactive, 7,500 - 9,999 as a little active and 10,000 active lifestyle (Tudor-Locke & Bassett, 2004; Tudor-Locke *et al.*, 2011). The dancers who participated in the present structured Greek traditional dance session exceeded their daily needs for steps, based on the recommended daily number of steps, 10,000 per day and 3,000 steps in 30 minutes required per day, for an active lifestyle (Yamanouchi *et al.*, 1995; Tudor-Locke & Bassett, 2004; WHO, 2010; Tudor-Locke *et al.*, 2011).

Greek traditional dance is inextricably linked to the Greek tradition, as it is an integral part of its tangible and intangible cultural heritage. The findings of the present study are in agreement with the existing literature. Greek traditional dance seems to be particularly beneficial, both for physical and mental well-being, since it was found to be a form of exercise, with its intensity being placed within the predetermined limits of an aerobic exercise routine (Pitsi *et al.*, 2008). More specifically, a Greek traditional dances session includes a great amount of performed movements,

indicating that, indeed, it constitutes a physical activity that may contribute to the improvement of physical fitness as a physical activity of moderate intensity, of approximately 3-5 METs and may lead to a calorie loss that amounts from 300-360 Kcal/h, when dancing in a low intensity pace, to 420-480 Kcal/h, when dancing in a more intensive way (Balady & Weiner, 1987; Byrne, 1991; Papanikolaou, 1993; Klissouras, 2004; Argiriadou *et al.*, 2013). In addition, other researchers have proved that Greek traditional dances is an aerobic exercise mode since they are performed in a HR training zone of approximately 75% of HR_{max} (Mavrovouniotis *et al.*, 2010; Argiriadou *et al.*, 2013), an exercise intensity that can develop and maintain adult people's cardiorespiratory fitness (ACSM, 1995). Thus, as dancing considered to be a pleasant physical activity, which contributes significantly to an increase in level of physical activity in participants, with all the health benefits this may have, providing a better quality of life, pedometer measurements are a safe and secure process and can be easily used in an hour-long dance class, improving motivation for participation (Thorup *et al.*, 2016).

In conclusion, pedometers were found to be an easy and reliable way of assessing physical activity in an hourly organized Greek traditional dance session. Thus, Greek traditional dance sessions may be planned and structured based on the principles for organizing an exercise session, and following the official physical activity guidelines. As a result, Greek traditional dance can be a means for participants in different age groups not only to obtain recreational benefits, but also, to achieve psychological and physiological health benefits, as well.

It is advisable that, the results of this study should not be generalized due to some limitations regarding the sample size and the fact that it was a convenient one. Future research is encouraged and it should focus in physical activity measurements in Greek traditional dances, not only in adults and the elderly, but also in children and adolescents, because dance has been one of the most suitable physical activities for children since antiquity. Finally, further future studies could be conducted beyond the folklore and cultural element of dance. A combination of questionnaires, pedometers, accelerometers and heart rate recorders could help the scientist of sports and physical education, who teaches Greek traditional dances, to examine more aspects of dance, scientifically and to objectively record the intensity of physical activity, receiving in this way important information, in order to organize lessons, not only as leisure activities, but also as a structured exercise dancing sessions, with purposeful health benefits for participants.

ACKNOWLEDGEMENTS

The authors appreciate the willingness and collaboration of participants and research assistants who

were involved in the study, as well as the physical education teacher of the dance club Mr. Alexandros Omiriadis.

Disclosure statement

There are no relevant financial or non-financial competing interests to report.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors

IRB consent

The research study was an undergraduate thesis which was approved by the departmental board of members, the adult participants in the study was approached personally and they gave their written consent for participation.

Data availability statement

The data that support the findings of this study are available from the corresponding author, [I. Pappas], upon reasonable request.

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