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Senior Women Golfers: A Pilot Study of Their Fitness Characteristics and Mood Disturbance After Exercise

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SENIOR WOMEN GOLFERS: A PILOT STUDY OF THEIR FITNESS CHARACTERISTICS AND MOOD DISTURBANCE AFTER EXERCISE

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ABSTRACT

Senior golfers (>50 yrs of age) constitute more than 25% of the approximately 20 million Americans who are "committed" golfers (NGF, 2016). Golf is an excellent way to stay physically active and to participate in a "lifetime" sport. **PURPOSE:** The purpose of this pilot study was to investigate how senior golfers performed both functional and golf-specific fitness tests, and a 6-minute walk test (6-MWT) (aerobic fitness test). Possible changes in mood also were monitored before and after the 6-MWT to determine if walking influenced their total mood disturbance score (TMD). **METHOD:** Twelve female senior golfers (mean age of 62.9 ± 6.9 yrs) completed the *Titleist Performance Institute*® (TPI®) golf fitness screen and the 6-MWT. They also completed the Profile of Mood States (POMS) before and after the 6-MWT. The POMS subscales were combined as a Total Mood Disturbance score (TMD). Heart rates (HR) and ratings of perceived exertion (RPE) were measured during and after the 6-MWT. Paired *t-tests* and Pearson correlation coefficients were calculated for all dependent variables (pilot study: $p \leq 0.10$). **RESULTS:** Physiological variables were TPI® Score, HR, RPE, and $\%HR_{max}$. Following a series of golf-specific exercises, TPI® golf fitness screen mean scores were 17.5 ± 4.2. The three TPI® tests that these golfers scored lowest on were the deep squat, and the single leg balance tests with their eyes open and again with eyes closed. The remaining variables included the following means and standard deviations at 3 and 6 minutes: HR = 123 ± 16, 130 ± 20 (beats/min); RPE = 12.0 ± 2.0, 13.0 ± 1.0 ("somewhat hard"); $\%HR_{max}$ = 79 ± 12; 83 ± 15% ("vigorous") (ACSM, 2014). The distance for the 6-MWT was used to measure aerobic endurance and a percentile rating was determined from their age group: 69.2 ± 18.8% (Rikli & Jones, 2013). After the 6-MWT, significant correlations were found for RPE and HR at 3 minutes ($p = 0.025$). However, RPE at 6 minutes was not correlated with any dependent variable. As

hypothesized, $\%HR_{max}$ was correlated with HR at 3 and 6 minutes ($p = 0.0001$). No correlations were found between exercise intensity and the change in TMD. The TMD scores on the POMS before and after walking were not correlated with the 6-MWT distances ($p's = 0.698, 0.896$). The mean TMD score was significantly lower after the 6-MWT, 98.4 ± 12.7, 89.3 ± 15.4 ($p = 0.026$). There were significant differences between RPE, HR, and $\%HR_{max}$ at 3 and 6 minutes ($p \leq .05$).

CONCLUSION: Senior women golfers were able to complete the golf fitness tests. Fitness characteristics were identified that could be improved with future golf-specific exercises. Senior women golfers were rated at the 69^{th} percentile for aerobic fitness for their age group and had desirable decreases in TMD after the 6-MWT. Participating in golf provides senior women with an opportunity to maintain functional movement, to exercise aerobically, and to have desirable changes in total mood disturbance.

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INTRODUCTION

During the 1990's, golf grew considerably in popularity (Lindsay, Horton & Vandervoot, 2000). The most notable increase was in participation in individuals between the ages of 50 and 59 years (Theriault & Lachance, 1998). In 2016, the National Golf Foundation has reported that approximately 33% of the 2 million golfers are > 50 years (i.e., senior golfers). Interestingly, it was reported that this age group played the largest percentage (56%) of all rounds of golf played (NGF, 2016). It is expected that the senior population will continue grow with the maturing age of the "baby boomer" era (Morehouse, 1990).

There are many reasons as to why this older generation may gravitate towards a sport such as golf. The popularity of golf among older persons is likely due to a variety of reasons such as increased leisure time and disposable income (Morehouse, 1990). As people age, they eventually want to retire from their chosen careers. When they are retired, they have more free time and can find various activities to occupy their time. Many people may take up golf simply because they love the sport, but this may not be the only reason for why people will participate in something. For some seniors, it is important for those activities to be enjoyable, and to also have long lasting health effects. The walking associated with a game of golf represents a moderate intensity, long duration, interval form of exercise that can maintain or increase the aerobic capacity of older people (Murase, Kamie & Hoshikawa, 1989).

Walking is a rhythmic, dynamic, and aerobic activity of large muscles that confers many benefits with minimal adverse effects (Morris & Hardman, 1997). In older populations, walking can be the primary form of exercise and golf is an excellent sport to promote this activity. Golf is a social and pleasurable form of activity that includes long bouts of low to moderate intensity walking and it can be enjoyed by all age groups and by both sexes (Parkkari, Natri, Kannus,

Manttari, Laukkanen, Haapasalo, Nenonen, Pasanen, Oja, & Vuori, 2000). Social interaction for older adults can add to exercise enjoyment and may give them the motivation to participate in exercise, especially in golf. Golf courses add uniqueness to a person's exercise based on having to carry around his/her bag of clubs and possibly having numerous hills to walk up and down. This gives an older adult more of an opportunity to use larger muscle groups more consistently at a strenuous level to maintain a certain level of strength. Although the amount of walking during a golf game depends on the golf course, the estimated distance walked per round is about 7 km (4.38 miles) (Palank & Hargreaves, 1990). The intensity of walking during golf depends on the pace of the game and the weight of the clubs that a player carries or pulls (Magnusson, 1998). In previous studies, walking has not usually been reported to increase muscle strength, but it may have important functional gains in the elderly (Pink, Perry, & Jobe, 1993). It was found that regular golf participation increased trunk muscle endurance, which might reduce the frequency of generalized weakness, therefore lessening the risk of falls and fractures (Watkins, Uppal, Perry, Pink, & Dinsay, 1996).

Six Minute Walk Test (6-MWT)

The ability to walk for a distance is a field test performance-based measure, and is an important representation of the quality of life the person may have because it reflects the capacity to undertake day-to-day activities (Guralnik, Branch, Cummings, & Curb, 1989). Normally, the 6-MWT is used for individuals with chronic obstructive pulmonary disease, heart failure, and healthy older populations (McGavin, Gupta, & McHardy, 1976; Diaz, Morales, Osses, Klaassen, Lisboa, & Saldias, 2010; Camarri, Eastwood, Cocins, Thompson, & Jenkins, 2006). A previous study has independently shown that both the 6-MWT and aerobic fitness are predictive of morbidity and mortality (Burr, Bredin, Faktor, & Warburton, 2011). There are

other exercise tests which can be used to determine fitness capacity, such as the Rockport walk test and the Leger 20-m shuttle, but there are multiple advantages to using the 6-MWT. The 6-MWT is used because of its reliable performance-based measures in elderly adults, rather than using chair stands or weight lifting (Enright, McBurnie, Bittner, Tracy, McNamara, Arnold & Newman, 2003). In addition, the test is simple, can be performed indoors, is not disruptive to the workplace environment, and does not require a 400-m track (Burr, Bredin, Faktor, & Warburton, 2011). In order to perform the test, very little equipment is needed. The required equipment includes a stopwatch and a long corridor, minimal tester experience, a short test duration (i.e., 6 min), and a relatively nonintimidating exercise challenge (Burr, et al., 2011). Participants are asked to walk as fast and as far as they can, thus the exercise can be self-regulated also adding to the feasibility of the test.

Ratings of Perceived Exertion and Heart Rate

In both clinical and applied settings, the evaluation of perceived exertion is useful both to the participant and the researcher (Wenos, Wallace, Surburg, & Morris, 1996). However, the total amount of data for perceived exertion reported by individuals 60 years of age and older is limited; this amount becomes even smaller when the focus is on women (Carton & Rhodes, 1985; Sidney & Shephard, 1977). There exists a need for population or age specific research because of intergroup differences (Sidney & Shephard, 1976).

Exercise eliciting a given HR is perceived to be significantly more stressful for older subjects (Wenos, Wallace, Surburg, & Morris, 1996). This could be why it is more difficult to gain a larger number of older adults willing to exercise at high intensities due to the increased stress put on their bodies. Walking at an "all-out" intensity could result in the same HR as a younger individual, but would represent a high percentage of VO_2max compared to that younger

individual. In addition, evidence suggests that perception of effort varies with age and sex of subjects (Arstila, Antilla, Wendelin, Vuori, & Valamaki, 1977; Bar-Or, 1977; Borg & Linderholm, 1967).

Total Mood Disturbance

It is commonly reported that participating in regular exercise has numerous health related benefits including reduced risk of coronary heart disease, weight control, improved cardiovascular efficiency and improved psychological well-being (Blair & Marrow, 1998; Kopelman, 2001; Berger, Darby, Zhang, Owen, & Tobar, 2016). Golf includes long bouts of low to moderate intensity walking, which have been shown to have favorable effects on many health and fitness indicators in middle aged men and has been recommended as an appropriate and risk-free form of health-enhancing physical activity (Parkkari, et al., 2000). While physical benefits of golf have been documented, psychological effects are less well understood (Lane & Terry, 2004).

One measure that can be used to progress the research about psychological benefits of golf could be the Profile of Mood States (POMS). Considerable research has investigated changes in psychological states assessed by self-report measures such as the POMS (McNair, Lorr, & Droppleman, 1971, 1981, 1992) following exercise (Biddle, 1995; Mutrie & Biddle, 1995). There is a strong consensus that mood enhancement is a primary benefit of physical activity (e.g., Berger, 1996; Berger & McInman, 1993; Morgan, 1997).

The POMS has been a widely used measure of mood in physical activity research (Berger & Motl, 2000). The original version of the POMS was developed in 1971 and consisted of 65 items; an abbreviated 30-item version of the POMS has been developed more recently (McNair et al., 1971, 1981, 1992). On both versions, respondents rate each item on a 5-point Likert scale

with anchors ranging between “Not at all” to “Extremely.” (Berger & Motl, 2000). Items are combined to form six separate subscales: tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment (Berger & Motl, 2000). The subscale scores can be combined to form an overall measure of affect that is labeled total mood disturbance (TMD) (Berger & Motl, 2000). The separate subscales are useful when researchers are interested in examining changes in specific moods. TMD is useful in studies containing a small number of participants or when researchers are interested in a single, global estimate of affective states (Berger & Motl, 2000).

Balance

Balance is an essential part of being a successful golfer. As one ages, balance plays an even greater role in determining one’s success during a round of golf. It is not just during the golf swing where balance is critical when it comes to older folks. Falls have been identified as one of the major causes of morbidity and mortality in older adults (Carter, Kannus, & Khan, 2001; Tinetti, Gordon, Sogolow, Lapin, & Bradley, 2006). About one third of the falls resulted in soft-tissue injuries, with 4.6% of the falls in men and 8.5% in women resulting in fractures (Tsang & Hui-Chan, 2010). In the United States, the cost of hip fractures attributable to falls in the older population was reported to be about $10 billion in 2001 (Carter, et al., 2001).

Golf is a posture-challenging sport that is popular among older people (Tsang & Hui-Chan, 2010). Hitting the ball in the right direction and to an accurate location requires golfers to develop a highly precise and efficient swing motion (Tsang & Hui-Chan, 2010). With repeated practice, golfers aspire to be able to execute accurate shots in a reproducible and consistent manner (Tsang & Hui-Chan, 2010). Golf demands sensory, motor, and dynamic postural control with precise trunk motion and appropriate weight shifting from both legs to predominantly one

leg during end-swing (Okuda, Armstrong, Tsunezumi, & Yoshiike, 2002). Because walking consists of double-leg and single-leg support phases, walking on the uneven golf fairways may enhance balance performance in someone's single-leg stance (Tsang & Hui-Chan, 2010).

In a review, Horak, Henry, and Shumway-Cook (1997) reported that 35% of falls among older persons could result from inadequate responses to perturbations caused by external displacements of the body's center of mass. They noted that balance control in response to environmental perturbations is important as part of effective postural control during functional activities. Such daily activities demand greater balance control and could pose particular problems for older adults (Tsang & Hui-Chan, 2010). Weight shifting from two legs to predominantly one leg while moving the trunk and arms in a precise golf swing is an activity that demands a high level of balance control (Tsang & Hui-Chan, 2010). Extrinsic causes such as uneven ground and obstacles in the environment combined with intrinsic causes of poor balance in older adults may precipitate falls (Li, Keegan, Sternfeld, Sidney, Quesenberry, & Kelsev, 2007). Golfing 18 holes often involves walking with double-and single-leg support up and down hills and sometimes through bunkers (Parkkari et al., 2000; Stauch, Liu, Giesler, & Lehmann, 1999), activities that may promote balance control in both static and perturbed single-leg stance, as well as multidimensional balance tests.

TPI® Score

Titleist Performance Institute (TPI®) is the world's leading educational organization dedicated to the study of how the human body functions in relation to the golf swing (mytpi.com). A major purpose of TPI® is to educate golf industry professionals and the playing public on the importance of the body and how it relates to the golf swing. The most efficient swings are not the same for every golfer, because efficiency is unique to each person's body. To

achieve an efficient swing, a golfer must first be screened. The TPI® golf fitness screen involves an assessment of swing mechanics and biomechanics, physical fitness, movement quality, current health and a client history (mytpi.com). Once this screen is finished, the results can be used to create an exercise training plan that is unique for that golfer. The plan may include fitness training, physical therapy and treatment, coaching of swing mechanics and biomechanics, nutrition, mental strategy or all of the above (mytpi.com).

Based on the information provided in the literature review, the following hypotheses have been made.

Research Question #1 – What were the characteristics of the 12 senior women golfers before and after the 6-min walk test physiologically and psychologically?

Directional hypothesis #1 – If 12 senior women golfers enjoy exercise, then their physiological and psychological characteristics will reflect this.

Research Question #2 – Was there a correlation between HR, RPE, exercise intensity as measured by percent HR_{max} and the 6-min walk test (distance)?

Directional hypothesis #2 – If participants walk as fast as they can, then RPE, HR, and exercise intensity will be correlated with the 6-MWT (distance).

Research Question #3 – Was there a difference in 3 min vs. 6 min. HR, RPE, and $\%HR_{max}$?

Directional hypothesis #3 – If participants walked as fast as they could during the 6-MWT, then there will be a difference in their RPE, HR, and $\%HR_{max}$ recorded at 3 min vs. 6 min.

Research Question #4 – Was there a correlation between exercise intensity and change in mood states (TMD)?

Directional hypothesis #4 – If participants enjoy exercise (6-MWT), then their change in mood states (TMD) will be correlated with exercise intensity.

Research Question #5 – Was there a significant difference in TMD scores before and after the 6-min walk test?

Directional hypothesis #5 – If participants enjoyed the 6-MWT, then there will be a significant different in TMD scores before and after the test.

Research Question #6 – Did walk distance correlate with TMD scores at the end of 6-min walk test?

Directional hypothesis #6 – If participants enjoyed walking as fast as they could for 6-min, then their TMD scores at the end of the 6-MWT will be correlated with their walk distance.

METHOD

Participants

Twelve healthy females volunteered to take part in this research study. In order to be eligible to participate in the study, participants completed a medical history questionnaire providing any information that would otherwise limit their participation in the study. All participants were senior golfers (i.e., > 50 years of age) and only one of the participants did not have extensive golf playing experience. Participants were volunteering to participate in a golf specific training program. Demographic data prior to the program for the participants are shown in Table 1.

Measures

Profile of Mood States

The POMS (McNair et al., 1992) is a 65-item self-report inventory that assesses transient, fluctuating mood states along six dimensions: tension-anxiety, depression-dejection, anger-hostility, vigor-activity, fatigue-inertia, and confusion-bewilderment. Affective states are assessed along four-point scale (0 = *not at all,* 1 = *a little*, 2 = *moderately*, 3 = *quite a bit*, and 4

= *extremely*). Often employed in exercise settings to measure acute changes in mood (see Berger & Motl, 2000, for a review), the POMS has good internal consistency (α = .84 to .95) and adequate test–retest reliability (*r* = .65–74; McNair et al., 1992).

6-MWT

The 6-MWT is to be done as fast as a participant can walk. This test can be done around a track or even walking back and forth down a hallway. When measuring for distance, the researcher is responsible for counting the laps completed and marking where the participant came to a stop at the completion of the six minutes. At 3 and 6 minutes, the researcher recorded the participant's HR and RPE. Participants' scores were rated using the norms for the Senior Adult Fitness Tests (Rikli & Jones, 2013).

Open-Ended Comments

The participants commented on anything they chose to write about their day or in the past week that influenced how they "felt right now at that particular moment." They were asked to complete at least half a page or more and to provide explanations to the researchers for what they were feeling. The second time (i.e., post-6-MWT) that the participants wrote in the open-ended comments section, they wrote anything pertaining to the exercise (6-MWT) that they had just performed.

Procedures

Multiple variables were assessed to gain an understanding of how well senior golfers can withstand the physically demanding movement patterns throughout the course of play. In order to simulate the walking distances that are covered on the golf course during a round of golf, the researchers used the 6-MWT to record each participant's heart rate, rate of perceived exertion at three and six minutes, and her total 6-min walk distance. After the walk test was completed,

participants completed the Profile of Mood States questionnaire that would represent a score of their total mood disturbance (TMD). To test the participants physiologically, they performed and were rated for the 17 TPI® fitness screen movements which are indicators of how physically fit someone is to perform the golf swing.

Descriptive data were collected for all participants, including date of birth, height, age, body mass, and history of playing golf. The testing began by greeting each participant at the Eppler South gymnasium door. The researcher walked each participant to the testing room where the questionnaires and Titleist Performance Institute (TPI®) fitness screening were completed. Multiple questionnaires and forms were administered for the study. First, an informed consent form was distributed to each participant to be signed and returned to the researchers in order to take part in the study. Second, the Paffenbarger Physical Activity questionnaire was completed. Third, the participant was asked to fill out the POMS questionnaire, which contains 65 items. Fourth, the PACES Trait Scale was completed. This questionnaire is used to assess how each participant "feels" about exercise in general, most of the time. Fifth, the participants completed the Satisfaction with Life Scale. This scale consists of five questions that deal with how the participant would rate their happiness overall with how her life has turned out thus far. Sixth, a short essay was completed by each participant describing how events of the day or anything worth mentioning that happened within the past week.

The lead researcher then measured the participant's height and weight with shoes removed. Each participant was then fit with a Polar HR (Polar Electro, New York, USA) monitor and watch. Once these were in place, the participant took a seat to put her shoes back on. While each participant put her shoes back on, the researchers took this time to read an explanation of the rating of perceived exertion (RPE) scale and how it worked. The participant

then walked up a flight of steps to an indoor track for the 6-MWT. The researcher explained to the participant that HR and RPE would be measured at the three and six minute marks. At the three and six minute marks, the researcher went to the participant while she was walking as fast as she could to record those measures. While these measures were being recorded, each participant continued walking as fast as possible until the time was over. At the 6-min mark, the researcher told the participant to stop where she was so the total distance walked could be calculated in feet.

Immediately after the 6-MWT, the participant returned to the testing area to complete the second set of questionnaires. The HR monitor was removed prior to the completion of the questionnaires. The participant proceeded to complete the POMS, portraying how she felt at that moment, PACES State, how she felt about the exercise she just did, and completed a short essay explaining how she liked or disliked the 6-min walk test and why.

The final sequence of testing involved the TPI® certified golf fitness instructor having each participant perform the series of 17 exercises, known as the TPI® Fitness Screen: 1) The pelvic tilt test has the participant get into a normal five-iron set-up posture with their arms across their chest. The participant was then asked to tilt their pelvis anteriorly or forward and backward, increasing the arch in the lumbar spine; 2) The pelvic rotation test checks the player's ability to rotate the lower body independently from the upper body; 3) The torso rotation test checks the player's ability to rotate the upper body independently from the lower body; 4) The overhead deep squat test is used to assess bilateral, symmetrical mobility of the hips, knees, and ankles; 5) The toe touch test is for overall mobility in the lower back and hamstrings, plus it can help identify a hip problem versus a lower back/core limitation; 6) The 90/90 test is for overall external rotation in the shoulder and scapular stability in golf posture; 7) The single leg balance

test measures the golfer's overall balance; 8) The lat test evaluates shoulder flexion which includes the flexibility of the latissimus dorsi muscle group, shoulder joint restrictions and scapular motion limitations; 9) The lower quarter rotation test examines the hip and tibial internal/external rotation and foot inversion/eversion which are essential for a proper golf swing; 10) The seated trunk rotation test is a test for overall mobility between the upper and lower body; 11) The bridge with leg extension test is a test for stability in the pelvis/lumbar spine/core, especially the gluteal muscles; 12) The cervical rotation test is a combination pattern that incorporates assessment of the ability to do side-bending and rotation of the head; 13) The forearm rotation test is a combination of two movement screens that test pronation and supination of the forearms; 14) The wrist hinge test is a combination of two movement screens that test radial and ulnar deviation in the wrists; 15) The wrist flexion test screens the player's ability to bow the wrists; 16) The wrist extension test screens the player's ability to extend the wrists; 17) The reach, roll, and lift test is great for lower trapezius strength and mobility of the shoulder girdle. These ratings were put into the TPI computer software to calculate a score. The lower the score (similar to a golf score) the greater the participant's golf fitness abilities.

Statistical Analyses

Mean scores and standard deviations of the participants (i.e., age (years), body weight (kg & lbs), height (cm), percent body fat, HR_{max} (220 – age), years of playing golf, and their TMD scores) were calculated using SPSS V. 21.0 (Durham, NC, USA). When norms were available, mean scores for the dependent variables were rated with comparable groups of similar ages and sex. Pearson correlation coefficients were used to measure the relationship between HR, RPE, and exercise intensity as measured by percent HR_{max} and 6-MWT distance. Pearson correlations were used to measure the relationship between each participant's exercise intensities and TMD

scores, along with determining if walk distance correlated with TMD scores after the 6-MWT. Paired *t-tests* were used to determine if the differences between variables such as HR, RPE, and $\%HR_{max}$ at 3 and 6-min were statistically significant.

RESULTS

Research Question #1 – What were the characteristics of the 12 senior women golfers before and after the 6-min walk test physiologically and psychologically?

All participants completed the 6-MWT, questionnaires, and received a TPI® Golf Fitness Score. Only seven women participated in the golf swing analysis and were assigned a Big 12® Score at a separate golf swing evaluation session. All demographic data are shown in Table 1. Variables that were measured were height (cm), body weight (kg, lbs), percent body fat, HR_{max} (beats/min), years playing golf (yrs.), total mood disturbance (TMD), TPI® Score, and Big 12® Score. The TPI® Score mean values were 17.5 ± 4.2. These scores were the initial golf fitness screening to assist in the development of each woman's training program (Darby & Berger, 2016; Berger & Darby, 2016). Mean scores for the Big 12® golf swing analyses were 13.4 ± 8.5. These scores were an evaluation of their swing faults that were analyzed from a videotape of each golfer with a PGA golf professional present to give feedback.

Table 1.

Demographic data (*N*=12; Women)

Variable		*Mean*	*S.D.*
Age (yrs)		62.9	6.9
Height (cm)		164.2	1.7
Body weight (kg)		73.1	5.2
	(lbs)	161.1	40.1
% body fat		46.1	0.8
HR_{max} (beats*min^{-1})		157	2
Years Playing Golf (years)		24.5	5.7
TMD	Pre-6MWT	98.4	12.7
	Post-6MWT	89.3	15.4
TPI® Score		17.5	4.2
Big 12® Score		13.4	8.5

[a]*TPI® = Titleist Performance Institute, mytpi.com;* [b]*Big 12® Score* – Swing Fault, Evaluation (*n* = 7), *mytpi.com;* [c] 6-MWT = 6 minute walk test

For the 6-MWT, participants were asked to walk as fast as they possibly could. Mean scores showed that participants chose to walk at a vigorous level by walking at 79 ± 12% of their HR_{max} at the 3 minute mark (ACSM, 2014). At 6 minutes, mean scores showed that participants increased their $\%HR_{max}$ to 83 ± 15% of their $\%HR_{max}$, and maintained a vigorous level of exercise. This information is shown in Table 2.

Table 2.

Physiological data from the 6-min walk test. (*N*=12; Women)

	3 min		6 min	
Variable	*Mean*	*S.D.*	*Mean*	*S.D.*
Heart Rate (beats*min^{-1})	123	16	130	20
RPE[a]	12	2	13	1
% HR_{max} walk	79	12	83	15
6-min Walk Distance (yds)			644	71.6
6-min Walk Distance Rating (Percentile)[b]			69.2	18.8
Mean Walk Speed				

[a] Rating of Perceived Exertion; Borg scale 6-22 (Borg, G., 1998)
[b] Norms from Rikli and Jones (2013)

Research Question #2 – Was there a correlation between HR, RPE, exercise intensity as measured by percent HR_{max} and the 6-min walk test (distance)?

In Table 3, it is indicated that in the first 3 minutes of the 6-MWT, there was a significant correlation between HR and %HR_{max} (p = 0.0001) (see Table 3). There was also a significant correlation between participants' mean RPE and the mean total walk distance covered (p = 0.025).

The 6-min results are displayed in Table 4. Significant correlations were found between HR and %HR_{max}. No other variables that were measured at 6 minutes were correlated. Although no variables were correlated with walk distance, it was found that these senior women golfers

mean walking distance was in the 69th percentile for aerobic fitness in their respective age groups: 69.2 ± 18.8% (Rikli & Jones, 2013).

Research Question #3 – Was there a difference in 3 min vs. 6 min. HR, RPE, and %HR_{max}?

In Table 2, 3 min HR, RPE, and %HR_{max} were compared with the 6 min HR, RPE, and %HR_{max} to study the differences in mean scores. HR increased throughout the walk test from 123 ± 16 to 130 ± 20 beats/min. While the mean increased from 3 min to 6 min, the standard deviation was greater (i.e., had a wider range) at 6 min than 3 min. RPE increased from 12 ± 2 to 13 ± 1 from 3 min to 6 min. %HR_{max} slightly increased from 79 ± 12 to 83 ± 15%.

Table 3.

Pearson Correlations (r values) for 6-minute walk test variables (*N*=12; Women senior golfers)

Variable		3 min HR	3 min RPE	%HR_{max}	Walk Distance
3 min HR	Correlation	____	-.062	.965*	.069
	Sig	____	.847	.0001	.832
3 min RPE	Correlation	____	____	-.083	.641*
	Sig	____	____	.798	.025
%HR_{max}	Correlation	____	____	____	-.041
	Sig	____	____	____	.900

* $p \leq 0.05$

Table 4.

Pearson Correlations (r values) for 6-minute walk test variables (*N*=12; Women senior golfers)

Variable		6 min HR	6 min RPE	$\%HR_{max}$	Walk Distance
6 min HR	Correlation	____	-.108	.976*	.007
	Sig	____	.739	.0001	.984
6 min RPE	Correlation	____	____	-.102	.396
	Sig	____	____	.751	.202
$\%HR_{max}$	Correlation	____	____	____	-.078
	Sig	____	____	____	.811

* $p \leq 0.05$

Research Question #4 – Was there a correlation between exercise intensity and change in mood states (TMD)?

There was a significant difference in TMD scores from pre-6MWT to post-6MWT (See Table 5). TMD scores were lower and improved. Correlations were not found between the changes in TMD and exercise intensity (p = 0.678, 0.392).

Research Question #5 – Was there a significant difference in TMD scores before and after the 6-min walk test?

TMD was calculated by subtracting the pre- 6-MWT TMD scores from the post- 6-MWT TMD scores. Nine of the women golfers had improvements in TMD while the other three did not. The change in TMD should be a negative number because acute exercise has been shown to improve mood (Berger & Motl, 2000).

Research Question #6 – Did walk distance correlate with TMD scores at the end of 6-min walk test?

When investigating the women's walk distance and post-walk TMD scores, there was no significant correlation. The majority of the women received benefits from the 6-MWT and reported improvements in mood. There was only one participant who was within a -5 and 5 range of having no mood disturbance and mood disturbance. This would indicate that the walk did not change her mood.

Table 5.

Mean scores and standard deviations for TMD and change in TMD (N=12)

Variable	*Mean*	*S.D.*
TMD_1*	98.4	12.7
TMD_2	89.3	15.4
$\triangle$ TMD	-7.1	13.7

*$p \leq .05$, $TMD_2 < TMD_1$; TMD_1 = Total Mood Disturbance Score pre – 6-MWT; TMD_2 = Total Mood Disturbance Score post – 6-MWT; $\triangle TMD = TMD_1 - TMD_2$

DISCUSSION

The purpose of this study was to create a descriptive study to show how functional senior golfers, ages 50 years and older, performed during the TPI® golf fitness screen and the 6-MWT. In addition mood was assessed before and after the 6-MWT. Twelve healthy senior women golfers participated in this study. The 6-MWT was chosen based on its test-retest reliability and its ability to assess physical endurance in generally healthy older adults (Rikli & Jones, 1998).

The game of golf incorporates a considerable amount of walking over the course of a round. Golf has been shown to have aerobic benefits to senior golfers when walking down and over hills and distance covered throughout the round. Along with walking, it is important that the golfers enjoy golf or else there is a chance that they may give up the sport for a number of reasons.

Because of the growing research base characterizing the physical attributes of the golfing population, an understanding of the physiological nature of golf and learning about the players from a functional movement point of view is growing in popularity (Smith, 2010). By understanding the qualities exhibited by each player, a certified golf coach can determine what the areas of weakness are and then implement an effective fitness or skill development plan (Smith, 2010).

The purpose of the TPI® golf fitness screen is to find those fitness deficiencies (i.e., flexibility, strength, and/or balance weaknesses). The exercises that challenged the participants the most were the deep squat and the single leg balance tests. Having the inability to maintain movement positions during a golf swing can lead to ineffective movement patterns and unwanted shot outcomes (Smith, 2010). The deep squat test is a product of a person's quadriceps strength. According to the TPI® Certified Level 1 book (2013), 5,545 amateur golfers performed the full overhead deep squat. Out of those people, only 29% of those people could perform the movement perfectly. For the single leg balance tests with participants' eyes closed, a total of 18,768 took the test with their right leg and 18,761 with their left. The percentage of people that completed these tests between 0-5 seconds were 38% and 37% respectively. According to TPI® (2013) the majority of amateur golfers struggle with quadriceps strength and balance issues.

In order to have optimal execution of each shot, balance is crucial during a golfer's form as to not have unnecessary movements. Kras and Abendrroth-Smith (2001) measured the

duration of a one-legged stance with the player's eyes closed which was done during the TPI® golf screen. They reported wide ranges in times from 4-60 seconds while in the present study, all 12 women golfers barely lasted 5 seconds with their eyes closed. As people age in general, their balance will suffer leading to inconsistencies that can be improved with golf-specific strengthening and balance exercises.

The 6-MWT is a test that measures physical endurance in the senior population (Rikli & Jones, 1998). Physical endurance is defined as the ability to maintain submaximal aerobic exercise for an extended period of time (ACSM, 1997). The 6-MWT is considered to be more of a relevant test representative of older adult functioning than other common maximal measures such as VO_2max or VO_2peak (Rikli & Jones, 1998). Studies have revealed that oxygen consumption measures, whether based on maximal or submaximal performance, have questionable relevance to the demands of everyday activities for older adults and do not correlate well to measures of everyday functioning (Steele, 1996).

There was a relationship found between the participants' HR and $\%HR_{max}$ at 3 and 6 min meaning that they were exercising at a high level. There was also a relationship with the RPE scores at 3-min and the 6-MWT, but not at 6-min. The reason why RPE might not have had a relationship with walk distance is that the participants may have underestimated their RPE scores of how hard they were actually working at the end of the 6-MWT.

Total mood disturbance (TMD) scores were not correlated with exercise intensity or walk distance during the 6-MWT. Although there was a significant change in mean mood states, the fitness test and intensity did not have a noticeable effect on how the participants felt. There was no relationship between the variables, but the 6-MWT did cause a favorable change in mood from before to after the test. Therefore, the exercise did improve participants' moods by

decreasing their overall mood disturbance. TMD is particularly useful in studies containing a small number of participants (Berger & Motl, 2000). That is specifically why it was used for this pilot study, to determine if the 6-MWT was enough exercise to decrease the group's TMD, and it did.

Significant changes were found between HR, RPE, and $\%HR_{max}$ at 3 and 6-min. By comparing each variable at 3-min and at 6-min there were increases in all three variables. Participants were able to exercise at a vigorous level and maintain that for the entire 6-MWT. By being able to maintain that pace during the walk test, participants were placed into the 69^{th} percentile of aerobic fitness for their respective age groups (Rikli & Jones, 2013). This meaning that the participants are nearly in the top 25% of their age groups for aerobic fitness.

In summary, there should be future studies concerning senior women golfers and their total mood disturbance after walking a round of golf. There is not nearly enough research with senior women golfers and how playing golf can help in maintaining their functional fitness for a longer period of time. A limitation of this pilot study was that it was only women who volunteered and participated. During the recruitment process, there were only two men that volunteered to be tested. It will be interesting to observe the differences and comparisons between senior men and women golfers in future studies using measures completed in this pilot study, such as the TPI® golf fitness screen, Big 12® golf swing analysis, and 6-MWT measures.

References

Arstila, M., Antilla, K., Wendelin, H., Vuori, I., & Valamaki, F. (1977). The effect of age and sex on the perception of effort during an exercise test with a linear increase in heart rate, in Borg G. A. V. (Ed): *Physical Work and Effort*. Solna, Sweden, Pergamon Press, pp. 217-221.

Bar-Or, O. (1977). Age-related changes in exercise prescription. In Borg, G. A. V. (Ed.): *Physical Work and Effort*. Solna, Sweden, Pergamon Press. pp. 255-226.

Berger, B. G. & McInman, A. (1993). Exercise and the quality of life. In R. N. Singer, M. Murphey, & L. K. Tennant (Eds.), *Handbook of research on sport psychology* (pp. 729-760). New York: Macmillan Publishing.

Berger, B. G. (1996). Psychological benefits of an active lifestyle: What we know and what we need to know. *Quest, 48,* 330-353.

Berger, B. G. & Motl, R. W. (2000). Exercise and mood: A selective review and synthesis of research employing the profile of mood states. *Journal of Applied Sport Psychology, 12,* 69-92.

Berger, B. G., Darby, L. A., Zhang, Y., Owen, D. R., & Tobar, D. A. (2016). Mood alteration after 15 minutes of preferred intensity exercise: Examining heart rate, perceived exertion, and enjoyment. *Journal of Sport Behavior, 39,* 3-21.

Biddle, S. (1995). Exercise and psychosocial health. *Research Quarterly for Exercise and Sport, 66*, 292-297.

Blair, S., & Morrow, J. (1998). Cooper institute the American College of Sports Medicine - 1997 Physical Activity Interventions Conference. *American Journal of Preventive Medicine, 15*, 255-256.

Borg, G. A. V. & Linderholm, H. (1967). Perceived exertion and pulse rate during graded exercise in various age groups. *Acta Medica Scandinavica Supplementum, 472,* 194-206.

Borg, G. (1998). *Borg's perceived exertion and pain scales*. Champaign, IL: Human Kinetics.

Burr, J. F., Bredin, S. S. D., Faktor, M. D., & Warburton, D. E. R. (2011). The 6-minute walk test as a predictor of objectivity measured aerobic fitness in healthy working-aged adults. *Physician and Sports Medicine, 39,* 133-139.

Camarri, B., Eastwood, P. R., Cecins, N. M., Thompson, P. J., & Jenkins, S. (2006). Six minute walk distance in healthy subjects aged 55-75 years. *Respiratory Medicine, 100,* 658-665.

Carter, N. D., Kannus, P., & Khan, K. M. (2001). Exercise in the prevention of falls in older people: A systematic literature review examining the rationale and the evidence. *Sports Medicine, 31,* 427-438.

Carton, R. L. & Rhodes, E. C. (1985). A critical review of the literature on rating scales for perceived exertion. *Sports Medicine, 2,* 198-222.

Diaz, O., Morales, A., Osses, R., Klaassen, J., Lisboa, C., & Saldias, F. (2010). Six-minute walk test and maximum exercise test in cycloergometer in chronic obstructive pulmonary disease. Are the physiological demands equivalent? *Archivos de Bronconeumologia, 46,* 294-301.

Enright, P.L., McBurnie, M.A., Bittner, V., Tracy, R.P., McNamara, R., Arnold, A. & Newman, A.B. (2003). A quick measure of functional status in elderly adults. *CHEST, 123,* 387-398.

Guralnik, J. M., Branch, L. G., Cummings, S. R., & Curb, J. D. (1989). Physical performance measures in aging research. *Journal of Gerontology, 44,* M141-M146.

Haller, N., Haller, D, & Herbert, D. (1999). A multidisciplinary approach to performance enhancement in the aging golfer: a preliminary study. In Farrally, M. R., Cochran, A. J. *Science and Golf III: Proceeding of the World Scientific Congress of Golf*. Champaign (IL): Human Kinetics, pp. 97-104.

Horak, F. B., Henry, S. M., & Shumway-Cook, A. (1997). Postural perturbations: New insights for treatment of balance disorders. *Physical Therapy, 77,* 517-533.

Jensen, K. L. & Rockwood Jr., C. A. (1998). Shoulder arthroplasty in recreational golfers. *Journal of Shoulder and Elbow Surgery, 7,* 362-367.

Kras, J. M., Abendrroth-Smith, J. (2001). The relationship between selected fitness variables and golf scores. *International Sport Journal,* 33-37

Kopelman, P. (2001). Developing an action plan for obesity education. *International Journal of Obesity, 25*, S16-S19.

Lane, A. & Terry, P. (1998). Development of normative data for profile of mood states-c among adult and young athletes. *Journal of Sports Sciences, 16,* 89-90.

Li, W., Keegan, T. H., Sternfeld, B., Sidney, S., Quesenberry, C. P., Jr., & Kelsev, J. L. (2007). Outdoor falls among middle-aged and older adults: A neglected public health problem. *American Journal of Public Health, 96,* 1192-1200.

Lindsay, D. M., Horton, J. F., & Vandervoort, A. A. (2000). A review of injury characteristics, aging factors and prevention programmes for the older golfer. *Sports Medicine, 30,* 89-103.

Magnusson G. (1998). Golf: exercise for fitness and health. In: Farrally MR, Cochran AJ, eds. *Science and Golf: Proceedings of the World Scientific Congress of Golf*. St. Andrews, England. Champaign, Ill: Human Kinetics.

Mallon, W. J. & Callaghan, J. J. (1994). Total joint replacement in active golfers. *Journal of the Southern Orthopedic Association, 3,* 295-298.

Matheson, G. O., Macintyre, J. G., Taunton, J. E., Clement, D. B., & Lloydsmith, R. (1989). Musculoskeletal injuries associated with physical activity in older adults. *Medicine and Science in Sports and Exercise, 21,* 379-385.

McGavin, C. R., Gupta, S. P., & McHardy, G. J. (1976). Twelve-minute walking test for assessing disability in chronic bronchitis. *British Medical Journal, 1,* 822-823.

McNair, D. M., Lorr, M., & Droppleman, L. F. (1971, 1981, 1992). *Profile of Mood States manual*. San Diego: Education and Industrial Testing Service.

Morehouse, C. A. (1990). The super senior golfer. In: Cochrane A. J., (Ed.). *Science and golf.* London: Chapman & Hall, pp. 14-23.

Morgan, W. P. (Ed.) (1997). *Physical activity and mental health*. Washington, DC: Taylor and Francis.

Morris, J. N. & Hardman, A. E. (1997). Walking to health. *Sports Medicine, 23,* 306-332.

Murase, Y. S., Kamie, S., & Hoshikawa, T. (1989). Heart rate and metabolic response to participation in golf. *Journal of Sports Medicine and Physical Fitness, 29,* 269-272.

Mutrie, N., & Biddle, S. J. H. (1995). The effects of exercise on mental health in nonclinical populations. *European perspectives on exercise and sport psychology,* 50-70.

Nevitt, M. C., Cummings, S. R., & Hudes, E. S. (1991). Risk factors for injurious falls: A prospective study. *Journal of Gerontology, 46,* M146-M170.

NGF. (n.d.). Retrieved April 19, 2016, from http://www.ngf.org/

Okuda, I., Armstrong, C. W., Tsunezumi, H., & Yoshiike, H. (2002). Biomechanical analysis of professional golfer's swing: Hidemichi Tanaka. In. E. Thain (Ed.). *Science and golf IV* (pp. 18-27). London: Routledge.

Palank, E. A. & Hargreaves, E. H. (1990). The benefits of walking the golf course – effects on lipoprotein levels and risk ratios. *Physician and Sports Medicine, 18,* 77-80.

Parkkari, J., Natri, A., Kannus, P., Manttari, A., Laukkanen, R., Haapasalo, H., Nenonen, A., Pasanen, M., Oja, P., & Vuori, I. (2000). A controlled trial of the health benefits of regular walking on a golf course. *The American Journal of Medicine, 109,* 102-108.

Pink, M., Perry, J., & Jobe, F. W. (1993). Electromyographic analysis of the trunk in golfers. *American Journal of Sports Medicine, 21,* 385-388.

Rikli, R. E. & Jones, C. J. (1998). The reliability and validity of a 6-minute walk test as a measure of physical endurance in older adults. *Journal of Aging and Physical Activity, 6,* 363-375.

Rikli, R. E., & Jones, C. J. (2013). *Senior fitness test manual* (2nd ed.). Champaign, IL: Human Kinetics.

Sidney, K. H. & Shephard, R. J. (1976). Attitudes towards health and physical activity in the elderly: Effects of a training program. *Medicine and Science in Sports and Exercise, 8,* 246-252.

Sidney, K. H. & Shephard, R. J. (1977). Perception of exertion in the elderly, effects of aging, mode of exercise and physical training. *Perception of Motor Skills, 44,* 999-1010.

Smith, M. F. (2010). The role of physiology in the development of golf performance. *Sports Medicine, 40,* 635-655.

Stauch, M., Liu, Y., Giesler, M., & Lehmann, M. (1999). Physical activity level during a round of golf on a hilly course. *Journal of Sports Medicine and Physical Fitness, 39*, 321-327.

Steele, B. (1996). Timed walking tests of exercise capacity in chronic cardiopulmonary illness. *Journal of Cardiopulmonary Rehabilitation, 16*, 25-33.

Theriault, G. & Lachance, P. (1998). Golf injuries: an overview. *Sports Medicine, 26*, 43-57.

Tharrett, S. J., Peterson, J. A., & American College of Sports Medicine. (1997). *ACSM's health/fitness facility standards and guidelines* (2nd ed.). Champaign, IL: Human Kinetics.

Tinetti, M. E., Gordon, C., Sogolow, E., Lapin, P., & Bradley, E. H. (2006). Fall-risk evaluation and management: Challenges in adopting geriatric care practices. *The Gerontologist, 46,* 717-725.

TPI® - MyTPI.com. (n.d.). Retrieved April 19, 2016, from http://www.mytpi.com/

TPI® Certified Level One Manual. (2013). Oceanside, CA. Titleist Performance Institute.

Tsang, W. W. N & Hui-Chan, C. W. Y. (2010). Static and dynamic balance control in older golfers. *Journal of Aging and Physical Activity, 18*, 1-13.

Watkins, R. G., Uppal, G. S., Perry, J., Pink, M, & Dinsay, J. M. (1996). Dynamic electromyographic analysis of trunk musculature in professional golfers. *American Journal of Sports Medicine, 24*, 535-538.

Wenos, D. L., Wallace, J. P., Surburg, P. R., & Morris, H. H. (1996). Reliability and comparison of RPE during variable and constant exercise protocols performed by older women. *International Journal of Sports Medicine, 17*, 193-198.