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Gait, balance, mobility and muscle strength in people with anxiety compared to healthy individuals

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ABSTRACT

Background: Anxiety disorders are the most common mental disorders. Changes in psychomotor behavior can be observed in gross motor skills, with gait disturbances thought to reflect defective brain functions in psychiatric conditions. While balance deficits are well documented in anxiety, only little is known about gait characteristics of people with anxiety.

Objective: This study wishes to examine the existence of differences in gait, balance, mobility and muscle strength between people with anxiety and healthy individuals, and to investigate the relationship between level of anxiety and motor characteristics.

Methods: An observational study was conducted in a psychiatric out-patient unit at a large Israeli general hospital. The sample consisted of 93 participants, ages 18–65: 48 of them (27 female, 21 male) categorized as having anxiety, and 45 (25 female, 20 male) without anxiety. Participants were divided into two groups of various ages and both genders, and completed two questionnaires and four physical tests: objective anxiety assessment (Hamilton Anxiety Rating Scale); spatiotemporal gait parameters (10-meter walking test); balance function (Unipedal Stance Test); muscle strength evaluation, and mobility (Time Up and Go Test). No attempt was made to correlate between the anxiety and control groups based on age and/or gender.

Results: Participants with anxiety (both genders) were characterized by slower walking speed, shorter step length, and fewer steps per minute ($p < 0.001$), as well as balance deficiency and mobility dysfunction ($p < 0.001$), compared to the control group. Muscle strength in women with anxiety was found to be significantly lower than in healthy women.

Conclusions: To the best of our knowledge, this study is the first of its kind to examine spatiotemporal gait components in patients with anxiety. Based on the findings, there is room to consider implementing gait analysis into the physical examination of patients with anxiety, as well as muscle strength, balance, and mobility function. Correct assessment and proper treatment of these aspects might contribute to the well-being of patients with anxiety.

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1. Introduction

Anxiety is a normal response of worry from a perceived stressful event (Stein, Craske, Friedman, & Phillips, 2014). High levels of anxiety, which lead to decreased functioning, are categorized as an anxiety disorder. Anxiety disorders are the most prevalent of all mental disorders, affecting an estimated 40 million adults per year, and approximately 18% of the US population. Women are at higher risk to develop an anxiety disorder than men (Stein et al., 2014).

Gait is the most common function by which humans move from one place to another, and gait speed is an important parameter for their functional status (Bohannon & Williams Andrews, 2011; Fritz & Lusardi, 2016). As gait incorporates higher cerebral systems, changes in gait can reflect psychiatric conditions (Sanders & Gillig, 2010). Compared to other mental illnesses such as depression and schizophrenia, little is known about gait characteristics of people with anxiety. Patients with depression are characterized by impaired dynamic balance, and reduced gait velocity (Lemke, Wendorff, Mieth, Buhl, & Linnemann, 2000; Michalak, Mischnat, & Teismann, 2014; Michalak et al., 2009; Sanders & Gillig, 2010). Reduced walking speed is apparently the result of impaired step length and cadence (Lemke et al., 2000). Schizophrenic patients are characterized by impaired gait, as well as deficiencies in the balance system; their reduced walking speed is most likely due to the fact that this illness involves executive dysfunction (Lallart et al., 2014), whereas poor balance control appears to be linked to defective processing of spatial elements (Ahlgrén-Rimpiläinen et al., 2010; Kent et al., 2012; Matsuura et al., 2015; Teng et al., 2016).

Most studies of anxiety and gait have focused on fear of falling and gait, and found a link between anxiety, slow gait velocity and fear of falling (Reelick, van Iersel, Kessels, & Olde Rikkert, 2009; Richardson, 2014; Staab, Balaban, & Furman, 2013; Wynaden, Tohotoa, Heslop, & Al Omari, 2016).

A large and varied body of research has reported differences in gait and balance strategies when individuals including young and older adults perform under threatening or anxiety-inducing conditions (Bolmont, Gangloff, Vouriot, & Perrin, 2002; Hainaut, Caillet, Lestienne, & Bolmont, 2011; Staab et al., 2013). Researchers concur that anxiety is related to balance dysfunction (Balaban, 2002; Bart et al., 2009; Bolmont et al., 2002). It seems that anxiety-inducing situations and conditions affect the regulation and control of gait and balance performance in the healthy population (Hainaut et al., 2011; Pacheco-Unguetti, Acosta, Callejas, & Lupiáñez, 2010). As of yet, no data has been published on gait characteristics in people with anxiety compared to healthy adults.

People with gait impairments often present with reduced muscle strength (Fritz & Lusardi, 2016; van der Krogt, Delp, & Schwartz, 2012; Willén, Stibrant Sunnerhagen, Ekman, & Grimby, 2004). A critical consequence of balance disorders and reduction in muscle strength is an increased risk of falling. Anxiety increases the risk of falling, while at the same time being the consequence of falling (Wynaden et al., 2016). Other factors, such as different drugs and behavioral changes, might add to that risk (Huang et al., 2012). Anxiety disorders increase the risk of falling in men threefold, compared to women (Holloway et al., 2016).

It has been established that there are significant differences in balance, walking speed and muscle strength between males and females (Bohannon et al., 2011; Massy-Westropp, Gill, Taylor, Bohannon, & Hill, 2011; Van Milligen, Vogelzangs, Smit, & Penninx, 2012; Vereeck, Wuyts, Truijen, & Van De Heyning, 2008). Women performed significantly poorer during the Time Up and Go test and tandem Romberg close-eyed tests. A significant decrease in muscle strength was found in women compared to men, assessed by hand grip dynamometer (Massy-Westropp et al., 2011; Van Milligen et al., 2012)

The literature describes the relationship between motor deficiencies and anxiety disorders (Nieuwenhuys & Oudejans, 2012), but to the best of our knowledge no study has examined gait characteristics of people with anxiety. Therefore, the current study aimed to; (a) examine the differences in gait, balance, mobility and muscle strength between people with anxiety and healthy individuals, (b) examine whether these differences are gender-related, and (c) evaluate the correlation between anxiety levels and motor characteristics (gait, balance, mobility and muscle strength). We hypothesize that people with anxiety will demonstrate lower motor capabilities: slower gait, balance and mobility dysfunction and reduced muscle strength.

2. Method

2.1. Study Setting, design and population

Outpatient clinics is a public, fully-funded ambulatory service where patients are treated for a period of up to 12 weeks (5–6 h a day, 5 days a week), contingent on a referral from local public or private psychiatric clinics. Their main purpose is to prevent hospitalization of deteriorating ambulatory patients, with a secondary purpose of conducting a thorough diagnostic process, beginning with observation, and often including a battery of psycho-diagnostic or neuropsychological tests. Upon discharge, patients return to their referring clinic; once discharged, patients do not receive any follow-up treatment in the outpatient clinic.

Anxiety is a non-specific (i.e., not pathognomonic) symptom that may manifest in various mental conditions and general medical conditions (e.g., acute myocardial infarction, pulmonary edema, hyperthyroidism, etc.). It is not to be confused with anxiety disorders, a specific category of psychiatric disorders in which anxiety is a prominent symptom, accompanied by other mental and behavioral symptoms as the criteria for diagnosing a specific disorder (e.g., panic disorder) (Earle, 2014).

The current observational study, approved by the hospital's IRB (Approval number 0447–16-TLV), examined a group of individuals with anxiety symptoms (rather than diagnosed anxiety disorder) and a control group of individuals without anxiety. Of the 93 participants, the anxiety group consisted of 48 participants (27 female, 21 male) who were being treated in the psychiatric outpatient clinic at Tel Aviv Sourasky Medical Center; and a control group consisting of 45 participants (25 female, 20 male). Participants were divided into two groups of various ages and both genders. The control group was examined at the Department of Anatomy and Anthropology, Sackler School of Medicine at Tel-Aviv University. The observations and data collection were conducted between January 2017 and May 2018.

2.2. Inclusion criteria

Participation was contingent on meeting the following criteria:

Research group: Patients (men and women, 18–65 years of age) in a psychiatric outpatient clinic who displayed anxiety symptoms (scoring ≥ 14 on the Hamilton Anxiety Rating Scale) and sufficient command of the Hebrew language to enable comprehension and completion of the research questionnaires.

Control group: Volunteers (men and women, 18–65 years of age) without anxiety symptoms (scoring ≤ 5 on the Hamilton Anxiety Rating Scale), recruited from Tel-Aviv University, with sufficient command of the Hebrew language to enable comprehension and completion of the research questionnaires.

2.3. Exclusion criteria

Participants who met any of the following criteria were excluded from the study: any preexisting psychotic condition; any major affective condition (either mania or depression); a neurological or neuropsychological disorder (e.g., head injury), an orthopedic disorder that causes gait difficulties; vestibular issues or dizziness; cardiovascular disease; inability to comprehend questions on the research instruments; fever at the time of participation in the study. No one was excluded based on HAM-A score. Exclusion criteria for the anxiety group were based on medical records under the control and supervision of the head of the psychiatric outpatient clinic at Tel Aviv Sourasky Medical Center, whereas the exclusion criteria for the control group were based on self-report.

2.4. Procedure

After signing a consent form, the participants completed two questionnaires:

1. A socio-demographic and medical questionnaire (see Table 1);
2. The Hamilton Anxiety Rating Scale (HAM-A) (Maier, Buller, Philipp, & Heuser, 1988). A score of 14 or higher (exceeding the top cut-off point) suggests clinical anxiety, designating the participant for the anxiety group. A score of 5 or lower (below the bottom cut-off point) is considered healthy. A score between 5 and 14 suggests a person with partial and nonclinical anxiety symptoms.

Following questionnaire administration, participants underwent a series of four physical examinations.

2.4.1. Physical examination

Physical assessment was conducted by the principal investigator, a certified physiotherapist. Spatiotemporal gait parameters were measured using a 10-meter walking test (10 MWT). The test was conducted in a 20-meter-long corridor marked with adhesive tape in four points along the course, denoting the two ends of a 10-meter walkway and two additional marks for acceleration and deceleration. Altogether, the path totaled 14 m:10 m as prescribed by the test, two more for accelerations, and another two for deceleration. These additional spaces for acceleration and deceleration were disregarded in the data collection. Time was measured from the moment the participant crossed the starting line, stopping once they passed the 10-meter mark. Specific verbal instructions were given prior to the test: "*I will say: ready, set, go. When I say 'go', walk safely as you can in your normal, comfortable speed until I say stop*". Participants were timed walking for 10 m (m) at their comfortable speed. Spatiotemporal gait parameters were identified through the number of steps counted and the time taken to walk 10 m (measured with a stopwatch). The average time and number of steps of three paths was documented (Bohannon, Andrews, & Thomas, 1996; Bohannon & Williams Andrews, 2011; Marques, Cruz, Quina,

Table 1
Baseline participant characteristics.

Variables	Female (N = 52)			Male (N = 41)			Total (N = 93)		
	Control (N = 25)	Anxiety (N = 27)	p	Control (N = 20)	Anxiety (N = 21)	p	Control (N = 45)	Anxiety (N = 48)	P
Age (years)	43.4 (12.84)	43.2 (14.25)	0.95	37.6 (11.84)	36.6 (9.9)	0.78	40.8 (12.62)	40.3 (12.84)	0.85
Weight (kg)	60.7 (13.07)	63.4 (17.95)	0.54	75.6 (13.14)	84.2 (21.54)	0.13	67.3 (14.95)	72.5 (22.01)	0.19
Height (m)	1.6 (0.05)	1.6 (0.07)	0.32	1.7 (0.08)	1.8 (0.10)	0.26	1.6 (0.09)	1.7 (0.14)	0.65
BMI (Kg/m^2)	23.3 (4.34)	24.5 (6.72)	0.68	24.7 (3.91)	25.2 (4.90)	0.81	23.9 (4.17)	24.9 (5.95)	0.60
Education (years)	13.5 (1.78)	12.4 (1.95)	0.37	13.1 (1.90)	12.3 (1.56)	0.20	13.3 (1.82)	12.4 (1.77)	0.14
HAM-A(score)	2.6 (1.65)	38.7 (12.20)	<0.001	1.7 (1.75)	32.2 (9.03)	<0.001	2.2 (1.75)	35.9 (11.92)	<0.001
Hand dominance(RT/LT)	25/0	25/2	0.26	14/6	19/2	0.1	39/6	44/4	0.32

Frequencies and descriptive statistics of study participants. The first six variables are presented as means, with standard deviations provided in parentheses. The last three variables (hand dominance) are presented as frequencies (n). Kg – Kilogram; BMI – Body Mass Index; HAM-A – Hamilton Anxiety Rating Scale; Hand Dominance: RT – Right; LT – Left.

Regencio, & Jacome, 2015; Peters, Fritz, & Krotish, 2013; Wolf, Catlin, & a, Gage, K., Gurucharri, K., Robertson, R., & Stephen, K. , 1999). Finally, mean gait velocity (m/*sec*), step length (m) and cadence (steps/*sec*) were calculated for each participant.

Balance was assessed using the Unipedal Stance Test (UST). Participants were asked to stand barefoot on the leg of their choice, with the other raised near, but not touching, the ankle of their standing leg. Each participant was asked to focus on a spot on the wall at eye level in front of him. Prior to raising the leg, the participant was instructed to cross their arms over their chest. The researcher used a stopwatch to measure the duration of time the participant was able to stand on one foot. Time commenced once the participant raised their foot off the floor, and stopped when the participant either: (1) used their arms (i.e., uncrossed arms); (2) used the raised foot (moved it toward or away from the standing leg or touched the floor); (3) moved the weight-bearing foot to maintain balance (i.e., rotated foot on the ground); or (4) a maximum of 45 s had elapsed. The process was repeated three times. The average duration of the three trials was recorded (Hurvitz, Richardson, Werner, Ruhl, & Dixon, 2000; Springer, Marin, Cyhan, Roberts, & Gill, 2007).

Muscle strength was evaluated using a JAMAR Hand Grip Dynamometer. Participants were asked to sit with their shoulders adducted and neutrally rotated, elbow flexed at 90°, forearm in a neutral position, and wrist between 0° and 30° dorsiflexion and between 0° and 15° ulnar deviation. Once the participants were positioned properly, they were given specific verbal instructions: “Squeeze as hard as you can, harder! harder! And relax.” The score of three successive trials for each hand was recorded. The average score of the three trials compared to the normative data was measured in kg (Hamilton, McDonald, & Chenier, 1992; Massy-Westropp et al., 2011).

Timed Up and Go (TUG) was used to examine functional mobility. The TUG test was performed in a corridor with a 3-meter adhesive tape mark on the floor and a chair with armrests properly placed and fixed at the edge of the mark. Instructions to participants were as follow: when given the initiation word *go*, you should rise from the chair, walk 3 m as safely as possible, turn around, return to the chair, and sit down with your back against the backrest. The time (seconds (s)) needed to perform the entire sequence was recorded using a stopwatch. The average time of three paths was documented (Bohannon, 2006; Kear, Guck, & McGaha, 2017).

The physical parameters used in the study are all commonly known to be age and gender dependent (Bohannon & Williams Andrews, 2011; Kear et al., 2017; Massy-Westropp et al., 2011; Oberg, Karsznia, & Oberg, 1993; Springer et al., 2007). Thus, raw data of men and women in different age groups cannot be averaged and compared. In order to compare between our study groups, which included men and women divided into several age groups, all parameter scores were standardized according to participants' gender and age, using appropriate norms: i.e., the raw scores were transformed to Z-scores using the means and standard deviations of the normative distributions [Gait parameters: Mean gait velocity (m/*sec*) (Bohannon & Williams Andrews, 2011), Step length (m) and cadence (steps/*sec*) (Oberg et al., 1993); UST (Springer et al., 2007): Muscle strength: (Massy-Westropp et al., 2011); TUG: (Kear et al., 2017) norms for this variable were published by age only, so standardization was done only according to age group. That is, the original raw score of every participant in every test was replaced by Z-score, which represented the place of the score relative to the appropriate distribution in a normative population. Thus, average scores for the research groups could be calculated and compared.

2.5. Statistical analysis

The statistical analysis was conducted using SPSS v24 (IBM Corp., Armonk, NY, USA), with a p value <0.05 defined as statistically significant. Normality of distribution was assessed using the Kolmogorov-Smirnov test. Differences between study groups in the socio-demographic and anthropometric variables were explored using t, χ^2 and Mann-Whitney tests, according to variables scales and normality. Differences between study groups in dependent variables and the effects of gender were examined using group*gender ANOVA. Bootstrapping was used for variables not distributed normally. Linear relationships between anxiety levels (measured by Hamilton score) and dependent variables were evaluated using Spearman correlations. No attempt was made to correlate between the anxiety and control groups based on age and/or gender. A straightforward statistical approach was conducted on socio-demographic and anthropometric variables raw data scores (Table 1). A more sophisticated statistical approach (ANOVA 2X2) was conducted on standardization-dependent variables (Z score), according to published norms (Tables 2 and 3).

3. Results

BMI, Hamilton, step length, UST and TUG distributions were not normal. Thus, between-groups comparisons, taking these

Table 2
Group main effects on gait, balance, mobility and muscle strength.

Variables	$F(1,89)$	p	η^2
Gait velocity	77.43	<0.001	0.465
Step length	20.37	<0.001	0.186
Cadence	6.09	<0.001	0.454
UST	51.18	<0.001	0.365
TUG	122.30	<0.001	0.579
Hand grip RT	3.57	0.06	0.039
Hand grip LT	2.75	0.10	0.03

UST – Unipedal Stance Test; TUG – Time Up and Go; RT – Right; LT – Left.

Table 3
Spearman correlation analysis between anxiety and gait characteristics, balance, mobility and muscle strength.

Variables	Female (N = 52)		Male (N = 41)		Total (N = 93)	
	r_s	p	r_s	p	r_s	p
Gait velocity	−0.71	< 0.001	−0.64	< 0.001	−0.66	< 0.001
Step length	−0.33	0.01	−0.36	0.02	−0.36	< 0.001
Cadence	−0.70	< 0.001	−0.52	< 0.001	−0.57	< 0.001
UST	−0.62	< 0.001	−0.65	< 0.001	−0.62	< 0.001
TUG	0.76	< 0.001	0.73	< 0.001	0.75	< 0.001
Hand grip RT	v0.50	< 0.001	v0.14	0.37	v0.34	0.001
Hand grip LT	-0.44	< 0.001	-0.09	0.55	-0.30	< 0.005

UST – Unipedal Stance Test; TUG – Time Up and Go; RT – Right; LT – Left; r_s – Spearman's correlation.

variables into consideration, were conducted using Mann-Whitney tests, whereas the interactions between group and gender were examined using ANOVA with bootstrapping. Additionally, no significant differences ($p > .05$) were found between the two groups in socio-demographic and anthropometric variables (Table 1). Furthermore, the anxiety group scored significantly higher on the Hamilton Anxiety Rating Scale than the control group ($p < .001$), both overall and for each gender (Table 1).

As predicted, most of the dependent variables raw scores correlated with age (step length: r = −0.26, p < .05; UST: r = −0.38, p < .001; TUG:r = 0.22, p < .05; hand grip RT: r = −0.30, p < .005; hand grip LT:r = −0.31, p < .005) and differed between men and women (step length: U = 368.00, Z = −5.41, p < .001; Cadence: t(91) = −3.15, p < .005; hand grip RT: t(64.68) = 10.60, p < .001; hand grip LT:t(61.82) = 10.94, p < .001), thereby justifying standardization.

Main effects of the study groups on the dependent variables are presented in Table 2. The table presents the significant effects found in most of the variables. Means and standard errors are presented in Figs. 1 and 2, showing that in the anxiety group, gait velocity and cadence were lower, step length was shorter, UST score was lower- indicating shorter time spent standing on one leg, and TUG score was lower- indicating longer time to complete the task. Muscle strength in right hand tended to be lower in the anxiety group, compared to the control group, and no group difference was found in muscle strength in left hand.

Marginally significant group*gender interaction was found in right hand muscle strength ($F(1,89) = 2.97$, $p < .09$, $\eta^2 = 0.032$).

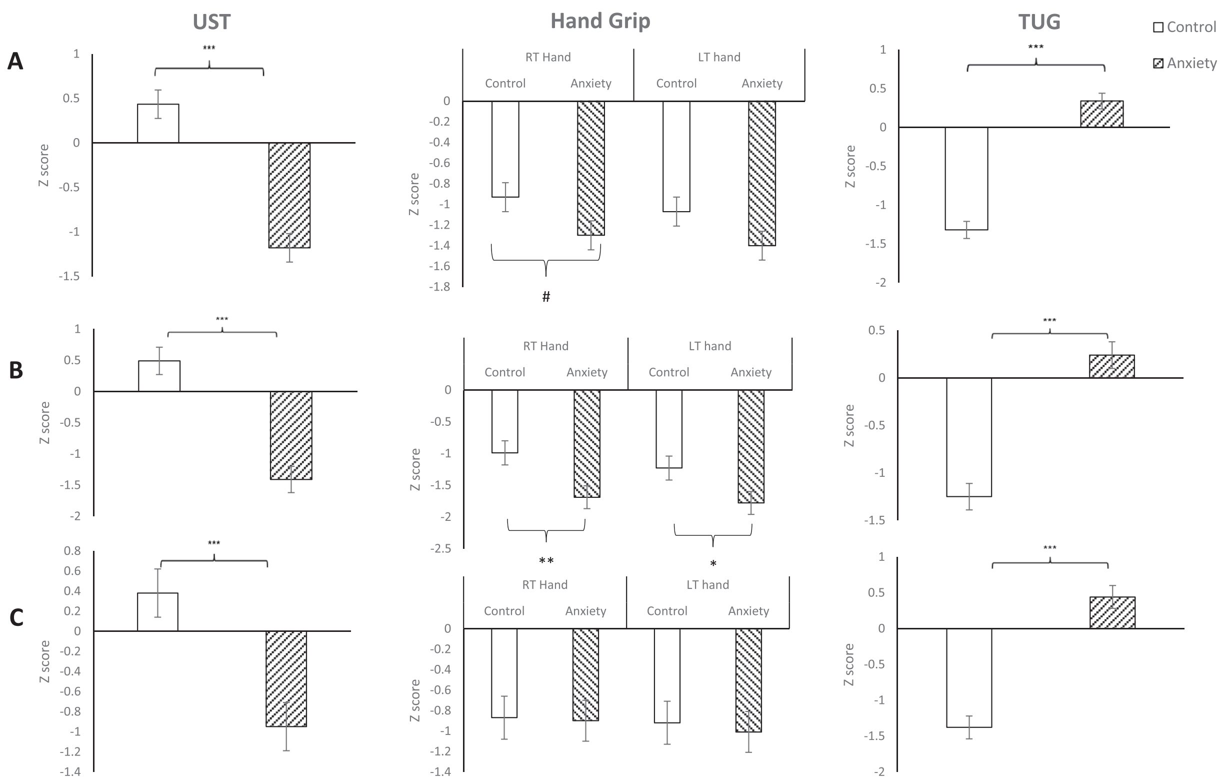

Fig. 1. Means and standard errors of balance, muscle strength and mobility between anxiety and control group: total (A), female (B) and male (C), using the Unipedal Stance Test (UST), handheld dynamometer and Time Up and Go (TUG) test. *$p < .05$, **$p < .01$, ***$p < .001$, #$p = .06$. Data is presented as Z scores, relative to appropriate distributions (by age and gender) in normative population.

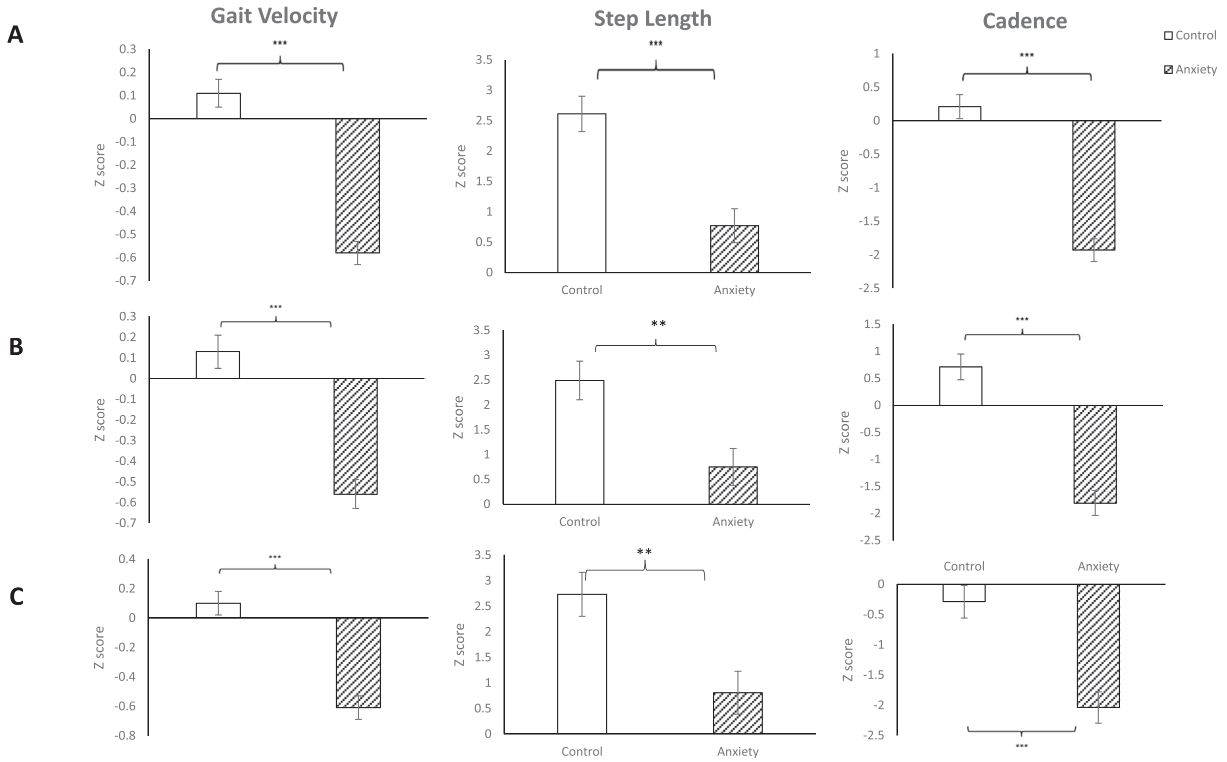

Fig. 2. Means and standard errors of gait characteristics (Velocity, step length and cadence) between anxiety and control group: total (A), female (B) and male (C). * $p < .05$, ** $p < .01$, *** $p < .001$. Data is presented as Z scores, relative to appropriate distributions (by age and gender) in normative population.

The Bonferroni post-hoc test showed that women in the anxiety group presented significantly less right-hand muscle strength than women in the control group ($p < .01$), as well as the left ($p < .05$). No such differences were found for men. No other interaction effects were found. The effects are presented in Fig. 1.

The correlations between anxiety score and gait, balance, muscle strength and mobility are presented in Table 3: higher anxiety levels were related to lower gait velocity, step length and cadence, decreased balance and mobility and lower muscle strength. The differences in velocity, cadence, balance and mobility were found in the total sample, and in males and females separately. The difference in step length was found in all sample only. The differences in muscle strength were found among females (the finding in left hand was found also in all sample).

4. Discussion

The current study compared gait, balance, muscle strength and mobility between people with anxiety and healthy individuals. Our findings indicate that people with anxiety are characterized by slower walking speed, shorter step length, and lower cadence compared to healthy individuals. According to the findings, people with anxiety are more prone to balance deficiencies and are at higher risk of mobility dysfunction compared to healthy individuals. Furthermore, women with anxiety exhibited weaker muscles compared to women without anxiety, whereas men – with and without anxiety – showed similar muscle strength

4.1. Gait and anxiety

The most prominent finding of this study was the relationship between gait characteristics and anxiety. To the best of our knowledge, this is the first study to compare gait characteristics in people with anxiety and healthy individuals; most of the existing literature has thus far focused on the relationship between fear of falling and reduction in walking speed (Wynaden et al., 2016) and the influence of anxiety on balance and gait performance in healthy individuals (Hainaut et al., 2011; Pacheco-Unguetti et al., 2010; Staab et al., 2013).

Our findings are consistent with those of other studies that examined the relationship between gait and mental illnesses (Lemke et al., 2000; Michalak et al., 2009; Putzhammer, Perfahl, Pfeiff, & Hajak, 2005), which found considerably lower gait velocity among people with depression and schizophrenia, compared to healthy individuals (Lemke et al., 2000; Michalak et al., 2009; Putzhammer et al., 2005).

Gait speed is affected by many factors, including general health, pain, balance, muscle strength, the sensory system, cognitive condition, motivation, and environment (Fritz & Lusardi, 2016). Damage to any of these might be expressed by a reduction of gait speed and impaired functioning (Fritz & Lusardi, 2016). The reduction in gait speed among male participants in this study might be the result of an explicit decline in balance. Of the women in the anxiety group, decline in balance and in muscle strength may have promoted reduced gait speed. However, we can neither confirm nor disprove the influence of additional factors, such as pain, cognitive states, and sensory processing on gait speed.

It is important to note that gait speed is an important factor in identifying and predicting falls (Montero-Odasso et al., 2005), decline in everyday functioning (e.g., dressing and bathing), mobility disorders, disabilities and mortality (Studenski et al., 2011) among the elderly ambulatory population (ages 65 and up). Moreover, speed and variability in gait are important predictive markers for the risk of developing dementia in the healthy elderly population (ages 75 and up) (Verghese et al., 2002). These suggest that the slow gait of people with anxiety might be also an indicator of decline in everyday functioning, disabilities and mortality.

4.2. Balance, functional mobility and anxiety

The present findings indicate that individuals with anxiety exhibit disturbances and deficiencies in their balance system (reduced UST scores). These findings are consistent with robust research of balance deficiencies in individuals with anxiety (Hainaut et al., 2011; Kogan, Lidor, Bart, Bar-Haim, & Mintz, 2008). These findings are consistent with previous research indicating balance deficits and dysfunction in other mental illness (e.g. major depression disorder and schizophrenia) (Bolbecker et al., 2011; Doumas, Smolders, Brunfaut, Bouckaert, & Krampe, 2012; Teng et al., 2016). TUG results showed that the anxiety group required significantly more time to complete the test, compared to the control group. This is in accordance with the reduced walking speed and balance demonstrated by the anxiety group. Clinicians are advised to consider routine assessment of mobility and balance in anxiety patients.

4.3. Muscle strength and anxiety

Significant reduction in muscle strength was identified in women with anxiety compared to the control group. This finding is consistent with the literature (Van Milligen, Lamers, De Hoop, Smit, & Penninx, 2011), and indicate a connection between anxiety disorders and reduction in muscle strength, listing this reduction as a marker of the chronic nature of this illness (Cheung, Nguyen, Au, Tan, & Kung, 2013; Van Milligen et al., 2011).

Unlike the difference found among the women in the current study, no significant difference were found between the men in the anxiety and control groups; parameter measurements were similar for both groups of men. This is consistent with the finding of Van Milligen et al. (2011) that demonstrated similar muscle strength between anxious men and their healthy counterparts. There are some possible explanations for this phenomena. In light of Pasco et al. (Pasco et al., 2015) findings of a direct relationship between anxiety and sarcopenia, it is possible that the difference in our study could be attributed to an age gap between the groups of men and women. The mean age of women was approximately eight years older than that of men (Table 1). Thus, the women in our study may have been experiencing anxiety for a longer period than the men, thereby having greater impact on muscle strength (Pasco et al., 2015; Van Milligen et al., 2011). The literature also indicates a link between the onset age of anxiety and muscle weakness. Women who experienced an anxiety attack at an older age (over 40) tend to suffer more from decreases in muscle strength (Van Milligen et al., 2011).

Last, it is important to acknowledge that hand grip has been found to correlate with greater risks of disability and mortality (Rantanen et al., 2003). Women with anxiety disorders were found to have declined physical functioning, which might suggest they are at greater risk for disability and mortality, compared to healthy women (Rantanen et al., 2003).

4.4. Pharmacological effects

The effects of the anxiety group's pharmacological treatment on the research results should also be addressed. As a rule, benzodiazepines are seldom (if ever) prescribed to patients for anxiety (Schreiber, 1993), due to their tendency to induce tolerance and addiction. Patients who do not gain satisfactory benefits from different behavioral techniques such as mindfulness, relaxation, EMDR (eye-movement desensitization and reprocessing), CBT (cognitive behavioral therapy) and the like, are usually prescribed SSRIs (selective serotonin reuptake inhibitor) or SNRIs (serotonin noradrenaline reuptake inhibitor); these drugs are prescribed for anxiety and, in higher doses, for depression. Contrary to neuroleptics, these medications decrease anxiety symptoms and help restore a mental state that is closer to the norm in people with anxiety. They do not affect the musculoskeletal system. To the best of our knowledge, these medications do not affect the motor system, and would not cause deficiencies or distort the physical findings of our study (Baldwin et al., 2014).

5. Limitations

Some methodological limitations of this study should be noted. First, this study was observational rather than randomized and clinically controlled. Due to the nature of this study, it was impossible to examine whether the anxiety disorder was caused by certain physical characteristics, or rather the anxiety disorder was the cause for physical deficiency. Second, the anxiety group was examined at the psychiatric outpatient unit, which might have given the study the ambience of a laboratory, thereby detracting from its external validity. Third, although the 10 MWT is an efficient, cost-effective and common test in the clinical field, more objective quantitative assessments (e.g., GaitRite system) have become a common means for determining spatiotemporal gait variables; as such, they may be employed in future research. Last, because the results do not provide any insight into cause-and-effect relationships, the overall results could indicate lower overall physical fitness levels in the anxiety group, compared to the healthy control group (Ströhle, 2009).

6. Conclusions

The results of this study highlight the differences in gait, balance, mobility and muscle strength between patients with anxiety and healthy individuals. Clinicians might consider implementing spatiotemporal gait analysis in diagnostic physical assessments of people with anxiety. A combination of spatiotemporal gait parameters with balance and muscle strength measures may improve the physical assessment of individuals with anxiety.

Mobility is another important parameter for consideration. A reliable and validated test such as TUG, is simple, applicable, convenient, and readily available in clinical settings. Initial screening which utilizes this measure can reliably reflect mobility and prevent future functional deterioration, disability, and mortality. Muscle strength (hand grip) can be considered a part of the physical assessment, especially for women. This parameter is significant for predicting disability and mortality, and may prove to be critical in the treatment and rehabilitation of this population. Expanding the clinical research on these topics, with emphasis on gait and balance, is recommended, as is further study of the relationship between these components and mental illnesses such as anxiety.

7. Contributors

We would like to confirm that all of the authors have made substantial contributions for (a) the conception and design of the study, (b) critically revising it for important intellectual content, and (c) final approval of the submitted manuscript.

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Ethical approval

Ethics committee protocol reference number provided where applicable.

Declaration of Competing Interest

No conflicts of interest were encountered in this study.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.humov.2019.102513.

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