

# CLINICAL MANAGEMENT

## extra

## A Comparative Study of the Five-Times-Sit-to-Stand and Timed-Up-and-Go Tests as Measures of Functional Mobility in Persons with and without Injection-Related Venous Ulcers



2.8 Contact Hours

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This continuing educational activity will expire for physicians on February 28, 2015.

### PURPOSE:

To provide information on the Five-Times-Sit-to-Stand (FTSTS) and Timed-Up-and-Go (TUG) tests in persons with injection-related venous ulcers (VU+) and persons without venous ulcers (VU-).

### TARGET AUDIENCE:

This continuing education activity is intended for physicians and nurses with an interest in skin and wound care.

## OBJECTIVES:

After participating in this educational activity, the participant should be better able to:

1. Identify the methods used in a comparative study of the FTSTS and TUG tests in persons with and without injection-related venous ulcers.
2. Evaluate results from this and other studies evaluating the use of the FTSTS and TUG tests for use in clinical practice.

## ABSTRACT

**OBJECTIVE:** To examine functional mobility using Five-Times-Sit-to-Stand (FTSTS) and Timed-Up-and-Go (TUG) tests in persons with injection-related venous ulcers (VU+) and compare these findings to persons without venous ulcers (VU-).

**DESIGN:** Cross-sectional, comparative design.

**SETTING:** Outpatient clinic.

**PARTICIPANTS:** Participants (n = 61) were 31 persons VU+ and 30 persons VU-; 57.4% men; mean age, 54 years; 93% African American.

**MAIN OUTCOME MEASURES:** Five-Times-Sit-to-Stand, TUG, physical activity, quality of life, comorbidities, falls, and body mass index.

**RESULTS:** Participants VU+ were 36.8% slower on completion of the TUG test ( $P = .012$ ) and 26.5% slower on completion of the FTSTS test ( $P = .081$ ). Five-Times-Sit-to-Stand and TUG were strongly correlated with each other,  $r = 0.93$ ,  $0.87$ ,  $P < .001$  for VU- and VU+, respectively. Test-retest reliabilities for the FTSTS and TUG tests were high (intraclass correlation coefficient =  $0.89$ - $0.94$ ) for the VU+ and VU-. Within each group, correlations of FTSTS and TUG were similar for each of the variables examined. Across groups, correlations showed that the time to complete FTSTS and TUG increased as a function of comorbidities in the VU+ group; the correlations in the VU- group were not significantly different from zero.

**CONCLUSIONS:** The VU+ group exhibited poorer physical performance than the VU- group. The high correlation between FTSTS and TUG and the similarity of correlations with other variables suggest that these physical performance measures may be interchangeable in their ability to predict physical functioning in these clinical groups despite differences in test demands. Clinicians need easy-to-perform reliable clinical tests such as FTSTS and TUG to assess mobility of aging injection users with venous ulcers.

**KEYWORDS:** injection-related venous ulcers, Five-Times-Sit-to-Stand Test, Timed-Up-and-Go test, functional mobility

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ment of the ankle joint,<sup>3</sup> decreased standing time,<sup>1</sup> impaired balance and gait,<sup>4</sup> and slow walk speed.<sup>4</sup> The impact of venous ulcers on functional mobility needs further examination. The Five-Times-Sit-to-Stand (FTSTS) and Timed-Up-and-Go (TUG) tests are physical performance measures commonly used to assess functional mobility in community-dwelling older adults. Difficulties with FTSTS and TUG have been related to abnormalities in balance and gait and increased risk of falls in community-dwelling older adults.<sup>5,6</sup> The authors examined the FTSTS and TUG tests in persons with injection-related venous ulcers and compared these findings with persons without venous ulcers.

## FIVE-TIMES-SIT-TO-STAND TEST

The FTSTS test is a functional performance measure of leg strength or the force-generating capacity of muscle by using the body's weight for resistance during functional activities.<sup>7</sup> Individuals stand up and sit down 5 times as quickly and safely as they can while being timed.

The FTSTS test has been used in many studies. Goldberg<sup>8</sup> used FTSTS when examining how rapidly community-dwelling adults aged 60 to 83 years could take a step (step execution time). Poorer performance on the FTSTS test was associated with slower time to execute a rapid step. Buatois et al<sup>9</sup> found recurrent fallers were more likely than nonfallers and single fallers to fail FTSTS. They concluded FTSTS has significant predictive value for recurrent falls, and clinicians could use it to identify people at high risk of recurrent falls and who are appropriate for preventive measures. Whitney et al<sup>6</sup> reported participants with balance impairments performed FTSTS more slowly as compared with persons without balance impairments. The FTSTS test was thought to be helpful in quantifying a transitional movement that is performed daily. Goldberg et al<sup>10</sup> examined the relationship between FTSTS and TUG in older adults. The Pearson correlation coefficient was  $0.64$  ( $P < .001$ ), suggesting that the FTSTS test, such as TUG, is a valid measure of dynamic balance and functional mobility in older adults. In summary, the FTSTS test has been associated with balance impairments, mobility, and prediction of falls.

## TIMED-UP-AND-GO TEST

The TUG test was developed as a test of basic functional mobility for frail older adults and has been used with community-dwelling older adults.<sup>11</sup> It incorporates a series of tasks: standing from a seated position, walking, turning, stopping, and sitting down.<sup>11</sup> The TUG test includes the ability to adjust the center of gravity

## INTRODUCTION

Venous ulcers are a problem in injection users because of the destruction of veins from the trauma of repeated injection, irritating qualities of the substances injected, and localized infection.<sup>1,2</sup> In fact, 17.8% of drug users were reported to have open or healed venous ulcers.<sup>2</sup> Venous disease and ulcers negatively affect functioning and use of the legs as noted by decreased move-

continuously over a moving base of support.<sup>12</sup> All of the tasks are important for independent living. The TUG test, as a performance test, is based on strength, coordination, and balance.<sup>13,14</sup>

The TUG test has been used to identify older adults who are prone to falls and who may benefit from interventions designed to improve balance and decrease falls and fall risk. Cho et al<sup>15</sup> reported that TUG had a significant odds ratio of 1.70 to predict frequent falling. Kristensen et al<sup>16</sup> found TUG performance at hospital discharge after hip fracture surgery was the only parameter that significantly predicted falls. Shumway-Cook et al<sup>17</sup> reported completion of a task (eg, carrying a full glass of water) with TUG, especially if the person had previously fallen, increased the time to complete TUG. Beauchet et al<sup>18</sup> performed a systematic literature review about the association and predictive ability of TUG on the occurrence of falls among people 65 years or older. Eleven studies met their selection criteria; fall rates ranged from 7.5% to 60%. All retrospective studies showed an association between time performance on TUG and history of falls; only 1 prospective study found a significant association with the occurrence of falls.<sup>18</sup>

## SUMMARY

The FTSTS and TUG tests are performance measures that have been used clinically and in research with older adults in terms of mobility and fall risk. There is limited research examining the relationship between FTSTS and TUG. Research could not be found about FTSTS and TUG testing in persons with injection-related venous ulcers. Yet, venous ulcers negatively affect the legs and impair mobility. Impaired mobility adversely affects employment, family life, self-esteem, and quality of life and increases the risk for falls. There is a need to examine functional mobility in persons with venous ulcers regardless of the cause.

The purpose of this study was to examine the FTSTS and TUG tests in persons with injection-related venous ulcers and to compare these findings to persons without venous ulcers. The research questions were as follows: (a) Are there differences in FTSTS and TUG performance for persons with and without injection-related venous ulcers? (b) Are the FTSTS and TUG tests equally reliable measures in these clinical populations?

## METHODS

### Design

This study used a cross-sectional, comparative design. Inclusion criteria included age 40 to 65 years, presence of an injection-related venous ulcer for the wound group (VU+) and no current lower-extremity wound (VU-) for the comparison group, able to respond in English, and a registered patient in the general practice (VU-) or wound care clinic (VU+) in an urban teaching

hospital. Exclusion criteria were physically or mentally too ill to respond to the questionnaires or allow the physical examination of the legs, had an amputation of a lower extremity, and not able to walk. VU+ patients were gender matched with VU- patients.

## Participants

The participants (n = 31 VU+ and n = 30 VU-) were described in detail in the study's report of pain<sup>19</sup> and falls and balance confidence.<sup>20</sup> Characteristics of the sample are presented in Table 1.

**Table 1.**

**CHARACTERISTICS OF PARTICIPANTS (N = 61) WITH (VU+) AND WITHOUT (VU-) INJECTION-RELATED VENOUS ULCERS**

Characteristic	VU+ (n = 31)	VU- (n = 30)	P
Age, mean (SD), y	56.10 (3.60)	52.00 (6.41)	.01
Male sex, n (%)	19 (61.29)	16 (53.3)	.52
African American, n (%)	28 (90.3)	29 (96.7)	.31
No. of comorbidities, mean (SD)	5.54 (2.56)	3.20 (1.71)	.001
Self-rated health, mean (SD)	5.84 (1.66)	6.93 (1.79)	.02
CEAP clinical score, <sup>a</sup> mean (SD)	7 (0)	1.43 (2.01)	<.01
BMI, mean (SD), kg/m <sup>2</sup>	27.6 (4.88)	29.8 (8.61)	.23
BPI severity			
Worst pain, mean (SD)	7.0 (3.3)	6.2 (3.9)	.36
Recurrent faller, n (%) ≥2 per year	19 (61.3)	10 (33.3)	.03
Daily walking, n (%) mile/d	20 (65)	11 (35)	.03
Positive attitude for physical activity, mean (SD)	3.3 (0.68)	3.7 (0.73)	.02
Quality of life, mean (SD)	0.85 (0.82)	1.2 (0.84)	.06
Did sitting increase or stay the same in 5 y?	28 (90)	24 (80)	.26
[n (%) increased or stayed the same]			
Did standing increase or stay the same in 5 y?	20 (65)	15 (50)	.25
[n (%) decreased]			
Did walking increase or stay the same in 5 y?	20 (65)	10 (33)	.02
[n (%) decreased]			

Values are mean (SD) or number (percentage). Statistics are independent group *t* test for continuous outcomes and Pearson <sup>2</sup> test of association for categorical outcomes.

<sup>a</sup>0, Meaning no evidence of venous disease, to 7, presence of venous ulcers.

The sample included 35 men (57.4%) and 26 women with mean age of 54 (SD, 5.53) years ; 57 participants (93%) were African American. Participants VU+ and VU- did not differ significantly on sex, race, body mass index (BMI), worst pain score, quality of life, or change in time spent sitting or standing.<sup>19,20</sup> Participants VU+ were significantly older (56 vs 52 years), rated their health worse (5.8 vs 6.9), and had more comorbidities (5.5 vs 3.2).<sup>19,20</sup> Significantly more VU+ participants reported walking less than 0.5 miles per day compared with those VU-.<sup>19</sup> A greater proportion of persons VU+ compared with VU- had decreased time engaged in walking over the past 5 years. For VU+, 4 persons had VUs on the right leg only, 13 had VUs on the left leg only, and 14 had VUs on both.

## Procedure

Participants were recruited consecutively when they came for their scheduled clinic appointment. A registered nurse assessed potential participants on inclusion and exclusion criteria. Participants signed a consent form. Nurses read questionnaires to participants to facilitate completion and avoid frustration if reading levels were low. All participants were asked to perform the FTSTS and TUG tests. Participants were compensated \$10 for their 1-hour participation time. The participation time did not appear to tire participants. The study was institutional review board approved.

## Instruments

The Demographic and Health Questionnaires obtained general information about each participant such as sex, race, education, age, medications, and medical diagnoses. Participants responded to a list of 21 medical diagnoses that a clinician stated they had. In the calculation of comorbidities, conditions that are causally related to VU+ status (deep vein thrombosis, liver disease including hepatitis B and C, and lower-extremity neuropathy) were omitted. Self-rated health was scored on a scale of 1 (*ill*) to 10 (*healthy*). The BMI was calculated from the person's weight in kilograms and height in meters (BMI in kg/m<sup>2</sup>). Participants were asked if they had fallen more than 1 time within the past year. A fall was defined as unintentionally coming to rest on the ground, the floor, or other lower surface.<sup>21</sup> The test-retest reliability values for the Demographic and Health History Questionnaires were 0.99 and 0.86, respectively.<sup>22</sup>

The Brief Pain Inventory (BPI) Short Form was used to measure pain severity. Participants rated worst pain for the past 2 weeks. Worst pain was rated on a scale that ranged from 0 (*no pain*) to 10 (*pain as bad as you can imagine*). The BPI pain items have Cronbach's values ranging from .84 to .85.<sup>23,24</sup>

The Global Health instrument was used to measure quality of life.<sup>25</sup> The Global Health instrument consists of 10 items that were tabulated for a total score. Relative to the general US population, persons with chronic illnesses had poorer quality of life, and this was more pronounced when 2 or more chronic conditions were present.<sup>26</sup> The Global Health total score has a reliability of 0.87.<sup>25</sup>

The Positive Attitude Toward Physical Activity scale consists of 7 items that were rated for how the person felt this week. Examples of items include feeling physically fit, feel better with activity, do not let how I feel affect activities, and do activities even if painful. Items were rated *strongly agree* (score 1) to *strongly disagree* (score 5). Items were tabulated for a total score. The scale has an internal consistency of .67 (n = 569).<sup>27</sup>

Activity level was examined with varied walking and activity questions. Participants were asked if they walked 30 minutes per day and how far they walked. They stated if their sitting, standing, or walking had increased, decreased, or stayed the same over the past 5 years (Active Living Scale). For analyses, *increased* and *stayed the same* responses were combined because of the sample size. Internal consistency reliability for daily walking scale is 0.58 and 0.67 for Active Living scales of sitting and standing.<sup>27</sup>

Both legs were assessed for venous disease using the clinical section of the Clinical-Etiology-Anatomy-Pathophysiology (CEAP) Classification.<sup>28</sup> The clinical CEAP assessment was done to ensure the VU- group did not have leg ulcers. The clinical CEAP ranges from class 0, no visible or palpable signs of venous disease, to class 6, active venous ulcer. All VU+ participants were class 6. The authors reported interrater reliability in a drug use population as 0.97 for the right leg and 0.94 for the left leg.<sup>2</sup> For participants with venous ulcers, the number of legs with ulcers and the number of ulcers per leg were recorded. Ulcers were measured for greatest length and width in centimeters to calculate area.

## Physical Performance Measures

The FTSTS test was performed in a quiet room and used a standard chair without armrests. Participants wore shoes, sat with their back against the back of the chair, and crossed their arms over their chest. They were told to stand up and sit down as quickly and safely as they could 5 times. The test ended when they sat for the last time with their back against the back of the chair. Time to complete the test was recorded in seconds with a standard stop watch. The test was performed twice (about 5 minutes apart). The faster of the 2 trials was used as the FTSTS score. Three individuals were unable to complete the FTSTS test because they could not stand up and down 5 times without a rest. For these persons, the authors used regression imputation to

estimate their FTSTS score. Omitting these individuals rather than imputing their scores would have biased comparisons between groups because these persons probably would have had the slowest scores if they had completed the 5 repetitions and they were in the VU+ group. Good reliability was reported for the FTSTS test in different studies: test-retest 0.89,<sup>29</sup> intraclass correlation coefficient (ICC) 0.957,<sup>7</sup> and ICC 0.89.<sup>5</sup>

The TUG test was performed in a quiet room. The participant wore shoes and was allowed to use an assistive device, such as a cane. The participant sat in a standard chair with armrests with his/her back against the chair and arms on the armrests. Each participant was told to perform the test as quickly and safely as possible. The TUG test included rising from the chair, walking 3 meters, turning, walking back to the chair, and sitting down with his/her back against the chair. Time to complete the test was recorded in seconds. The test was performed twice (about 5 minutes apart); the faster of the 2 performances was used in data analysis. Reliability of the TUG test has been examined in many populations. For example, reliability of TUG in a small sample of patients with Parkinson disease either off or on medication, respectively, was high for experienced (ICCs = 0.99 and 0.99) and inexperienced raters (ICC = 0.87 and 0.99).<sup>30</sup> Flansbjerg et al<sup>31</sup> examined the reliability of the TUG in adults with hemiparesis after stroke (ICC = 0.93–0.98). Piva et al<sup>14</sup> reported high intratester (0.95) and intertester (0.98) reliability in a convenience sample of older adults, most of whom had knee osteoarthritis.

## Data Analyses

Descriptive statistics were used to examine the frequency and distribution of demographic characteristics, along with means

and SDs of quantitative measures. Correlations and analysis of variance allowed the authors to examine the relationships among the variables. The differences in continuous variables between those with and without injection-related venous ulcers were examined with Student *t* test, whereas  $\chi^2$  test of association described between-group differences in categorical variables. Reliability was assessed using test-retest ICCs.  $\alpha$  was set to .05 2-tailed for all statistical tests. Analyses were carried out using SPSS (IBM, Armonk, New York).

The authors were especially interested in variables specific to VU+ because it is a clinical group with distinct lower-extremity changes. From the variables shown in Table 1, the authors selected those that were significantly correlated with either FTSTS or TUG for additional analysis. A within-group between-group (WGBG) analysis of correlations was used to examine and compare correlates of FTSTS and TUG performance across variables and groups.<sup>32</sup> In this analysis, the correlational profiles of related performance measures are compared within and across groups to gain understanding of their functional similarities and differences. It is expected that 2 tasks measuring functionally different outcomes will result in a different pattern of correlations than 2 tasks measuring the same functional outcome. Because performance profiles may differ by clinical population, comparisons of profiles are also examined across clinical groups.

This yields 3 sets of profile coefficients for comparing FTSTS and TUG performance: (a) correlations within group, (b) within-group differences in correlations, and (c) between-group differences in correlations. The tabular display of WGBG results and calculations of within- and between-group differences are shown in Table 2.

**Table 2.**

**PROFILE COEFFICIENTS FOR WITHIN-GROUP BETWEEN-GROUP ANALYSIS SHOWING WITHIN-GROUP CORRELATIONS, WITHIN-GROUP DIFFERENCES IN CORRELATIONS, AND BETWEEN-GROUP DIFFERENCES IN CORRELATIONS**

Variable/Correlate	Group				Within-Group Difference		Between-Group Difference	
	A		B		Test Y Minus Test X		Group B Minus Group A	
	Test X	Test Y	Test X	Test Y	Group A	Group B	Test X	Test Y
Variable 1	$r_{X1}^A$	$r_{Y1}^A$	$r_{X1}^B$	$r_{Y1}^B$	$r_{Y1}^A - r_{X1}^A$	$r_{Y1}^B - r_{X1}^B$	$r_{X1}^B - r_{X1}^A$	$r_{Y1}^B - r_{Y1}^A$
Variable 2	$r_{X2}^A$	$r_{Y2}^A$	$r_{X2}^B$	$r_{Y2}^B$	$r_{Y2}^A - r_{X2}^A$	$r_{Y2}^B - r_{X2}^B$	$r_{X2}^B - r_{X2}^A$	$r_{Y2}^B - r_{Y2}^A$
Variable 3	$r_{X3}^A$	$r_{Y3}^A$	$r_{X3}^B$	$r_{Y3}^B$	$r_{Y3}^A - r_{X3}^A$	$r_{Y3}^B - r_{X3}^B$	$r_{X3}^B - r_{X3}^A$	$r_{Y3}^B - r_{Y3}^A$
Variable 4	$r_{X4}^A$	$r_{Y4}^A$	$r_{X4}^B$	$r_{Y4}^B$	$r_{Y4}^A - r_{X4}^A$	$r_{Y4}^B - r_{X4}^B$	$r_{X4}^B - r_{X4}^A$	$r_{Y4}^B - r_{Y4}^A$

**Definitions:**

$r_{X1}^A$  is the correlation between test X and correlate/variable 1 in group A.  
 $r_{Y1}^A$  is the correlation between test Y and correlate/variable 1 in group A.  
 $r_{X1}^B$  is the correlation between test X and correlate/variable 1 in group B.  
 $r_{Y1}^B$  is the correlation between test Y and correlate/variable 1 in group B.  
 $r_{Y1}^A - r_{X1}^A$  is the difference in correlations of test X and test Y with variable 1 within group A.  
 $r_{X1}^B - r_{X1}^A$  is the difference in the correlation of test X with variable 1 between group A and B.



Statistical tests used in WGBG analysis are described as follows. The within-group correlations were tested against the null hypothesis of  $\rho = 0$ , using conventional Student  $t$  test. The within-group differences were tested using a test for dependent correlations. The null hypothesis is of the form:

$$\rho_{y1}^A - \rho_{X1}^A = 0$$

The superscript  $A$  refers to a particular subgroup, say  $A$  or  $B$ , and the subscript refers to the variables being correlated; the number in the subscript refers to a particular correlate/variable, for example, 1 through 8. These correlations are dependent because they contain a common correlate (variables 1, 2, and so on). Stieger  $Z$  test for correlated correlations was used to test these differences. The between-group difference (in correlation) was tested using Fisher  $Z$  test.<sup>32</sup> These correlations are independent but not normally distributed, requiring the  $r$ -to- $z$  transformation. Finally, moderated regression analysis was used to test the significance of difference in between group slopes for correlates that differed significantly by group.

Three cases were missing on 1 variable. Maximum likelihood estimation was used to impute these values. Analyses were run with and without the imputed data and did not differ.

## RESULTS

### Comparison of FTSTS and TUG in Persons VU+ versus VU–

Participants VU+ performed significantly slower than did VU– participants on TUG ( $P = .012$ ) (Table 3); in fact, participants VU+ were 36.8% slower on completion of TUG. Performance on FTSTS did not differ significantly by groups, but participants VU+ were 26.5% slower on completion of FTSTS ( $P = .081$ ).

**Table 3.**

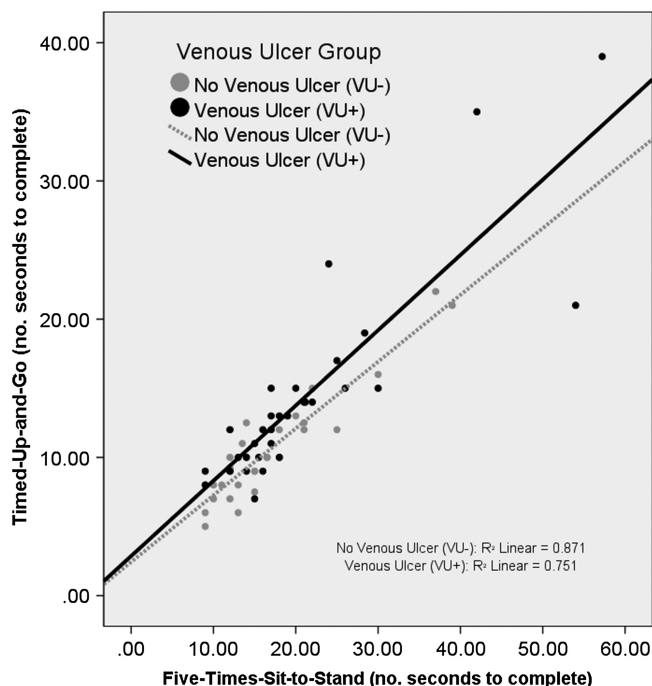
**PHYSICAL PERFORMANCE MEASURES IN PARTICIPANTS WITH (VU+) AND WITHOUT (VU–) INJECTION-RELATED VENOUS ULCERS, MEAN (SD)**

Physical Performance Measures	VU+ (n = 31)	VU– (n = 30)	P
FTSTS, seconds to complete task	21.10 (11.37)	16.68 (7.65)	.08
TUG, seconds to complete task	14.35 (7.1)	10.49 (3.96)	.01

Abbreviations: FTSTS, Five-Times-Sit-To-Stand; TUG, Timed-Up-and-Go.

**Figure 1.**

**LINEAR REGRESSION OF FIVE-TIMES-SIT-TO-STAND AND TIMED-UP-AND-GO TESTS IN VU+ AND VU– GROUPS SEPARATELY (N = 58)**



### Within-Group Comparisons of FTSTS and TUG

The FTSTS and TUG test were strongly correlated with each other,  $r = 0.93$ ,  $0.87$ , and  $P < .001$  for VU– and VU+, respectively. As shown in Figure 1, the regression of TUG on FTSTS was strongly linear in both groups. The linear regression accounted for 87% of the variance in VU– and 75% of the variance in VU+.

In order to compare the relative predictive ability of FTSTS and TUG from the variables included in the study, the authors selected those that were significantly correlated with either FTSTS or TUG (Table 4) for additional analyses. The nonsignificant ( $P > .05$ ) variables were age, sex, self-rated health, BPI worst pain score, and change in sitting over the past 5 years. Thus, each of the variables shown in Table 4 was significantly correlated with either FTSTS or TUG.

Given the high correlation between FTSTS and TUG, it is not surprising that many of the variables that correlated with one

**Table 4.**

**WGBG ANALYSIS SHOWING WITHIN-GROUP CORRELATIONS, WITHIN-GROUP DIFFERENCES IN CORRELATIONS (TUG MINUS FTSTS), AND BETWEEN-GROUP DIFFERENCES IN CORRELATIONS (VU+ MINUS VU−)**

Variables	Within-Group Correlations				Within-Group Difference		Between-Group Difference	
	No Venous Ulcer (VU−)		Venous Ulcer (VU+)		TUG Minus FTSTS		VU+ Minus VU−	
	FTSTS	TUG	FTSTS	TUG	VU−	VU+	FTSTS	TUG
Positive attitude for physical activity	−0.51 <sup>a</sup>	−0.49 <sup>a</sup>	−0.48 <sup>a</sup>	−0.47 <sup>a</sup>	0.02	0.01	0.03	0.02
Quality of life	−0.41 <sup>b</sup>	−0.43 <sup>b</sup>	−0.45 <sup>b</sup>	−0.40 <sup>b</sup>	−0.02	0.05	−0.04	0.03
Recurrent faller (≥2 in past year)	0.37 <sup>b</sup>	0.41 <sup>b</sup>	0.44 <sup>b</sup>	0.43 <sup>b</sup>	0.04	−0.01	0.07	0.02
Daily walking (<0.5 or >0.5 miles/d)?	−0.27	−0.22	−0.31	−0.39 <sup>b</sup>	0.05	−0.08	−0.04	−0.17
Did walking increase or stay the same in 5 y?	−0.06	−0.11	−0.35	−0.39 <sup>b</sup>	−0.05	−0.04	−0.29	−0.28
Did standing increase or stay the same in 5 y?	−0.21	−0.16	−0.36 <sup>b</sup>	−0.40 <sup>b</sup>	0.05	−0.04	−0.15	−0.24
No. of comorbidities	0.05	0.08	0.49 <sup>a</sup>	0.55 <sup>a</sup>	0.03	0.06	0.44	0.47 <sup>b</sup>
BMI	0.23	0.23	0.43 <sup>a</sup>	0.53 <sup>a</sup>	0.00	0.10	0.20	0.30

Abbreviations: BMI, body mass index; FTSTS, Five-Times-Sit-to-Stand, seconds to complete task; TUG: Timed-Up-and-Go, seconds to complete task; WGBG: within-group between-group analysis of correlations.  
<sup>a</sup>*P* < .01.  
<sup>b</sup>*P* < .05.

were also correlated with the other. As shown in Table 4, within each group (VU−, VU+), the correlations of TUG and FTSTS were similar for each of the variables examined. The Within-Group Difference column of Table 4 shows that no differences were greater than 0.10 in absolute value, and no differences were significant.

However, some differences between groups in the within-group correlations were observed. Three variables that were significantly correlated in the VU+ group were not significant in the VU− group, namely, “Did standing increase or stay the same in 5 years,” “Number of comorbidities,” and “BMI” (Table 4). In VU+, TUG was correlated with the number of comorbidities ( $r = 0.55$ ); in contrast, in VU−, the correlation between TUG and number of comorbidities was only 0.08. The magnitude of the difference ( $0.55 - 0.08 = 0.47$ ) was significant,  $P < .05$ . As shown in the Between-Group Difference column, no other correlation differences were significant. However, similar to the difference found for TUG, FTSTS difference for comorbidities approached significance ( $0.49 - 0.05 = 0.44$ ,  $P = .051$ ). No other correlation differences were significant. Inspection of the within-

group regressions showed that the time to complete TUG and FTSTS increased as a function of comorbidities in the VU+ group; the regressions in the VU− group were relatively flat (Figure 2).

### Reliability of FTSTS and TUG by Group

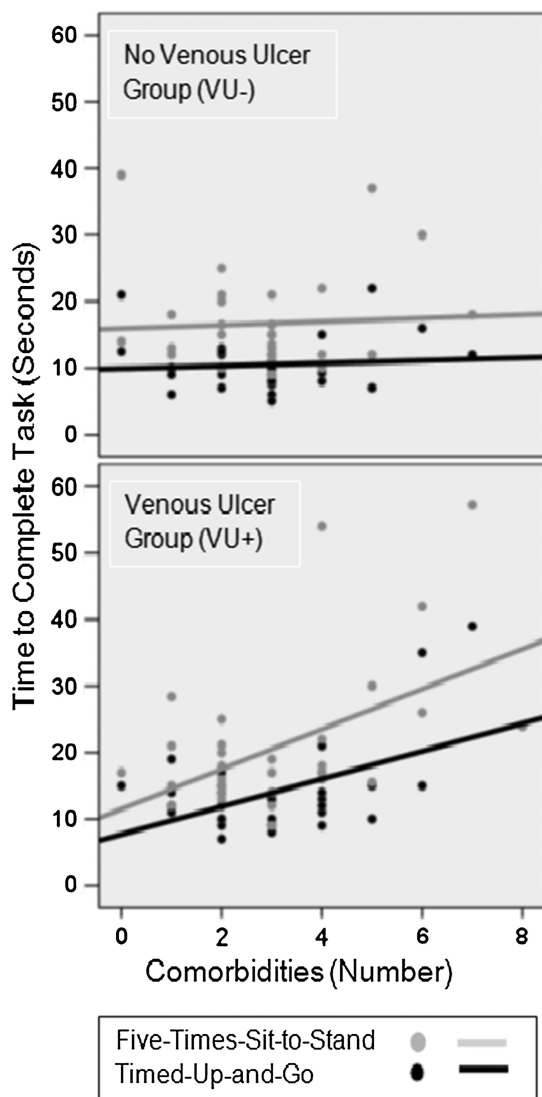
Test-retest reliability for the FTSTS test was high both for the VU+ (ICC = 0.89; 95% confidence interval [CI], 0.79–0.95;  $P < .001$ ) and VU− (ICC = 0.91; 95% CI, 0.81–0.95;  $P < .001$ ) groups. This was also true for the TUG test (VU+, ICC = 0.94; 95% CI, 0.88–0.97 [ $P < .001$ ]; and VU−, ICC = 0.92; 95% CI, 0.83–0.96 [ $P < .001$ ]).

## DISCUSSION

For patients with and without injection-related venous ulcers, FTSTS and TUG were compared. The VU+ group exhibited poorer physical performance than the VU− group on both measures. These differences were significant for TUG and approached

**Figure 2.**

**LINEAR REGRESSION OF TIMED-UP-AND-GO AND FIVE-TIMES-SIT-TO-STAND TESTS ON COMORBIDITIES WITHIN VU+ AND VU-**



significance for FTSTS. The VU+ patients were 37% slower on TUG and 27% slower on FTSTS, reflecting the fact that venous ulcers is a disease of the lower extremities.

These 2 physical performance measures, FTSTS and TUG, were highly correlated with each other. Both had excellent test-

retest reliability. The high correlation between these measures made it interesting to compare them across a wide range of different variables. Both the high correlation between these tests and the similarity of correlations with other variables suggest that these physical performance measures may be interchangeable in their ability to predict physical functioning in these clinical populations. From a clinical perspective, however, there are important task demand differences between FTSTS and TUG. The FTSTS test assesses ability to rise up and down 5 times against gravity without use of the arms, whereas the TUG test assesses ability to rise up from a chair using the arms and assistive devices as needed, walk and turn before returning to a seated position. This study also adds to the literature about reliability of the FTSTS and TUG tests with clinical groups.

Correlations did not differ when comparing tests within groups, but tended to be stronger in persons with venous ulcers (VU+). The co-occurrence of other health conditions (comorbidities and BMI) affected physical performance more when the legs were affected with venous ulcers. When legs had venous ulcers, additional health challenges in terms of comorbidities resulted in an additional decrement in performance. This relationship between comorbidities and the physical performance measures did not occur in patients without venous ulcers.

To the authors' knowledge, this is the first investigation of FTSTS and TUG in persons with injection-related venous ulcers and who were also in the baby-boomer cohort. Yet, examining physical performance in injection users in the baby-boomer cohort (born 1946–1964) is critical because this group has the greatest lifetime drug use rates compared with previous generations and is aging (first group became 65 years of age in 2011).<sup>33,34</sup> The authors' mean values for FTSTS (mean, 21.10 [SD, 11.37] seconds) in the VU+ group tended to be high. Whitney et al<sup>6</sup> reported a mean FTSTS for a control group of 8.2 seconds compared with 16.4 seconds for older subjects with balance disorders. Lord et al<sup>5</sup> reported mean sit-to-stand values across the age range of 75 to 93 years of 12.8 seconds for men and 12.9 seconds for women.

Slow performance on the FTSTS test has been related to fall risk. Buatois et al<sup>9</sup> reported those who took greater than 15 seconds to complete FTSTS had a 74% greater risk of recurrent falls. The authors' participants in the VU+ group had a median FTSTS score of 16 seconds. Using Buatois et al's<sup>9</sup> 15 seconds as a cut-off point, 55% of the VU+ patients were at risk for recurrent falls.

The mean value of TUG (mean, 14.35 [SD, 7.1]) in the VU+ group also tended to be high. Cho et al<sup>15</sup> for older adults with balance impairments reported a mean TUG at 15 seconds, and Flansbjerg et al<sup>31</sup> reported for men and women with hemiparesis



after a stroke a mean of 14.3 seconds. For patients with Parkinson disease and on medication, Morris et al<sup>30</sup> reported mean TUG ranges of 13.06 to 14.64 seconds. The TUG scores in the VU+ group were comparable to scores achieved in clinical populations with known balance disorders and functional impairments.

Venous ulcer occurrence generally increases with aging. Thus, there is a great need to use tests such as TUG and FTSTS to examine functional mobility in persons with injection-related venous ulcers. Deficiencies in functional mobility will aid development of treatment protocol to maintain mobility for an independent lifestyle. It is not known if persons with venous ulcers not related to injection drug use would perform better on these tests compared with the authors' sample.

Age, self-rated health, and pain were not significantly related to FTSTS or TUG. Bohannon et al<sup>7</sup> reported age was correlated significantly with FTSTS. Aging has been associated with progressively diminished muscle strength and power, flexibility, and postural stability.<sup>5,12,35</sup> The lack of significance of age, self-rated health, and pain may reflect other factors negatively affecting physical functioning for those with venous ulcers.

Although FTSTS and TUG were empirically indistinguishable in the clinical samples used in this study, it is possible that differences will emerge in patient groups with a different profile of functional deficits. Lord et al<sup>5</sup> concluded the FTSTS test in community-dwelling older adults is influenced by multiple sensorimotor, balance, and psychological factors; it is not simply a proxy measure of lower-limb strength. Similarly, Kwan et al<sup>13</sup> concluded TUG performance was related to lower-limb strength, balance, reaction time, vision, pain, cognitive function, and health status. All of the above factors need to be considered when comparing functional mobility in persons from different clinical groups.

Three VU+ participants could not perform FTSTS. The FTSTS test was more difficult to perform than TUG because participants could not use their arms/hands or assistive devices with FTSTS when they could with TUG. For HIV-infected ambulatory adults, Richert et al<sup>36</sup> reported the FTSTS test compared with 5 other locomotor tests as having the most abnormal results; 53.3% of patients had poor performance on this test. They concluded 1 of 2 adults with controlled HIV infection had poor lower-limb muscle performance, which may put these persons at risk of falls and fracture. The authors recorded the time to complete FTSTS. Because some persons could not do this test, this complicated the authors' analysis. The authors recommend recording the number of sit-to-stands done in a designated period so that zero values are more easily analyzed. This number can then be converted to the usual scoring by a simple mathematical transformation.

The FTSTS and TUG tests were not found to be significantly different when examining within-group correlation differences across several variables. This raises the question if FTSTS and TUG are measuring the same construct even though they are performed differently. Both are easy and quick to perform, thus not a burden to the patient or clinician. Researchers and clinicians need to decide for their population if both tests are needed. Performance-based measures are important because they identify limitations in physical function earlier and more frequently than do self-reported measures.<sup>14</sup>

Future studies need to examine if intervention programs can strengthen the legs and maintain function of lower-extremity joints for those with injection-related venous ulcers. Sousa and Sampaio<sup>12</sup> reported an intensity-progressive strength training program resulted in an improvement in TUG scores for community-dwelling older adults.<sup>12</sup> Capodaglio et al<sup>37</sup> found a long-term mixed-strength training program significantly improved TUG scores as well as muscle function, functional ability, and physical activity profiles in health community-dwelling adults older than 75 years. As more persons who injected drugs become older aged, it is crucial to know what interventions are most effective in maintaining independence in this cohort.

## LIMITATIONS

This study had limitations. The sample size was modest. Replication of the study is warranted with larger sample sizes. A detailed illicit drug assessment is needed to examine the effect of drug use history on FTSTS and TUG. The study was cross-sectional. A longitudinal study may provide insight into when changes in balance and gait occur in this population. This study did not include persons who have venous ulcers that are not related to injection drug use or other wounds; these individuals must also be examined in terms of the effect of venous ulcers or other wounds on FTSTS and TUG.

## CONCLUSIONS

The VU+ group exhibited poorer physical performance than the VU- group. This poor performance reflects negatively on balance and gait and functional mobility. The high correlation between FTSTS and TUG and the similarity of correlations with other variables suggest that these physical performance measures may be interchangeable in their ability to predict physical functioning in these clinical groups despite differences in test demands. It is possible that differences between FTSTS and TUG will emerge in patient groups with a different profile of functional deficits. Clinicians need easy-to-perform reliable clinical tests,

such as FTSTS and TUG, to assess mobility of aging injection users with venous ulcers. This testing is crucial in terms of long-term patient safety and fall prevention as well as for an independent life style.

## PRACTICE PEARLS

- The Five-Times-Sit-to-Stand (FTSTS) and Timed-Up-and-Go (TUG) tests are physical performance measures commonly used to assess functional mobility and dynamic balance in community-dwelling older adults. Difficulties with FTSTS and TUG have been related to abnormalities in balance and gait and increased risk of falls in community-dwelling older adults.
- Venous ulcers negatively affect the legs and impair mobility. Impaired mobility adversely affects multiple aspects of a person's life. There is a need to examine functional mobility in persons with venous ulcers regardless of the cause.
- The VU+ patients were 37% slower on TUG and 27% slower on FTSTS reflecting the fact that venous ulcers are a disease of the lower extremities.
- The FTSTS and TUG tests were highly correlated with each other and had excellent test-retest reliability.
- Venous ulcer occurrence generally increases with aging. There is a great need to use easy-to-perform, reliable tests like TUG and FTSTS to examine functional mobility in persons with venous ulcers. Deficiencies in functional mobility will aid development of treatment protocols to maintain mobility for an independent lifestyle.
- It is not known if persons with venous ulcers not related to injection drug use would perform better on FTSTS and TUG tests.

## REFERENCES

- Pieper B, Kirsner RS, Templin TN, Birk T. Injection drug use—an understudied cause of venous disease. *Arch Dermatol* 2007;143:1305-9.
- Pieper B, Templin TN, Birk TJ, Kirsner RS. Impact of injection drug use on distribution and severity of chronic venous disorders. *Wound Repair Regen* 2009;17:485-91.
- Pieper B, Templin TN, Birk TJ, Kirsner RS. Effects of injection-drug injury on ankle mobility and chronic venous disorders. *J Nurs Scholarsh* 2007;39:312-8.
- Pieper B, Templin TN, Kirsner RS, Birk T. Injection-related venous disease and walking mobility. *J Addict Dis* 2010;29:481-92.
- Lord SR, Murray SM, Chapman K, Munro B, Tiedmann A. Sit-to-stand performance depends on sensation, speed, balance, and psychological status in addition to strength in older people. *J Gerontol A Biol Sci Med Sci* 2002;57(8):M539-M543.
- Whitney SL, Wrisley DM, Marchetti GF, Gee MA, Redfern MS, Furman JM. Clinical measurement of sit-to-stand performance in people with balance disorders: validity of data for the Five-Times-Sit-to-Stand Test. *Phys Ther* 2005;85:1034-45.
- Bohannon RW, Shove ME, Barreca RS, Masters LM, Sigouin CS. Five-repetition sit-to-stand test performance by community-dwelling adults: a preliminary investigation of times, determinants, and relationship with self-reported physical performance. *Isokinetics Exerc Sci* 2007;15:77-81.
- Goldberg A. The Five-Times-Sit-to-Stand-Test (FTSTS), the short version of the Activities-Specific Balance Confidence (ABC) scale, and fear of falling predict Step Execution Time (SET) in older adults. *Arch Gerontol Geriatr* 2012;54:434-8.
- Buatois S, Manckoundia P, Gueguen R, et al. Five times sit to stand test is a predictor of recurrent falls in healthy community-living subjects aged 65 and older. *J Am Geriatr Soc* 2008;56:1575-7.
- Goldberg A, Chavis M, Watkins J, Wilson T. The Five-Times-Sit-to-Stand-Test: validity, reliability and detectable change in older females. *Aging Clin Exp Res* 2012;24:339-44.
- Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991;39:142-8.
- Sousa N, Sampaio J. Effects of progressive strength training on the performance of the functional reach test and the timed get-up-and-go test in an elderly population from the rural north of Portugal. *Am J Hum Biol* 2005;17:746-51.
- Kwan MM, Lin SI, Chen CH, Close JC, Lord SR. Sensorimotor function, balance abilities and pain influence Timed Up and Go performance in older community-living people. *Aging Clin Exp Res* 2011;23:196-201.
- Piva SR, Fitzgerald GK, Irrgang JJ, Bouzubar, Starz TW. Get up and go test in patients with knee osteoarthritis. *Arch Phys Med Rehabil* 2004;85:284-9.
- Cho BL, Scarpace D, Alexander NB. Tests of stepping as indicators of mobility, balance, and fall risk in balance-impaired older adults. *J Am Geriatr Soc* 2004;52:1168-73.
- Kristensen MT, Foss NB, Kehlet H. Timed "Up & Go" test as a predictor of falls within 6 months after hip fracture surgery. *Phys Ther* 2007;87:24-30.
- Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go test. *Phys Ther* 2000;80:896-903.
- Beauchet O, Fantino B, Allali G, Muir SW, Montero-Odasso M, Anweiler C. Timed Up and Go test and risk of falls in older adults: a systematic review. *J Nutr Health Aging* 2011;15:933-8.
- Pieper B, DiNardo E, Nordstrom CK. A cross-sectional, comparative study of pain and activity in persons with and without injection-related venous ulcers. *Ostomy Wound Manage* 2013;59(5):14-23.
- Pieper B, Templin TN, Goldberg A, DiNardo E, Wells M. Falls and balance confidence in persons with and without injection-related venous ulcers. *J Addict Med* 2013;7: 73-8.
- Gibson MJ, Andres RO, Isaacs B, Radebaugh T, Worm-Petersen J. The prevention of falls in later life. A report of the Kellogg International Work Group on the prevention of falls by the elderly. *Danish Med Bull* 1987;34(Suppl 4):1-24.
- Pieper B, Templin TN, Birk TJ, Kirsner RS. Chronic venous disorders and injection drug use: impact on balance, gait, and walk speed. *J Wound Ostomy Continence Nurs* 2008; 35:301-10.
- Tan G, Jensen MP, Thornby JI, Shanti BF. Validation of the brief pain inventory for chronic nonmalignant pain. *J Pain* 2004;5:133-7.
- Pieper B, Vallerand AH, Norstrom CK, DiNardo E. Comparison of bodily pain: persons with and without venous ulcers in an indigent care clinic. *J Wound Ostomy Continence Nurs* 2009;36:493-502.
- Patient-Reported Outcomes Measurement Information System (PROMIS). <http://www.nihpromis.org>. Last accessed December 11, 2013.
- Rothrock NE, Hays RD, Spritzer K, Yount SE, Riley W, Cella D. Relative to the general US population, chronic diseases are associated with poorer health-related quality of life as measured by the Patient-Reported Outcomes Measurement Information System (PROMIS). *J Clin Epidemiol* 2010;63:1195-204.
- Pieper B, Templin TN, Kirsner RS, Birk TJ. The impact of vascular leg disorders on physical activity in methadone-maintained adults. *Res Nurs Health* 2010;33:426-440.
- Eklof B, Rutherford RB, Bergan JJ, et al. Revision of the CEAP classification for chronic venous disorders: consensus statement. *J Vasc Surg* 2004;40:1248-52.
- Butler AA, Menant JC, Tiedemann AC, Lord SR. Age and gender differences in seven tests of functional mobility. *J NeuroEng Rehabil* 2009;6:31.
- Morris S, Morris ME, Iansek R. Reliability of measurements obtained with the Timed "Up & Go" test in people with Parkinson disease. *Phys Ther* 2001;81:810-8.
- Flansbjerg UB, Holmbeck AM, Downham D, Patten C, Lexell J. Reliability of gait performance tests in men and women with hemiparesis after stroke. *J Rehabil Med* 2005;37:75-82.
- Steiger JH. Tests for comparing elements of a correlation matrix. *Psychol Bull* 1980;87:245-51.
- Colliver JD, Compton WM, Groer JC, Condon T. Projecting drug use among aging baby boomers in 2020. *Ann Epidemiol* 2006;16:257-65.

34. Giroer J, Penne M, Pemberton M, Folsom R. Substance abuse treatment need among older adults in 2020: the impact of the aging baby-boom cohort. *Drug Alcohol Depend* 2003;69:127-35.
35. de Brito LBB, Ricardo DR, Sardinha D, de Arajo MS, Ramos PS, Myers J, de Arajo CDS. Ability to sit and rise from the floor as a predictor of all-cause mortality [published online ahead of print December 13, 2012]. *Eur J Prevent Cardiol*.
36. Richert L, Dehail P, Mercie P, et al. High frequency of poor locomotor performance in HIV-infected patients. *AIDS* 2011;25:797-805.
37. Capodaglio P, Capodaglio EM, Ferri A, Scaglioni G, Marchi A, Saibene F. Muscle function and functional ability improves more in community-dwelling older women with a mixed-strength training programme. *Age Aging* 2005;34:141-7.

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