Self-performed Five Times Sit-To-Stand test at home as (pre-)screening tool for frailty in cancer survivors: Reliability and agreement assessment

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ORIGINAL ARTICLE

Self-performed Five Times Sit-To-Stand test at home as (pre-) screening tool for frailty in cancer survivors: Reliability and agreement assessment

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Abstract

Aims and Objectives: The self-performance of a Five-Times-Sit-To-Stand (FTSTS)-test, without the usual supervision by a medical professional, provides valuable opportunities for clinical practice and research. This study aimed: (1) to determine the validity of the self-performed FTSTS test in comparison to a supervised reference test and (2) to determine the reliability of a self-performed FTSTS test by cancer survivors.

Background: Early detection of frailty in cancer survivors may enable prehabilitation interventions before surgery or intensive treatment, improving cancer outcomes.

Design: A repeated measures reliability and agreement study, with one week in between measures, was performed.

Methods: Cancer survivors (n = 151) performed two FTSTS tests themselves. One additional reference FTSTS test was supervised by a physical therapist. The intraclass correlation coefficient (ICC), structural error of measurement (SEM) and minimally important clinical difference (MID) were calculated comparing a self-performed FTSTS test to the reference test, and comparing two self-performed FTSTS tests. The Guidelines for Reporting Reliability and Agreement Studies (GRASS) have been used.

Results: Mean age of cancer survivors was 65.6 years (SD = 9.3), 54.6% were female, median time since diagnosis was 2 years [IQR = 1], and tumour type varied (e.g., breast cancer (31.8%), prostate cancer (17.2%), gastrointestinal cancer (11.9%) and haematological cancer (11.9%)). Validity of the self-performed FTSTS test at home was acceptable in comparison with the reference test (ICC = .74; SEM = 3.2; MID = 3.6) as was the reliability of the self-performed FTSTS test (ICC = .70; SEM = 2.2; MID = 3.8).

Conclusions: The self-performed FTSTS test is a valid and reliable measure to assess lower body function and has potential to be used as objective (pre-)screening tool for frailty in cancer survivors.

Relevance to clinical practice: The self-performed FTSTS test at home may indicate the cancer survivors in need of prehabilitation in advance of surgery or

intensive treatment. The feasibility, short amount of time needed and potential cost-effectiveness of the self-performed FTSTS test can make it a valuable contribution to personalised care and precision medicine.

KEYWORDS
(pre-)screening tool, cancer survivors, Five Times Sit-To-Stand Test, frailty, reliability, validity

1 | INTRODUCTION

Frailty is increasingly recognised as an important health concern, increasing the risk of mortality, hospitalisation, physical limitations, falls and fractures (Cruz-Jentoft et al., 2010; Rizzoli et al., 2013; Vermeiren et al., 2016). Although frailty is typically a geriatric syndrome, it is important to realise that frailty is also common in younger cancer survivors due to cancer and its treatment (Baijal & Periyakoil, 2014; Ethun et al., 2017). Frail cancer survivors are at risk for postoperative complications, chemotherapy intolerance, rapid progression of the disease and death (Baijal & Periyakoil, 2014; Ethun et al., 2017). Frailty is not an irreversible process, therefore screening for frailty and early intervention to improve a frail survivors' physiological reserve prior to surgery or intensive treatment is important (Baijal & Periyakoil, 2014; Gill et al., 2006; McCorkle et al., 2000).

Currently, comprehensive geriatric assessment (CGA) is performed to detect the vulnerable elderly cancer survivors, however, this is time consuming and expensive (Hamaker et al., 2012). Therefore, pre-screening strategies are often used to select survivors who need a full CGA (Hamaker et al., 2012). In younger cancer survivors, screening on frailty status is less common and it may be warranted to screen more intensively on frailty status, to identify those at high risk of frailty in order to start (prehabilitation) interventions early (Lozano-Montoya et al., 2017). To increase screening on frailty, a short and easy-to-perform test is needed. As sarcopenia and increased falls risk are both key elements of physical frailty (Cruz-Jentoft et al., 2010; Rizzoli et al., 2013), the Five Times Sit-To-Stand test (FTSTS test) might be a good objective (pre-) screening tool for frailty. The FTSTS test is a well-established and valid lower body function test (Guralnik et al., 1994; Pavasini et al., 2016), focusing on the performance of one of the most demanding activities in daily life (e.g., getting out of a chair, climbing stairs, rising from horizontal positions). The FTSTS test is able to assess balance dysfunction (Lord et al., 2002; Lusardi et al., 2003; Whitney et al., 2005), falls risk (Buatois et al., 2008; Doheny et al., 2013; Najafi et al., 2002), sarcopenia (Rier et al., 2018) and frailty status (Greene et al., 2014; Panhwar et al., 2019). In general, the FTSTS test is instructed and supervised by a physical therapist.

The performance of a FTSTS test at home, without supervision by a medical professional provides valuable opportunities for both clinical practice and research. As the test takes less than a minute to perform, the self-performed FTSTS test could be used for (pre-) screening of frailty during the treatment process and thereafter. In addition, survivors can be instructed to contact a medical professional if their FTSTS-time exceeds a certain cut-off value. Hereby, objective (pre-)screening on a larger scale can take place, while empowering cancer survivors by involving them in their care plan (Kondylakis et al., 2020; Yamanaka, 2018). Moreover, with respect to research, if the test is found to be valid while self-performed at home, the test can be used as measure to assess lower body function in large cohort studies among patients with various diagnoses.

What does this paper add to the wider global clinical community?

- The self-performed FTSTS test at home has found to be a valid and reliable measurement instrument in comparison with the usual FTSTS test under instruction and supervision of a medical professional;
- The self-performed FTSTS test at home, without the usual instruction and supervision of a medical professional, could be used as objective (pre)screening tool for frailty in cancer survivors;
- The self-performed FTSTS test at home may indicate the cancer survivors in need of prehabilitation in advance of surgery or intensive treatment, improving cancer outcomes.

The aim of this study is to determine validity of the self-performed FTSTS test in comparison with a FTSTS test supervised by a trained physical therapist among cancer survivors. In addition, this study aimed to determine the reliability of the self-performed FTSTS test comparing two self-performed FTSTS tests.

2 | METHODS

2.1 | Setting and participants

A prospective repeated measures study, with one week in between measures, was performed. Cancer survivors were recruited in the Spring of 2020 from five different physical therapy practices in the Netherlands. All participants were recruited by their treating oncological physical therapist who gave them the study information letter. Cancer survivors were eligible when they were aged 50 years or older, able to speak, understand and read the Dutch language,

diagnosed with cancer, and within 1 year after completion of cancer treatment. In addition, cancer survivors in a wheelchair or with physical or cognitive problems (assessed by the physiotherapist) hampering their ability to perform the FTSTS test were excluded. Four out of five participating physical therapists provided supervised FTSTS reference measures, participants of all five physical therapy practices provided self-performed FTSTS scores. The study protocol was approved by the Ethics Review Board of Tilburg University and was exempted from medical ethical review by the METC Brabant (the Netherlands), according to the Dutch Medical Research Involving Human Subjects Act (WMO). All participants signed written informed consent prior to the study. The funders played no role in the design, conduct or reporting of this study.

2.2 | Data collection

All participants performed the FTSTS measurements three times (see Figure 1), and in the following consecutive order:

1. Self-performed FTSTS test 1 = unguided FTSTS test executed by the cancer survivor at the physical therapy practice using written instructions (T_1);
2. Self-performed FTSTS test 2 = unguided FTSTS test executed by the cancer survivor at their home using written instructions ($T_2 = T_1 + 1$ week);
3. FTSTS reference test = FTSTS test executed receiving instruction and supervision of the physical therapist at the physical therapy practice ($T_3 = T_2 + 1$ week).

2.3 | Measures

2.3.1 | Five Times Sit-to-Stand Test (FTSTS test)

For the self-performed FTSTS tests, participants received a stopwatch and a paper instruction with the test procedures illustrated with pictures. They were asked to read the test instructions carefully and to perform the test independently. Specifically, the written information instructed them to sit on the chair (i.e., seating height between 41–45 cm, no elbow rests and wheels), to fold arms across the chest (retaining the stopwatch), and to stand up and sit down from a chair five times in a row. Participants were instructed to come to a full upright stand, to sit down against the backrest, to refrain from using hands while standing up, and to stop the stopwatch as soon as possible after finishing the test. No reference standard results were available for the participants. To determine the FTSTS reference test time, the trained physical therapist supervised the test following the procedure previously described by Guralnik et al. (1994).

2.3.2 | Test execution rated by physical therapist

The physical therapist rated the test performance during the self-performed FTSTS test 1, when the participant performed the unguided test at the physical therapy practice. The physical therapist rated five dimensions of test execution: coming to a full upright stand (yes/no), correct number of sitting and standing up (yes/no), lack of using hands for standing up (yes/no), sitting down with their back against the chair (yes/no) and correct use of the stopwatch (yes/no). The physical therapist only observed and gave no verbal information about the test execution by the participants. In addition, the test execution ratings were not discussed with the participants to avoid influencing the results of the self-performed FTSTS test 2.

2.3.3 | Questionnaire

Following the self-performed FTSTS test 2 at home, participants completed a questionnaire. The questionnaire assessed sociodemographic information including gender, age, employment, education level and clinical information including time since diagnosis, tumour localisation, tumour stage and treatment types. Comorbidities in the past 12 months were assessed using the validated Self-administered Comorbidity Questionnaire (SCQ; Sangha et al., 2003). The SCQ is a list of 14 medical conditions. Due to the age of our study population, we added 3 extra medical conditions to

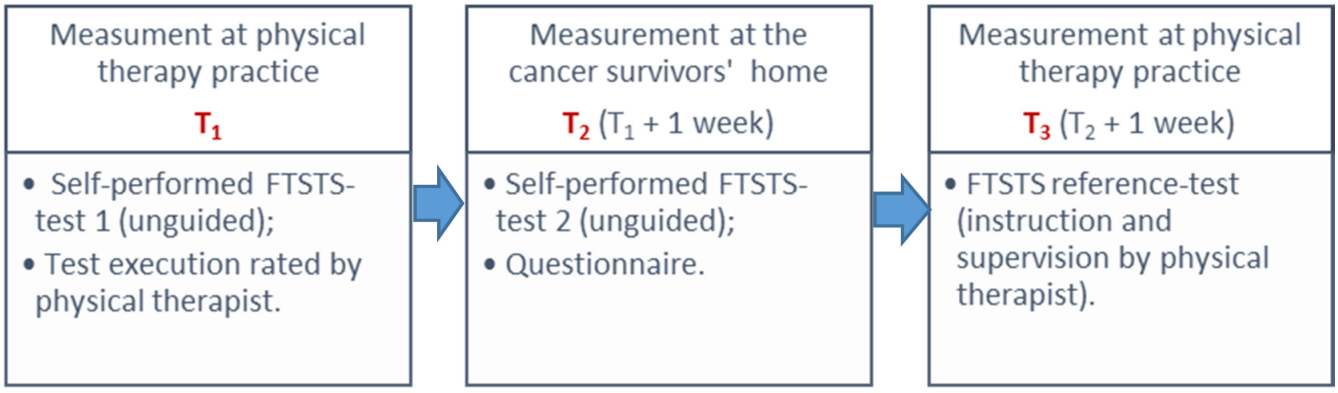

FIGURE 1 Design of the repeated measures study. *Note*. FTSTS: Five Times Sit-To-Stand test [Colour figure can be viewed at wileyonlinelibrary.com]

the list of 14 in advance of the study: dementia, multiple sclerosis, and Parkinson's disease. As in the original SCQ, participants had the option to add up to 3 medical conditions to the list of 17.

2.4 | Statistical analyses

Descriptive statistics were used to describe socio-demographic, clinical and treatment characteristics, FTSTS test times and test execution scores. Continuous variables were presented by means and standard deviations and categorical variables by frequencies and percentages. Outliers were detected and winsorised according to the rule: mean ± 3*SD (Tukey, 1977).

2.4.1 | Validity and reliability analysis

The intraclass correlation coefficient (ICC) was calculated to determine the test-retest reliability between the two self-performed FTSTS tests. Furthermore, the validity of the FTSTS test executed by the survivor at their home was evaluated by calculating the ICC between the self-performed FTSTS test 2 and the FTSTS reference test. The ICCs were calculated using the 2-way, random, absolute agreement on single measures model with a 95% confidence interval (CI). A positive rating is given to an ICC of at least 0.70 in a sample size of at least 50 participants (Terwee et al., 2007). Besides this reference, also references set by Koo and Li (2016) are considered. Specifically, an ICC less than 0.5, between 0.5 and 0.75, between 0.75 and 0.9, and greater than 0.9 indicate respectively a poor, moderate, good and excellent reliability (Koo & Li, 2016).

Besides the ICC, the standard error of measurement (Bruton et al., 2000; Keating, 1998; Ostchega et al., 2000), the Minimal Detectable Change (MDC) and the Minimally Important Difference (MID; Turner et al., 2010) were computed for the self-performed test 2. In addition, the Bland–Altman method was used for visual judgement of absolute reliability. It provided insight in agreement between FTSTS measurements of different sessions, specifically agreement between the FTSTS reference test and the self-performed FTSTS test (Rankin & Stokes, 1998). A positive rating for agreement between both methods will be given in case the upper and lower limit of the Bland–Altman plot are smaller than the MID.

The SEM provides insight in the range within the participants' true score may fall (Bruton et al., 2000; Domholdt, 2005).

$$\mathrm{SEM} = \sqrt{\sigma_e^2}$$

The 95% CIs for the SEM were calculated as described by Stratford and Goldsmith (1997). The following formula was used to calculate the MDC with 95% CI (Ries et al., 2009):

$$\mathrm{MDC}_{95} = \mathrm{SEM} \times z_{95}\,(1.96) \times \sqrt{2}$$

To determine the smallest change large enough for meaningful change, we calculated the MID by use of the following formula (Riemann & Lininger, 2018; Turner et al., 2010):

$$\mathrm{MID} = X \times \mathrm{SD}_{\mathrm{Baseline}}$$

X is set at 0.2 for a small effect, 0.5 for a moderate effect and 0.8 for a large effect (Turner et al., 2010).

Next, we examined whether socio-demographic characteristics (gender, age, education, employment) or test characteristics (i.e., coming to a full upright stand, sitting down with their back against the chair, lack of using hands for standing up, correct number of sitting and standing up, correct use of the stopwatch) differed between individuals with larger (than 1 SEM) or smaller (within ±1 SEM) time differences between the self-performed FTSTS test 2 and the FTSTS reference test. We used binary logistic regression to compare both groups. Effect sizes to label the magnitude of the possible difference will be labelled to small, moderate or large (>2.5; 2.5–3.5; >3.5, respectively) in line with cut-off values previously described for risk estimates (Ferguson, 2016). In addition, we performed multivariate logistic regression to adjust for age as a possible confounder.

The Guidelines for Reporting Reliability and Agreement Studies (GRASS) were used as supporting file during this study (Supplementary File S1).

3 | RESULTS

3.1 | Socio-demographic and clinical characteristics

One hundred fifty-one participants were enrolled in the study. Participants were most often female (54.6%), often had two or more comorbidities (54.3%), were of medium education level (65.3%) and were most often unemployed (60%) (see Table 1). Mean age of the participants was 65.6 years (SD = 9.3). Participants were included with varying tumour types, most common was breast cancer (31.8%), prostate cancer (17.2%), gastrointestinal cancer (11.9%) and haematological cancer (11.9%). Most survivors had undergone surgery (70.9%) and had received chemotherapy (59.6%) and/or radiotherapy (51.0%). The median of the time since diagnosis was 2 years (25th–75th percentile: 1–2 years).

3.2 | Results Self-performed Five Times Sit-to-Stand Test

The median of the FTSTS reference test time was 13.12 s (25th–75th percentile: 11.2–15.7 s). The median of the time needed to complete the first and second self-performed FTSTS test were, respectively, 15.22 s (25th–75th percentile: 13.4–18.0 s) and 14.06 s (25th–75th percentile: 11.9–16.5 s) (Table 2). The validity of the self-performed FTSTS test 2 in comparison with the FTSTS reference test was acceptable (ICC = 0.74). In addition, the test-retest reliability

TABLE 1 Socio-demographic and clinical characteristics

	Total population ($N = 151$) Number (percentage), mean ± SD or median [IQR]
Gender	
Male	68 (44.7%)
Female	83 (54.6%)
Age	65.6 ± 9.3
Education[a]	
Low	14 (9.3%)
Medium	98 (65.3%)
High	38 (25.3%)
Employment	
Yes	57 (38.5%)
No	91 (61.5%)
Time since diagnosis	2 [1–2]
Comorbidities	
0	36 (25.7%)
1	28 (20.0%)
≥2	76 (54.3%)
Tumour localisation	
Gastrointestinal cancer	18 (11.9%)
Lung cancer	15 (9.9%)
Gynaecological cancer	6 (4.0%)
Haematological cancer	18 (11.9%)
Breast cancer	48 (31.8%)
Prostate cancer	26 (17.2%)
Other	19 (12.6%)
Tumour stage	
Stage I	15 (10.3%)
Stage II	16 (11.0%)
Stage III	18 (12.3%)
Stage IV	15 (10.3%)
Unknown	82 (56.2%)
Surgery	
Yes	107 (70.9%)
No	44 (29.1%)
Chemotherapy	
Yes	90 (59.6%)
No	61 (40.4%)
Radiotherapy	
Yes	77 (51.0%)
No	74 (49.0%)
Hormonal therapy	
Yes	43 (28.5%)
No	108 (71.5%)

Note: Variables may deviate from 100% due to rounding off.

Abbreviations: IQR, interquartile range; SD, standard deviation.

[a]Education: Low (no or primary school); medium (lower general secondary education or vocational training); high (pre-university education, high vocational training, university).

comparing the self-performed FTSTS test 1 and self-performed FTSTS test 2 was also acceptable (ICC = 0.70). The SEM indicated a 68% probability that repeated measures of the FTSTS will be ±3.2 s (=1 SEM) of the original score, which is a fair score for expected error either from the true score or test-retest fluctuations. The MDC_{95} is 9.0 s. However, a smaller time difference in repeated measures may already indicate a clinically meaningful change. Specifically, the distribution-based MID indicates that a small clinical effect may be visible with a change of 0.9 s, a moderate effect with a change of 2.3 s and a large effect with a change of 3.6 s.

The Bland–Altman method indicated that the average difference between the FTSTS reference test and self-performed FTSTS test 2 is close to zero, specifically −0.668. This indicates a small mean difference between both methods. In addition, the visual judgement showed no consistent bias of one measurement vs. the other (see Figure 2). Agreement between both methods is acceptable, 80% of difference values lies within the distribution-based MID's. Preferably, all difference values would have been within the MIDs.

Binary logistic regression revealed that participants with a smaller difference between the self-performed FTSTS test 2 and the FTSTS reference test were significantly more often employed ($p = .019$; 45.7% vs. 17.4%) compared to participants with larger differences (see Table 3). Participants with a more accurate self-performed FTSTS test score showed significantly better test execution for sitting down with their back against the back rest ($p = .033$; 79.8% vs. 58.3%), and correct use of the stopwatch ($p = .033$; 91.5% vs. 75.0%) compared to participants with more time difference (see Table3). No significant differences between both groups were found for coming to a full upright stand ($p = .13$), the correct number of sitting and standing up ($p = .35$) and lack of using hands for standing up ($p = 1.0$; see Table 3). Multivariate logistic regression indicated that age may explain part of the difference found between both groups with respect to employment, sitting against the back rest and correct use of the stopwatch (see Table 3).

4 | DISCUSSION AND CONCLUSION

This study examined whether a FTSTS test performed by cancer survivors at their home, without supervision of a medical professional, can be a valid and reliable substitute for a supervised test. We found an acceptable agreement between the self-performed FTSTS test and the FTSTS reference test, and a measurement error of 3.2 s. In addition, the test-retest reliability of the self-performed FTSTS test was acceptable, ICC = 0.70. The distribution-based MID indicated that a change of 3.6 s may result in a large clinically important effect, which could be used as cut-off value during ongoing (pre-)screening for frailty during and after the treatment process. As this MID exceeds the measurement error, no unnecessary overburdening of medical professionals and cancer survivors is expected.

To the best of our knowledge, no similar studies have been conducted so far investigating the strength of the relationship of the FTSTS test between a trained medical professional and a patient, or between two self-performed FTSTS tests by a patient. Previous

TABLE 2 Validity and reliability of the Self-performed Five Times Sit-To-Stand test

Test 1	Median (25th–75th percentile [IQR]) Min–Max	Test 2	Median [IQR] Min–Max	*N*	ICC[a]	CI_{95} ICC[b]	SEM[c]	CI_{95} SEM[d]	MDC_{95}[e]
FTSTS reference-test[f]	13.12 (11.2–15.7 [4.5]) 7.2–27.5	Self-performed FTSTS test 2[g]	14.06 (11.9–16.5 [4.6]) 7.3–29.4	119[h]	0.74	0.64–0.81	3.2	2.3–5.7	9.0
Self-performed FTSTS test 1[i]	15.22 (13.4–18.0 [4.6]) 7.2–26.5	Self-performed FTSTS test 2	14.06 (11.9–16.5 [4.6]) 7.3–29.4	151	0.70	0.54–0.80	2.2	1.6–3.6	6.2

Note: [a]ICC: Intraclass correlation coefficient.

[b]CI_{95} ICC: 95% confidence intervals of the intraclass correlation coefficient.

[c]SEM: structural error of measurement.

[d]CI_{95} SEM: 95% confidence intervals of the structural error of measurement.

[e]MDC_{95}: Minimal Detectable Change with 95% confidence interval.

[f]FTSTS reference test: FTSTS test executed as usual receiving instruction and supervision of the physical therapist at the physical therapy practice.

[g]Self-performed FTSTS test 2: FTSTS test executed independently by the patient at their home.

[h]One participating physical therapists practice did not provide supervised FTSTS reference measures leading to 30 missings. In another physical therapy practice, one cancer survivor had missing data on the FTSTS reference measure. Together, leading to a total of 31 missings.

[i]Self-performed FTSTS test 1: FTSTS test executed independently by the patient at the physical therapy practice.

studies have shown slightly higher interrater reliability scores for the FTSTS test, compared to the agreement between the self-performed FTST-2 and the FTSTS reference test; however, these were conducted among equivalent raters (e.g., two trained medical professionals). The reliability of the self-performed FTSTS test is comparable to that of measurements performed by trained medical professionals in other populations (ICC range, 0.64–0.96; Bohannon et al., 2007; Duncan et al., 2011; Jette et al., 1999; Lord et al., 2002; Ostchega et al., 2000; Schaubert & Bohannon, 2005). The strength of the relationship between the FTSTS reference test and self-performed test 2 found in this study is comparable to the previously mentioned level of agreement between two FTSTS tests found in other populations. The FTSTS test instructed and supervised by a medical professional has been found effective in detecting early declines in functional independence and frailty in previous studies. Even biomechanical studies show that the velocity peaks and 'modified impulse' parameters of the stand-up and sit-down phase can clearly differentiate subjects of different frailty levels (Millor et al., 2013).

Overall, the results indicate that the self-performed FTSTS test at home has potential as (pre)-screening tool for frailty in cancer survivors. Measurement error (Ostchega et al., 2000) and MID scores point towards the potential of monitoring for frailty during and after the treatment process by use of the self-performed FTSTS test. Using the self-performed FTSTS test for frailty detection and monitoring resulting in subsequent targeted treatment is in line with approaches as personalised care and precision medicine, that is, treating each patient with the most optimal treatment at the right time (Kondylakis et al., 2020). Self-management by cancer survivors will (continue to) be an important component of cancer care. It can contribute to high quality, cost-effective medical care (Gulliford et al., 2006). Moreover, cancer survivors can feel more engaged/empowered due to this commitment towards their own care (Kondylakis et al., 2020; Yamanaka, 2018). In addition, the FTSTS test may transcend using a questionnaire for (pre-)screening for frailty as it is a less biased, valid measure of physical performance status (less susceptible for social desirable answers), and it may be less time consuming for medical professionals and cancer survivors. Even though the FTSTS test is expected to be less susceptible for social desirable answers, it remains important to explain to the patient that early detection of frailty may enable interventions to prevent further deterioration and improve cancer outcomes. Otherwise, fear of less intensive treatment schedules might influence the patient-reported FTSTS test scores.

Being unemployed may increase the time difference between a self-performed FTSTS test at home and a FTSTS reference test. However, age may play a role in this association. In some cases deficits in attention, memory and executive functions may be related to unemployment, which may also relate to self-performance on the FTSTS test. Moreover, participants with more time difference between the self-performed FTSTS test at home and a FTSTS reference test showed less optimal test execution with respect to sitting down with their back against the chair and correct use of the stopwatch, compared to the participants with less than 1 SEM time difference between both tests. To optimise test accuracy, it may be valuable to add a video instruction to the paper instruction. Furthermore,

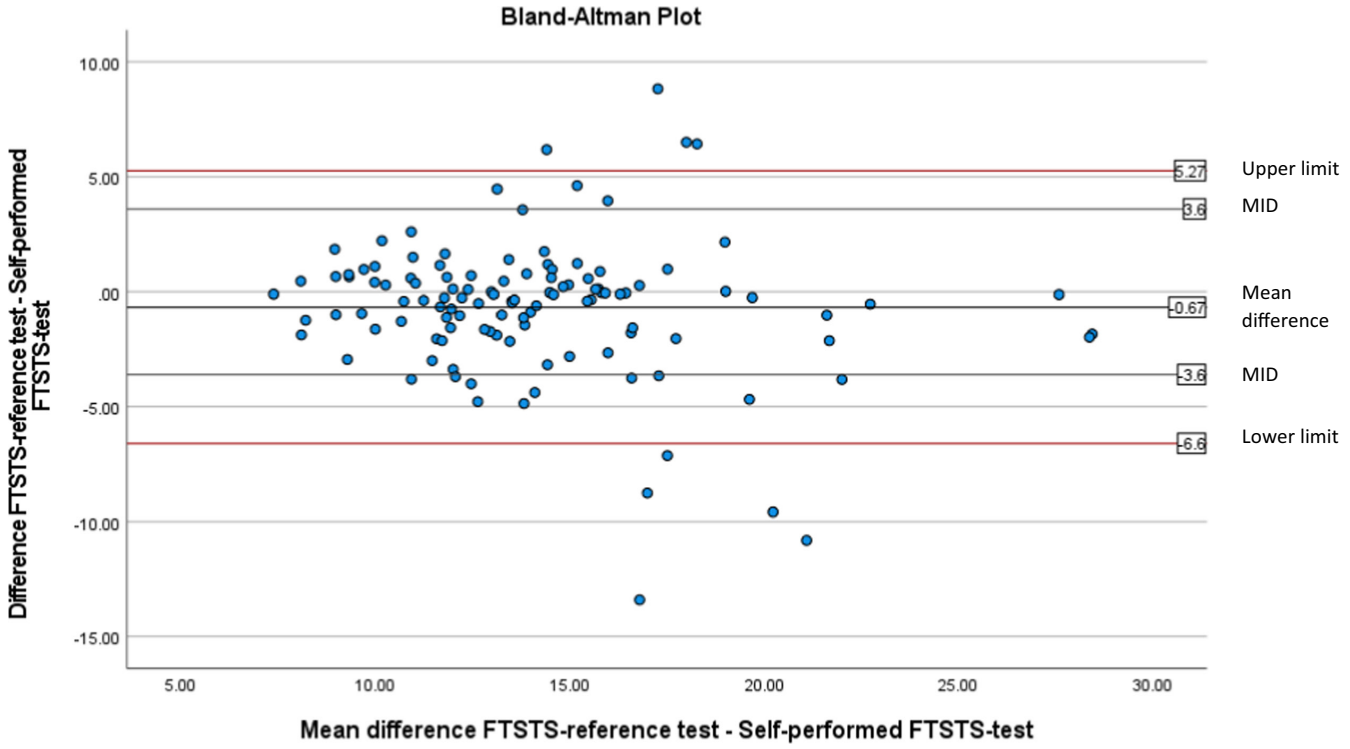

FIGURE 2 Bland–Altman plot visualising the absolute reliability between the FTSTS reference test and self-performed FTSTS test. MID, Minimal important difference [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 3 Characteristics and test execution of participants with an accurate measurement (difference score within ± one SEM) and those with a difference score larger than one SEM (comparing the self-performed FTSTS test 2 and FTSTS reference scores)

			Bivariate model (unadjusted)			Multivariate model (adjusted for age)		
	Accurate measurement[a]	Self-performed FTSTS test within ±1 SEM of FTSTS reference test	Effect size OR (95% CI) [b]	Effect size interpretation[c]	*p*-Value	Effect size OR (95% CI) [b]	Effect size interpretation[c]	*p*-Value
Number	94 (79.6%)	24 (20.3%)						
Age			0.96 (0.91; 1.01)	Small	.084			
Mean age (years +SD)	64.8 ± 9.4	68.5 ± 8.2						
Education[d]			1.53 (0.90; 2.58)	Small	.12	1.42 (0.83; 2.43)	Small	.20
Low	9 (9.7%)	3 (12.5%)						
Medium	57 (61.3%)	18 (75.0%)						
High	27 (29.0%)	3 (12.5%)						
Employment			3.99 (1.26; 12.65)	Large	.019	3.60 (0.95; 13.66)	Large	.059
Yes	42 (45.7%)	4 (17.4%)						
No	50 (54.3%)	19 (82.6%)						
Test execution								
Standing[e]			2.35 (.83; 6.71)	Small	.11	2.13 (0.73; 6.20)	Small	.17
Yes	80 (85.1%)	17 (70.8%)						
No	14 (14.9%)	7 (29.2%)						
Back[f]			2.82 (1.09; 7.33)	Moderate	.033	2.32 (0.83; 6.44)	Small	.11
Yes	75 (79.8%)	14 (58.3%)						
No	19 (20.2%)	10 (41.7%)						
Hands[g]			1.57 (0.18; 13.68)	Small	.68	1.90 (0.21; 17.25)	Small	.57
Yes	6 (6.4%)	1 (4.2%)						
No	88 (93.6%)	23 (95.8%)						
Number[h]			1.62 (0.29; 8.90)	Small	.58	1.49 (0.26; 8.52)	Small	.65
Yes	90 (95.7%)	22 (91.7%)						
No	4 (4.3%)	2 (8.3%)						
Stopwatch[i]			3.58 (1.11; 11.59)	Moderate- Large	.033	2.85 (0.83; 9.72)	Moderate	.095

(Continues)

TABLE 3 (Continued)

	Accurate measurement[a]	Self-performed FTSTS test within ±1 SEM of FTSTS reference test	Bivariate model (unadjusted)			Multivariate model (adjusted for age)		
			Effect size OR (95% CI)[b]	Effect size interpretation[c]	p-Value	Effect size OR (95% CI)[b]	Effect size interpretation[c]	p-Value
Yes	86 (91.5%)	18 (75.0%)						
No	8 (8.5%)	6 (25.0%)						

Note: Variables may deviate from 100% due to rounding off.

SD, standard deviation; SEM, structural error of measurement.

[a]Accurate measurement: score on self-performed FTSTS test 2 within ±1 SEM of FTSTS reference score.

[b]Effect size: OR = unadjusted odds ratio; OR = adjusted odds ratio, adjusted for age.

[c]Effect size interpretation according to references by Ferguson (2016).

[d]Education: Low (no or primary school); medium (lower general secondary education or vocational training); high (pre-university education, high vocational training, university).

[e]Standing: coming to a full upright stand (yes/no).

[f]Back: Sitting down with their back against the chair (yes/no).

[g]Hands: Lack of using hands for standing up (yes/no).

[h]Number: Correct number of sitting and standing up (yes/no).

[i]Stopwatch: Correct use of the stopwatch (yes/no).

blended test instructions, combining a face-to-face instruction with following self-performed FTSTS home tests by the survivors, might also be promising (Wentzel et al., 2016).

4.1 | Study limitations and strengths

The present study has a few limitations. Due to the single self-performed 5TSTS test at home, it is not possible to draw conclusions with respect to responsiveness to change of the self-performed FTSTS test at home. Additionally, due to the relatively large $MDC_{95,}$ it is recommended to be cautious with interpretation of follow-up measurements until further results of the responsiveness to change of the self-performed FTSTS test at home become available. However, the difference between both self-performed tests was small, and responsiveness to change may be stronger influenced by test execution than by test setting (i.e., home vs. at the physical therapy practice). In addition, distribution-based MIDs were calculated; however, it would be valuable to establish anchor-based MIDs in a future study to incorporate the patient's experience in meaningful clinical change (Turner et al., 2010). Moreover, while using the self-performed FTSTS as (pre-)screening tool for frailty, patients may report whether they experience small, moderate or large change with respect to their frailty status. These experiences may be evaluated as anchors for relevant MIDs in clinical practice, instead of the determined distribution-based MIDs. Furthermore, comparable to other tests, the self-performed FTSTS test may be at risk for ceiling-effect impairing the ability to detect changes over time, which might be useful to consider in certain test populations. Finally, participants were invited within one year since their final treatment. Therefore, generalisability of the results to participants under treatment may need further investigation.

Our study also had a number of strengths, including a clinical sample of 94 cancer survivors all performing the FTSTS test following their final treatment (i.e., more homogenous group), however, varying in tumour type, gender, working status and age. In addition, strengths of the study were inclusion of four oncological physical therapist practices providing reference measures, included rating of test execution, and the first direct comparison of the FTSTS performance between inequivalent raters (i.e., cancer survivors and trained medical professional), and between two tests performed unguided by patients.

5 | RELEVANCE TO CLINICAL PRACTICE

In conclusion, the results of this study indicate the potential of the self-performed FTSTS test at home as a valid and reliable objective (pre-)screening tool for frailty of cancer survivors. The feasibility, short amount of time needed and potential cost-effectiveness of the self-performed FTSTS test can make it a valuable contribution to personalised care and precision medicine. In research, the test can

be used as measure for assessment of lower body function in large cohort studies among patients with various diagnoses.

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CONFLICT OF INTEREST

None declared.

AUTHORS' CONTRIBUTIONS

Material preparation and data collection, and performance of analyses: S.J.M. van Cappellen-van Maldegem and S. Beijer; First draft of the manuscript: S.J.M van Cappellen-van Maldegem; Study conception and design, previous versions of the manuscript, and read and approved the final manuscript: All authors.

ETHICS APPROVAL

The study protocol was approved by the Ethics Review Board of Tilburg University and was exempted from medical ethical review by the METC Brabant (the Netherlands), according to the Dutch Medical Research Involving Human Subjects Act (WMO).

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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