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Potencial da PASS e do TCT como Preditores da Marcha 3 meses após o AVC – Estudo Observacional Longitudinal Prospetivo

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Mestrado em Fisioterapia – Especialização em Fisioterapia Neurológica

(esta versão inclui as críticas e sugestões feitas pelo júri)

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Predictors of Gait in Post-Stroke Patients: The potential of PASS and TCT as Predictors of Walking After Stroke – A Prospective Longitudinal Observational Study

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Abstract

Background and Purpose: Early prognosis and goal setting are important for stroke management. Independent gait is a key rehabilitation goal. This study evaluates whether the Postural Assessment Stroke Scale (PASS) and Trunk Control Test (TCT), measured 5 days post-stroke, can predict independent walking (Functional Ambulation Categories (FAC) at 3 months. It also aims to establish optimal cut-off values for predicting independent gait in a hospital stroke care context.

Methods: This prospective longitudinal observational study included 42 post-stroke patients who completed a 3-month follow-up. Demographic and clinical data, along with postural control scores (PASS and TCT) were collected at 5 days post-stroke. Patients were classified as independent walkers (FAC ≥ 4) or dependent walkers (FAC < 4). Univariate and multivariate logistic regression analyses were performed to identify significant predictors. Receiver Operating Characteristics (ROC) curve analysis determined predictive accuracy and optimal cut-off scores.

Results: Of the 42 patients, 64,3% (n=27) achieved independent gait at 3 months. The PASS on day five was the only significant predictor of independent walking (odds ratio = 0.903, 95% CI: 0.832–0.982). The area under the ROC (AUC) for PASS was 0.746 (95% CI: 0.587–0.904). The optimal PASS cut-off score for predicting independent gait was 13,50, with 81,5% sensitivity and 33,3% specificity.

Conclusions: The PASS score on day 5 post-stroke is a significant predictor of independent walking at 3 months. A PASS score ≥ 13.5 indicates a high likelihood of achieving independent gait. Each additional PASS point increases the odds of independent walking 9.7%, providing valuable insights for clinical decision-making and discharge planning.

Keywords: Walking, Postural Control, Predictors, Stroke

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List of Abbreviations

AUC – Area Under the Curve

BBS – Berg Balance Scale

PASS – Postural Assessment Scale for Stroke

FAC – Functional Ambulation Categories

LACI – Lacunar Infarct

mRS – Modified Rankin Scale

NIHSS – National Institutes of Health Stroke Scale

PACI – Partial Anterior Circulation Infarct

POCS – Posterior Circulation Infarct

ROC – Receiver operating characteristic

SPSS – Statistical Package for the Social Sciences

TACI – Total Anterior Circulation Infarct

TCT – Trunk Control Test

TIS – Trunk Impairment Scale

Chapter 1. Introduction

The present study was developed as part of a master's degree in neurological physiotherapy. The primary objective was to investigate the predictive power of two postural control assessment scales, the Postural Assessment Scale for Stroke Patients (PASS) and the Trunk Control Test (TCT), in determining the likelihood of independent walking in patients three months post-stroke. By exploring these predictive factors, the study aims to contribute to the early identification of expected walking levels, enabling more informed decision-making at the acute stage.

Stroke, defined as the sudden rupture or blockage of a cerebral blood vessel leading to damage in central nervous system cells and tissues due to the interruption of oxygen supply, remains a major health challenge affecting 17 million people worldwide each year (1). Despite significant advancements in primary prevention and acute care, including thrombolysis and thrombectomy, stroke remains a leading cause of long-term disability, increasing the need for targeted rehabilitation strategies. In the European Union, is the second most common cause of death, with an estimated cost of €45 million, encompassing both direct and indirect costs related to care provision and productivity loss from adult disability. It affects approximately 1,1 million people in Europe annually, causing 440,000 deaths, with an overall prevalence of 3,7 million individuals (2,3). In 2022, Portugal reported 31,971 stroke admissions to hospital, with an in-hospital mortality rate of 15,9% (4).

The number of people living with stroke is projected to increase by 27% between 2017 and 2047 in the European Union. This rise is attributed to improved acute stroke care leading to higher survival rates, a globally growing population, and an increasing proportion of individuals aged 70 and older, who are at higher risk for stroke (3,5). Ischemic stroke is the most common subtype, accounting for 55 to 90% of cases, while intracerebral hemorrhage represents 10 to 25%, and subarachnoid hemorrhage accounts for 0,5 to 5% (6). Statistically, women are slightly more affected than men (3). Stroke survivors often face long-term consequences, including impairments related to cognition, memory, movement, sensation (e.g., vision or hearing), speech, swallowing, and emotional functioning (e.g., personality changes, depression) requiring ongoing support from various therapies such as physiotherapy, speech therapy, occupational therapy and psychology (7).

One of the most prevalence issues following a stroke is balance and mobility limitations, which negatively impact daily activities (8,9). Achieving safe and independent

walking is a top rehabilitation goal for stroke patients and is a crucial indicator of independence in daily living, social participation, overall autonomy and quality of life (5,10,11). At the acute stage, one of two stroke survivors are unable to walk. Though 80% recover independent gait capacity at the chronic stage, many experience some level of impairment and only 30%-50% are able of community ambulation (2,10,12). Statically, stroke survivors with poor walking ability are more likely to be discharged to residential care (9).

Prognosis involves predicting or estimating the probability or risk of future health conditions based on an individual's clinical and non-clinical profile. In healthcare, prognosis is crucial for providing clinicians, patients, and caregivers with insights into future expectations (7,13-14). Cost-effectiveness and timely management of resources are critical in stroke care, making it essential to optimize resource allocation while maintaining high-quality patient care. Consequently, there is growing interest in using demographic, clinical, and neurological variables to predict functional outcomes, with more than half of the models reviewed being published since 2017 (15).

During admission to a stroke unit or inpatient rehabilitation, clinicians often have limited time for measuring the impairment of functional mobility repeatedly after stroke. Therefore, prognosis and discharge planning are typically based on clinical impressions, incorporating clinical and demographic factors. This can lead to high variability in decision-making and potentially inequitable access to rehabilitation (9,15).

Accurate early prediction of independent walking ability post-stroke is crucial for tailoring multidisciplinary treatment programs with concrete goals and informed discharge planning. It also helps patients and their caregivers anticipate future needs, such as home modifications and community support (2,9-10,14,16). A recent survey revealed that only 9% of physiotherapists and occupational therapists use prognostic tools in clinical practice, despite 89% recognizing their importance for predicting recovery potential after stroke (14).

The literature identifies several factors present within the firsts two weeks post-stroke that predict better walking outcomes, including younger age (9,17-18), stroke severity (19), stroke type (12), intact corticospinal tract (9), preserved cognitive skills (20-21), absence of depressive symptoms (11), less lower limb motor impairment (22), higher initial walking speed and distance (16,23-24), less sensory loss, and absence of hemianopia. Among these, postural control is the most frequently studied predictor of ambulation in stroke patients (23).

Postural control is the process of maintaining balance by keeping the center of gravity within the base of support and it is a prerequisite for maintaining sitting or standing position and mobility. This process requires multisensory information (somatosensory, visual and vestibular) and involves various brain areas to achieve adaptable postural control (8,25). The trunk plays a crucial role in postural control, facilitating selective and coordinated limb movements by stabilizing the pelvis and the spine allowing free movement of the head and the limbs (26). In contrast to the extremities, the trunk is bilaterally impaired after a stroke. Therefore, the paretic and non-paretic side of the trunk are characterized by reduced activity levels, limited trunk strength, delayed onset times, and diminished synchronization of the trunk musculature (27). These postural deficits particularly affect sitting balance, transfers and often results in biomechanical changes during walking (28). For this reason, sitting balance has been proposed as a predictor of walking outcome for at least 30 years (29). Through the years many researchers have studied the predictive capacity of the postural control measured < 1 month poststroke to accurately predict independent walking ability at 2-6 months poststroke (19,26,28,30–36). Trunk performance can be evaluated through several methods, such as clinical scales, isokinetic muscle tests, electromyography, muscle strength measurements, and movement analyses. Researchers often prefer trunk control scales owing to their affordability, feasibility and quickly application (26).

In this study, we explore two different types of postural scales – The PASS and the TCT. The PASS was specifically developed for stroke patients, evaluating both static and dynamic balance in basic activities. The psychometric properties of the PASS are well-established in stroke patients within the first 3 months, demonstrating good internal consistency, high interrater and interrater reliability, and fair predictive validity for functional performance. Furthermore, the PASS has no significant floor or ceiling effects during the early stages of recovery (28,30,37-39)**.** Furthermore, showed to be effective and sensitive to detect changes in highly affected patients and in patients with a high function (40,41). Moreover, previous studies suggest that PASS may have better prognostic value then other postural control scales like Trunk Impairment Scale (TIS) or Berg Balance Scale (BBS) (30).

The TCT is the first specific clinical tool reported in the literature that evaluates motor performance of the trunk (42). It is a short, simple test that assesses rolling performances on the bed, sitting transfer, and sitting balance. Through the years, TCT

reliability, validity and interobserver predictive validity have been proven in stroke patients as well as the predictive value for ambulation (18,19,26,33–37). However, some studies have also pointed out that a high percentage of stroke patients achieve the maximum score, showing a ceiling effect and limiting its sensitivity mostly in the acute stage (30,37).

Walking capacity was assessed using the Functional Ambulation Categories (FAC), developed in 1984 by Holden et al. (44). It is a quick visual measurement, simple to use, easy to interpret and cost-effective, that classifies the level of physical support needed for safe ambulation after a stroke. Mehrholz et al., (45) concluded that, in stroke patients, the FAC has excellent reliability, good concurrent and predictive validity, and is responsive to changes over time. They suggested that the FAC is an appropriate tool for assessing walking ability in both clinical and research settings**.** While other outcomes like walking speed or distance are often studied, the ability to walk indoors without another person present (FAC ≥4) is more likely to influence discharge timing and the level of support needed post-hospitalization (2,17).

Based on the patients admitted to the stroke unit in a single center, the aim of the present study was to investigate the predictive value between the TCT and PASS in patients assessed at 5 days after and the level of walking ability 3 months post stroke. The second aim was to explore the cut-off scores to discriminate between dependent and independent walkers upon acute phase.

Chapter 2. Methods

This is a prospective, longitudinal and observational study. Data collection was conducted in stroke patients admitted to the stroke unit of a single hyperacute and acute-care hospital (Hospital Amato Lusitano, ULS Castelo Branco) in Portugal between November 2021 and September 2023. Patients hospitalized on the stroke unit were eligible for inclusion in this study if they met the following criteria: age ≥ 18 years old, ischemic or hemorrhagic stroke confirmed by magnetic resonance imaging or computerized tomography, a score within 2-26 points on National Institutes of Health Stroke Scale (NIHSS), presence of motor paralysis and/or sensorial deficits and inability to walk independently (FAC < 4). Treatment with recombinant tissue plasminogen activator or thrombectomy approach was permitted. Exclusion criteria were as follows: requirement for supervision or assistance to walk prior to admission (FAC < 4), a clinical state of pre-morbid modified Rankin Scale (mRS) score ≥ 3, clinical situations unrelated to the stroke that could interfere with their clinical stability and capability for recovery (skeletal muscle pathologies, unstable cardiovascular or other neurological situation), presence of severe deficits of communication, memory or understanding identified by the speech therapy team.

Demographic and stroke characteristics were recorded on day 5 of poststroke. The recorded variables included age, gender, stroke type (ischemic or hemorrhagic), affected side (left or right), subtypes of cerebral infarction based on the Oxford stroke classification (TACI, PACI, LACI or POCS) (46), stroke severity according to the National Institutes of Health Stroke Scale (NIHSS) (47) and the number of days hospitalized.

A total of 304 patients were initially evaluated, and after applying inclusion and exclusion processing, 47 patients were enrolled in the study. Five patients were lost to follow-up at 3 months due to death (n=3), lower limb amputation surgery (n=1), and inability to contact (n=1). Therefore, a total of 42 patients were available for further analysis.

During their stay at the stroke unit, the patients typically received 45-90 minutes of individualized physical and speech therapy, five days a week. All patients began a rehabilitation program either on the day of admission or shortly thereafter. After discharge, all patients continued with various rehabilitation programs in different rehabilitation centers. The type, frequency, and intensity of the interventions were not controlled in this study.

The Functional Ambulation Category (FAC) score was assessed at 3 months post-stroke by telephone call. This follow-up timing was decided in agreement with several studies that have showed that most motor recovery occurs within this period (48). For the assessment, a standardized interview schedule adapted to Portuguese language (suggested by Mehrholz et al(45) – *annex 4*) was used during phone consultations. Information about walking ability was verified with a family member and/or the participant's physiotherapist from the rehabilitation team, or staff at the residential care facility. The Portuguese version of the adapted FAC was applied.

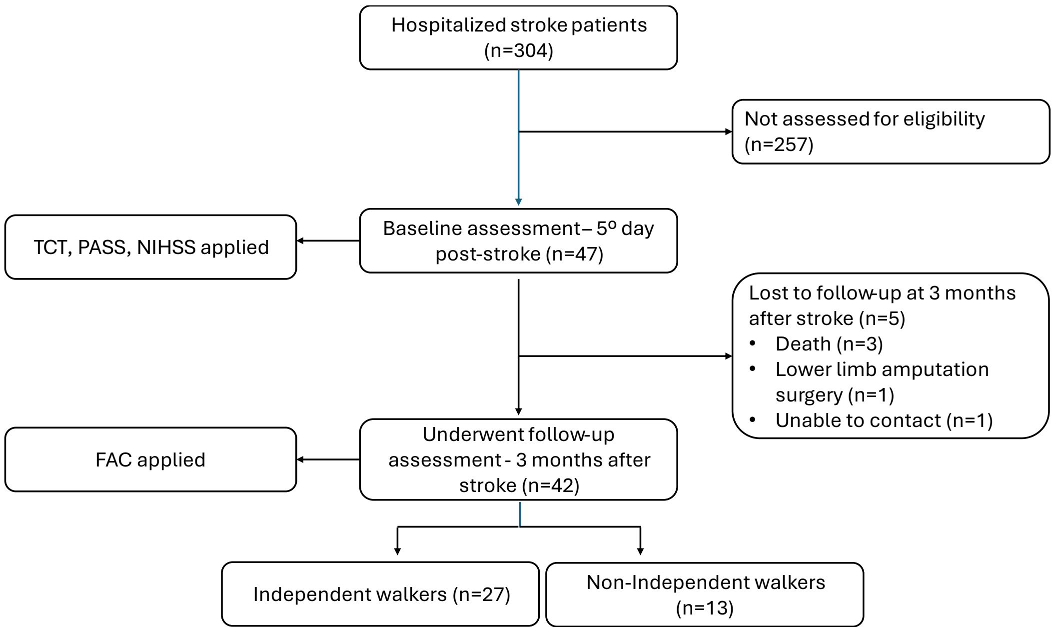

Figure 1. Flowchart of study design
TCT: Trunk Control Test; PASS: Postural Assessment Scale for Stroke; NIHSS: National Institutes of Health Stroke Scale; FAC: Functional Ambulation Categories.

The outcome measures utilized were the PASS, the TCT and the FAC. The FAC is 6-point scale that assesses walking ability, with a score of 0 indicating the patient is non-ambulatory or requires the assistance of at least two people to walk. A score of 1 and 2 indicates that the patient requires one person to assist with walking. A score of 3 means that a person can walk without hands-on assistance but requires supervision. A FAC score of 4 indicates that the patient can walk indoors on level surfaces without hands-on assistance or supervision. Finally, a score of 5 means the patient is able to walk independently on various surfaces, including stairs and slopes without assistance or supervision. Participants were permitted to use walking aids such as a cane, quad stick, or ankle support if necessary (43). *Mehrholz et al.,* (45) concluded that, in stroke patients, the FAC has excellent reliability, good concurrent and predictive validity, and is responsive to changes over time. They suggested that the FAC is an appropriate tool for

assessing walking ability in both clinical and research settings**.** For the present study, the FAC score was dichotomized into independent gait (FAC = 4,5) and dependent gait (FAC 0, 1, 2, 3).

The PASS contains 12 four-point items rated on a 4-point scale that assess a patient's ability to maintain or change various postures. Five items evaluate posture maintain (e.g., sitting without support, standing with support, standing without support, standing on non-paretic and paretic leg), and seven items assess posture changes (e.g., supine to affected side lateral, supine to non-affected side lateral, supine to sitting up on the edge of the mat, sitting on the edge of the mat to supine, sitting to standing up, standing up to sitting down, standing and picking up a pencil from the floor). Each item is scored from 0 (worst performance) to 3 (best performance), with a maximum total score of 36 (40). The psychometric properties of the PASS are well-established in stroke patients within the first 3 months, demonstrating good internal consistency, high interrater and intra-rater reliability, and fair predictive validity for functional performance. Furthermore, the PASS has no significant floor or ceiling effects during the early stages of recovery (28,30,37–39,49).

The TCT is a simple, validated 4-item scale that measures both static and dynamic trunk control by assessing four movements: rolling from a supine position to the weak side and to the strong side, sitting up from a lying-down position, and sitting in a balanced position on the edge of the bed with feet off the ground for 30 seconds. Each movement is scored as follows: 0 (unable to perform movement without assistance), 12 (able to perform movement but abnormally) and 25 (able to perform normally). The total score range from 0 to 100 (42). The TCT has demonstrated validity and reliability in stroke patients and interobserver predictive validity (26,31,34,35). However, some studies have also pointed out that a high percentage of stroke patients achieve the maximum score, showing a ceiling effect and limiting its sensitivity in certain contexts (30,37).

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) Version 29.0.2 for Windows and results were considered significant at a 5% significance level ($p < 0.05$). Detailed statistical analysis is explained at *annex 1.*

This study was conducted in accordance with the ethical principles recommended by the declaration of Helsinki, developed by the World Medical Association (2013). In this context, participants and their relatives confirmed their agreement with the proposed procedures, which were described in an informed consent format that they read and signed. This form also stated that their privacy and the confidentiality of the collected

data would be respected, and they were informed that they could withdraw from the study at any time, if they wished.

Additionally, this study was approved by the Ethics Committee of the Escola Superior de Tecnologia da Saúde de Lisboa and the Ethics Committee of the Hospital Amato Lusitano – ULS Castelo Branco.

This work resulted in the production of a scientific article, which was submitted for publication in the journal *Physiotherapy Research International* and is presented in *Annex 1* with all details.

Chapter 3. Results

A total of 42 patients (n= 27 men; n= 15 women) met the inclusion criteria, with a mean age of 69.6 (44-91) years. Among these patients, 8 (19%) had a hemorrhagic stroke, and 34 patients (81%) had an ischemic stroke. In terms of side, 24 patients (57,1%) had right-sided hemiplegia after stroke, and 18 patients (42,9%) had left-sided hemiplegia after stroke. According to the Oxford scale, 4.8% had a TACI, 50% had a PACI, 33.3% had a LACI and 11.9% had a POCS stroke type. The median length of hospital stay was 13 days (4-27 days). At day 5 post-stroke, the median baseline NIHSS score was 6 (2–13 points). The mean PASS score was 18 (4– 34 points) and a mean TCT score was 57 (12–100). By the 3-month follow-up, 27 participants (64,7%) achieved independent walking (FAC ≥ 4) while 15 (35,7%) remained dependent walkers (FAC < 4) (Table 1).

Table 1. Patients' demographic and clinical characteristics

	All Participants (n=78)
Gender [n(%)]	
Masculine	27 (64%)
Feminine	15 (35%)
Age [mean ± SD (min-max)]	44±11 (44-91)
Affected Side [n(%)]	
Right	24 (57%)
Left	18 (42%)
Type of Stroke [n(%)]	
Ischemic	34 (81%)
Hemorrhagic	8 (19%)
Oxford Classification [n(%)]	
TACI	2 (5%)
PACI	21 (50%)
LACI	14 (33%)
POCS	5 (12%)
Length of stay (days) [mean ± SD (min-max)]	12± 6 (5-27)
Fifth day after stroke [mean ± SD (min-max)]	
NIHSS	6 ± 3 (2-18)
PASS	18 ± 9 (4-34)
TCT	57 ± 27 (100-12)
3 months after Stroke [mean ± SD (min-max)]	
FAC	3,5 ± 1,6 (5-0)
Dependent Walking [n (%)]	15 (35,7%)
Independente Walking [n (%)]	27 (64,3%)

Dependent Walking: FAC < 4; Independent Walking: FAC ≥ 4
SD: Standard Deviation; TACI: Total Anterior Circulation Infarct; PACI: Partial Anterior Circulation Infarct; LACI: Lacunar Anterior Circulation Infarct; POCS: Posterior Circulation Infarct; NIHSS: National Institutes of Health Stroke Scale; TCT: Trunk Control Test; PASS: Postural Assessment Scale for Stroke; FAC: Functional Ambulation Categories

At 3 months, FAC score was significantly correlated with PASS (r_S=0,44, $p < 0,01$) and TCT (r_S=0,316, $p < 0,05$) scores measured at 5 days post-stroke. Both PASS and TCT on day 5 post-stroke showed a negative correlation with NIHSS [PASS (r_S=- 0,625, $p < 0,01$), TCT (r_S = -0.687, p < 0,01)] and a moderate negative correlation with the length of hospital stay [PASS (r_S = -0,387, $p < 0,01$], TCT [r_S = - 0,381, $p < 0,01$)]. Additionally, a strong positive correlation was observed between PASS and TCT on day 5 (r_S = 0,777, $p < 0.01$) (Table 2).

Table 2. Multivariate binary logistic regression between baseline variables and the follow-up outcome

	NIHSS at day 5	PASS at day 5	TCT at day 5	FAC follow-up at 3 months
Lenght of stay	,400**	-,387*	-,381*	-0,129
NIHSS at day 5		-,625**	-,687**	-0,203
PASS at day 5			,777**	,441**
TCT at day 5				,316*

*** The correlation is significant at the 0.01 level (2-tailed).*

** The correlation is significant at the 0.05 level (2-tailed).*

TCT: Trunk Control Test; PASS: Postural Assessment Scale for Stroke; NIHSS: National Institutes of Health Stroke Scale; FAC: Functional Ambulation Categories.

For the subsequent analysis FAC score was dichotomized as independent (FAC score ≥ 4) (n = 27) or non-independent (FAC < 4) (n = 15) based on ambulatory ability 3 months post-stroke.

PASS was identified as the strongest predictor of independent walking in the logistic regression analysis (OR= 0,903; 95% CI= 0,832–0,982) (table 3) and this was the only outcome remaining in the final model (table 4). NIHSS (p= 0,588), TCT on the fifth day (p= 0,245) and length of stay (p= 0,856) were not considered significant predictors of independent gait.

ROC curve analysis showed that the PASS score had an AUC of 0,746 (CI95%= 0,587–0,904), indicating acceptable discrimination between dependent and independent walkers (Figure 2). The optimal cut-off score for distinguishing between the two groups was 13.5 points, with a sensitivity of 81,5% and a specificity of 33,3% (Table 4).

Additionally, our findings suggest that for each 1-point increase in the PASS score, the odds of achieving independent walking increased by 9.7% (OR= 0,903, 95%CI= 0,832–0,982).

Table 3. Multivariate binary logistic regression to predict independent walking at 3 months post-stroke

Variable	B	S.E.	*p*-value	Odds ratio	95% C.I. for Odds ratio	
					Inferior	Superior
PASS at day 5	-0,102	0,042	0,016	0,903	0,832	0,982

B: Regression coefficient; S.E: Standard Error; PASS: Postural Assessment Scale for

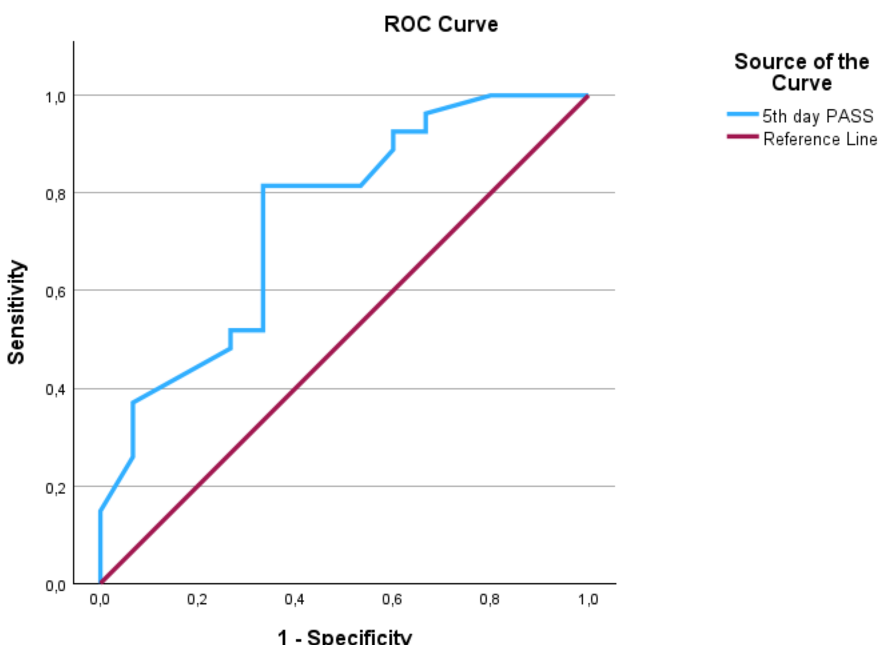

Figure 2. ROC curve analysis of the Postural Assessment Scale for Stroke at 5th day poststroke for predicting independent walking at 3 months (FAC ≥4).

Table 4. The optimal PASS cut-off value for independent walking after 3 months determined from the ROC curve

PASS Cut-off Score	Area Under the ROC Curves (95%CI)	Standard Test Statistic	p^b	Sensitivity	Specificity
13,5	0,746 (0,587-0,904)	0,081	0,002	0,815	0,333

ROC: Receiver Operating Characteristics; PASS: Postural Assessment Scale for Stroke; CI: Confidence

Chapter 4. Discussion

The present study aimed to investigate the potential of the PASS and TCT, measured at day 5, as predictors of walking at 3 months post-stroke. Contrary to the findings reported in previous literature, only PASS demonstrated significant predictive power. This discussion will reflect and compare the conclusions of the previous studies, explore possible reasons for these different results, provide an interpretation within the context of stroke rehabilitation, and examine the practical implications for clinical practice and future research.

The percentage of dependent walkers at 3 months (35,7%) aligns closely with findings from *Moore et al.,* (50) who reported that approximately one-quarter of stroke survivors do not achieve independent walking this timeline. Our statist analysis revealed that TCT and PASS scores on the fifth day post-stroke were associated with independent gait at 3 months, according to previous studies (19,26,30-31,33-34,36,41,51). Notably, we observed a negative correlation between the NIHSS score, length of stay and postural control outcomes (TCT and PASS), suggesting that higher NIHSS scores and longer hospitalization could be linked to diminished postural control. However, after conducting multivariate logistic regression analysis, PASS was identified as the sole significant predictor of independent walking.

Comparing our findings with other studies is challenging due to the limited number of prognostic studies investigating early predictions within the initial days of post-stroke. Simultaneously, no other previous study analyzes at the same time the predictive power of PASS and TCT on walking abilities. Previous research has indicated that PASS demonstrates slightly better psychometric characteristics and predictive capabilities in early assessment compared to other postural control measures, such Berg Balance Scale or the Balance Subscale of Fugl-Meyer test (49). *Di Monaco et al.,*(30) also reports that PASS scores at admission to inpatient rehabilitation might have superior prognostic value compared to the Trunk Impairment Scale. Additionally, *Aaslund et al.,* (52) found that PASS scores within the first week post-stroke were good predictors of long-term walking speed for community independence at 6 months. Moreover, *Huang et al.,*(41) investigated the predictive capacity of the PASS scale for walking ability after discharge in stroke patients upon admission to rehabilitation center (after a mean hospital stay of 18.12 days) defining a cut-off value of 12.50. In contrast, *O'Dell et al.*,(28) found only weak associations between the admission PASS scores and discharge walking speed.

Regarding TCT, there is no consensus in literature. While some studies have shown promising results using TCT as a predictor scale, others highlight its psychometric limitations and do not recommend its use in the clinical practice, as noted in the review developed by *Sullivan et al.* (50). For instance, *Esther Duarte et al.,* (35) concluded that TCT score ≤ 50 at 14-day post-stroke predicts a low likelihood of walking at 6-month follow-up. *Smith et al.* (53) reported that patients with TCT scores higher than 40 at 1 week achieved independent walking by 6 weeks, whereas those with lower scores lower did not achieve independent walking until 12 weeks post-stroke. Similarly, *Gatti et al.,*(36) suggested that subjects scoring ≥ 49 on the initial test (45 days post-stroke stroke) had a 93.75% probability of achieving independent gait at 6 months.

The lower predictive value of TCT compared to PASS in our study may be attributed to psychometrics characteristics. The TCT ceiling effect - where many stroke patients quickly reach the maximum score – limits its ability to differentiate between individuals who can walk independently and those who cannot. Additionally, although both scales use scores, the PASS provides a more nuanced gradient of difficulty in tasks, allowing for finer differentiation between levels of ability. In contrast, TCT has only four items with relatively uneven scores. When scores are treated as linear measures, the PASS likely provides a more accurate assessment of the patient's ability to walk independently.

Furthermore, independent walking after a stroke requires a combination of dynamic balance, postural stability, weight shifting, and the ability to adjust to external perturbations. The PASS includes items that directly test these abilities (e.g., shifting weight, standing without support, standing on one leg), which are essential components of gait. TCT focuses more narrowly on trunk stability, which is only one aspect of the overall balance needed for walking. This findings seems to emphasizes the connection between functional postural control and medial descending pathways, such as the reticulospinal and vestibulospinal tract, which play a crucial role in walking capacity (54–56).

The PASS demonstrated high sensitivity (81,5%) but lower specificity (33,3%) in predicting independent walking. High sensitivity indicates that PASS is effective at detecting true positives - patients who will walk independently - thus ensuring that most of those who are predicted to achieve independence do indeed do so. This is crucial in clinical settings, where it is more beneficial to identify as many potential independent walkers as possible, even at the risk of some false positives. However, the lower

specificity means that the PASS may also incorrectly classify some individuals as capable of independent walking when they are not. This could lead to an overestimation of walking potential and potentially premature discharge or inadequate rehabilitation planning for some patients.

Despite the promising results, this study has several limitations, and his results need to be applied carefully. The relatively small sample size, single follow-up timepoint, and limited range of postural control outcomes analyzed may affect the generalizability of the findings. Additionally, data collection was performed by a non-blinded physiotherapist, increasing the potential for bias. The reliance on telephone interviews for gait evaluation rather than in-person assessments also poses a limitation. Furthermore, the study does not differentiate between hemorrhagic and ischemic strokes, which could impact the results. Due to initial hematoma expansion as well as increasing cerebral edema, which usually occurs within 2 days but can persist up to 3 weeks post-stroke. Individuals with hemorrhagic stroke may present worst scores on postural scales and consequently a worst gait prognostic at fifth day, that can be inaccurate. However, interestingly, *Kennedy et al.,* (12) reported that by 3 months post-stroke, the chance of walking was similar for patients with hemorrhagic and ischemic strokes. For the other side, a positive aspect of the study is that patients were treated at various rehabilitation centers with different approaches (not controlled by the study), reflecting real-world clinical settings.

Future research should involve longer follow-up periods (e.g., 6 months and community living), and investigate additional predictors, including modifiable factors potentially affecting achievement of independent walking, such as lower extremity motor function, somatosensory and proprioception measures, fear of falling, cognitive status, depression, motivation and socioeconomic status.

It is important to emphasize that this result predicts the recovery of independent walking (without assistance), rather than other parameters such gait motor quality, speed or community walking capability. As *Moore et al.,* (10) noted, 90% of stroke survivors achieve better walking outcomes at 6 months. Thus, this study's focus on 3-month gait levels does not preclude the possibility of further walking improvements later.

Our findings suggest that PASS shows promise as a predictive tool for independent walking and this fact has practical implication for all physiotherapists working on acute/sub-acute stage. PASS is a simple, time-efficient scale that requires minimal equipment, making it useful for guiding discharge decisions, rehabilitation planning, and setting intervention goals based on anticipated gait progress. However, it

is important to notice that while PASS seems to be a reliable tool for identifying those who will likely walk independently, clinicians should interpret its results cautiously and consider supplementary assessments or clinical judgment to ensure comprehensive patient evaluation and management. The use of prediction tools in clinical practice should be globally careful, ensuring that the main goal is assisting in discharge planning, rehabilitation process, and goal setting, rather than restricting access to services or a restricted rehabilitation approach. Furthermore, the communication of prognostic information to patients and their family needs to be carefully managed. It is crucial to adapt the information provided in a way that maintains motivation and focuses on achieving further functional capabilities.

Chapter 5. Conclusion

Based on our best knowledge, the present study is the first to investigate and establish an association between PASS at an acute stage and walking capability at 3-month post-stroke.

Given its predictive value, PASS should be considered a standard tool for evaluating postural control and guiding discharge planning in acute stroke care. Clinicians and physiotherapists should use PASS scores to tailor rehabilitation strategies and set realistic goals for patients.

Our prospective longitudinal study in an acute stroke unit demonstrates that balance assessed during the PASS score can predict walking ability. Patients with PASS scores of ≥ 13.5 on the fifth day after stroke were highly likely to achieve independent gait (FAC ≥ 4) within 3 months. The sensitivity and specificity of this cutoff point were 82% and 32%, respectively. Additionally, the statistical analysis allows us to conclude that each 1-point increase in the PASS score is associated with a 9.7% increase in the odds of achieving independent walking

In conclusion, while PASS shows promise as a predictive tool for independent walking, further research with larger sample sizes, extended follow-up periods, and inclusion of additional predictors is needed to validate these findings and enhance their applicability in clinical practice.

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Annexes

Annex 1. Scientific Article Submitted - Predictors of Gait in Post-Stroke Patients: The potential of two Postural Control Measures as Predictors of Walking After Stroke – A Prospective Longitudinal Observational Study

Title: Predictors of Gait in Post-Stroke Patients: The potential of two Postural Control Measures as Predictors of Walking After Stroke – A Prospective Longitudinal Observational Study

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki

Ethics Committee Approval: The study protocol was approved by the Escola Superior de Tecnologia da Saúde de Lisboa Ethics Committee (date: 17/01/2022) and the Hospital Amato Lusitano – ULS Castelo Branco Ethics Committee (date: 22/10/2021)

Patient Consent for Publication: Informed consent was obtained from all subjects (patients and their relatives) involved in the study. This form also stated that their privacy

and the confidentiality of the collected data would be respected, and they were informed that they could withdraw from the study at any time, if they so wished.

Conflicts of Interest: The authors declare no conflict of interest with respect to the authorship and/or publication of this article.

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Research Article

Predictors of Gait in Post-Stroke Patients: The potential of Two Postural Control Measures as Predictors of Walking After Stroke – A Prospective Longitudinal Observational Study

Submission Status	Draft
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ABSTRACT

Background and Purpose: Early prognosis and appropriate goal setting are important for stroke management. Independent gait is a meaningful goal for stroke patients. Previous literature suggests that postural control in the acute stage is the most important predictor for walking capability. To investigate whether Postural Assessment Stroke Scale (PASS) and Trunk Control Test (TCT) at 5 days after stroke can predict independent walking (Functional Ambulatory categories (FAC) at 3 months. Additionally, the study aimed to establish optimal cut-off values for predicting independent gait in hospital stroke care context.

Methods: This prospective longitudinal observational study included 42 post-stroke patients who completed a 3-month follow-up. Demographic, clinical data and postural control scores (PASS and TCT) were collected at 5 days post-stroke. Patients were classified as independent walkers (FAC ≥ 4) or dependent walkers (FAC < 4). Univariate binary logistic regression identifies significant predictors, followed by multivariate logistic regression. Receiver Operating Characteristics (ROC) curve analysis assessed predictive power accuracy and determine optimal cut-off scores.

Results: Of the 42 patients, 64,3% (n=27) achieved independent gait at 3 months. The PASS at 5th day was the only significant predictor of independent walking (odds ratio = 0.903, 95% CI: 0.832–0.982). The area under the ROC (AUC) for PASS was 0.746 (95% CI: 0.587–0.904). The optimal PASS cut-off score for predicting independent gait was 13,50, with 81,5% sensitivity and 33,3% specificity.

Conclusions: The PASS score at day 5 post-stroke is a significant predictor of independent walking at 3 months. The PASS score ≥ 13.5 strongly indicates the likelihood of achieving independent gait. Each additional point on the PASS increases the odds of achieving independent walking 9.7%. These findings provide valuable insights for early clinical decision-making, rehabilitation goal setting, and discharge planning.

Keywords: Walking, Postural Control, Predictors, Stroke

INTRODUCTION

Stroke remains a major health challenge affecting 17 million people worldwide annually (1). Despite advancements in prevention and acute care, stroke continues to be a leading cause of long-term disability, increasing the demand for effective

rehabilitation strategies. In the European Union, stroke is the second most common cause of death, responsible for 440,000 deaths annually, with a prevalence of 3.7 million individuals and an estimated cost of €45 billion due to direct care and productivity loss (2,3).

The number of people living with stroke is expected to rise by 27% between 2017 and 2047 in the European Union, driven by improved acute care, an aging population, and higher survival rates among individuals aged 70 and older, who are at greater risk for stroke (3,4). Stroke survivors often face long-term consequences, including impairments related to cognition, memory, movement, speech, swallowing, and emotional functioning (e.g., personality changes, depression) necessitating ongoing support from various therapies such as physiotherapy, speech therapy, occupational therapy and psychology (5).

One of the most prevalence issues following a stroke is balance and mobility limitations, which negatively impact daily activities (6,7). Independent walking is a primary rehabilitation goal, crucial for autonomy, social participation, and quality of life (4,8,9). At the acute stage, one of two stroke survivors are unable to walk. Though 80% recover independent gait capacity at the chronic stage, many experience some level of impairment and only 30%-50% are able of community ambulation (2,8,10). Statically, those with poor walking ability are more likely to be discharged to residential care (7).

In healthcare, prognosis is crucial for providing clinicians, patients, and caregivers with insights into future expectations (5,11,12). The cost-effectiveness and timely management of resources are critical in stroke care, making it essential to optimize resource allocation while maintaining high-quality patient care. Consequently, there is growing interest in using demographic, clinical, and neurological variables to predict functional outcomes, with more than half of the models reviewed being published since 2017 (13).

Therefore, prognosis and discharge planning are typically based on clinical impressions, incorporating clinical and demographic factors. This can lead to high variability in decision-making and potentially inequitable access to rehabilitation (7,13) Accurate early prediction of independent walking ability post-stroke is crucial for tailoring multidisciplinary treatment programs with concrete goals and informed discharge planning. It also helps patients and their caregivers anticipate future needs, such as home modifications and community support. (2,7,8,12,14). A recent survey revealed that

only 9% of physiotherapists and occupational therapists use prognostic tools in clinical practice, despite 89% recognizing their importance (12).

The literature identifies several factors present within the first two weeks post-stroke that predict better walking outcomes, including younger age (7,15,16), stroke severity (17), stroke type (10), intact corticospinal tract (7), preserved cognitive skills (18,19), absence of depressive symptoms (9), less lower limb motor impairment (20), higher initial walking speed and distance (14,21,22), less sensory loss, and absence of hemianopia. Among these, postural control is the most frequently studied predictor of ambulation in stroke patients (21).

Postural control is the process of maintaining balance by keeping the center of gravity within the base of support and it is a prerequisite for maintaining sitting or standing position and mobility. This process requires multisensory information (somatosensory, visual and vestibular) and involves various brain areas to achieve adaptable postural control (6,23). The trunk plays a crucial role in postural control, facilitating selective and coordinated limb movements by stabilizing the pelvis and the spine allowing free movement of the head and the limbs (24). In contrast to the extremities, the trunk is bilaterally impaired after a stroke. Therefore, both the paretic and non-paretic side of the trunk are characterized by reduced activity levels, limited trunk strength, delayed onset times, and diminished synchronization of the trunk musculature (25). These postural deficits particularly affect sitting balance, transfers and often result in biomechanical changes during walking (26). For this reason, sitting balance has been proposed as a predictor of walking outcome at least 30 years (27). Numerous studies have studied the predictive capacity of the postural control measured < 1 month poststroke to accurately predict independent walking ability at 2-6 months poststroke (17,24,26,28–34). Trunk performance can be evaluated through several methods, such as clinical scales, isokinetic muscle tests, electromyography, muscle strength measurements, and movement analyses. Researchers often prefer trunk control scales owing to their affordability, feasibility and quickly application (24).

This study explores two different types of postural scales: the PASS and the TCT. The PASS was specifically developed for stroke patients, evaluating both static and dynamic balance in basic activities. The psychometric properties of the PASS are well-established in stroke patients, demonstrating good internal consistency, high interrater and interrater reliability, and fair predictive validity for functional performance. Furthermore, showed to be effective and sensitive to detect changes in highly affected patients and in patients with a high function (35,36). Furthermore, the PASS has no

significant floor or ceiling effects during the early stages of recovery (26,28,37–40). Moreover, previous studies suggest that PASS may have better prognostic value then other postural control scales like Trunk Impairment Scale (TIS) or Berg Balance Scale (BBS) (28).(41)

The TCT is the first specific clinical tool reported in the literature that evaluates motor performance of the trunk (42). Through the years, TCT reliability, validity and interobserver predictive validity have been proven in stroke patients as well as the predictive value for ambulation (16,17,24,27,31–34,38). However, some studies have also pointed out that a high percentage of stroke patients achieve the maximum score, showing a ceiling effect and limiting its sensitivity in certain contexts (28,38,43).

Walking capacity was assessed using the Functional Ambulation Categories (FAC), developed in 1984 by Holden et al., (45). It is a quick visual measurement, simple to use, easy to interpret and cost-effective, that classifies the level of physical support needed for safe ambulation after a stroke. Mehrholz et al., (41) concluded that, in stroke patients, the FAC has excellent reliability, good concurrent and predictive validity, and is responsive to changes over time. They suggested that is an appropriate tool for assessing walking ability in both clinical and research settings**.** While other outcomes like walking speed or distance are often studied, the ability to walk indoors without another person present (FAC ≥4) is more likely to influence discharge timing and the level of support needed post-hospitalization (2,15).

Based on the patients admitted to the stroke unit in a single center, the aim of the present study was to investigate the predictive value between the TCT and PASS in patients assessed at 5 days after and the level of walking ability 3 months post stroke. The second aim was to explore the cut-off scores to discriminate between dependent and independent walkers upon acute phase.

MATERIAL AND METHODS

DESIGN

This prospective, longitudinal and observational study was conducted in stroke patients admitted to a single acute care hospital in Portugal between November 2021 and September 2023. Ethical approval was obtained from both the hospital and university ethics committees. Written informed consent was provided by all participants and their relatives.

PARTICIPANTS

Patients were eligible for inclusion in this study if they met the following criteria: age ≥ 18 years old, had ischemic or hemorrhagic stroke confirmed by computerized tomography, scored within 2-26 points on National Institutes of Health Stroke Scale (NIHSS) and were unable to walk independently (FAC < 4).

Exclusion criteria included prior FAC < 4, a modified Rankin Scale score ≥ 3, other conditions that could interfere with their clinical stability and capability for recovery (e.g., skeletal muscle, cardiovascular or other neurological pathologies), or severe communication or memory deficits.

PROCEDURES

Demographic and stroke characteristics recorded included age, gender, stroke type (ischemic or hemorrhagic), affected side, subtypes of cerebral infarction based on the Oxford stroke classification (TACI, PACI, LACI or POCS), stroke severity according to the National Institutes of Health Stroke Scale (NIHSS) and the length of stay.

The different assessments were conducted by a trained physiotherapist researcher.

A total of 304 patients were initially evaluated, 47 met the criteria and were enrolled in the study. Five patients were lost to follow-up (3 deaths, 1 lower limb amputation, 1 unable to contact). Therefore, a total of 42 patients were available for further analysis.

All patients participated in rehabilitation starting at or soon after admission, with 45-90 minutes of individualized physical and speech therapy. After discharge, all patients continued with various rehabilitation programs in different rehabilitation centers. The type, frequency, and intensity of the interventions were not controlled in this study.

Walking ability (FAC score) was assessed at 3 months post-stroke by telephone call. This follow-up timing was decided in agreement with several studies that have showed that most motor recovery occurs within this period (46). For the assessment, a standardized interview schedule adapted to Portuguese language (suggested by Mehrholz et al – *see appendices 1*) was used during phone consultations. Information about walking ability was verified with a family member and/or the rehabilitation staff.

OUTCOME MEASURES

The FAC is 6-point scale that assessing walking ability. A score of 0 indicates non-ambulation or the need for two-person assistance. A score of 1 and 2 indicate the need for one-person assistance, while a score of 3 means that a person can walk without hands-on assistance but requires supervision. A score of 4 indicates that the patient can walk indoors on level surfaces without hands-on assistance or supervision and a score of 5 means the patient is able to walk independently on various surfaces, including stairs and slopes without assistance or supervision (44). For the present study, the FAC score was dichotomized into independent gait (FAC = 4,5) and dependent gait (FAC 0, 1, 2, 3).

The PASS consists of twelve four-point items that assess the ability to maintain or change postures. Five items evaluate posture maintain (e.g., sitting without support, standing with support, standing without support, standing on non-paretic and paretic leg), and seven assess posture changes (e.g., supine to affected side lateral, supine to non-affected side lateral, supine to sitting up on the edge of the mat, sitting on the edge of the mat to supine, sitting to standing up, standing up to sitting down, standing and picking up a pencil from the floor). Each item is scored from 0 (worst performance) to 3 (best performance), with a total possible score of 36 (35).

The TCT is a 4-item scale that measures both static and dynamic trunk control through movements such rolling to the weak or strong side, sitting up from lying down, and sitting in balance. Each movement is scored 0 (unable to perform movement without assistance), 12 (able to perform movement but abnormally), or 25 (able to perform normally), with a maximum total score of 100 (42).

DATA ANALYSIS

Baseline patient demographic and clinical characteristics were summarized using descriptive statistics of frequencies, percentages, means and standard deviations. Results were considered significant at a 5% significance level. Normal distribution of data was checked using the “Shapiro-Wilk test”. If data were normally distributed, parametric tests would have been applied, otherwise, non-parametric tests, such as the Spearman correlation, were used.

To evaluate walking ability, the sample was dichotomized into two groups based on the FAC score at 3 months follow-up: independent walkers (FAC ≥ 4) and dependent walkers (FAC < 4).

In order to analyze the association between baseline variables and the follow-up outcome, a logistic regression was performed. In the first step, all factors were tested one at a time in a univariate binary logistic regression model. All statistically significant variables were included in the multivariate binary logistic regression model, with $p < 0.05$. The number of days of hospitalization, stroke severity (NIHSS), PASS and TCT were entered as independent variables in the multivariate binary logistic regression analyses. A backward conditional method was used, where all significant variables were included in the first step as potential predictors, and variables with the highest significance were removed until all variables had a $p < 0.05$. Additionally, model fit was evaluated using the Hosmer-Lemeshow goodness-of-fit test, with $p > 0.05$.

Receiver operating characteristic (ROC) curves were used to determine the discriminatory power of the different variables for classifying the walking capability. A sensitivity analysis was conducted to verify the robustness of the logistic regression findings. Accuracy was assessed using the area under the curve (AUC), interpreted as the probability of correctly identifying participants with an independent ambulation at 3 months post-stroke. In general, an AUC less than 0,5 suggests no discrimination, 0,5 to 0,7 is considered weak, 0,7 to 0,8 is considered acceptable, 0,8 to 0,9 is considered good, and more than 0,9 is excellent. The AUC was calculated with a 95% confidence interval (CI). Predictive power was evaluated using sensitivity and specificity. Sensitivity was calculated using the formula 'true positives / (true positives + false negatives)' and specificity through equation 'true negatives / (true negatives + false positives)'. Models with sensitivity and specificity above 80% suggests good abilities, those between 50% to 80% were considered reasonable and, those below 50% were considered to have poor predictive power (47). The optimal cut-off point was determined using the highest sum of specificity and sensitivity from the ROC curve.

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) Version 29.0.2 for Windows.

RESULTS

A total of 42 patients (27 men and 15 women) met the inclusion criteria, with a mean age of 69.6 (44-91) years. Among these patients, 8 (19%) had a hemorrhagic stroke, and 34 patients (81%) had an ischemic stroke. In terms of side, 24 patients (57,1%) had right-sided hemiplegia after stroke, and 18 patients (42.9%) had left-sided hemiplegia after stroke. According to the Oxford scale, 4.8% had a TACI, 50% had a PACI, 33.3% had a LACI and 11.9% had a POCS stroke type. The median length of

hospital stay was 13 days (4 minimum - 27 maximum). At day 5 post-stroke, the median baseline NIHSS score was 6 (2 minimum – 13 maximum). The mean PASS score was 18 (4 minimum – 34 maximum) and a mean TCT score was 57 (12 minimum – 100 maximum). By the 3-month follow-up, 27 participants (64.7%) achieved independent walking (FAC ≥ 4) while 15 (35.7%) remained dependent walkers (FAC < 4) (Table 1).

At 3 months, FAC score was significantly correlated with PASS (r_S = 0.44, p = 0.003) and TCT (r_S = 0.316, p = 0.042) scores measured at 5 days post-stroke. Both PASS and TCT at day 5 post-stroke showed a negative correlation with NIHSS (PASS (r_S = - 0.625, p < 0.00), TCT (r_S = -0.687, p < 0.00)) and a moderate negative correlation with the length of hospital stay (PASS (r_S = -0.387, p = 0.11), TCT (r_S = - 0.381, p = 0.013)). Additionally, a strong positive correlation was observed between PASS and TCT at day 5 (r_S = 0.777, p = 0.013) (Table 2)

For the subsequent analysis FAC score was dichotomized as independent (FAC score ≥ 4) (n = 27) or non-independent (FAC < 4) (n = 15) based on ambulatory ability 3 months post-stroke.

PASS was identified as the strongest predictor of independent walking in the logistic regression analysis (OR = 0.903; 95% CI = 0.832–0.982 (table 3) and this was the only outcome remaining in the final model (table III). In the final model, only the PASS score remained a significant predictor. NIHSS (p = 0.156), TCT at fifth day (p = 0.094) and length of stay (p = 0.458) were not considered significant predictors of independent gait.

ROC curve analysis showed that the PASS score had an AUC of 0.746 (CI95% = 0.587–0.904), indicating acceptable discrimination between dependent and independent walkers (Figure 2). The optimal cut off score for distinguishing between the two groups was 13.5 points, with a sensitivity of 81.5% and a specificity of 33.3% (Table Additionally, our findings suggest that for each 1-point increase in the PASS score, the odds of achieving independent walking increased by 9.7% (OR = 0.903, 95% CI = 0.832–0.982).

DISCUSSION

The present explored the potential of the PASS and TCT scales measured at day 5 post-stroke as predictors of walking ability at 3 months. The percentage of dependent walkers at 3 months (35,7%) aligns closely with findings from *Moore et al.,* (43) who reported that approximately one-quarter of stroke survivors do not achieve independent

walking at this timeline. Our statist analysis revealed that TCT and PASS scores on the fifth day post-stroke were associated with independent gait at 3 months, according to previous studies (17,24,28,29,31,32,34,36,48). Notably, we observed a negative correlation between the NIHSS score, length of stay and postural control outcomes (TCT and PASS), suggesting that higher NIHSS scores and longer hospitalization could be linked to diminished postural control. However, after conducting multivariate logistic regression analysis, PASS was identified as the sole significant predictor of independent walking.

Comparing our findings with other studies is challenging due to the limited number of prognostic studies investigating early prediction within the initial days of post-stroke. Simultaneously, no other previous study analyzes at the same time the predictive power of PASS and TCT on walking abilities. Previous research has indicated that PASS demonstrates slightly better psychometric characteristics and predictive capabilities in early assessment compared to other postural control measures, such Berg Balance Scale, the Balance Subscale of Fugl-Meyer test or the Trunk Impairment Scale (28,37). Additionally, *Aaslund et al.,* (49) found that PASS scores within the first week post-stroke were good predictors of long-term walking speed for community independence at 6 months. Moreover, Huang et al., (36) investigated the predictive capacity of the PASS scale for walking ability after discharge (after a mean hospital stay of 18.12 days) defining a cut-off value of 12.50. In contrast, *O'Dell et al.*,(26) found only weak associations between the admission PASS scores and discharge walking speed.

Regarding TCT, there is no consensus in literature. While some studies have shown promising results using TCT as a predictor scale, others highlight its psychometric limitations and do not recommend its use in the clinical practice, as noted in the review developed by *Sullivan et al.* (43). For instance, *Esther Duarte et al.,* (33) concluded that TCT score ≤ 50 at 14-day post-stroke predicts a low likelihood of walking at 6-month follow-up. *Smith et al.* (50) reported that patients with TCT scores higher than 40 at 1 week achieved independent walking by 6 weeks, whereas those with lower scores lower did not achieve independent walking until 12 weeks post-stroke. Similarly, *Gatti et al.,*(34) suggested that subjects scoring ≥ 49 on the initial test (45 days post-stroke stroke) had a 93.75% probability of achieving independent gait at 6 months.

The lower predictive value of TCT compared to PASS in our study may be attributed to psychometrics characteristics. The TCT ceiling effect - where many stroke patients quickly reach the maximum score – limits its ability to differentiate between

individuals who can walk independently and those who cannot. Additionally, although both scales use scores, the PASS provides a more nuanced gradient of difficulty in tasks, allowing for finer differentiation between levels of ability. In contrast, the TCT has only four items with relatively uneven scoring. When scores are treated as linear measures, the PASS likely provides a more accurate assessment of the patient's ability to walk independently.

Furthermore, independent walking after a stroke requires a combination of dynamic balance, postural stability, weight shifting, and the ability to adjust to external perturbations. The PASS includes items that directly test these abilities, while the TCT focuses more narrowly on trunk stability, which is only one aspect of the overall balance needed for walking. This findings seems to emphasizes the connection between functional postural control and medial descending pathways, such as the reticulospinal and vestibulospinal tract, which play a crucial role in walking capacity (51–53)

The PASS demonstrated high sensitivity (81,5%) but lower specificity (33,3%) in predicting independent walking. High sensitivity indicates that PASS is effective at detecting true positives - patients who will walk independently - thus ensuring that most of those who are predicted to achieve independence do indeed do so. This is crucial in clinical settings, where it is more beneficial to identify as many potential independent walkers as possible, even at the risk of some false positives. However, the lower specificity means that the PASS may also incorrectly classify some individuals as capable of independent walking when they are not. This could lead to an overestimation of walking potential and potentially premature discharge or inadequate rehabilitation planning for some patients.

Despite the promising results, this study has several limitations, and his results need to be applied carefully. The relatively small sample size, single follow-up timepoint, and limited range of postural control outcomes analyzed may affect the generalizability of the findings. Additionally, data collection was performed by a non-blinded physiotherapist, increasing the potential for bias. The reliance on telephone interviews for gait evaluation rather than in-person assessments also poses a limitation. Furthermore, the study does not differentiate between hemorrhagic and ischemic strokes, which could impact the results. Due to initial hematoma expansion as well as increasing cerebral edema, which usually occurs within 2 days but can persist up to 3 weeks post-stroke. Individuals with hemorrhagic stroke may present the worst scores on postural scales and consequently a worst gait prognostic at fifth day, that can be

inaccurate. However, interestingly, *Kennedy et al.,* (10) reported that by 3 months post-stroke, the chance of walking was similar for patients with hemorrhagic and ischemic strokes.

A positive aspect of the study is that patients were treated at various rehabilitation centers with different approaches (not controlled by the study), reflecting real-world clinical settings.

Future research should involve longer follow-up periods (e.g., 6 months and community living), and investigate additional predictors, including modifiable factors potentially affecting achievement of independent walking, such as lower extremity motor function, somatosensory and proprioception measures, fear of falling, cognitive status, depression, motivation, and socioeconomic status.

It is important to emphasize that this result predicts the recovery of independent walking (without assistance), rather than other parameters such gait motor quality, speed or community walking capability. As *Moore et al.,* (8) noted, 90% of stroke survivors achieve better walking outcomes at 6 months. Thus, this study's focus on 3-month gait levels does not preclude the possibility of further walking improvements later.

Our findings suggest that PASS shows promise as predictive tool for independent walking and this fact have practical implication for clinical. PASS is a simple, time-efficient scale that requires minimal equipment, making it useful for guiding discharge decisions, rehabilitation planning, and setting intervention goals based on anticipated gait progress. However, it is important to notice that while PASS seems to be a reliable tool for identifying those who will likely walk independently, clinicians should interpret its results cautiously and consider supplementary assessments or clinical judgment to ensure comprehensive patient evaluation and management. The use of prediction tools in clinical practice should be globally careful, ensuring that the main goal is assist in discharge planning, rehabilitation, and goal setting, rather than restricting access to services. Furthermore, the communication of prognostic information to patients and their family’s needs to be carefully managed. It is crucial to adapt the information provided in a way that maintains motivation and focuses on achieving further functional capabilities.

CONCLUSION

Based on our research, this study is the first to investigate and establish that postural control assessed with the PASS at an acute stage can predict walking ability at 3-month post-stroke. Patients with PASS scores of ≥ 13.5 on fifth day after stroke were highly likely to achieve independent gait (FAC ≥ 4) within 3 months. Additionally, the

statistical analysis allows us to conclude that each 1-point increase in the PASS score is associated with a 9.7% increase in the odds independent walking.

While PASS shows potential as a tool, further research is necessary to confirm its clinical value through larger studies, extended follow-up periods and additional predictors.

FIGURES AND TABLES

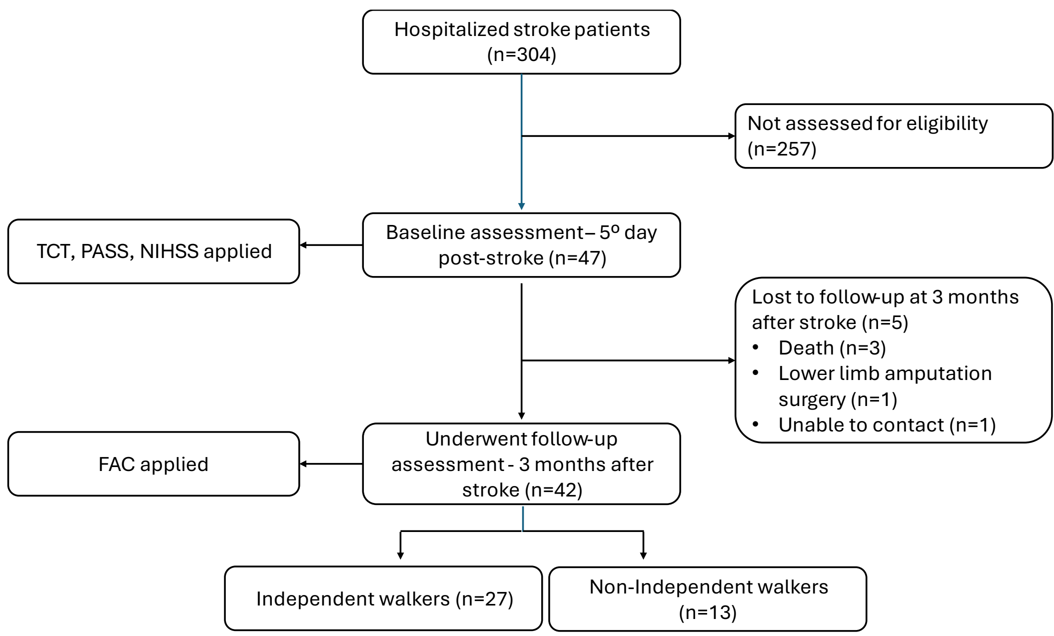

Figure 3. ***Flowchart of study design***
TCT: Trunk Control Test; PASS: Postural Assessment Scale for Stroke; NIHSS: National Institutes of Health Stroke Scale; FAC: Functional Ambulation Categories.

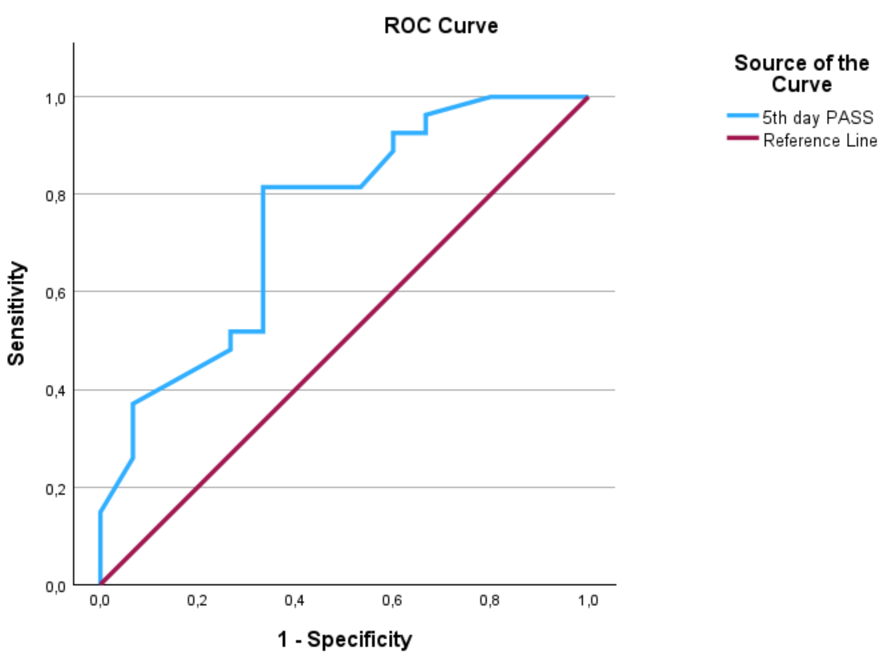

Figure 4. ***ROC curve analysis of the Postural Assessment Scale for Stroke at 5th day poststroke for predicting independent walking at 3 months (FAC ≥4).***

Table 5. ***Patients' demographic and clinical characteristics***

	All Participants (n=78)
Gender (n(%))	
Masculine	27 (64%)
Feminine	15 (35%)
Age (mean ± SD (min-max))	44±11 (44-91)
Affected Side (n(%))	
Right	24 (57%)
Left	18 (42%)
Type of Stroke (n(%))	
Ischemic	34 (81%)
Hemorrhagic	8 (19%)
Oxford Classification (n(%))	
TACI	2 (5%)
PACI	21 (50%)
LACI	14 (33%)
POCS	5 (12%)
Length of stay (days)(mean ± SD (min-max))	12± 6 (5-27)
Fifth day after stroke (mean ± SD (min-max))	
NIHSS	6 ± 3 (2-18)
PASS	18 ± 9 (4-34)
TCT	57 ± 27 (100-12)
3 months after Stroke (mean ± SD (min-max))	
FAC	3,5 ± 1,6 (5-0)
Dependent Walking (n(%)	15 (35,7%)
Independente Walking (n(%)	27 (64,3%)

Dependent Walking: FAC < 4; Independent Walking: FAC ≥ 4
SD: Standard Deviation; TACI: Total Anterior Circulation Infarct; PACI: Partial Anterior Circulation Infarct; LACI: Lacunar Anterior Circulation Infarct; POCS: Posterior Circulation Infarct; NIHSS: National Institutes of Health Stroke Scale; TCT: Trunk Control Test; PASS: Postural Assessment Scale for Stroke; FAC: Functional Ambulation Categories

Table 6. ***Multivariate binary logistic regression between baseline variables and the follow-up outcome***

	NIHSS at day 5	PASS at day 5	TCT at day 5	FAC follow-up at 3 months
Lenght of stay	,400**	-,387*	-,381*	-0,129
NIHSS at day 5		-,625**	-,687**	-0,203
PASS at day 5			,777**	,441**
TCT at day 5				,316*

*** The correlation is significant at the 0.01 level (2-tailed).*

** The correlation is significant at the 0.05 level (2-tailed).*

TCT: Trunk Control Test; PASS: Postural Assessment Scale for Stroke; NIHSS: National Institutes of Health Stroke Scale; FAC: Functional Ambulation Categories.

Table 7. ***Multivariate binary logistic regression to predict independent walking at 3 months post-stroke***

Variable	B	S.E.	*p*-value	Odds ratio	95% C.I. for Odds ratio	
					Inferior	Superior
PASS at day 5	-0,102	0,042	0,016	0,903	0,832	0,982

B: Regression coefficient; S.E: Standard Error; PASS: Postural Assessment Scale for

Table 8**. The optimal PASS cut-off value for independent walking after 3 months determined from the ROC curve**

PASS Cut-off Score	Area Under the ROC Curves (95%CI)	Standard Test Statistic	p^b	Sensitivity	Specificit y
13,5	0,746 (0,587-0,904)	0,081	0,002	0,815	0,333

ROC: Receiver Operating Characteristics; PASS: Postural Assessment Scale for Stroke; CI: Confidence

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Annex 2. Escola Superior de Tecnologias da Saúde de Lisboa, Instituto Politécnico de Lisboa Ethical Committee Approval

CE-ESTeSL-Nº 77-2021 - Mariana Barbas Ferreira

De Comissão Ética em 2022-01-17 18:36

Detalhes Cabeçalhos Texto simples

REFERÊNCIA INTERNA DO PROJETO: CE-ESTeSL-Nº 77-2021 - Mariana Barbas Ferreira

TÍTULO PROJETO: Fatores Preditores da Marcha em Doentes após AVC – Potencial da PASS e do TCT como preditores da marcha 3 meses após AVC

TIPO DE PROJETO/ESTUDO: Investigação 2º ciclo

INVESTIGADOR PRINCIPAL: Dr.ª Mariana Barbas Ferreira

ORIENTADOR: Professora Doutora M. Beatriz Fernandes

INSTITUIÇÃO PROMOTORA:

Escola Superior de Tecnologias da Saúde de Lisboa, Instituto Politécnico de Lisboa

EQUIPA DE INVESTIGAÇÃO:

Mariana Barbas Ferreira, Fisioterapeuta, Estudante Mestrado em Fisioterapia, ESTeSL, Investigadora Principal

Beatriz Fernandes, Professora, Professora Coordenadora, ESTeSL, Investigadora, Orientadora

Exma. Senhora Professora Doutora Beatriz Fernandes

Exma. Dr.ª Mariana Barbas Ferreira, estudante de mestrado em Fisioterapia

Annex 3. Hospital Amato Lusitano – ULS Castelo Branco Ethical Committee Approval

Comissão de Ética da ULS de Castelo Branco

Exma. Senhora

Mariana Barbas Ferreira

Sua Referência	Sua comunicação	N/ Ofício - Data
		01/10/2021

HAL 01 3153 2021-11-04 14:35:50

Assunto	Pedido de parecer para a realização do estudo "Fatores preditores da marcha em doentes após AVC"

Para conhecimento e devidos efeitos, junto se anexa cópia do parecer da Comissão de Ética da ULSCB, EPE, datado de 6 de outubro de 2021, e homologado pelo Conselho de Administração da ULSCB, E.P.E, no dia 22 de outubro de 2021.

Com os melhores cumprimentos,

O Serviço de Investigação, Formação e Ensino da ULSCB, EPE

O Gabinete de Comissões Técnicas da ULSCB, EPE

SIFE - ULSCB
Coordenadora Técnica

Dra. Maria Helena Lopes

Na resposta indicar a nossa referência. Em cada ofício tratar apenas um assunto.

Unidade Local de Saúde de Castelo Branco
Avenida Pedro Alvares Cabral, 6000-085 Castelo Branco
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ULSCB-MOD.24.03

Annex 4. Key Questions for FAC

Key questions for a FAC level of 0:

"Is walking really only possible if two persons hold this patient?"

If answer is "yes" then FAC=0

Key questions for a FAC level of 1:

1. "Would the patient fall without assistance of the therapist?"
2. "Is the patient supported by the therapist during the whole video sequence?"
3. "Is it clearly visible that the chest is supported by the therapist?"

Two or more answers have to be "yes" for FAC=1. Two or more answers have to be "no" for FAC=2

Key questions for a FAC level of 2:

1. "Is there no visible bearing of weight by the therapist?"
2. "Does the therapist at least once move the affected leg of the patient?"
3. "Is it clearly visible that the chest is NOT supported by the therapist? Is only hand support visible?"

Answer to question 1 and 3 have to be "yes" and the answer to question 2 has to be "no" for FAC=2

Key questions for a FAC level of 3:

1. "Is it clearly visible that the affected leg of the patient is NOT moved by the therapist?"
2. "Is it clearly visible that the therapist does NOT support the patient, although stand by is allowed?"
3. "Would this patient probably not able to walk alone in his room?"

If one answer to the three questions is "no", choose FAC=3

Key questions for a FAC level of 4:

1. "Is it clearly visible that the therapist does NOT support the patient at any time?"
2. "Would this patient probably be able to walk alone in his room?"

Both answers have to be "yes" for FAC=5. If one answer is "no", choose FAC=4

Key questions for a FAC level of 5:

"Would this patient be able to walk alone over a variety of surfaces, such as uneven ground, grass, stairs etc.?"

Answer with "yes" for FAC=5

Annex 5. Portuguese Version of Functional Ambulation Categories scale

CATEGORIAS FUNCIONAIS DE MARCHA

Atribua apenas uma das seguintes categorias:

Nº	Categoria	Ajuda
0	Não funcional (incapacitado)	O doente não consegue andar, ou precisa de ajuda de duas ou mais pessoas.
1	Dependente — nível 2	O doente precisa de apoio firme e contínuo de uma pessoa que o ajude a suportar o peso e a equilibrar--se.
2	Dependente — nível 1	O doente precisa de apoio contínuo ou intermitente de uma pessoa para ajudar com o equilíbrio ou coordenação.
3	Dependente — supervisão	O doente precisa de supervisão verbal ou de ajuda eventual de uma pessoa sem contacto físico.
4	Autónomo em chão nivelado	O doente consegue andar autonomamente em chão nivelado, mas precisa de ajuda em escadas, declives ou superfícies irregulares.
5	Autónomo	O doente consegue andar autonomamente em qualquer sítio.

Nota: Esta classificação não tem em conta qualquer ajuda usada.

Annex 6. Portuguese Version of Postural Assessment Scale for Stroke

MANUTENÇÃO DE UMA POSTURA

1. Sentar-se sem apoio (sentar-se na extremidade de uma marquesa com 50 cm de altura (uma marquesa Bobath, por exemplo) com os pés a tocar no chão.
- ☐ 0 = Não consegue sentar-se.
- ☐ 1 = Consegue sentar-se com ligeiro apoio, por exemplo, de uma mão.
- ☐ 2 = Consegue estar sentado mais de 10 segundos sem apoio.
- ☐ 3 = Consegue estar sentado durante 5 minutos sem apoio.

2. Estar de pé com apoio (posição dos pés livre, sem outras restrições).
- ☐ 0 = Não consegue estar de pé, mesmo com apoio.
- ☐ 1 = Consegue estar de pé com um forte apoio de 2 pessoas.
- ☐ 2 = Consegue estar de pé com apoio moderado de 1 pessoa.
- ☐ 3 = Consegue estar de pé com o apoio apenas de uma mão.

3. Estar de pé sem apoio (posição dos pés livre, sem outras restrições).
- ☐ 0 = Não consegue estar de pé sem apoio.
- ☐ 1 = Consegue estar de pé sem apoio durante 10 segundos ou apoiar-se pesadamente sobre 1 perna.
- ☐ 2 = Consegue estar de pé sem apoio durante mais de 1 minuto ou estar de pé com uma ligeira assimetria.
- ☐ 3 = Consegue estar de pé sem apoio durante mais de 1 minuto e ao mesmo tempo executar movimentos dos membros superiores acima do nível do ombro.

4. Estar de pé sobre a perna não hemiparética (sem outras restrições).
- ☐ 0 = Não consegue estar de pé sobre a perna não hemiparética.
- ☐ 1 = Consegue estar de pé sobre a perna não hemiparética alguns segundos.
- ☐ 2 = Consegue estar de pé sobre a perna não hemiparética durante mais de 5 segundos.
- ☐ 3 = Consegue estar sobre a perna não hemiparética durante mais de 10 segundos.

5. Estar de pé sobre a perna hemiparética (sem outras restrições).
- ☐ 0 = Não consegue estar de pé sobre a perna hemiparética.
- ☐ 1 = Consegue estar de pé sobre a perna hemiparética alguns segundos.
- ☐ 2 = Consegue estar de pé sobre a perna hemiparética durante mais de 5 segundos.
- ☐ 3 = Consegue estar sobre a perna hemiparética durante mais de 10 segundos.

Sub-score

MUDANÇA DE POSTURA

A pontuação dos itens de 6 a 12 é como se segue (itens de 6 a 11 são para ser executados com uma marquesa a 50 cm de altura, como uma mesa de Bobath; itens 6, 11 e 12 são para ser executados sem qualquer suporte, sem outras restrições):

- ☐ 0 = Não consegue executar a actividade.
- ☐ 1 = Consegue executar a actividade com muita ajuda
- ☐ 2 = Consegue executar a actividade com pouca ajuda.
- ☐ 3 = Consegue executar a actividade sem ajuda.

6. De pé para sentado
☐ 0 ☐ 1 ☐ 2 ☐ 3

7. De sentado na extremidade da marquesa para decúbito dorsal
☐ 0 ☐ 1 ☐ 2 ☐ 3

8. De decúbito dorsal para o lado afectado
☐ 0 ☐ 1 ☐ 2 ☐ 3

9. De decúbito dorsal para o lado não afectado
☐ 0 ☐ 1 ☐ 2 ☐ 3

10. De decúbito para sentado na extremidade da marquesa
☐ 0 ☐ 1 ☐ 2 ☐ 3

11. De sentado para a posição de pé
☐ 0 ☐ 1 ☐ 2 ☐ 3

12. Em pé, apanhar uma caneta do chão.
☐ 0 ☐ 1 ☐ 2 ☐ 3

Sub-score _______

TOTAL_________

Annex 7: Portuguese version of Trunk Control Test Scale

Teste de Controlo do Tronco para incapacidade motora após Acidente Vascular Encefálico (AVE)

Visão geral: O Teste de Controlo do Tronco pode ser utilizado para avaliar a incapacidade motora num indivíduo após AVE. Está correlacionado com a eventual capacidade de andar.

1) Testes realizados pelo indivíduo em decúbito dorsal na cama/marquesa:
   - 1a) Rolar para o lado contralesional ( )
   - 1b) Rolar para o lado ipsilesional ( )
   - 1c) Passar para a posição de sentado ( )
2) Manter o equilíbrio na posição de sentado no bordo da cama/ marquesa sem contacto dos pés com o chão, pelo menos, durante 30 segundos ( )

Pontuação de cada teste	Pontos
Incapaz de realizar sem assistência	0
Capaz de realizar recorrendo a ajuda não muscular ou de forma atípica; utiliza os membros superiores para manter a estabilidade quando se senta	12
Capaz de completar a tarefa de forma adequada	25

Teste de controlo de tronco = SOMA (pontos para os 4 testes)

Annex 8. Informed Consent for Research Participation

DECLARAÇÃO DE CONSENTIMENTO INFORMADO, LIVRE E ESCLARECIDO PARA PARTICIPAÇÃO EM INVESTIGAÇÃO

Por favor, leia com atenção a seguinte informação. Se achar que algo está incorreto ou não está claro, não hesite em solicitar mais informações. Se concorda com a proposta que lhe foi feita, queira assinar este documento.

O Acidente Vascular Cerebral (AVC) está muitas vezes associado a um conjunto de alterações motoras que podem condicionar a realização de várias atividades básicas da vida diária. A manutenção da capacidade de realizar marcha é uma das atividades essenciais na autonomia e qualidade de vida dos doentes após AVC. Assim, a possibilidade de predizer com precisão a capacidade de marcha após AVC numa fase inicial é essencial para a construção de um prognóstico funcional, para direcionar o processo de reabilitação e adequar as expectativas e necessidades a nível pessoal e familiar.

Este estudo é referente à dissertação para obtenção do grau de Mestre em Fisioterapia Neurológica pela Escola Superior de Tecnologia de Saúde de Lisboa. O seu objetivo é investigar se determinados fatores ou características presentes na fase inicial após o quadro de AVC poderão estar relacionados com a realização de marcha independente num período a curto-médio prazo.

Metodologicamente, este estudo irá desenvolver-se em dois momentos distintos. Inicialmente irá consistir na recolha de um conjunto de dados e na avaliação de duas escalas funcionais ao 5º dia após o quadro de AVC. Os dados recolhidos serão relativos ao género, idade, hemisfério cerebral lesado, tipo e localização do AVC, escala da National Intitute of Health Stroke Scale (avaliada pelo clínico responsável) e presença/ausência de quadro de *Neglet*. As duas escalas funcionais mencionadas anteriormente denominam-se ‘’Escala de Avaliação Postural para Pacientes com Sequelas de AVC’’ e ‘’Teste de controlo de tronco para incapacidade motora após Acidente Vascular Cerebral’’ que consistem na avaliação do controlo postural e contêm determinadas tarefas a realizar sob a supervisão do investigador responsável e de acordo com a sua capacidade e tolerância.

Numa segunda fase, três meses após esta data inicial será realizado um contacto por via telefónica previamente agendado onde poderá também ser

solicitada a participação de um cuidador e/ou do Fisioterapeuta responsável pelo processo de reabilitação, de forma a clarificar e classificar a capacidade de realizar marcha após este período avaliado através da Escala ordinal Funcional Ambulatorie Categories (FAC) que se expande entre o valor mininimo (0) em que o individuo não consegue andar ou requer o auxilio de duas ou mais pessoas, até ao nível máximo (5) em que o individuo consegue realizar marcha de forma independente em qualquer lugar.

Os dados recolhidos serão analisados através de procedimentos estatísticos, sendo apenas do conhecimento dos investigadores, e a divulgação dos resultados à comunidade académica e em revistas científicas terá sempre garantida a sua confidencialidade, respeitando a privacidade de cada participante. Caso o participante pretenda, ser-lhe-ão comunicados os resultados do estudo.

A participação no estudo será pseudo-anonimizada, os dados relativos ao nome pessoal do participante e o contacto telefónico de referência hospitalar serão recolhidos atendendo ao princípio de minimização dos dados e exclusivamente devido à existência protocolada de um processo de *follow-up* após 3 meses (t1). Os dados fornecidos serão tratados e guardados pelo investigador responsável no período de duração do projeto de investigação (ano letivo 2021/2022) e apenas serão utilizados no âmbito académico. Os dados utilizados e armazenados serão pseudo-anonimizados e agregados quer na sua análise quer na sua apresentação, sendo posteriormente destruídos aquando da conclusão do projeto de investigação e apresentação do Trabalho Final de Mestrado em Fisioterapia – Ramo de Fisioterapia Neurológica, presumivelmente no término do ano letivo 2021/2022.

Os dados pessoais que fornecer, serão tratados em estrita conformidade com a Lei nº 58/2019 que assegura a execução, na ordem jurídica nacional, do Regulamento (UE) 2016/679 do Parlamento e do Conselho, de 27 de abril de 2016, relativo à proteção das pessoas singulares no que diz respeito ao tratamento de dados pessoais e à livre circulação desses dados.

A participação neste estudo é voluntária e revogável, podendo desistir da colaboração em qualquer momento, sem necessidade de justificação e sem discriminação por tal desejo. Para o facto deverá contactar o Investigador Principal: Profª. Doutora Maria Beatriz Dias Fernandes (Telf: 218980400; Email: beatriz.fernandes@estesl.ipl.pt), da Escola Superior de Tecnologia da Saúde de Lisboa - ESTeSL | Av. D João II, Lote 4.69.01 1990-096 Lisboa. A participação neste estudo não contempla qualquer benefício financeiro ou material.

O investigador encontram-se disponível para qualquer esclarecimento adicional, através dos contactos mencionados.

Agradecemos, desde já, a disponibilidade prestada.

O investigador,
Mariana Barbas Ferreira
Fisioterapeuta na ULSCB – Hospital Amato Lusitano
Estudante do Mestrado em Fisioterapia Neurológica da Escola Superior de Tecnologia da Saúde de Lisboa
Contacto telefónico: 963166769
Endereço electrónico: marianafisioferreira@gmail.com

(parte declarativa da pessoa que consente)

Declaro que me foi entregue um documento explicativo onde consta a identificação do projeto de investigação e respetiva justificação, assim como os objetivos, métodos e procedimentos utilizados na realização do estudo e respetiva duração previsível.

Declaro que me foi proporcionada a oportunidade de ler e considerar a informação apresentada e de esclarecer todas as minhas dúvidas, recebendo uma resposta satisfatória, compreendendo este documento e todas as informações verbais que me foram fornecidas pela pessoa que acima assina.
Compreendo igualmente que a participação no presente estudo não acarreta qualquer tipo de vantagens e/ou desvantagens, nem tem qualquer interferência com o meu tratamento. Fui informado(a) que a minha participação é voluntária, podendo, a qualquer momento, recusar participar, desistir e invalidar que os meus dados sejam utilizados, sem nenhuma consequência.

Compreendo que tenho o direito de colocar qualquer questão sobre o estudo agora e durante o seu desenvolvimento, assim como aceder aos dados e resultados do mesmo ou pedir para serem retificados ou apagados. Foi-me garantido que os dados recolhidos pela investigadora serão usados apenas para fins científicos e caso esta investigação venha a ser publicada, todos os dados serão mantidos anónimos e nenhuma informação será identificável como sendo minha.

Confirmo que fui informado que tenho o direito de apresentar reclamação e pedir esclarecimentos junto ao encarregado de Proteção de Dados do Instituto Politécnico de Lisboa, Nuno Pires,\ cujos contactos são: Telf. + 351 21 046 47 00 | + 351 21 046 47 08 Email. npires@net.ipl.pt.

Desta forma, declaro que aceito participar neste estudo, e que tomo a minha decisão de forma inteiramente livre, e permito a utilização dos dados que de forma voluntária forneço, confiando em que apenas serão utilizados para esta

O participante ____

Telefone/telemóvel____

Se não for o próprio a assinar por idade ou incapacidade
deve também assinar, se consentir

Nome:____

BI/CC Nº:_______________________________ Data ou Validade ___ /___ /___

investigação e nas garantias de confidencialidade e anonimato que me são dadas pela investigadora.

(parte declarativa do investigador)

Confirmo que expliquei à pessoa acima indicada, de forma adequada e inteligível, os procedimentos necessários à realização deste estudo. Respondi a todas as questões que me foram colocadas e assegurei-me de que houve um período de reflexão suficiente para a tomada da decisão livre, informada e esclarecida

Garanti também que existe a possibilidade de recusar a participação, neste e em qualquer momento do estudo, sem quaisquer consequências.

Nome legível do investigador____

Telemóvel: 963166769

ESTE DOCUMENTO É COMPOSTO DE 4 PÁGINAS E É FEITO EM DUPLICADO: UMA VIA PARA O INVESTIGADOR, OUTRA PARA A PESSOA QUE CONSENTE