[SYSTEMATIC REVIEW]

Trunk scales as a predictor of Gait in Stroke Patients- A Systematic Review

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ABSTRACT

Background: Trunk control is known to be an early predictive factor for one's ability to perform activities of daily living (ADL) as well as the hospitalization period in stroke survivors. Gait disturbance is a major problem for many patients after stroke and causes difficulties in performing daily activities. are tools for assessing trunk control, such as the Trunk Impairment Scale (TIS), Trunk Control Test (TCT), Postural Assessment Scale for Stroke-Trunk Control (PASS-TC). These scales have not been used to predict gait independence.

Objective: To find out if trunk scales predict gait independence in patients of stoke

Data Sources: The biomedical databases CINAHL, Cochrane, Scholar and PubMed were searched. Each database was searched until 2024 .

Review Methods: The four databases were searched with the terms plus 'stroke' and 'trunk' plus 'scale' and 'Gait' mentioned in the title or abstract. The search strategy included all studies in humans with original data from adults after stroke. All articles were selected for this review which reported or included a clinical measure of trunk performance. Only articles that were published in English were included.

Result: After screening of 367 studies, 9 studies met the inclusion criteria. The mean PEDro score was 6 out of 10 which corresponds with a low risk of bias.

Conclusion: Prediction of gait independence can be done using trunk scales such as Trunk Impairment Scale (TIS), Ability for Basic Movement Scale II (ABMS II), Trunk Control Test (TCT), in patients with stroke.

Keywords: *Stroke, Trunk Impairment Scale, Gait*

Introduction

Stroke is a prevalent neurological condition and one of the leading causes of long-term disability. It poses a significant public health challenge that necessitates continuous and comprehensive rehabilitation efforts[1]. One of the common consequences of stroke is weakened trunk muscles and reduced trunk coordination, which often leads to decreased independence due to impaired trunk function[2]. The trunk plays a vital role in stabilizing the pelvis and spine, contributing significantly to anticipatory postural adjustments required for coordinated limb movements[3]. Effective trunk control has been identified as an early indicator of a stroke survivor's capacity to perform activities of daily living (ADLs) and is also associated with the length of hospital stay[4]. Postural control, enabled by the trunk, is essential for coordinated limb function through pelvic and spinal stabilization[4].

Gait abnormalities are among the most frequent impairments following a stroke[5]. These disturbances not only hinder mobility but also interfere with routine daily activities[6]. While normal walking primarily relies on the trunk and neck muscles to maintain spinal neutrality, stroke survivors often experience compromised balance and core stability. As a result, rehabilitation programs frequently emphasize trunk and balance training, which are

directly linked to improvements in gait function. A stroke typically impairs one side of the body but can also impact trunk muscle function bilaterally, undermining core stability and affecting balance, walking ability, and motor control. These impairments often lead to reduced independence in daily life and an elevated risk of falls.

Several assessment tools are available for evaluating trunk control, including the Trunk Impairment Scale (TIS), Trunk Control Test (TCT), and the Postural Assessment Scale for Stroke – Trunk Control (PASS-TC). These scales are used to measure aspects such as bed mobility, sitting balance, and trunk function. The TIS and TCT have been associated with mobility measures like the gait subscale of the Tinetti Performance-Oriented Mobility Assessment, the Functional Ambulation Category, and the 10-Meter Walk Test in stroke patients. However, despite these associations, they have not been widely applied to predict gait independence specifically. This review aims to determine whether trunk assessment scales can be used to predict gait independence in individuals recovering from stroke.

Methodology :

The biomedical databases CINAHL, Cochrane, Scholar and PubMed were searched. Each database was searched from its starting date 2016 until 2024 . The four databases were searched with the terms plus 'stroke' and 'trunk' plus 'scale' and 'Gait' mentioned in the title or abstract. The search strategy included all studies in humans with original data from adults after stroke. All articles were selected for this review which reported or included a clinical measure of trunk performance. Only articles that were published in English were included.

One reviewer (GV) independently assessed each title and abstract located through the search engines of the different databases. All predetermined criteria as described above were applied and full-text articles that met inclusion criteria were retrieved. Reference lists from included articles were hand-searched to detect further relevant papers. Data were extracted from the collected articles by one reviewer (GV) and included information on examined population, number of patients and psychometric characteristics presented
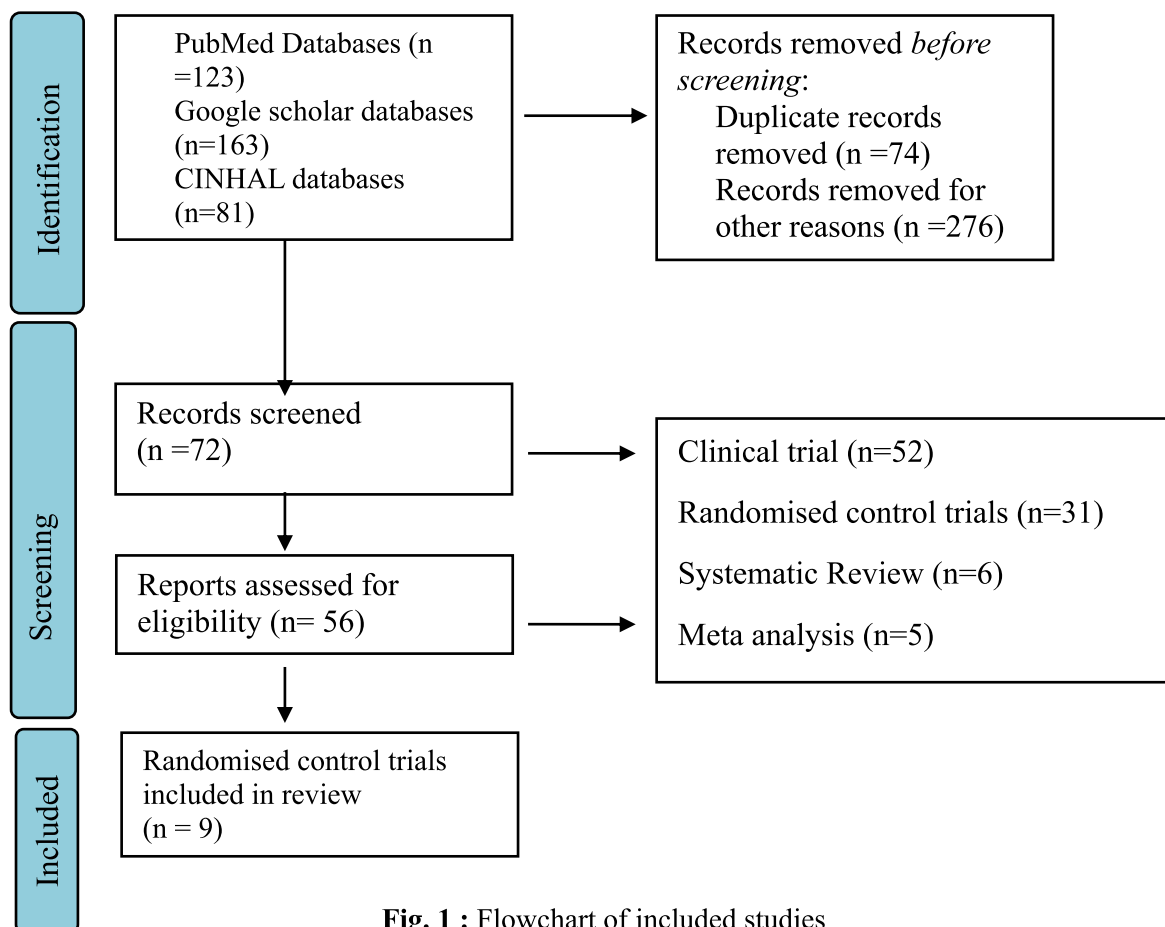

Fig. 1 : Flowchart of included studies

Results

The search of the Searching, the PubMed database listed 213 publications, 2 of which mentioned a clinical scale to evaluate trunk performance after stroke. The search of the Searching, the Scholar database listed 320 publications, 2 of which mentioned a clinical scale to evaluate trunk performance after stroke. The search of the Searching, the Cochrane database listed 4 publications, 0 of which mentioned a clinical scale to evaluate trunk performance after stroke.

Authors	H. Hale Hekim et. al.	Masahiro Ishiwatari et. al.	Manasi Desai et. al.	Yoshitake Hiranoet. al.	YunBok Lee et. al.	Hiroyuki Uwatoko et. al.	Tamay Van Criekinge et. al.	Doriana Ciobanu et. al.	Randah AhmedAlomari et. al.
Eligibility criteria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Random allocation	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Concealed allocation	No	No	No	No	No	No	No	No	No
Groups similar at baseline	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Participants blinding	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Therapists blinding	No	No	No	No	No	No	No	No	No
Outcome assessor blinding	No	Yes	No	No	No	No	No	No	No
Less than15% dropouts	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Intention- to treat analysis	No	No	No	No	No	No	Yes	Yes	Yes
Between Groups Statistical Comparison	Yes	No	No	Yes	No	No	Yes	Yes	Yes
Point Measures and Variability Data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PEDro score	6	7	5	7	6	5	7	7	7

Sr. No.	Year of publication	Authors	No. of patients and Stage of stroke	Outcome measures	Results
1.	2016	Yoshitake Hirano et. al.	72 Chronic Stroke patients	Trunk Control Test (TCT), KES/BW-US values	The study found that physical function parameters (TCT and KES/BW-US) were higher in the independent group. Age, TCT score, and KES/BW-US at admission were strong influencers of walking ability at discharge.
2.	2017	YunBok Lee et. al.	55 Chronic stoke patients 29 healthy adults	5-m Walk Test Functional Ambulation Category for gait; Trunk Control and Trunk Control Test	mTIS has a strong relationship with balance, mobility, and lower extremity function, and a moderate relationship with overall functional independence. The sensitivity and specificity values indicate

					that the mTIS can be a useful tool in predicting ADL independence, but not with perfect accuracy.
3.	2018	Manasi Desai et. al.	40 Sub-acute stroke patients	Trunk Impairments Scale (TIS), Gait Assessment and Intervention Tool (G.A.I.T).	The strong negative correlation (-0.961) suggests that as trunk impairment increases, gait ability decreases, and vice versa. This supports the study's objective and highlights the important relationship between trunk control and gait in stroke patients.
4.	2020	Hiroyuki Uwatoko et. al.	67 Acute stroke patients	Ability for Basic Movement Scale II (ABMS II), FIM score (motor function domain)	The study found that higher ABMS II scores are associated with independent gait in patients. The ROC curve analysis identified specific score thresholds (26 and 15) that can predict independent gait on the 14th and 90th days after admission, respectively. These findings can help clinicians assess patients' progress and potential for independent gait.
5.	2020	Tamaya Van Criekinge et. al.	39 Sub-acute stroke patients	Trunk Impairment Scale, spatiotemporal gait parameters, center of-mass excursions, and trunk and lower limb kinematics during walking	Decreased thorax sagittal ROM is associated with improved gait parameters (increased walking speed, step length, and decreased step width).Increased trunk rotations have a weaker relationship with gait parameters. Pelvis and thorax rotation angle is positively correlated with step length, suggesting that increased rotation is associated with longer steps.
6.	2020	Doriana Ciobanu et. al.	36 Sub-acute stroke patients	Trunk control test , Functional Independence Test, Timed Up and Go Test	There was a statistical difference between the baseline and final score Trunk control test (p < 0,001), and Timed Up and Go Test (p < 0,000). Also, there was a positive correlation between the increasing of trunk control and ADL independence and walking (p < 0,001)
7.	2022	Masahiro Ishiwatari et. al.	102 Acute stroke patients	TIS, FIM	The study found that TIS is a useful predictor of gait outcomes in patients with acute stroke, and that age and motor impairment level are also significant predictors. The correlation between TIS and FIM gait item scores was only significant at discharge, possibly due to initial symptom instability

| 8. | 2023 | H. Hale Hekim et. al. | 126 Sub- Acute Stroke Patients | Trunk Impairment Scale, Trunk Recovery Scale, Trunk Control Test | In Group 1, the total and maintaining dimension of the PASS scale, and the TCT score and MBI were moderately positive. There was also a moderate positive correlation between the total score of the PASS scale, TCT score, and MBI in Group 2. However, there was a weak or no relationship between trunk control tests and MBI in Group 3 |
| 9. | 2024 | Randah Ahmed Alomari et. al. | 61 Acute Stroke patients | Trunk control test (TCT) , Reintegration to Normal Living Index (RNLI) | There was a significant positive correlation between RLNI and each of TCT (r=0.72; 95% CI=0.59–0.83; p value<0.0001). Trunk control assessed by TCT was identified as the strongest predictor of post-stroke community mobility among all factors (β=0.72; 95% CI=0.004–0.007; p value <0.0001) |

Discussion

This review aimed to assess the effectiveness of trunk assessment scales as predictors of gait performance in stroke patients. A total of 11 studies involving 998 participants were analyzed. Of the 9 studies detailing stroke phases, 3 focused on acute stroke patients, 4 on sub-acute cases, and 2 on chronic stroke populations. The Trunk Control Test (TCT) was utilized as either a primary or secondary outcome measure in 5 of the studies. Two studies employed the Trunk Impairment Scale (TIS), while one used the Modified Trunk Impairment Scale (m-TIS), and another used the Ability for Basic Movement Scale II (ABMS II) as a primary measure.

Gait evaluation across studies involved a variety of tools, including KES/BW-US values, the Functional Independence Measure (FIM), the Timed Up and Go Test (TUG), spatiotemporal gait parameters, center-of-mass excursions, trunk and lower limb kinematics, the Gait Assessment and Intervention Tool (G.A.I.T.), the 5-meter Walk Test, and the Functional Ambulation Category (FAC).

The Trunk Control Test (TCT), a simple and validated tool, has consistently been shown to predict post-stroke walking ability. Administered six weeks after a cerebrovascular accident (CVA), it can predict gait function at 18 weeks. E. Duarte et al. demonstrated a significant correlation between TCT scores and length of hospital stay (r = -0.722), as well as discharge FIM scores (r = 0.738), motor FIM, and the Berg Balance Scale[13]. Higher TCT scores at admission were positively associated with walking speed at discharge[14]. The reliability and validity of TCT have been well established in stroke rehabilitation and show a strong relationship with functional outcomes, such as hospital discharge performance measured by FIM[15]. Yoshitake Hirano et al. found that discharge walking ability was significantly influenced by factors like age, TCT score, and admission KES/BW-US values[1].

The Ability for Basic Movement Scale II (ABMS II) is a revised tool designed to evaluate fundamental movements at the bedside following a stroke. It assesses five components-turning over from a supine position, sitting up, maintaining a sitting position, standing up, and remaining standing-totaling a maximum score of 30. According to Hiroyuki Uwatoko et al., ABMS II scores were significantly predictive of independent walking. Receiver operating characteristic (ROC) analysis identified threshold scores of 26 and 15 as predictors for independent gait on the 14th and 90th days post-admission, respectively. Higher ABMS II scores at admission have been associated with better recovery, shorter hospital stays, and higher likelihood of

discharge to home settings in convalescent stroke patients[18-19].

The Trunk Impairment Scale (TIS) is a clinical tool developed to evaluate trunk dysfunction post-stroke. It measures static and dynamic sitting balance as well as trunk coordination-specifically lateral flexion and rotational movements of the upper and lower trunk. Masahiro Ishiwatari et al. reported a strong correlation between TIS scores at admission and gait-related FIM scores at discharge[12]. The TIS has proven effective in predicting gait independence when administered within 48 hours of stroke onset[12]. Similar results were observed by Manasi Desai et al., who confirmed a positive association between trunk impairment and gait ability[7]. TIS has also been explored for assessing lumbar bone fragility in sub-acute stroke patients[21] and is valuable in evaluating trunk function as a basis for daily activities, balance, and gait, including in patients with Parkinson's disease[20-22]

Conclusion

In conclusion, prediction of gait independence can be done using trunk scales such as Trunk Impairment Scale (TIS), Ability for Basic Movement Scale II (ABMS II), Trunk Control Test (TCT), in patients with stroke. This indicates the need for the early implementation of trunk control exercises post-stroke which may lead to better outcomes.

Conflict of Interest : There are no conflicts of interest.

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