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Prevalence of Saccadic and Vestibular Dysfunction in Post-Stroke Patients Affecting their Activities of Daily Living: A Cross-Sectional study

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Abstract

Background: Stroke is a major cause of long-term disabilities and sensory-motor impairments, which hinder functional independence in the world. Among these, oculomotor and vestibular dysfunctions, including saccadic abnormalities, are often overlooked despite their significant contribution to balance impairment and restrictions in ADLs. The objectives of this study were to evaluate the frequency of saccadic and vestibular dysfunction in post stroke patients and to examine their associations with functional independence.

Methods: This cross-sectional study involved 80 participants diagnosed with Ischemic or Hemorrhagic stroke, recruited between July and December 2024 from PSRD Hospital and Hijaz Hospital in Lahore, Pakistan. Academically supervised by Hajvery University (Ethical Approval No: HU-ECRB-DPT-2025-62), the study included stroke survivors aged 50–75 years who were at least one-year post-stroke and provided written informed consent. Saccadic and vestibular assessments were conducted via standardized clinical protocols focusing on rapid eye movement accuracy and symptomatic responses to the Dix-Hallpike maneuver. Functional dependency was strictly categorized into Severe, Moderate, or Minimal groups based on validated Barthel Index (BI) scores. Data analysis performed in **SPSS version 27 using the Pearson Chi-square test** revealed a highly significant association between dual sensory-motor dysfunction and dependency levels ($x2 = 39.725$, $df = 2$, $p < 0.001$). These results indicate that the combined presence of saccadic and vestibular impairments serves as a strong predictor of severe dependency in activities of daily living among stroke survivors.

Results: Out of 80 participants 52.5% were male, and 86.3% had ischemic stroke. Combined saccadic and vestibular dysfunction was found in 40% of patients. Among these, 84.4% were classified as severely dependent on the Barthel Index, while 37.5% of participants without dysfunction were minimally dependent or independent. A statistically significant association was observed between dysfunction and dependency level ($p < 0.001$).

Conclusion: Saccadic and vestibular abnormalities are frequently observed in patients' post-stroke patients and are strongly associated with impaired function outcomes. Identifying these impairments at an early stage and rehabilitation with particular attention to them might improve the ADL performance and quality of life.

Keywords: Activities of Daily Living, Rehabilitation, Stroke, Saccadic Disorder, Sensory-Motor Impairment, Vestibular Diseases.

Introduction

Stroke is a dominant cause of long-term disability on a global level and is a significant cause of both morbidity and mortality, especially in older adults. It is defined by the abrupt loss of cerebral blood flow, leading to focal or general neurological impairments. [1] Stroke survivors frequently have a large and diverse set of motor, sensory, cognitive, and visual dysfunctions that significantly restrict functional autonomy and engagement in everyday living, depending on the brain areas impacted. The proposed academic study explores the sensory-motor disabilities occurring post-stroke and captures their prevalence data together with impact on ADLs on stroke survivors and the need to have dedicated rehabilitation services in order to improve their functional outcome. [2, 3]

There are two major types of strokes. The most common ones are ischemic strokes due to the formation of blood clots and a blockage of blood vessels in the brain, whereas bleeding in the brain leads to hemorrhagic strokes that contribute to the burden. Moreover, one can mention mini stroke known as transient ischemic attack, when blood flow to a part of the brain is blocked temporarily and there is no damage. [4]

Among the myriads of post-stroke impairments, the most commonly underdiagnosed—yet functionally significant deficits are **vestibular dysfunction** and **saccadic dysfunction**. Vestibular dysfunction is operationally defined as a disruption of the sensory system responsible for providing balance and spatial orientation. This leads to persistent vertigo, dizziness, and postural instability, which significantly hinder fundamental movements such as standing, ambulation, and transitional movements. [5]

Simultaneously, saccadic dysfunction involves impairment in rapid, ballistic eye movements required for efficient target scanning and visual localization. These oculomotor deficits are not merely isolated visual issues; they disrupt the "search and find" mechanism of the eyes, negatively affecting reading, spatial navigation, and visual-motor coordination. Because the vestibular and oculomotor systems are neurologically and functionally linked, a deficit in both creates a synergistic negative effect, compounding the risk of falls and increasing patient dependency. [6,7]

The vestibular and oculomotor systems are closely linked; consequently, impairment in both can have a synergistic negative effect on balance, visual stability, and overall task performance. [8, 9]

One of the main aims of post-stroke rehabilitation is the restoration of independence in the field of ADLs. The visual scanning of the environment is complicated or impossible due to impaired saccades (rapid eye movements necessary to move the eyes quickly) when performing such tasks as reading, cooking, and navigation. [10] These sensory-motor impairments are not commonly tested during a standard post-stroke evaluation despite their clinical relevance. Weaknesses of the vestibular and saccadic functions could be a major barrier to recovery as they disrupt balance, mobility, and spatial processing of visual information. [11, 12]

The clinical trajectory of stroke whether categorized as Ischemic, resulting from arterial occlusion and subsequent infarction, or Hemorrhagic, involving intracranial rupture and pressure-induced tissue damage is frequently complicated by secondary functional decline. While traditional rehabilitation protocols prioritize the prevention of musculoskeletal complications like muscle atrophy and contractures through early mobilization, a significant clinical oversight remains regarding the sensory-motor foundations of independence. Patients suffering from major strokes, including those categorized under Transient Ischemic Attacks (TIA**)** that serve as precursors to permanent deficits, often struggle with fundamental self-care tasks such as bathing, dressing, and feeding. However, these impairments are not solely the result of gross motor loss. They are

profoundly influenced by undetected **vestibular and saccadic dysfunctions** which disrupt the postural stability and visual scanning necessary for safe locomotion and task execution. The primary aim of post-stroke rehabilitation must therefore expand beyond simple ambulation to address these specific sensory deficits. By restoring oculomotor accuracy and vestibular balance, patients can regain true autonomy in Activities of Daily Living (ADLs), thereby reducing long-term caregiver burden and mitigating the psychological impact of dependency, such as depression and social withdrawal. [13,14]

The primary purpose of this study is to investigate the prevalence of saccadic and vestibular dysfunction in post-stroke patients and to quantify their direct impact on functional independence. Current clinical literature suggests that oculomotor and vestibular deficits may affect up to 40% to 50% of stroke survivors, yet these impairments are frequently overlooked in favor of gross motor recovery. This creates a significant **research gap**, as the underlying sensory-motor disharmonies responsible for spatial disorientation and ocular discoordination are rarely addressed in standard bedside evaluations. Consequently, while patients may regain muscle strength, they remain functionally dependent due to an inability to safely navigate their environment or perform gaze-dependent tasks. A **cross-sectional design** was specifically chosen for this study to provide a definitive point-prevalence snapshot of these disorders within the current clinical landscape of Lahore. By establishing a clear correlation between these sensory deficits and Barthel Index scores, the findings provide a robust rationale for more comprehensive assessment strategies and targeted rehabilitation interventions designed to optimize recovery outcomes and restore quality of life for stroke survivors.

Methodology

A cross-sectional study design was utilized to establish the prevalence of saccadic and vestibular dysfunction in post-stroke patients and to determine their correlation with functional independence in Activities of Daily Living (ADLs). Data collection was conducted over a six-month period from July to December 2024 at PSRD Hospital and Hijaz Hospital in Lahore, Pakistan. [14] [15] The study was academically supervised and ethically cleared by the **Institutional Review Board of Hajvery University (No: HU-ECRB-DPT-2025-62).**

The study population consisted of survivors of Ischemic and Hemorrhagic stroke. A sample of 80 participants was recruited through a non-probability convenience sampling method. The study targeted individuals aged 50 to 80 years who were at least one-year post-stroke to ensure assessment within the chronic phase of recovery. The **Inclusion Criteria** was Diagnosed stroke survivors (Ischemic or Hemorrhagic) of at least one-year duration; age range 50–80 years; both genders included; and participants providing written informed consent. The **Exclusion Criteria:** Pre-existing history of vestibular disorders prior to the stroke; severe cognitive impairment (e.g., Mini-Mental State Examination score indicating inability to follow commands); significant pre-existing visual impairments (e.g., advanced cataracts); and comorbid neurological conditions affecting sensory-motor function, such as Multiple Sclerosis or Parkinson's Disease.

The assessment protocol utilized validated clinical instruments to ensure data reliability and diagnostic accuracy. Vestibular function was screened using the **Dix-Hallpike maneuver**, a gold-standard clinical test with high sensitivity for identifying peripheral comorbidities like BPPV in post-stroke populations. **Saccadic eye movements** were evaluated using a standardized protocol to measure central oculomotor velocity and accuracy; this method is recognized for its high test-retest reliability ($r > 0.80$) in neurological cohorts. [16] Functional independence was quantified via the **Barthel Index (BI)**, a 10-item scale widely documented for its excellent internal consistency (Cronbach's alpha = 0.87–0.92) and inter-rater reliability in stroke research. To minimize bias and ensure technical precision, all clinical assessments including the Dix-Hallpike maneuver and

oculomotor testing were performed by a trained Neurological Physiotherapist who remained **blinded** to the participants' specific medical histories during the physical evaluation phase. [17, 18] Following formal ethical approval, written informed consent was obtained from all participants. Demographic and clinical data were documented prior to sensory-motor testing. Statistical analysis was performed using **SPSS version 27**. Participant characteristics were summarized using descriptive statistics (means, standard deviations, and frequencies). The **Pearson Chi-square test** was employed to analyze the associations between dysfunction status and dependency levels, with a significance threshold set at **$p < 0.05$**.

Results

Among the 80 post-stroke participants (52.5% male; 86.3% Ischemic), sensory-motor impairments were categorized into isolated and combined deficits to ensure diagnostic clarity. Isolated saccadic dysfunction was identified in 15% (n=12) of the sample, while isolated vestibular dysfunction (screened via Dix-Hallpike) was present at 12.5% (n=10). The primary clinical focus combined with saccadic and vestibular impairment was identified in 40% (n=32) of participants. Functional dependency correlated significantly with the complexity of these impairments; specifically, 84.4% (n=27) of the combined dysfunction group were categorized as Severely Dependent on the Barthel Index (BI < 60), whereas 0% achieved independence. A Pearson Chi-square test confirmed a highly significant association between dual sensory-motor deficits and low functional autonomy ($x2 = 39.725$, $df = 2$, $p < 0.001$), establishing these combined deficits as a robust predictor of post-stroke dependency.

Table 1: Descriptive statistics of variables N=80

Statistics	Age
N Mean Std. Deviation	80 62.8375 8.12473

Table 1 shows the mean age of 80 in the subject is 62.84 years and standard deviation is 8.12

Table 2: Frequency Distribution of N=80

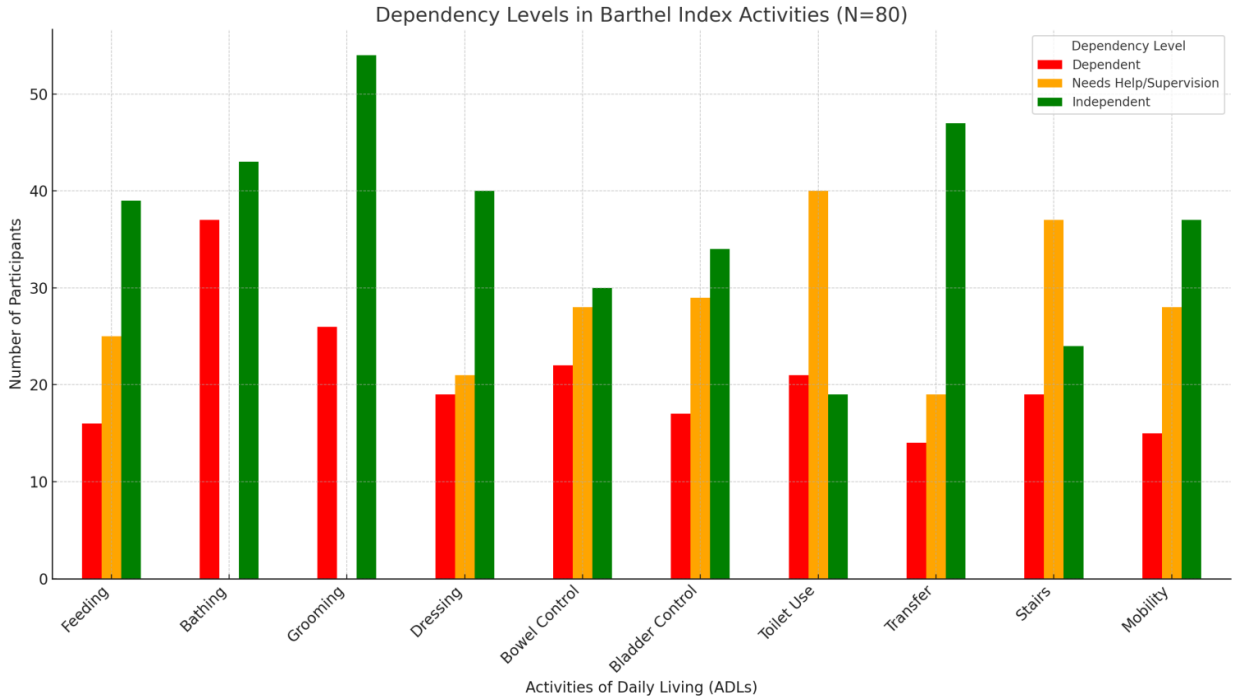
Variable		**Frequency**	**Percent**
Gender	Male	42	52.5%
	Female	38	47.5%
Type of stroke	Ischemic	69	86.3%
	Hemorrhage	11	13.7%
Region of brain affected	Right Hemisphere	42	52.5%
	Left Hemisphere	27	33.8%
	Widespread Region	11	13.7%

Clinical Grouping (No dysfunction+ Isolated saccadiac+ Vestibular:n=48)	Both saccadic and Vestibular Dysfunction	32	40%
	No dysfunction	26	32.5%
	Isolated Saccadic	12	15.0%
	Isolated Vestibular	10	12.5%
Dependency (BI)	Severely dependent	34	42.5%
	Moderately dependent	28	35.5%
	Minimal dependency/ Independent	18	22.5%

Table 3: Frequency Distribution of Barthel index Activities N=80

Barthel Index Activities				
Item	**Dependent**	**Need help or supervision**	**Independent**	**Total**
Feeding	16 (20.00%)	25 (31.3%)	39(48.7%)	100%
Bathing	37 (46.30%)	-	43(53.7%)	100%
Grooming	26 (32.50%)	-	54(67.5%)	100%
Dressing	19 (23.80%)	21 (26.30%)	40(50.0%)	100%
Bowel control	22 (27.50%)	28 (35.00%)	30(37.5%)	100%
Bladder control	17 (21.30%)	29 (36.30%)	34(42.5%)	100%
Toilet use	21 (26.30%)	40 (50.00%)	19(23.7%)	100%
Transfer(bed/chair)	14 (17.50%)	19 (45.00%)	47(58.7%)	100%
Mobility (Level)	15 (18.80%)	28 (35.00%)	37(46.2%)	100%
Stairs	19 (23.80%)	37 (46.30%)	24(30.0%)	100%

Figure 1: Frequency distribution of Dependency Levels in Barthel Index Activities N=80



A chi-square analysis was performed to test the relationship between dysfunction (combined dysfunction and no dysfunction) and dependency category of Barthel Index (severe, moderate, and minimal). The findings showed a statistically significant correlation ($p < 0.001$) which emphasize the fact that existence of both vestibular and saccadic impairments have a close association with the levels of dependency in post-stroke patients.

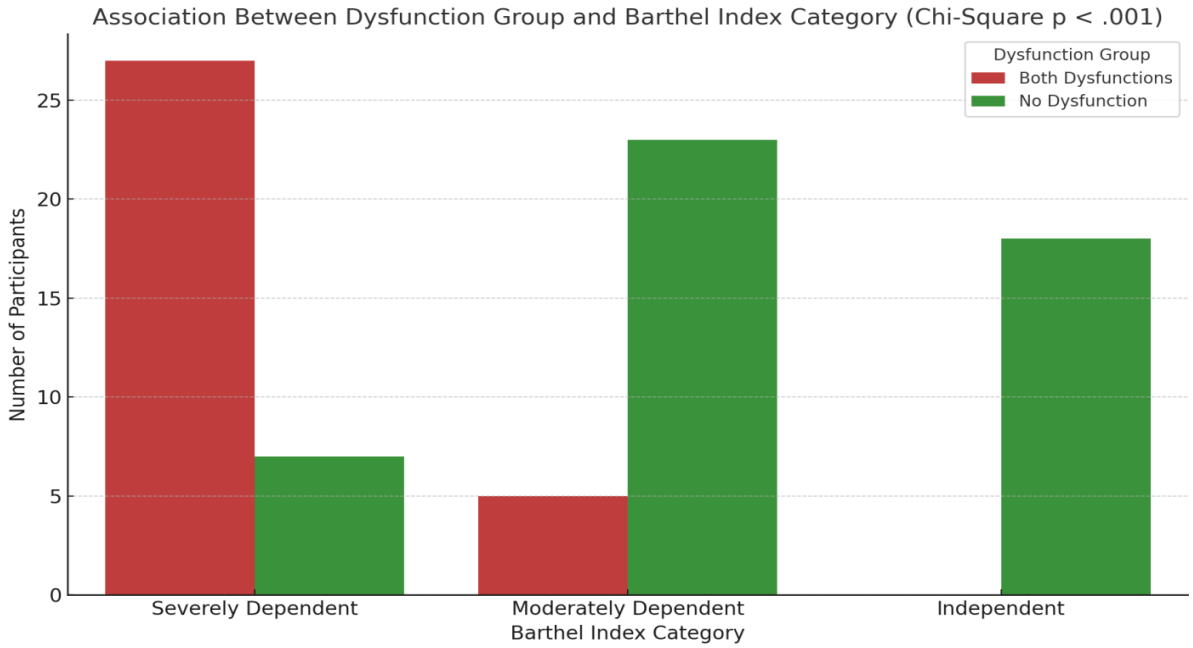
Table 4: Chi-Square Association between dysfunctional group and Barthel category

Dysfunction Group * Barthel category Cross tabulation				
Count				
Barthel Index category				
	Severely Dependent		**Moderately Dependent**	**Minimal Dependent** **Total**
Dysfunction Group				
Both saccadic and vestibular dysfunction	27		5	0 32
No dysfunction	7	23	18	48
Total				80
Chi Square Test				
	Value	**Df**		**Asymptotic Significance (2 sided)**

Pearson Chi-Square	39.725[a]	2	<0.001
Likelihood Ratio	46.831	2	< 0.001
Linear-by-Linear Association	35.780	1	<0.001

These results suggest that bilateral sensory-motor limitations significantly impact the functional capacity of stroke survivors, specifically their ability to perform activities of daily living (ADLs) independently, as illustrated in the figure below.

Figure 2: Chi Square Association of variables N=80



These results highlight the clinical relevance of detecting and treating vestibular and saccadic deficits in the post-stroke rehabilitative period because their occurrence seems to hinder better functional performance and an increased caregiver burden.

Discussion:

The current research focused on the occurrence of saccadic and vestibular impairment in patients with post-stroke conditions and their correlation with functional independence in activities of daily living (ADLs). The results show that combined sensory and motor impairments are very common and that there is a strong statistically significant relationship between the dysfunctions and high degrees of dependency. These findings underscore the significant but unacknowledged role played by both oculomotor and vestibular deficits in post-stroke disability.

Chan et al., the participants who had eye-tracking impaired parameters (post-stroke) had lower saccadic velocities and worse processing of visual data, all of which were related to functional and cognitive factors. Our study builds upon these observations by showing that the saccadic and vestibular impairments are not merely common but also directly relate to the worse independence in the ADLs, which highlights the functionality of the two mechanisms in more than diagnostic or cognitive screening roles. [19]

According to a report given by Khan and Chevidikunnan et al, impaired balance and loss of independence is caused by weakness and limitation of movements in the muscles and other psychological factors. Although this is significant, the current evidence indicates that sensory impairments, especially the loss of vestibular and saccadic functions, could also be another and clinically relevant process that can contribute to balance impairments and dependency. These findings will favor a more detailed model of post-stroke impairment taking into account the sensory, oculomotor, and motor components. [20]

Objective assessment equipment, including the Dix -Hallpike maneuver and standardized saccadic eye movement testing, are comparable with approaches suggested in the literature to detect vestibular and oculomotor deficits. The inclusion of these assessments in the clinical practice can be used to identify impairments that have an adverse impact on balance, visual stability, and functional recoveries earlier on. There are a number of limitations to be considered. The cross-sectional design does not allow for making causal conclusions, and the sample size is rather small, which can be a drawback regarding generalization.

More sophisticated digital eye-tracking and vestibular analysis technologies were not used as well, and this could have led to a decrease in the accuracy of measurements. The longitudinal designs, bigger samples, and objective digital tools should be utilized in future studies to define better recovery trajectories and the effects of specific rehabilitation interventions.

All in all, the results highlight the clinical effectiveness of the systematic evaluation and treatment of vestibular and saccadic conditions during the rehabilitation of post-stroke patients. Specific interventions to be used to address these sensory-motor impairments can help to promote functional recovery, decrease dependency, and improve the quality of life of stroke survivors.

Future Recommendations:

Improving post-stroke evaluation and integrating technology into long-term monitoring are the main suggestions of this study. To go beyond conventional motor evaluations, rehabilitation methods should specifically include thorough eye-tracking and vestibular tests to ensure early identification of the sensory abnormalities proven to limit functional recovery. Furthermore, longitudinal studies that track patients over a long period of time are essential to fully comprehending the effectiveness of treatment and the course of recovery. This long-term data collection would yield priceless information about neuroplasticity and the longevity of functional gains brought about by focused therapies. Lastly, a move toward AI-assisted tracking technologies is advised to increase the accuracy and objectivity of these monitoring and assessment procedures. This will allow for the fine-grained measurement of functional improvements and the accurate quantification of neuroplasticity.

Conclusion

The research establishes a statistically significant correlation between combined saccadic and vestibular impairments and severe functional dependency in post-stroke patients. While isolated deficits exist, the "dual-dysfunction" cohort (n=32) represents the most clinically vulnerable group, with **84.4%** classified as **Severely Dependent** on the Barthel Index ($p < 0.001$).

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Conflict of Interest

The authors declare no conflict of interest related to this study

References

Li X, He Y, Wang D, Rezaei MJ. Stroke rehabilitation: from diagnosis to therapy. Frontiers in neurology. 2024;15:1402729. https://doi.org/10.3389/fneur.2024.1402729

Meng L, Liang Q, Yuan J, Li S, Ge Y, Yang J, et al. Vestibular rehabilitation therapy on balance and gait in patients after stroke: a systematic review and meta-analysis. BMC medicine. 2023;21(1):322. https://link.springer.com/article/10.1186/s12916-023-03029-9

Yang X, Liu Q, Zhang H, Lu Y, Yao L. A predictive model for functionality improvement after stroke rehabilitation. Journal of Neurorestoratology. 2025;13(1):100157. https://www.sciencedirect.com/science/article/pii/S2324242624000640

Pimentel BN, Santos VAVd, editors. Influence of visual symptoms on posturographic performance after stroke. CoDAS; 2023: SciELO Brasil. https://www.scielo.br/j/codas/

Batool S, Zafar H, Gilani SA, Ahmad A, Hanif A. Effects of visual scanning exercises in addition to task specific approach on balance and activities of daily livings in post stroke patients with eye movement disorders: a randomized controlled trial. BMC neurology. 2022;22(1):312. https://doi.org/10.1186/s12883-022-02843-7

He W, Ji Y, Wei X, Wang F, Xu F, Lu C, et al. Eye movement technique to improve executive function in patients with stroke: A randomized controlled trial. Frontiers in Neurology. 2021;12:599850. https://doi.org/10.3389/fneur.2021.599850

Escribano-Colmena G, Rey-Mota J, Hadid-Santiago S, Ramos-Garrido Á, Tornero-Aguilera JF, Clemente-Suárez VJ, editors. Vestibular well-being benefits of a single session of functional neurology intervention on saccadic stimuli dysfunction. Healthcare; 2025: MDPI. https://www.mdpi.com/2227-9032/13/9/989

Wang Y-C, Chang P-F, Chen Y-M, Lee Y-C, Huang S-L, Chen M-H, et al. Comparison of responsiveness of the Barthel Index and modified Barthel Index in patients with stroke. Disability and rehabilitation. 2023;45(6):1097-102. https://www.tandfonline.com/doi/abs/10.1080/09638288.2022.2055166

Tang Z, Liu T, Long J, Ren W, Liu Y, Li H, et al. Static and temporal dynamic changes in brain activity in patients with post-stroke balance dysfunction: a pilot resting state fMRI. Frontiers in Neuroscience. 2025;19:1558069. https://doi.org/10.3389/fnins.2025.1558069

Thabet ER, Marzouk MH, Fayez ES. Effect of vestibular rehabilitation on balance and gait after stroke: A narrative review. Benha International Journal of Physical Therapy. 2025:68-79. https://bijpt.journals.ekb.eg/article_445357.html

Moon S-J, Park C-H, Jung SI, Yu J-W, Son E-C, Lee HN, et al., editors. Effects of an eye-tracking linkage attention training system on cognitive function compared to conventional computerized cognitive training system in patients with stroke. Healthcare; 2022: MDPI. https://www.mdpi.com/2227-9032/10/3/456

Sayed SZ, Abdul Wahat N, Raymond A, Hussein N, Wan Asyraf W, Omar M. Quantitative vestibular function tests in posterior circulation stroke patients: a review. Med J Malaysia. 2021;76(6):898-905. https://www.e-mjm.org/2021/v76n6/vestibular-function-tests.pdf

Kuipers JA, Hoffman N, Carrick FR, Jemni M. Post-Stroke Rehabilitation: Neurophysiology Processes of Bilateral Movement Training and Interlimb Coupling—A Systematic Review. Journal of Clinical Medicine. 2025;14(11):3757. https://pmc.ncbi.nlm.nih.gov/articles/PMC12156210/

Wang YL, Kapoor M, Fielding J, Reddel S, Zhu C, Clough M, et al. Saccadic eye movements in neurological disease: cognitive mechanisms and clinical applications. Journal of Neurology. 2025;272(8):539. https://link.springer.com/article/10.1007/s00415-025-13275-x

Sánchez-Sánchez M-L, Ruescas-Nicolau M-A, Carrasco JJ, Espí-López G-V, Pérez-Alenda S. Cross-sectional study of quadriceps properties and postural stability in patients with

chronic stroke and limited vs. non-limited community ambulation. Topics in stroke rehabilitation. 2019;26(7):503-10. https://www.tandfonline.com/doi/abs/10.1080/10749357.2019.1634360

Sana V, Ghous M, Kashif M, Albalwi A, Muneer R, Zia M. Effects of vestibular rehabilitation therapy versus virtual reality on balance, dizziness, and gait in patients with subacute stroke: A randomized controlled trial. Medicine. 2023;102(24):e33203. https://pubmed.ncbi.nlm.nih.gov/37327306/

Nairn B, Koohi N, Kaski D, Bamiou DE, Pavlou M. Impact of Vestibular Rehabilitation and Dual-Task Training on Balance and Gait in Survivors of Stroke: A Systematic Review and Meta-Analysis. Journal of the American Heart Association. 2025;14(11):e040663. https://doi.org/10.1161/JAHA.124.040663

Aderinto N, AbdulBasit MO, Olatunji G, Adejumo T. Exploring the transformative influence of neuroplasticity on stroke rehabilitation: a narrative review of current evidence. Annals of Medicine and Surgery. 2023;85(9):4425-32. https://journals.lww.com/annals-of-medicine-and-surgery/pages/default.aspx

Chan MK-l, Wong CL, Yu KP, Tong RK-y. Examining eye tracking metrics and cognitive function in post-stroke individuals: a comparison of visual searching tasks between those with and without cognitive impairment. Cerebrovascular Diseases. 2025;53(6):683-92. https://karger.com/ced/article/53/6/683/880156/Examining-Eye-Tracking-Metrics-and-Cognitive

Khan F, Chevidikunnan MF, editors. Prevalence of balance impairment and factors associated with balance among patients with stroke. A cross sectional retrospective case control study. Healthcare; 2021: MDPI. https://www.mdpi.com/2227-9032/9/3/320