Research Article

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# A Study on Quality of life, Gait Characteristics & Fatigue in Post Stroke Survivors of Odisha

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## Abstract

***Background & Purpose***

*Stroke is the 3rd leading cause of death in India with a prevalence of 200/1 lakh population. More than 80% of stroke patients have difficulties in ambulation and daily life activities decreasing the quality of life. Community dwelling stroke survivors have high risk of fall owing to the abnormal gait pattern. There is increased fatigue and low performance due to the neuromusculoskeletal abnormalities. This study aims to find out the prevalence of post stroke complications like quality of life, gait characteristics & fatigue in geographical region of Odisha.*

***Methods***

*A descriptive observational study was conducted in various hospitals in Cuttack & Khordha districts of Odisha. Two hundred stroke patients, 140 males & 60 females were included in the study. Video analysis was done using a normal videography camera. Stroke specific-QOL(SSQOL) was used to determine the quality of life, on observational gait analysis (OGA- Videography) to find out the gait abnormalities & Fatigue severity scale (FSS) to assess the level of fatigue.*

***Results***

*85% patients showed reduced ankle dorsiflexion and 70% patients showed reduced knee flexion in swing phase. 85% patients showed disturbances in mood & personality & around 95% people showed fatigue following low intensity exercise.*

***Conclusion***

*The results of this study showed a prevalence of 84.6 % post stroke complications in stroke survivors of Odisha*

**Keywords:** Circumduction Gait, Fatigue, Post Stroke Complications, Stroke, Quality of Life

## 1. Introduction

Stroke is defined by WHO as “rapidly developing clinical signs of focal disturbance of cerebral function, lasting more than 24 hours owing to vascular origin” [1]. Stroke contributes to be the second leading cause of death worldwide with date rate increasing by 25% over the last two decades [2]. In India, stroke accounts for being the 3rd leading cause of death followed by coronary heart disease & cancer [3].

Statistical data on epidemiology of stroke is very limited with varying incidence of stroke worldwide [4]. Asian studies have mostly documented reports from Japanese & Chinese population. India being a developing country is seeing an increase incidence of stroke over the years. Studies on prevalence & incidence of stroke started in late 1960’s in India [3]. The 1st epidemiological study was conducted in a rural town of Vellore followed by Kolkata, Mumbai & Bangalore. These studies reported a high prevalence

of stroke with highest prevalence among the Parsi population of about 8.42/1000 population [5].

In India, the prevalence of stroke was higher in rural than urban population (165/1000 to136/1000) [2]. The age-related prevalence reported with stroke was 250-300/1 lakh population. The annual Incidence rate of stroke in India is clearly not mentioned in any literature. Only one study by Banerjee et al, on incidence of rate stroke with taking in accounts the death showed an incidence of 105/100,000 population with women highly affected than the males [3]. However, a few studies found males to be more affected than females [6].

Another literature reports an incidence of 165000 stroke cases/ year in India [7]. Studies conducted so far show store commonly occurring in in persons over 60 years compared to people over 40 years [2]. Studies on stroke incidence & prevalence in Odisha is very scarce. Only one study by ICMR showed higher stroke in Cuttack district of Odisha ranging from 96.6 to 1876 for 1,00,000 population per year [8]. No documented study on incidence and prevalence of stroke in Odisha is till now present. Odisha accounts to be the 6th ageing state in India and as stroke has been widely seen in the elderly group it is expected to get a higher stroke incidence in Odisha. It has also been seen that stroke incidence is higher in lower middle-income countries compare to high income countries [8].

The common medical complication seen following stroke both in acute and rehabilitation phases are neurological cardiovascular and immobility complications [9]. The most devastating complication is the motor impairment affecting about 80% of the patients. This largely depends on the side of the brain injured. The rehabilitation in the post stroke phase largely affects the functional outcome. Rehabilitation is an interdisciplinary approach consisting of healthcare practitioner, medical doctors, speech therapist, nurses, physiotherapists, occupational therapists, vocational and social workers. The motor requirements commonly dealt during the rehabilitation process are spasticity, pain, pressure ulcer, gait impairments, balance coordination and fatigue [10]. All these impairments hampered the quality of life and overall exercise performance off the individual. It is highly required to understand which of these complications are the reason for maximum disability.

Gait abnormalities accounts for a large contributor for reduction in performance of activities daily. Common gait abnormalities seen in a stroke patient are abnormal spatio temporal parameters like reduce cadence, increase time of gait cycle and asymmetrical step length [11]. However there is no fix study telling which of the gate abnormality contributes to the circumductory gait. Some studies say ankle Dorsiflexion component as a major contributor for circumductory gait while few others report pelvic and hip knee component to be the main factor.

Owing to insult to the brain by any non-traumatic origin there is a wide range of focal neurological deficit characterised by sensory, motor cognitive and language abnormalities. These all together affect the overall functional status of the stroke survivor. Out of 15,000,000 people suffering from stroke worldwide [12, 13]. 5,000,000 suffer from common in disability which in turn affects the physical social mental and vocational life of the individual [14]. The statistics suggest there is a decrease in quality of life of this individual which demands towards more attention to this healthcare outcomes. Studies in the literature have suggested reduced fuel quality of life and its association with increased anxiety depression and fatigue [15-18].

In order to determine this aspect many scales are available like the SF 36, Euro QL, Stroke specific quality of life questionnaire (SSQOL), stroke impact scale. SSQOL measures the health-related quality of life and has a high reliability of 0.92 [19]. This is a self-administered scale but can also be administered over the telephone by the therapist [20]. Till now no study has been done on the prevalence of stroke complications in the geographical region of Odisha. As the incidence of hypertension and elderly population rise stroke cases are expected to increase so as the complications. 85% population of Orissa being rural based are at a risk of developing stroke end therefore require a proper exposure to the rehabilitation process. Gait abnormalities, quality of life, fatigue being some of the major complications of stroke have never been discovered in Odisha. The main purpose of the study was to study the abnormal get characteristics, quality of life and fatigue if any in stroke survivors of Odisha so that their rehab needs can be addressed, and a better quality of life can be provided.

## 2. Materials and Methods

This was an observational descriptive study done by including subjects from various outpatient clinics, rehabilitation setups and hospitals of Bhubaneswar and Cuttack districts of Odisha. Patients reporting for rehabilitation from August 2022 to November 2022 who fulfil the inclusion and exclusion criteria were taken in the study. Their available medical records and MRI scans were scrutinised by a neurologist to confirm the diagnosis.

This was a multicentred study that dint involve any invasive procedures. There were no adverse effects expected from this study, hence ethical clearance was obtained from the institutional review board of Sri Sri University & informed consent was obtained from all the subjects. Subjects were included if they had a stroke of duration more than 3 months, mentally conscious (MMSE>24) & were able to walk for 1 minute with or without support. Subjects with decreased cognition, mentally impaired, any other neurological diseases, acute stroke, non-ambulatory stroke cases were excluded. Two hundred subacute & chronic stroke survivors (140 males & 60 females) with mean age 58.50 ± SD 10.8 volunteered to participate & informed consent was taken.

### 2.1 Experimental Set up

All the data was collected using a normal videography camera for gait analysis & quality of life & fatigue were assessed by SSQOL scale & fatigue severity scale (FSS) either by the patient or over telephone. Demographic details included age, gender, duration of stroke & side of hemiplegia.

SSQOL is a self-administered questionnaire comprising of 49 items in 12 domains in a 5-point Likert scale. It covers domains of energy, family duty, language, mobility, mood, personality, self-care, social role, thinking, upper extremity function, vision & work/productivity with total scores ranging from 49-245. Higher scores denote better functional outcome [19]. A score less than 147(60%) is low quality of life (QOL) [21, 22]. FSS is a 9-item questionnaire measured on a 7-point Likert scale. Maximum score obtained is 63 & minimum is 7. Higher scores denote more fatigue. The intensity of fatigue at present was determined by visual fatigue analogue scale (VAFS).

### 2.2 Experimental Procedure

After Obtaining the informed consent, the subjects were asked to walk for few meters completing at least 5 gait cycles and their video was recorded using a normal videography camera. Video was taken from the sagittal & frontal view & was used for analysis. After the subjects completed the video recording, they were asked to fill up the SSQOL & FSS questionnaire. The English version of SSQOL & FSS was explained to the patients in Odia by the principal investigator & responses were recorded.

Video analysis was done by on observational gait analysis (OGA) method & kinematics parameters were recorded for each patient. Spatial parameters were not analysed as it was a OGA method. Hip, knee, ankle movements were observed in stance & swing phases by freezing & playing the video & those movements were compared to normal gait kinematics.

The scores from SSQOL & FSS were recorded for each domain & analysed for two hundred subjects.

## 3. Data Analysis

Shapiro-Wilk test was carried out to test the normality of the data. Descriptive Statistics were carried out to analyse SSQOL, FSS scores. The Video analysis was represented as Present /Absent if the specific movement of hip, knee & ankle was present at that phase of gait cycle & qualitative analysis was carried out.

## 4. Results

The age of the subjects ranged from 32-77 with a mean of 58.5+-10.85 years. The age distribution in this study is presented in table below.

20% of the samples were below 50 years of age & 80% above 50 years. There were 70% (140) males & 30% (60) females in the sample.

Out of 200 participants, 130 (65%) people were right hemiplegic whereas 70(35%) people were left hemiplegic. The duration of the stroke was from 3-13 months with a mean of 6.28± 2.6

The demographic details are presented in the table below. (Table 1)

| Variables | | Mean value |
|---|---|---|
| Age(n=200) | | 58.50 ± 10.85 |
| Duration in months | | 6.28 ± 2.66 |
| Side of hemiplegia (in Percent) | Right | 65% |
| | Left | 35% |
| Gender (in Percent) | Male | 70% |
| | Female | 30% |

**Table 1: Demographic Details**

### 4.1 SSQOL

In the present study, 25% of people felt tiered most of the time, 50% people believed they were burden on the family, 10% of people had difficulties in speaking, 55% people have difficulty in walking & 60% have issues in maintaining their balance. We found only 10% people to be irritable & low in mood. 30% of people were facing difficulties in self-care activities whereas >50% have an increased social isolation owing to their disability. Our study found a good upper extremity function in these patients but a decline in the work/productivity as a result of the stroke. (Fig. 1)

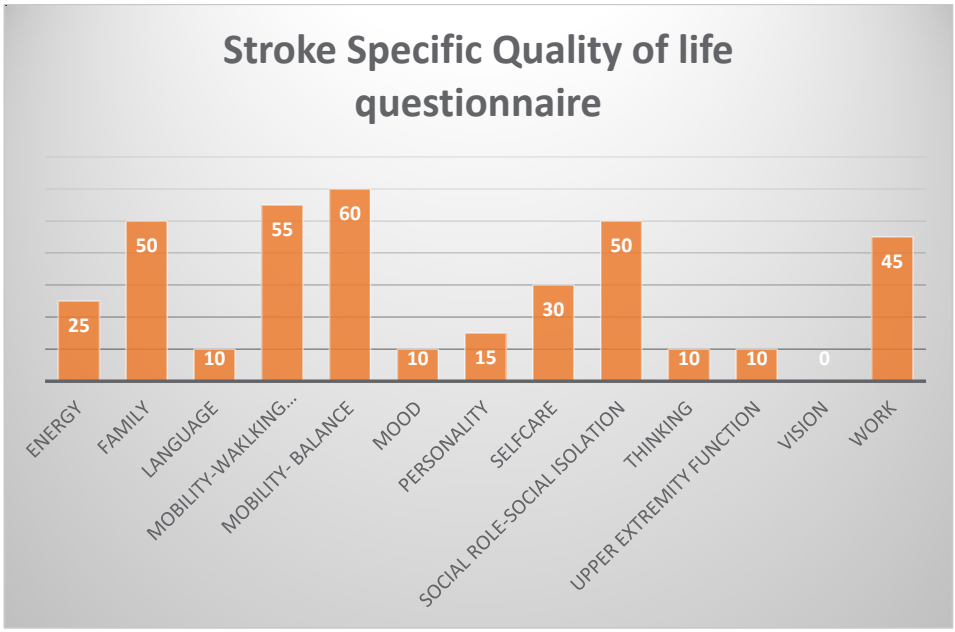


**Figure 1:** SSQOL domain in percentage

The mean total score was 168.20 with a SD of 25.42. Results show that QOL was low in 35% of the sample. (Fig. 2)

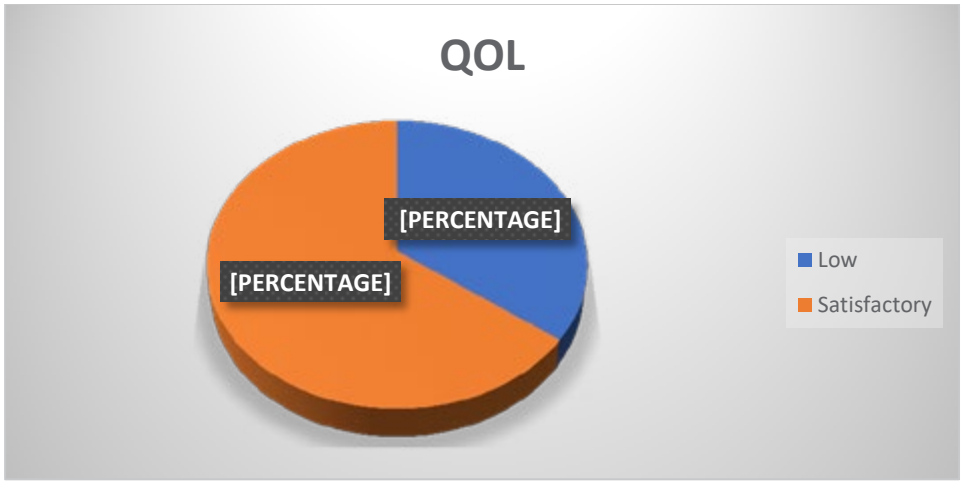


**Figure 2:** QOL in stroke patients

### 4.2 FSS

Results of our study show only 35% of people believe fatigue to be a factor for low motivation while 65% people say exercise is the main contributor to fatigue. 25% people believe they are easily fatigued & 45% said fatigue interfered with their physical function & it prevented sustained physical functioning. About 55% said fatigue is among their most disabling symptom & 50% said fatigue affected their social life. (Fig. 3)

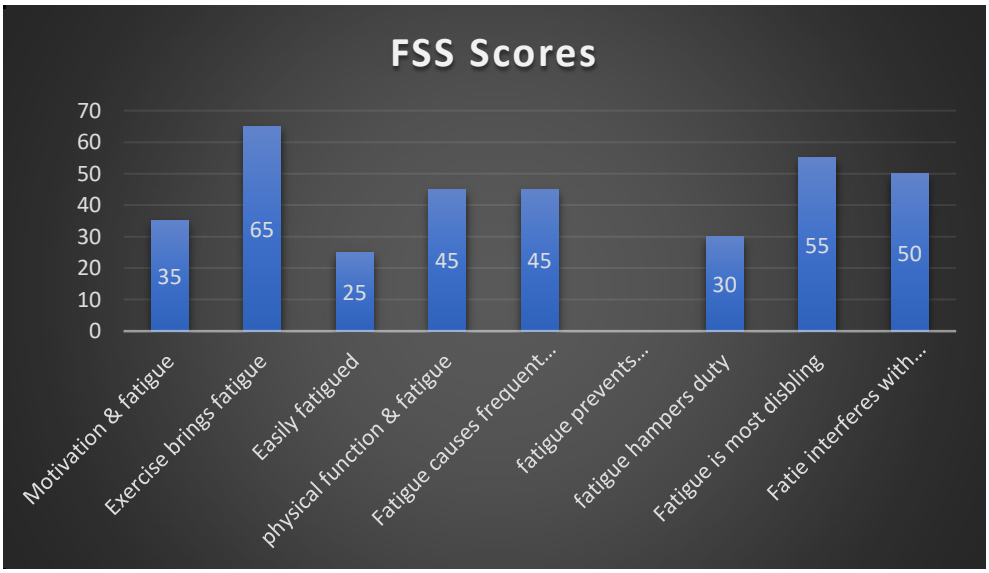


**Figure 3:** FSS Scores

Out of 200 patients, 120 patients rated > 5 of VAFS scale & 80 patients< 5, indicating more severe fatigue.

### 4.3 Kinematic Analysis

We studied the kinematics of 200 patients with stroke by video analysis method. Our results show at heel strike hip flexion was present in all samples, knee extension in 95% 7 only 50% people had ankle plantar flexion while 50% of the sample lacked an effective heel strike. Kinematics were normal at foot flat & midstance for hip, knee & ankle movements. In push off/ pre swing phase (60% of gait cycle) 25% of the sample lacked hip flexion, 40% lacked knee flexion & 25% lacked ankle plantar flexion. On further assessment we found, frequent deviations from normal gait in the swing phase giving rise to circumductory pattern of gait. 85% of sample lacked an effective ankle dorsi flexion & 75% lacked knee flexion. Hip flexion was not present in only 10% of the sample. Pre swing & swing phase kinematics are shown in figure 4 & 5 respectively.

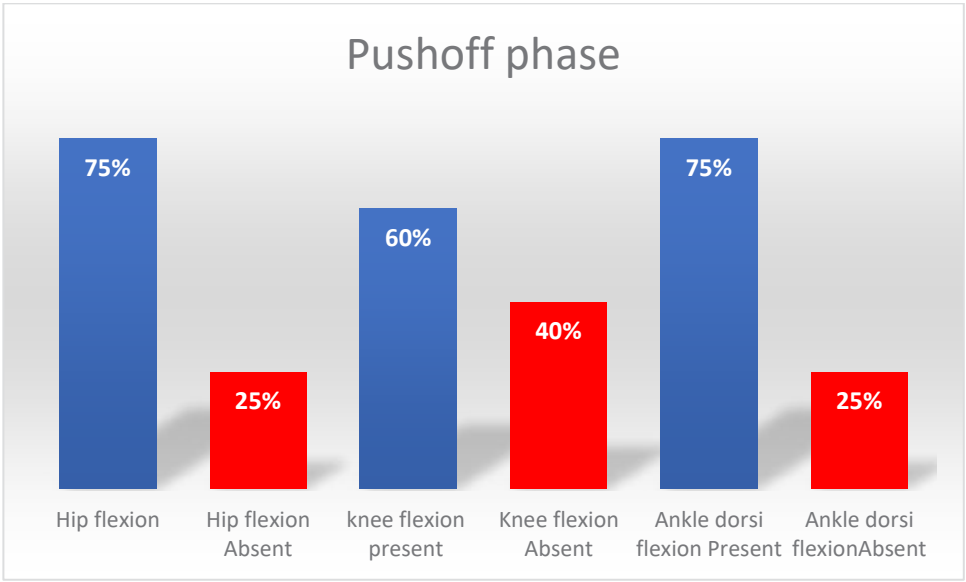


**Figure 4:** Push off phase kinematics.

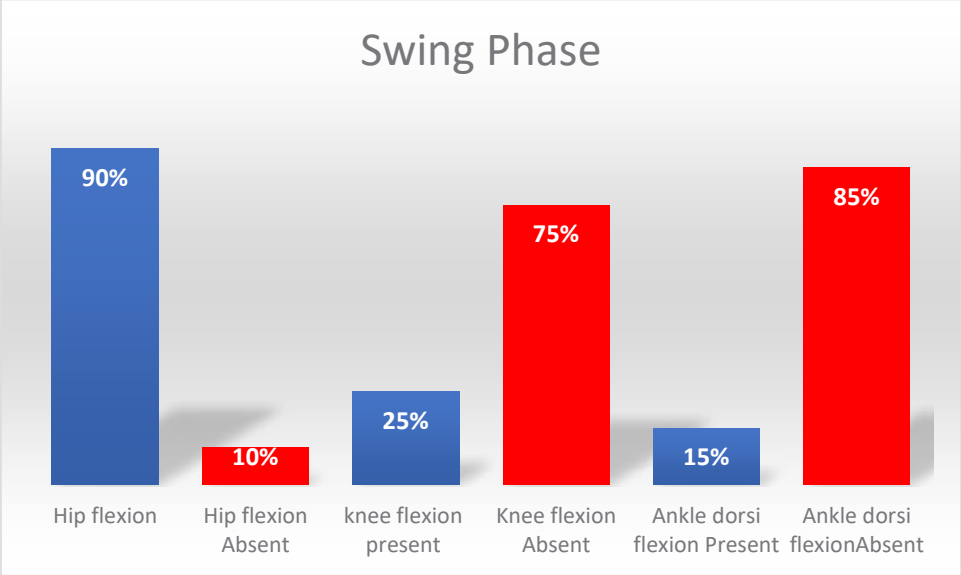


**Figure 5:** Swing Phase Kinematics

## 5. Discussion

In the present study we examined the post stroke complications among stroke survivors of Odisha. Mean age of patients was 58.5± 10.85 years. In the study, 70% were males & 30% females. We aimed to study the occurrence of gait abnormalities in these patients & if these abnormalities affect the quality of life (QoL) of the subjects. Since most of the stroke patients also complain of decreased exercise performance, we tried to find out if fatigue is a contributor for the same. As expected, this study found few domains of SSQOL greatly affected in stroke survivors. The domains of mobility, social isolation & work/productivity & personality produced very low scores. This is supported by previous studies which showed work & productivity to be the most affected segment followed by mobility & then social roles & then language [14,23].

QoL was found to be low in 35% of our sample. The mean scores obtained was 168.82±25, a value less than 147(60%) is said to represent low QoL. In our study,70 subjects had scores less than 140. A study by King R B who studied the QoL in stroke reported a decrease in health related QoL during stroke rehabilitation [24]. 65% of the subjects reported a satisfactory QoL. The domains where the respondents scored better were language, vision, thinking, selfcare & personality. This can imply that stroke rehabilitation is now increasing implying better family support which could have contributed to better SSQOL scores in those domains. Studies done in Nigeria; Brazil & Pakistan showed average scores in QoL. These differences may be due to the cross-cultural socioeconomic variations.

Fatigue is defined as a feeling of early exhaustion with weariness, lack of energy & aversion to effort [25]. Post stroke fatigue is a very ignored symptom and often gets missed. Fatigue greatly affects the exercise performance of the stroke patient. In our study, we used fatigue severity scale (FSS) questionnaire to find out the occurrence of fatigue. The mean score obtained on FSS was 36.05 which indicates fatigue as average symptom in our study. This is supported by previous studies done on post stroke fatigue [26,27]. We also scored the intensity of fatigue measured by visual fatigue analogue scale (VAFS). Lesser the score worst is the fatigue. The mean score obtained on VAFS was 5.2, also indicating fatigue intensity to be average. Previous studies done on fatigue intensity in stroke also suggest fatigue intensity average to normal in stroke patients. So, more studies need to be conducted on finding the main cause of fatigue in stroke patients. Most of our subjects said exercise brings their fatigue & fatigue is one of their disabling symptoms. This bring us to the fact that reduction or lack of exercise can be a result of fatigue & we need to address their fatigue symptoms & focus the rehabilitation on addressing the issues of fatigue. We also found a high correlation between FSS scores & VAFS scores. The higher the scores of FSS the lower was the scores in VAFS.

### 5.1 Gait Kinematics

Normal human locomotion involves forward propulsion of the centre of gravity (COG) in a sinusoidal pathway. The cycle of events occurring between initial contact of one foot & subsequent contact of the same foot is defined as the gait cycle. The whole gait cycle can be divided into a stance phase, in which the limb is in contact with the ground & a swing phase in which the limb is off the ground. Considering the whole gait cycle to be 100%, stance phase constitutes 60% & swing phase 40 % [28]. In our study, we tried to find out the deviations from the normal pattern. The stance & swing phases are further divided into sub phases that specifically produces three major tasks- weight acceptance, single limb support & limb advancements [29].

The advancement of COG includes heel strike, foot flat, mid stance, heel off & toe off in the stance phase & initial swing, terminal swing in the swing phase. Our study focused only on the motion component without considering the force factors by observational methods. Various studies in past have used OGA method to analyse gait & found it moderately reliable(r=0.60) [30]. In this study, we found almost all subjects had a normal hip movement in the initial contact, foot flat & mid stance phase. Though previous studies have shown decreased hip extension in stance phase (Richards 1981, Lehmann 1987). We dint find any deviations of hip in stance phase. One of the major reasons for decreased hip extension is reduced work of gluteus maximus, gluteus Medius, semitendinosus & biceps femoris along with appropriate plantar flexor activation. However, the subjects we took were in subacute & chronic stage& might have developed a good hip flexor activity by that time which could have prevented the restriction of hip extension. Knee extension was not there in only 5% of the subjects in the initial stance phase. However, 80% of the people had knee hyperextension in the midstance phase. This finding is supported by studies done on hemiplegic gait by Knulsson & Richards 1979, Lehmann et al 1987. One possible reason could be decrease in the knee flexor muscle component enabling the knee to rapidly hyperextend in the midstance phase.

50% of our subjects lacked an effective ankle movement for heel strike. From terminal swing to hill strike the dorsiflexors most contract towards a plantigrade position. One possible reason that could avoid this is this spasticity in the ankle plantar flexors. This is supported by previous studies which have reported changes in the biomechanical properties of the ankle in persons with hemiplegia. [31]. We found the major deviations in the pre-swing and swing phases for hip knee and ankle movements. Our study found hip flexion was lacking in 25% of the subjects, knee flexion in 40% and ankle plantar flexion in 25% during the pre-swing phase. Study by Moosely et al on-stance phase of hemiplegia supports our finding [31]. Hip flexion in the pre-swing phase is by contraction of hip flexor muscles and gravitational forces. Decrease in concentric contraction of the hip flexors in the pre-swing phase might have reduced the angular velocity of the thigh resulting in a decreased hip flexion. This reduction of hip flexion in the pre-swing phase eventually leads to reduction of peak hip flexion in the swing phase as well.

The deviations from normal gait were more pronounced in the swing phase with 75% up the subjects lacking an effective knee flexion and 85% of our subjects lacking an effective ankle dorsiflexion. These findings are supported by previous studies done by Knulsson and Richard 1979, Lehmann et al 1987, Grihithusane et al 1982. Moseley et.al have extensively laid down the best possible causes for reduced hip flexion [32]. We could not establish the facts contributing to this decreased hip flexion as we were only studying the kinematic parameters. One possible cause that can be deduced by taking into reference the previous studies is decreased knee flexors activity and increased knee extensors activation might have prevented the knee flexion during the swing phase.

Moosely et al have also found reduce ankle dorsi flexion in the swing phase as a common deviation in the post stroke patients. Our study also established similar results where 85% of subjects lag dorsiflexion in the swing phase. This can likely be due to reduced dorsiflexors muscle activation or increased plantar flexors activation. Inability to flex the knee and dorsiflex the ankle make the stroke survivors elevate they are pelvis on the swing leg and abduct it to bring it forward to avoid the dragging of foot. These typical patterns of hiking the pelvis and swinging the lake along the arc of a circle is known as circumduction gait which is a typical pattern of hemiplegic gait. In our study we tried to establish the prevalence of circumduction gait in the stroke survivors of Odisha and found a high prevalence of it. The main purpose of our study was to identify the gait abnormalities, their quality of life and fatigue which might have hampered their rehabilitation process. We also aimed to find their quality of life after stroke and any persistence of fatigue as a post stroke complication. We found an average quality of life and moderate fatigue in stroke survivors of Odisha. The findings of this study will help readers towards the common prevalent complications in the stroke survivors of Odisha and demands for appropriate rehabilitation measures to tackle these complications.

The major limitations of the study were it was a descriptive study, and the sample size was less. Since we did an observational analysis method for gait kinematics, in the future we can use a 3D marker system along with EMG sensors to establish the kinetics and kinematics components in quantifiable form. In future we can conduct studies to find out the major contributor for circumductory gait weather decreased knee flexion or decreased ankle dorsiflexion.

## 6. Conclusion

This study concludes that gait deviations were present in most of the patients of stroke survivors of Odisha with average quality of life and moderate fatigue.

## List of Abbreviations

QoL: Quality of life
SSQOL: Stroke specific quality of life
FSS: Fatigue severity scale
VAFS: Visual analogue fatigue scale

## Declaration

**Ethics approval & Consent to participate:** Ethical clearance was obtained from the institutional review board of Abhinav Bindra Sports medicine & research institute. Informed consent was obtained from all subjects before recruiting them for the study.
**Consent to publish the results:** All the participants were informed about the need of the study & consent to publish the results were obtained.
**Data Availability statement:** The data that support the findings

of this study are available from the corresponding author upon request.

**Conflict of interest:** The authors declare they have no conflict of interest.

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**Authorship contribution:** 1st Author SS collected data and designed the study. Second author TG analysed the data & prepared the manuscript.

## References

1. Coupland, A. P., Thapar, A., Qureshi, M. I., Jenkins, H., & Davies, A. H. (2017). The definition of stroke. Journal of the Royal Society of Medicine, 110(1), 9-12.
2. Kamalakannan, S., Gudlavalleti, A. S., Gudlavalleti, V. S. M., Goenka, S., & Kuper, H. (2017). Incidence & prevalence of stroke in India: A systematic review. The Indian journal of medical research, 146(2), 175.
3. Banerjee, T. K., & Das, S. K. (2006). Epidemiology of stroke in India. Neurology asia, 11, 1-4.
4. Sethi, P. K. (2002). Stroke-incidence in India and management of ischemic stroke. Neurosciences, 4(3), 139-41.
5. Banerjee, T. K., & Das, S. K. (2016). Fifty years of stroke researches in India. Annals of Indian Academy of Neurology, 19(1), 1.
6. Dalal. P. G. (2005). Stroke initiative: A report on population-based Mumbai stroke registry. India Int J Stroke. 4:234–40.
7. Padma, V. M., Bhatia, R., Kuruttukulam, G., Alurkar, A., Talwar, K. K., Khurana, D., ... & Huded, V. (2016). A call for neurologists to take up stroke intervention. Annals of Indian Academy of Neurology, 19(4), 429.
8. ICMR report. Stroke Incidence and Mortality: A Report of the Population Based Stroke Registries, India (National Stroke Registry Programme). ISBN: 978-93-5578-518-3
9. Gourie-Devi, M., Gururaj, G., Satishchandra, P., & Subbakrishna, D. K. (2004). Prevalence of neurological disorders in Bangalore, India: a community-based study with a comparison between urban and rural areas. Neuroepidemiology, 23(6), 261-268.
10. Rohweder, G., Ellekjær, H., Salvesen, Ø., Naalsund, E., & Indredavik, B. (2015). Functional outcome after common poststroke complications occurring in the first 90 days. Stroke, 46(1), 65-70.
11. Whitehead, S., & Baalbergen, E. (2019). Post-stroke rehabilitation. South African Medical Journal, 109(2), 81-83.
12. Wang, Y., Mukaino, M., Ohtsuka, K., Otaka, Y., Tanikawa, H., Matsuda, F., ... & Saitoh, E. (2020). Gait characteristics of post-stroke hemiparetic patients with different walking speeds. International journal of rehabilitation research. Internationale Zeitschrift fur Rehabilitationsforschung. Revue internationale de recherches de readaptation, 43(1), 69.
13. Stroke Statistics [ internet stroke centre/ Cited 20th June,2010.
14. Muralidharan, D. P., Babu, B., Chitra, G., Sreejith, K., & Gafoor, S. A. (2019). Quality of life in stroke survivors in Central Kerala. J Med Sci Clin Res, 7, 986-95.
15. Heikinheimo, T., & Chimbayo, D. (2015). Quality of life after first-ever stroke: An interview based study from Blantyre, Malawi. Malawi Medical Journal, 27(2), 50-54.
16. Laurent, K., De Sèze, M. P., Delleci, C., Koleck, M., Dehail, P., Orgogozo, J. M., & Mazaux, J. M. (2011). Assessment of quality of life in stroke patients with hemiplegia. Annals of physical and rehabilitation medicine, 54(6), 376-390.
17. Babitha, R., Tyloth, M., & Murthy, N. S. (2019). Assessment of quality of life among stroke survivors: A longitudinal study.
18. Raju, R. S., Sarma, P. S., & Pandian, J. D. (2010). Psychosocial problems, quality of life, and functional independence among Indian stroke survivors. Stroke, 41(12), 2932-2937.
19. Williams, L. S., Weinberger, M., Harris, L. E., Clark, D. O., & Biller, J. (1999). Development of a stroke-specific quality of life scale. Stroke, 30(7), 1362-1369.
20. Williams, L. S., Redmon, G., Saul, D. A. C., & Weinberger, M. (2000). Reliability and telephone validity of the Stroke-Specific Quality of Life (SS-QOL) scale. Stroke, 32(suppl_1), 339-339.
21. Rangel, E. S. S., Belasco, A. G. S., & Diccini, S. (2013). Qualidade de vida de pacientes com acidente vascular cerebral em reabilitação. Acta paulista de enfermagem, 26, 205-212.
22. Naess, H., Lunde, L., Brogger, J., & Waje-Andreassen, U. (2012). Fatigue among stroke patients on long-term follow-up. The Bergen Stroke Study. Journal of the neurological sciences, 312(1-2), 138-141.
23. Williams, L. S., Weinberger, M., Harris, L. E., Clark, D. O., & Biller, J. (1999). Development of a stroke-specific quality of life scale. Stroke, 30(7), 1362-1369.
24. King, R. B. (1996). Quality of life after stroke. Stroke, 27(9), 1467-1472.
25. Staub, F., & Bogousslavsky, J. (2001). Fatigue after stroke: a major but neglected issue. Cerebrovascular Diseases, 12(2), 75-81.
26. Lerdal, A., Bakken, L. N., Kouwenhoven, S. E., Pedersen, G., Kirkevold, M., Finset, A., & Kim, H. S. (2009). Poststroke fatigue—a review. Journal of pain and symptom management, 38(6), 928-949.
27. Tseng, B. Y., Gajewski, B. J., & Kluding, P. M. (2010). Reliability, responsiveness, and validity of the visual analog fatigue scale to measure exertion fatigue in people with chronic stroke: a preliminary study. Stroke research and treatment, 2010.
28. Bonnefoy, A., Armand, S. (2015). Normal Gait. In: Orthopedic Management of Children with Cerebral Palsy: A Comprehensive Approach. [s.l.]: Nova Science Publishers Inc, 2015. p. 567.
29. Roberts, A. (2010). Gait analysis: Normal and pathological function (2nd edition). The Journal of Bone and Joint Surgery. British volume, 92-B(8), 1184-1184.
30. Krebs, D. E., Edelstein, J. E., & Fishman, S. (1985). Reliability of observational kinematic gait analysis. Physical Therapy, 65(7), 1027-1033.

31. Moseley, A., Wales, A., Herbert, R., Schurr, K., & Moore, S. (1993). Observation and analysis of hemiplegic gait: stance phase. Australian journal of physiotherapy, 39(4), 259-267.

32. Moore, S., Schurr, K., Wales, A., Moseley, A., & Herbert, R. (1993). Observation and analysis of hemiplegic gait: swing phase. Australian journal of physiotherapy, 39(4), 271-278.