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# Balance impairment and associated factors among stroke survivors in public hospitals of Amhara regional state: a multicenter cross-sectional study

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## Abstract

**Introduction** Balance impairment is one of the common impairments in patients after stroke. It can lead to depression reduced speed of mobility, dependent on assistive device and reduce quality of life. However, evidence on balance impairment and its risk factors among stroke survivors in Ethiopia was lacking particularly in the study area. Therefore, this study aimed to investigate prevalence and associated factors of balance impairment among stroke survivor's attendee at an outpatient clinic in Amara regional state comprehensive specialized hospital.

**Methods** An institutional based cross-sectional study was conducted from April 1-June 30, 2022. A total of 400 participants were selected using the systematic random sampling technique. Standard Berg balance scale tool and semi-structure questionnaire was used. Multicollinearity and model fitness were checked. Variables with a p-value of less than 0.25 in the Bivariable regression were entered into a multivariable logistic regression and p value < 0.05 was used as cutoff point for significant variables.

**Result** The prevalence of balance impairment was 51.5% (95% CI (46.58, 56.39)). Being depressed (AOR= 12.25:95% CI (4.727, 31.779)), using walking aids (AOR=8.76:95%CI(3.469, 22.117)), abnormal speed (AOR=6.73:95%CI (2.671, 16.977)), did not have physiotherapy treatment (AOR= 3.96:95%CI (1.483, 10.586)), and unmarried (AOR= 2.71, 95% CI = 1.061, 6.903) were significantly associated with balance impairment.

**Conclusion and recommendation** The prevalence of balance impairment in the study was high. Being depressed, use walking aids, did not have physiotherapy treatment, abnormal speed of mobility, and unmarried were significantly associated factors. Therefore; it is better to give greater emphasis for those factors.

**Keywords** Stroke, Balance impairment, Risk of fall, Balance impairment rehabilitation

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## Introduction

Stroke is a chronic and devastating disease with an estimated high level economic burden [1, 2]. Stroke remain the second leading causes of mortality in worldwide and has long term consequence including significant activity limitation, participate restriction, reduce quality of life and impaired balance [3–10]. In addition that, stroke has short term consequence that can impair patients ability to sitting, get in and out of their beds and chairs, with unfavorable impact on caregivers wellbeing and dress themselves [5, 11–15]. Stroke patient face challenges; such as motor deficit, sensory deficit, communication deficit, declining cognition, mental and physical health problem [14, 16–19].

Balance impairment (BI) is commonly found in stroke survivors [20]. It has been related to worse physical impairments, disability, and low quality of life [21]. Balance impairment in stroke has common cause of poor standing ability, asymmetrical weight distribution, difficult in weight shifting, impaired coordination and somatosensory function, muscle weakness, and increased postural sway [22, 23]. Furthermore, the effects of balance impairment following a stroke cause survivors to feel more alone and depressed, experience a higher risk of falls that result in fractures and other fall-related injuries, fear of falling, significantly limit their activities and participation, spend longer time in the hospital, which costs the family and society money, have a lower quality of life, and have less mobility [19–21, 24–28].

The possible factors for balance impairment reported in different literatures are severity of stroke, being depressed, older age, female gender, post-stroke duration, abnormal speed of mobility, decreased level of activity, use assistive device, did not have physiotherapy treatment, handedness, decreased power of knee flexor, knee extensor, ankle plantar flexor and dorsiflexors [21, 25, 27, 29]. Since the balance function has been shown decrease with aged [30].

Assessment of balance impairment at admission could explain the motor response to the rehabilitation programs in sub-acute patients, and could also act as a predictor for balance stability during the discharge [28]. Similarly, balance confidence has been reported to predict perceived physical function, mobility and recovery at 12 months in patients with stroke [31]. Good balance is also important for stepping patterns, gait velocity, and initial training of gait in subjects with stroke [32, 33].

Evidence in different publication has shown that the prevalence rate of balance impairment is different due to the use of different evaluating or diagnostic procedure and assessment time. A systematic review of the literature reported that approximately 26 to 35% of stroke survivors experiences post stroke balance impairment [34]. A network metaanalysis assessing the prevalence of

post stroke balance impairment by observational studies found that a prevalence of 83% of the stroke survivors had balance impairments, while another metaanalysis examining the prevalence of balance impairment found 47% [20, 35]. However, there are paucity of studies about balance impairment magnitude and correlates among stroke survivors in Ethiopia. Data on stroke in Ethiopia are evidently lacking, and this marked lack of evidence in the region regarding both the incidence and the prevalence of stroke has made the assessment of prevalence of post-stroke balance impairments even more difficult [36]. With the importance of establishing the prevalence of balance impairments and the factors associated, it is accordingly necessary to provide such a study for the region. Therefore, this study aimed to investigate prevalence and associated factors of balance impairment among stroke survivor's attendee at outpatient clinic in Amhara regional comprehensive specialized hospital, North West Ethiopia, 2022.

## Methods

### Study design and period

Institutional based crosssectional study was conducted from April 1 to June 30, 2022 to assess the prevalence and associated factors of balance impairment among stroke survivors' attendee at outpatient (OPD) clinic at University of Gondar Comprehensive Specialized Hospital (UOGCSH), Felege Hiwot Comprehensive Specialized Hospital (FHCSH), Tibebe Gion Comprehensive Specialized Hospital (TGCSH), and Dessie Comprehensive Specialized Hospital (DCSH).

### Study area

A study was conducted at Amhara regional state comprehensive specialized hospitals following medical and physiotherapy outpatient clinic in UOGCSH, FHCSH, TGCSH and DCSH. Amhara region is the second most populous region in Ethiopia. There area total of eight referral hospitals in Amhara regional state. Among them four are compressive specialized hospital, such as; FHCSH, UOGCSH, DCSH and TGCSH. Each compressive hospital serves 3.5-5 million people per year. FHCSH and TGCSH are found in Bahir Dar which is the capital city of the Amhara National Regional State, located approximately 565 km northwest of Addis Ababa, DCSH found at Dessie town 480 km from Bahir Dar, the capital city of Amhara regional state and located 401 km away from Addis Ababa, the capital city of Ethiopia [37].

Monthly 69 new Stroke survivor patients at FHCSH and 63 at TGSH are following at the medical and Physiotherapy OPD clinic. Similarly, 66 and 66 patients visiting per month averagely in DCSH and UOGCSH respectively. On three months based on information from registration book, on average total stroke survivors in each

selected compressive hospital such as FHCSH=207, TGCSH=189, UoGCSH=198 and at DCSH=198 stroke survivors are following medical and physiotherapy OPD. Totality 792 stroke survivors are served from the four compressive specialized hospitals within 3 months.

**Source population** All stroke survivors who were following medical and Physiotherapy outpatient clinic at Amhara regional comprehensive specialized hospitals.

**Study population** All selected stroke survivors' who were following medical and Physiotherapy outpatient clinic in UOGCSH, FGCSH, TGCSH and DCSH during the study period.

**Inclusion criteria** -those survivors diagnosed with stroke, aged 18 and older, post stroke duration 2 weeks and more since the onset of stroke, walk independently with or without assistive device, and who can follow simple instructions on berg balance scale and can sign the consent form.

**Exclusion criteria** patients with pre stroke balance impairments, ataxic patients, osteoarthritis of the joints of the lower extremity [38].

#### Sample size determination and sampling procedure

##### Sample size determination

The sample size was determined by single proportion formula assumption. Due to no prior study done in Ethiopia the following assumptions were considered. A 5% level of significant, proportion of 50% prevalence of balance impairment (since no study has been done in the study area with the same population) [39], and a marginal error of 5%. The required sample size was obtained by the following calculation ( $n$ =sample size,  $p$ =anticipated prevalence,  $d$ =margin of error).

$$n = (z / 2)^2 (p) (1 - p) / d^2$$

$$n = (1.96)^2 (0.5) (1 - 0.5) / (0.05)^2$$

$$n = 384.16 \approx 385.$$

By considering 10% of non-response rate,  
 $n = 424.$

##### Sampling technique and procedure

First study participants were proportionally allocated to each selected Comprehensive Specialized Hospital. A systematic random sampling technique was used to select study participants and to collect data from stroke survivors waiting for clients or based on their order of appearance in that selected Hospitals.

The sampling interval value was determined by  $K = N/n$  for each selected compressive specialized hospital accordingly at which stroke survivors' who had a follow-up. For each selected hospital  $K$  value is two. The first individual was taken using a lottery method within sampling interval to know whether even or odd number to select stroke survivors in every other two stroke survivors with their entrance time to follow up ward at each selected compressive Hospital. To avoid recycling of data's special marks were used in the chart and verbal confirmation with participate was performed. The total source of population in each respective hospitals were FHCSH=207, TGCSH=189, UOGCSH=198, and DCSH=198.

Ultimately, the participant was taken from each compressive specialized hospital who had follow up in medical and physiotherapy OPD until the required number of sample size 424 was found (Fig. 1).

#### Study variables

##### Dependent variables

**Balance impairment (BI):** The balance impairment was measured by the berg balance scale (BBS) which assessed 14 aspect of BI: Sitting to standing, Standing unsupported, Sitting unsupported, Standing to sitting, Transfers, Standing with eyes closed, Standing with feet together, Reaching forward with outstretched arm, Retrieving object from floor, Turning to look behind, Turning 360 degrees, Placing alternate foot on stool, Standing with one foot in front and Standing on one foot [40]. A score of "0–20" on BBS is regarded as "balance impaired" while a score of "21–40" and "41–56", respectively, depict acceptable balance and good balance [41]. In this study the score of balance impairment on BBS was dichotomized with "0–20" represented as "balance impaired" while a score of "21–56" represented as "no balance impaired".

##### Independent variable

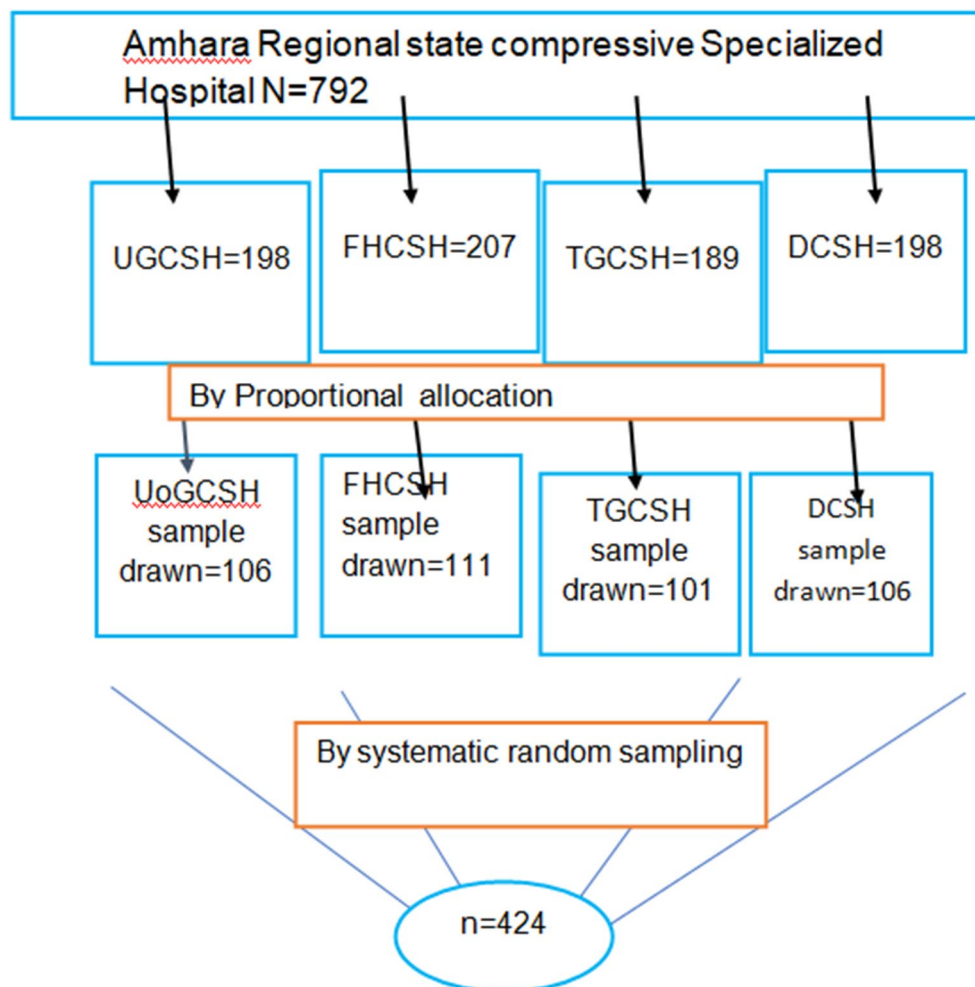
**Socio demographic of participant** age, sex, religion, marital status, income level and educational status.

**Clinical and rehabilitation related factor** type of stroke, cerebral hemisphere injured, post-stroke duration, number of physiotherapy treatment taking sessions, use walking aid.

**Activity and speed of mobility-related factor** activity of daily living, speed of mobility.

**Psychosocial factor** depression.

**Activity of daily living (ADL)** were assessed in all study participants by Barthel index (BI), which measure the



**Fig. 1** schematic presentation of sampling procedure among stroke survivors at Amhara regional compressive specialized hospital northwest of Ethiopia 2022

extent to which somebody can function independently and has mobility in their activity of daily living [42, 43].

**The Barthel Index (BI)** =is an ordinal scale used to measure performance in activities of daily living. The score  $\leq 60$  indicate “dependency, 61–100 = indicate “independent” [44].

**Speed of mobility** Were assessed in all participant through a time up and go (TUG) test. Assistive device typically used during ambulation were permitted during testing, but participants did not receive physical assistance during move/walk [45].

**Time up and Go (TUG)** =is an objective clinical measure for assessing speed of mobility and the risk of falling [46]. The TUG test measures the time taken for the participant to rise from a chair, walk 3 m, turn, walk back and sit down [47]. Time  $< 14$  s was considered as ‘normal speed’, and time  $> 14$  s was considered as ‘abnormal speed’ [45].

**Depression** : were assessed in all study participants by geriatrics depression scale which has 15 item scale with a yes/no response format [48].

**The Geriatric Depression Scale–Short Form (GDS-SF)** was used to screen for depressive symptoms in this study. The 15 items in the GDS-SF were extracted from the original 30-item GDS. Respondents were required to answer ‘yes’ or ‘no’ to the 15 statements that describe either a positive or a negative emotion/condition. The score of depression in the GDS were categorized in this presented study with  $> 10$  representing “depressed” while scores of  $GDS \leq 10$  representing “not depressed” [49]. GDS is a reliable and valid measure have been ascertained with large samples of depression in post stroke patients [48, 50].

#### Data collection tool and procedure

Data was collected using semistructured questionnaire. Eight junior BSC physiotherapists collected the data and

two experienced BSC physiotherapist supervised the data collection process. The data was collected by face-to-face interviews, chart review, examination, and observation, with the participant, regarding on balance impairment. An English version of the questionnaires were first changed to Amharic language to collect data and then changed again into English language for consistency and further analysis purpose.

The questionnaire containing information about factors will have five parts. Those are socio-demographic related factor (age, sex, weight, height, educational background, marital status and income), clinical and rehabilitation related factor (Type of stroke, Cerebral hemisphere injured, post-Stroke duration, number of physiotherapy treatment session, use of walking aids), activity and physical.

Related factor (Activity of Daily Living, Speed of mobility), Psychosocial (information on depression), related factor and balance impairment examination parts.

Berg Balance Scale (BBS) was the primary outcome tool evaluate the balance impairment contain 14 item [40]. The BBS is a valid, reliable and commonly used outcome measure in stroke rehabilitation [40]. The Barthel index (BI): The instrument used for the assessment of ADL. It contains a total of 10 items describing different activities. The scoring is done by adding individual item scores to give a total score ranging from 0 (totally dependent) to 100 (completely independent). On the BI, lower score indicates greater dependency with ADL. Geriatrics depression scale was the secondary contains fifteen items (GDS\_SF) for the assessment depression [49]. GDS is a reliable and valid measure of depression in post stroke patients [50]. Timed up and go (TUG) were another secondary tool which assess speed of mobility respectively.

#### Data quality control

First, questionnaires were prepared in English version and translated to local language Amharic version and then back translated into English to insure its consistency. To ensure the quality of the data, the data collectors and supervisors were trained for one day and the supervisor was had routine checkups for completeness and consistency of the data during data collection. Then questionnaires were pre tested with 5% [21] of the total sample size in Debre tabor referral hospital before the actual data collection period were conducted to check for the accuracy of responses, language clarity, and appropriateness of the tools on the population other than the study population which has similar characteristics with the population selected for the actual study. The necessary changes were done based on the findings of the pre-test for the actual study. The data was coded, stored in a proper area and kept its confidentiality, entered and cleaned with the use of Epi-data version 4.6.02. Finally,

the data was exported to Stata version 16 for further analysis. Missing values and outliers were checked using frequency tabulation and residual plotting, and then was controlled accordingly.

#### Data processing and analysis

The collected data was edited, coded and cleaned and then it was entered Epi-data version 4.6.02. And then, after exportation, the data analysis was done using Stata Version 16.0. Descriptive statistics like; percentage, frequency, mean, median, range, and standard deviation was used for describing the study population in relation to relevant for continuous variables and findings was presented with texts, tables and figures. Multicollinearity was checked by the variance inflation factor (VIF). A variable such as daily living activity was not included in the multivariate logistic analysis model does not fit Hosmer Lemeshow goodness of fit test for logistic regression used for variables with a cut-off point below p-value 0, 25 [51].

Binary logistic regression was used to identify the sociodemographic, clinical and rehabilitation-related factor, activity and speed of mobility related factor and psychosocial related factor that are independently associated with the prevalence of balance impairment.

Independent variables which had significant association with dependent variable in bivariate logistic regression at p-value of less than 0.25 were considered as a potential candidate to a final logistic regression. Then all potential candidates were entered to multivariate analysis to identify statically significant factors of balance impairment in stroke survivors and helps to control for possible confounding effects. Finally, AOR with 95% of confidence interval at p value of <0.05 will be reported as statistically significant.

## Result

### Characteristics of participants

A 51.5% prevalence of balance impairment was found in the study. The study included 400 stroke survivors in total, yielding a response rate 95% confidence interval (46.58, 56.38). The participant's mean age was 56.065 ( $\pm 20.12 = SD$ ) years. The majority of participants had never been married, with 54% of them being Unmarried. The participants ranged in age from 18 to 95 years. The age range of the participants was 18 to 95 years old, with 57.5% of them being female. About 48.5% of the participants had a monthly income of less than 1000 Ethiopian birr, and the majority of them (23.25%) were employed by non-governmental organizations (Table 1).

**Table 1** Amhara regional comprehensive specialized hospital, northwest Ethiopia, 2022: sociodemographic features of study participants with the presence and absence of balance impairment including p-value ( $n=400$ )

Variable	Frequency(n)	Percent (%)	Balance impairment		OR95%CI COR (95% CI)	p-value
			Yes	No		
<b>Age</b>	101	25.25%	21	80	1	1
18–40						
41–60	99	24.75%	25	74	1.29(0.66,2.49)	0.454
61–95	200	50.00%	160	40	15.24(8.43,27.56)	0.000
<b>Sex</b>						
Male	170	42.5%	86	84	1	1
Female	230	57.5%	120	110	1.06(0.75,1.58)	0.754
<b>Marital Status</b>						
Unmarried	216	54%	119	97	1.37(0.92,2.03)	0.120
Married	184	46%	87	97	1	1
<b>Education</b>						
Formal educates	70	17.5%	41	29	1	1
Non-Educate	330	82.5%	165	165	0.71(0.419,1.19)	0.194
<b>Residence</b>						
Urbane	179	44.75%	82	97	1	1
Rural	221	55.25%	124	97	1.51(1.01744,2.2475)	0.041
<b>Income level</b>						
< 1000	194	48.5%	93	101	1	1
1001–2000	54	13.5%	21	33	0.69(0.373,1.278)	0.239
2001–3000	51	12.75%	30	21	1.55(0.8306,2.897)	0.168
> 30,000	101	25.25%	62	39	1.72(1.058,2.817)	0.029

### Clinical and physiotherapy rehabilitation characteristics of study participants

About half of the study participants 49.75% had hemorrhagic strokes, while 48.75%, experienced ischemic strokes. Of the individuals involved in the research, more than half were 57%, who had an acute post-stroke duration, and 53.25% had not followed up with physiotherapy treatment in the past. The majority of participants 59.75% utilized walking assistance; of these, 32.08% used canes and 27.92%, used walkers (Table 2).

### Activity of daily living, speed, and psychosocial characteristics of participant

Of the participants, the majority (54.75%) showed abnormal speed mobility, 53% had normal psychosocial or normal depressive traits, and 58.25% reported requiring assistance from others or said they were dependent on others for help with daily living tasks daily living tasks (Table 3).

The following variables are used in bivariate logistic regression: sex, age, married status, educational attainment, place of residence, post stroke duration, activity of daily living, physiotherapy treatment, depression, walking aids, mobility speed, income level, religion, and occupation. Several of those variables were found to have p values less than 0.25, suggesting they would be strong candidates for the final logistic regression.

### Factors associated with balance impairment among stroke survivors

In the multivariate logistic regression analysis, the following factors were found to be significantly associated with balance impairment: the participant's lack of physiotherapy treatment at an early stage (AOR=3.96; 95% CI=1.483, 10.586); the participants were found to have depression (AOR=12.25; 95% = 4.727, 31.779); the subjects were found to have use of walking aids at the time of being assessed Berg balance scale for balance impairment, (AOR=8.76; 95% CI=3.469, 22.117); the participants who were found to have abnormal speed of movement (AOR=6.73; 95% CI (2.671, 16.977)); and the participants who were unmarried 2.71 (AOR=2.71; 95% CI=1.061, 6.903) times more likely to develop balance impairment than married individuals. Lastly, there was a statistically significant correlation found between balance impairment and variables such as depression, the use of walking aids, not receiving physiotherapy treatment early, abnormal mobility speed, and unmarried status (Table 4).

### Discussion

The purpose of this study at Amhara Regional Comprehensive Specialized Hospital was to evaluate the prevalence of balance impairment among stroke survivors and the factors that are linked with it.

51.5% (46.58, 56.39) of the participants in this study had balance impairment, and 94% of them responded. The current study's prevalence is consistent with a study

**Table 2** Clinical and physiotherapy rehalitation characteristics of study participants with the presence and absence of balance impairment including p-value at Amhara regional comprehensive specialized hospital Northwest Ethiopia, 2022( $n = 400$ )

Variables	Frequency( $n$ )	Percent (%)	Balance impairment		OR95%CI	p-value
			Yes	No	COR (95% CI)	
<b>Type of stroke</b>						
Ischemic	195	48.75%	104	91	0.43 (0.78, 2.44)	0.34
Hemoragic	199	49.75%	100	99	0.49(0.88, 2.76)	0.42
undetermined	6	1.5%	2	4	1	1
<b>Type of hemisphere</b>						
Right	199	49.75%	115	84	0.62(0.20, 1.93)	0.41
Left	188	47.00%	85	103	1.03(0.33, 3.20)	0.94
Undetermined	13	3.25%	6	7	1	1
<b>Post stroke duration</b>						
Acute/sub-acute	228	57%	174	54	0.07(0.04, 0.11)	0.000
Chronic	172	43%	32	140	1	1
<b>Physiotherapy treatment</b>						
Treated	187	46.75%	159	28	28.88 (16.81,49.6)	0.000
Not treated	213	53.25%	35	178	1	1
<b>walking aids</b>						
With aids	239	59.75%	190	49	35.14(19.20, 64.30)	0.000
Without aids	161	40.25%	16	145	1	1
<b>Type of walking aid</b>						
Cane	76	31.80%	60	16	1	1
Crunch	63	26.36%	44	19	1.61(0.74, 3.49)	0.26
Walker	67	28.03%	56	11	0.73(0.31, 1.72)	0.41
Wheelchair	33	13.81%	30	3	0.37(0.10, 1.38)	0.42
<b>Comorbidity</b>						
Yes	68	17%	52	16	3.75(2.06, 6.875)	0.674
No	332	83%	154	178	1	1

**Table 3** Participants activity of daily living, psychological traits, and activity of daily living wit presence and absence of balance impairment including the p-value at Amhara Regional Comprehensive Specialized Hospital in Northwest Ethiopia, 2022 ( $n = 400$ )

Variable	Frequency( $n$ )	Percent (%)	Balance impairment		OR95%CI	p-value
			Yes	No	COR (95% CI)	
<b>Depression</b>						
Depressed	188	47.00%	176	12	88.97(44.15,179.32)	0.000
Not depressed	212	53.00%	30	182	1	1
<b>Activity of daily living</b>						
Dependent	233	58.25%	162	71	6.37 (4.09-9.93)	0.356
Independent	167	41.75%	44	123	1	1
<b>Speed of mobility</b>						
Abnormal	219	54.75%	189	30	60.77(32.34,114.1929)	0.000
Normal	181	45.25%	17	164	1	1

done in Saudi Arabia (48.1%) [52]. This might be because the assessment instruments were identical, the operational definitions were similar, the study participants' mean ages were comparable, and the sample sizes were comparable.

The present study is lower than the study conducted in the United Kingdom reported a higher prevalence of balance impairment (83%) [21]. The possible reason for this difference could be the study was conducted in the acute period including, inpatient, in which the mean duration was  $21 \pm 4$  days, in current study all stroke survivors

visiting outpatient department were included, difference methodology, they took a sample size higher than our study, they used prospective study design which can reduce recall bias and A systematic review done in China higher prevalence 83% [20]. The possible reason for the difference between our study and the systematic review done in China could be, difference in methodology.

The present study is higher than the study conducted in South Africa (24.07%) [29], Nigeria (36%) [27]. The possible reason for the difference between our study and the study done South Africa and Nigeria, could be different

**Table 4** Factor associated with balance impairment among stroke survivors in multivariate logistic regression analysis at Amara regional comprehensive specialized hospital North West Ethiopia 20,222( $n = 400$ )

Variable	BI		OR95%CI	
	Yes	No	COR (95% CI)	AOR (95% CI)
<b>Age</b>	21	80	1	1
18–40	25	74	1.29(0.66,2.49)	1.67(0.537,5.250)
41–60	160	40	15.24(8.43,27.56)	2.03(0.678,6.084)
61–95				
<b>Marital Status</b>				
Unmarried	119	97	1.37(0.92,2.03)	<b>2.71(1.061, 6.903) *</b>
Married	87	97	1	1
<b>Depression</b>				
Depressed	176	12	88.97(44.15,179.32)	<b>12.25(4.727,31.779) **</b>
Not depressed	30	182	1	1
<b>Stroke duration</b>				
Acute/sub-acute	174	54	14.09(8.6, 23.03)	0.81(0.257,2.531)
Chronic	32	140	1	1
<b>Physiotherapy</b>				
Not treated	178	35	28.88(16.81,49.60)	<b>3.96(1.483,10.586) **</b>
Treated	28	159	1	1
<b>Walking aids</b>				
With aids	190	49	35.14(19.20, 64.30)	<b>8.76(3.469, 22.117) **</b>
Without aids	16	145	1	1
<b>Speed of mobility</b>				
Abnormal	189	30	60.77(32.34,114.1929)	<b>6.73 (2.671, 16.977) **</b>
Normal	17	164	1	1
<b>Education</b>				
Formal educates	41	29	1	1
Non-Educate	165	165	0.71(0.419,1.19)	1.12(0.332, 3.798)
<b>Residence</b>				
Urbane	82	97	1	1
Rural	124	97	1.51(1.01744,2.2475)	2.26(0.961, 5.341)
<b>Income level</b>				
< 1000	93	101	1	1
1001–2000	21	33	0.69(0.373,1.278)	0.78(0.225,2.727)
2001–3000	30	21	1.55(0.8306,2.897)	0.73(0.197, 2.690)
> 30,000	62	39	1.72(1.058,2.817)	0.95(0.319, 2.882)

Key: BI=balance impairment Bold indicate the significant explanatory variables with their COR=crude odd ratio, AOR=Adjusted odd ratio and CI=confidence interval, 1=reference category

\* Significant at  $p < 0.05$  and \*\* Significant at  $p < 0.001$

methodology the other possible reason for this difference could be race difference, and age range variation of the participants, narrow operational definition.

The results of the present study also showed that balance impairment among stroke survivors had a significant relationship with; walking aid users, being depressed, speed, did not have Physiotherapy treatment and ever married.

In the current study the odds of developing balance impairment for those who didn't follow physiotherapy treatment were 3.96 times more likely to develop balance impairment than did have physiotherapy treatment. This could be physiotherapy treatment have an impact in improving patient strength for those had balance impairment [20]. This study result agreed the study done in South Africa showed that having no physiotherapy treatment follow up two times more likely to developed balance impairment [29]. This also supported by recent systematic review and meta-analysis on BI after stroke.

concluded that functional taskoriented training associated with musculoskeletal intervention and/or cardio-pulmonary intervention and sensory interventions seem to be immediately effective in improving balance and postural stability, respectively (55). Another systematic review with metaanalysis demonstrated the evidence of the effectiveness of walking training on balance, motor functions, activity, participation and quality of life in people with chronic stroke therapy to produce significantly positive improvements in balance function amongst patients with stroke (56). Although less explored in literature, the strength of lower limb muscles and their ability to predict balance impairment post-stroke is another important finding that could be easily incorporated into a physical therapy rehabilitation program for stroke patients in order to improve balance (57). The possible reason for this could be physiotherapist might give exercise and balance re-training, they'll work with the find out what you find difficult, and set activities to help the patient improve his/her balance, Moreover, they use a multidisciplinary team in the treatment and rehabilitation of stroke.

The odd of used walking aids were 8.76 times more likely to develop balance impairment than those with out used walking aids. Because the participant who used walking aids did not use them at the time of evaluating balance impairment, this study result was agreed with study done in Saudi Arabia where participants using a walking aids were 10 times more likely to have their balance impaired post-stroke with comparison to nonaid requiring patients (odds ratio (OR)=10.8 (95% CI=3.827–30.577).

[52]. This also supports by a systematic review done by Harris et al., 2005 in stroke survivors showed that a mobility aid that could reduce the risk of falls and decrease the



patient confidence of stability of balance [53]. The possible reason for this could be assistive device users have limited mobility, developed dependent adaptation and increased risk for fall injury compared with non-users.

The odds of having balance impairment among depressed participants were 12.25 times higher compared to nondepressed. The current study results in consistent with study done in Saudi Arabia showed that stroke survivors were having depression 1.33 more likely to develop balance impairment than those who had no depression (52). Likewise, it is also supported by other studies conducted in middle eastern/African indicated that there was a significant associations between balance impairment and depression (59). The possible reason for this could be their is biochemical changes in the brain. When the brain is injured, the survivor may not be able to feel positive emotions. This implies that depression further increases the risk of balance impairment.

The odds of developing balance impairment in respondents which have abnormal speed of mobility develop were 6.73 times compared respondent who had normal speed of mobility. The present study results are supported by study done in Saudi Arabia showed that stroke survivors were having abnormal speed of mobility was 1.2 more likely to develop balance impairment than those who had normal speed of mobility [52]. The current study supported by study done in United State of America showed that having inability to increase mobility speed on demand is common in individuals with chronic stroke, and balance appears to be a significant contributor to this difficulty [54]. The possible reason for this could be the ability to increase walking/mobility speed on demand is important for successful, safe and adaptable community ambulation, lacking the speed reserves needed to respond to environmental demands, especially in acute and subacute phase of stroke survivors [55].

In the other hand, there is a strong association this study between the unmarried participants and their circumstances Compared to married individuals, unmarried participants had a 2.71 times increased risk of developing balance impairment. The unmarried participants are socially isolated because they typically live alone and lack a caregiver and support system.

This study finding in contrast with other study conducted in South Africa, and Nigeria [29, 56]. This discrepancy may be due those studies were used a narrow operational definition, a small sample size, less standard Berge Balance scale questionnaire to assess balance impairment, had non comparable mean ages of study participants conducted.

#### Limitation of the study

This study has provided important information regarding the prevalence and the factor of balance impairment.

The study used the internationally validated tool for the objective examination of balance impairment.

Beside of the strength, it had some limitations, although we assessed a wide range of variable such as proprioception, sensation, spasticity, burden of physiotherapy treatment access that might have been associated with balance impairment were not assessed because there was no strategy to follow patient progress after evaluation of their balance ability.

Assessment centers were limited the university hospital so these results may not be generalizable to very limited community survivors or those unable to attend outpatient clinics. Since it is a cross sectional study, it does not show a strong association of causes and effects and we cannot tell the temporal relationship.

#### Conclusions

The prevalence of balance impairment in this study is high. Being depressed, did not have physiotherapy treatment, use of a walking aid, abnormal Speed of mobility and unmarried were all found to be significant factors influencing balance in survivors with stroke. As such, all these relations should be taken into consideration when planning rehabilitation in patients with stroke.

#### Recommendation

##### *To amhara regional state compressive specialized hospitals*

Balance impairment examination should be performed on each clinic visit. This could also be implemented by attending Physician, nurse and physiotherapist directly involved in care stroke survivors. Furthermore, hospitals should be design exercise prescription manuals to each individual patient with stroke, especially in the acute period of the stroke.

##### *To Physiotherapist*

Clinicians shall give attention for balance impairment while treating stroke survivor patients. Need to give greater emphasis on the associated factors, especially on depressed stroke survivors factor, speed of mobility, a survivors using walking aids and physiotherapy treatment follow up to reduce the risk of balance impairment among stroke survivors. It is better to prepare guidelines to balance impairment for stroke survivors.

##### *To researchers*

Researchers shall conduct a prospective study so as to come up with stronger evidence that shows the temporal relationship and fully avoid recall bias.

#### Abbreviations

ADL	Activity of Daily living
AOR	Adjusted Odd Ratio
BI	Barthle Index
BBS	Berge Balance Scale

CI	Confidence Interval
DCSH	Dessie Comprehensive Specialized Hospital
FHCSH	Felege Hiwot Comprehensive Specialized Hospital
GUG	Go Up and Go Up Test
OR	Odd Ratio
OPD	Out Patient Department
PT	Physiotherapist
QOL	Quality of Life
SD	Standard Deviation
TGCSH	Tibebe Gion Comprehensive Specialized hospital
TUG	Time Up and Go Test
UoGCSH	University of Gondar Comprehensives Specialized Hospital

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### Author contributions

This study was done in collaboration between all authors. MG: conceived the idea for this study and design, participated in the data management and write-up of the manuscript. TK, JS, GA, MDT, DAB, SM and AKK Participated in the analysis, in interpretation of the result, and reviewing of the draft manuscript. All authors participated sufficiently in the work and take responsibility for the appropriate portions of the content.

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### Data availability

No datasets were generated or analysed during the current study.

### Declarations

#### Ethics and consent to participate

Ethical approval was obtained from University of Gondar ethical review board. Letter of support and cooperation was obtained from the department of physiotherapy and the university. Participation in this study was completely voluntary and participants had the right to refuse or participate in the study after purpose, duration, benefit and possible risks of participation was presented to each participant. Data confidentiality kept throughout the study. The collected data used only for the intended purpose of the study. The study participants from each selected compressive hospital were informed about the study and then written consent were obtained from each participant before the actual data collection. Participants that are found to have balance impairment disorders at the time of data collection were given appropriate advice and care and management.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare no competing interests.

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