Motor Impairments and Mobility Limitations influencing community participation among Stroke Survivors at Three Months Follow up

Saeed M. Alghamdi

Abstract— Stroke is damaging the motor system which included either blood supply or brain hemorrhage. Due to that damaging in the motor system, stroke individuals suffer from major impairments like mobility limitations. Mobility limitations in preforming daily life activities can prompt tosedentary lifestyle and reduced activity tolerance. Literatures show that 90% of stroke survivors couple with mobility limitations such as imbalance and muscle weakness. The findings help health care provider to understand which factors could improve community participation in stroke patients such as mobility. Also, it taking in consideration the factors that might improve stroke survivor mobility and community reintegration.

Index Terms—Stroke, Mobility, Imbalance, Muscle weakness, community reintegration.

1.Inroduction:

Stroke is a main source of disabilities and chronic impairments. Stroke is damaging the motor system which included either blood supply or brain hemorrhage [1]. Due to that damaging in the motor system, stroke individuals suffer from major impairments like mobility limitations. Mobility limitations in preforming daily life activities can prompt to sedentary lifestyle and reduced activity tolerance [2]. Literatures show that 90% of stroke survivors couple with mobility limitations such as imbalance and muscle weakness [3, 4]. Also, patients after stroke crisis cannot walk independently and they need to enroll in rehabilitation program to improve social activities and community participation. Acute and long term rehabilitation programs post stroke found a helpful intervention to improve community participation in stroke survivors [2]. Furthermore, assessing stroke survivors by using standardized measurements will help to evaluate functional abilities of stroke patients and provide them with appropriate interventions to improve community participation. This project estimate the community participation for stroke survivors at three months after stroke crisis. Particularly, this project predicate community participation after three months follow up in rehabilitation program based on the motor impairment and mobility limitation.

2. Research question:

Among stroke survivors, to what extent dose motor impairment and mobility limitation will affect community participation at three months follow up?

3.Objective:

The aim of this project is to estimate the association between community participation, and (1) motor impairments; (2) mobility limitation at three months follow up in stroke survivors while taking into consideration the confounders such as sex, age, and associated comorbidities with stroke. The variables included in this project are motor recovery, mobility, and community participation.

4. Conceptual framework:

International Classification of Functioning, Disability and Health (ICF) theoretical framework has been used in this project to better understand the impact of the stroke on the community participation. The ICF illustrates the factors that lead to body dysfunction and impairments as well as it explains participation limitations for stroke survivors. ICF theoretical framework identifies and describes the factor that might effect the health outcomes. Referring to ICF theoretical framework, personal factors and environmental factors could impact body function and structure, activity, and participation. In this paper, it has been hypothesized that community participation among stroke survivors might be influenced by motor impairments and mobility limitations. Results from this regression will be able to allow readers understand the factors that explain the variation in the community participation among stroke survivors. Literatures identify some personal factors that affect community participation ; for example, sex, gender, and stroke severity [5]. Not only personal factors do effect community participation, but also environmental factors do. For example, unavailability of health services, and negative attitude towards stroke survivors are consider as environmental factors that restrict community participation [6]. Based on the data set, this project will concentrate more on the personal factor and try to answer the question above by investigating the motor impairments and mobility limitations associated with community participation at three months following stroke onset.

5. Inclusion and exclusion criteria:

Inclusion criteria involved individuals who hospitalized within 72 hours after stroke confirmed. Stroke confirmation used the World Health Organization definition "rapidly developing clinical signs of focal (or sometimes global) disturbances of cerebral function lasting more than 24 hours or leading to death with no apparent cause other than that of vascular origin" [6]. Participants did not meet the criteria of the inclusion, died, or have another clinical condition were excluded.

6. Outcome measurements:

Community participation consider as an important outcome of rehabilitation with stroke survivors [7]. In this project, community participation has been used as a main outcome to answer the research question.
Community participation selected because it is critical outcome of successful rehabilitation, and it is reflecting to functional status recovery in stroke [8]. Also, the recent literatures in the discipline of rehabilitation give a lot of attention to measuring participation with stroke because it is significantly contributing to improve patient's activities as well as improve occupational and functional status [7].
Stroke Impact Scale (SIS) has been used to assess the participation in stroke survivors at three months follow up. In this study, SIS has been administrated as a reliable , valid, and responsive measurement to measure stroke participation [9]. SIS has score range from 0 which means stroke survivor is totally dependent to 100 which mean stroke survivor is independent.
To explain the variation in the community participation, any element has impact on community participation in stroke individuals were included. Rational for selecting these variable illustrate in the following: After stroke onset, 50–60% of stroke survivors are suffered from chronic motor dysfunctions which directly impact on the functional independence [10]. These chronic motor dysfunctions impair the individual performance in everyday life task such as bathing, toileting, bladder control, bowel control [11]. Additionally , stroke can cause impairments in mobility, which lead to persistent impairment with walking function [2]. Also, existing of comorbidities found highly interfere with the participation the community activities as well as it expected to effect on community reintegration [12]. Other elements such as gender, age, comorbidity were included in the analysis as predictors for community participation. It is expected for stroke survivors to have community participation challenges if they have motor impairments and mobility limitations. For this reason, motor impairments and mobility limitations selected to predict community participation in stroke survivors.
In term of collinearity, it has been checked if there is any strong association between predictors before beginning the modeling process. Data analysis show collinearity between STREAM upper limb score and STREAM lower limb score. However, these two covariates are not contributed to the predicators in this regression model and they were excluded respectively. On the other hands, the total score of mobility STREAM was included in the modeling. The variable included in the prediction model are age, gender, comorbidities, 2- minute walk test, walking speed, motor recovery, and community participation.

7. Data collection and procedures:

Trained healthcare professionals were evaluated stroke survivors by using the same tasks at 2 time points; at the baseline (within 3-days after stroke) and after three months. Healthcare professionals observed the individuals' performance on specific tasks, and asked the individuals to rate their difficulty in performing certain tasks. The sociodemographic data such as sex, age at stroke onset, type of lesions, and side of lesion were collected from patient medical records. Also, values of the assessment were reported using standardized measurements that generally used with stroke patients. All measurements were valid and reliable such as Stroke Rehabilitation Assessment (STREAM) that using to evaluate mobility, Two Meters Walking Test (2MWT), walking speed, and Stroke Impact Scale (SIS) [13-15].

8. Data analysis:

Descriptive statics were used to describe the participant's characteristics and study measures. To check the normality and homoscedasticity of the data, histogram or boxplot for each variable were generated. Also, boxplots were used to identify if there are outliers or influential points. Any errors or incorrect records in the data set were removed from the analysis. After that, multiple linear regression was used to (1) estimate the association between the covariates and the outcome; (2) determine which covariate best explained the variation of the community participation.

In this model, scatterplots of the residuals values against fitted values were created to check the assumptions of multiple linear regression. Also, histogram of the residuals and Q-Q plots were examined. All the variables were treated as their original forms either continuous or dichotomous. Detect influential points has been checked by Cook's distance. Also, it has been challenged to find interaction between covariates included in the predication model to determine "the best" model. Thus, the prediction model considers as the best model to show the variation in the community participation among stroke survivors. Any missing data points were identified and excluded from the analysis. Validation process of the model that generated in this project went through analysis of the residuals, the goodness of fit of the regression, and the Akaike criterion. The level of significant was set at alpha = 0.05, and confidence interval is 95%. All analyses were performed using available R version 3.1.2. (R Foundation for Statistical Computing, Vienna, Austria).

9. Results:

Data was collected from 262 stroke survivors admitted to acute care hospital. Twenty-seven participants (11.5%) were excluded because missing data at one time point such as (10) death, (10) refused to follow up, (4) moved out of the area, (2) had accident, and (1) lost to follow up.

Proportions and number of the participants were provided for the categorical variable. The means, standard deviation(SD), and ranges were provided for the predictor variables. Data show that 61% of the participants were men and 39% were women. The mean (SD) for the participants' age in this study was 71.53±12.9. Participants in this study were divided as follow: 85% had an ischemic stroke, 15% had a hemorrhagic stroke, 53% had right stroke lesion, and 43% had left stroke lesion. Most subjects had a moderate stroke (44%).

Figure 2 represents the distribution of the predictors included in this project. As shown in comorbidity distribution, figure 2.a positive right skewed which means that most of the stroke survivors have less than one disease. The total score of stroke rehabilitation assessment of movement (STREAM) at 3 days show a left tail skewed and it illustrate that most of the participants have greater mobility after 3 day of stroke onset. Figure 2.c shows the distribution of 2-minute walking test within 72 hours after stroke. The distribution of 2-minute walking test has right skewed. Also, it shows that most of the stroke survivor cannot walk within 3 days after stoke onset. Figure 2.d show right skewed in the walking speed within 3 days and it illustrates that majority of the stroke survivors have walking speed problems after the stroke onset. Figure 3. show the distribution of the response variable which is the Stroke Impact Scale (SIS-16) after 3 months follow up. The distribution of SIS-16 show left skewed. Majority of the stroke survivors have high score (> 80) in SIS-16 after three months which indicate improvement in the participation.

Figure 2: Distribution of the predictors variables within 72 hours after stroke.

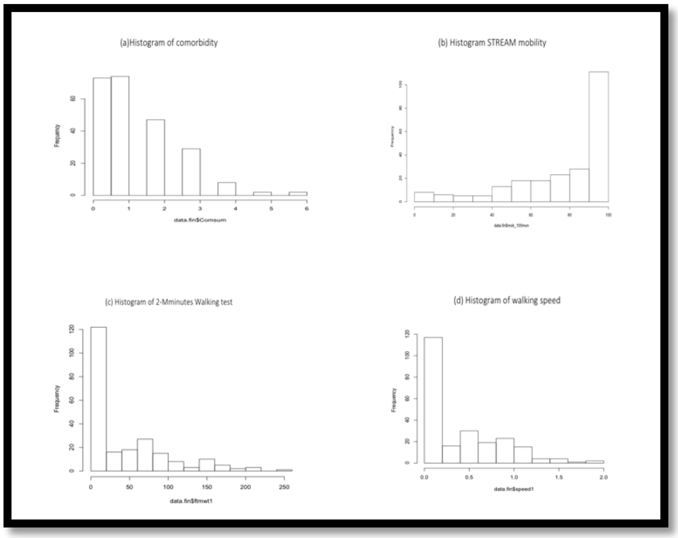
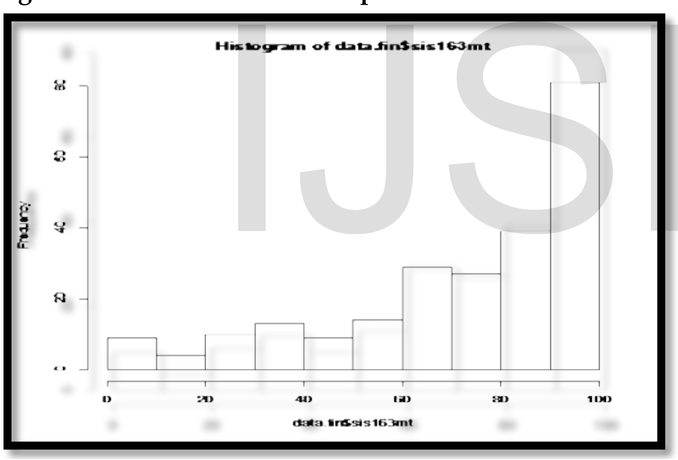


Figure 3: Distribution of the response variable: SIS-16 in three months follow up.



10. Multiple linear regression:

Final prediction model included the following predictors: age, gender, comorbidity, 2 meter walk test, walking speed and total score of stroke rehabilitation assessment of movement (STREAM). All predictors included in the final models were continuous except gender variable. These predictors included to estimate the difference in the community participation after three months among stroke survivors. These predictors make clinical sense. Since interaction term would not make any improve in fitting the data, it didn't include in the model. Also, data transformation didn't apply for this model because transformation didn't improve the model fit. Verifying the model assumptions used scatterplots, histogram, and normal q-q plot. Figure 4 represent the scatterplots of the residuals values versus fitted values. The variances seem constant around the mean and the residuals are normally distributed which consider that the prediction model was a good fit for the data. Figures 5 represents Q-Q plot and histogram for the residuals. The normal Q-Q plot shows influential points. However, Cook's distance applied to delete the influential points from the analysis. The histogram of the residuals show the residuals are normally distributed around the mean.

The model:

Community participation = 68.38+2.37 (walking speed) + 0.56(STREAM) – 0.013(2MWT) – 1.21 (comorbidities) – 0.41(age) – 8.5 (gender)

This is the multiple linear regression model of community participation on age, gender, comorbidities, walking speed, 2-minute walking test, and mobility STREAM. All the predictor variables are included to explain the change in community participation (response variable) and make inferences about stroke survivors. Age, gender, and STREAM score were significant factors that contributed to the variation in the stroke impact scale score at three months follow up stroke.

Age has coefficient of -0.416 that means every 1 year increase in the old age holding other predictors constant, the community participation will decrease by -0.416. The p-value for age variable is significant (0.000) and that's mean age variable has influence on the community participation. The association between age and community participation indicates increasing in the age could influence negatively on the community participation. STREAM mobility total has coefficient of 0.562 that means every 1 score increase in the STREAM mobility holding other predictors constant, the community participation will increase by 0.562. The p-value for the STREAM mobility is statistically significant (< 2e-16) and that's mean that STREAM mobility variable has influence on the community participation. The association between STREAM mobility and community participation indicates increasing in the STREAM mobility could influence on the community participation. Gender also found that could influence on the community participation. However, further techniques could be applied to identify which gender group (male or female) has more influence on the community participation. These techniques didn't apply here in this project.

Walking capacity, walking speed, and number of comorbidities were not significant to explain the variation in the stroke impact scale score. Taking the significant predictors independently and held remaining predictors constant, having high score in STREAM indicate better community participation, whereas being older and female had a negative effect on the community participation among stroke survivors. In this model, we hypothesized that mainly age, gender, number of comorbidities, walking speed, 2-minute walking test, and mobility STREAM (predictors) would account for most of the variation of community participation. The F-statistic for the overall model is statistically significant with a p-value of < 2.2e-16. The covariates explain 53% of the variability in community participation amongst stroke survivors. This suggests that there are still other variables could explain the variability in community participation.

Figure 4: Scatterplots of residuals versus fitted values.

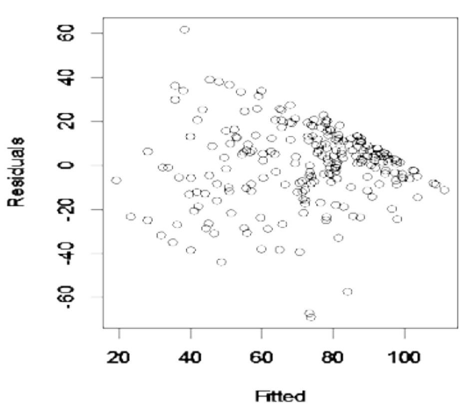
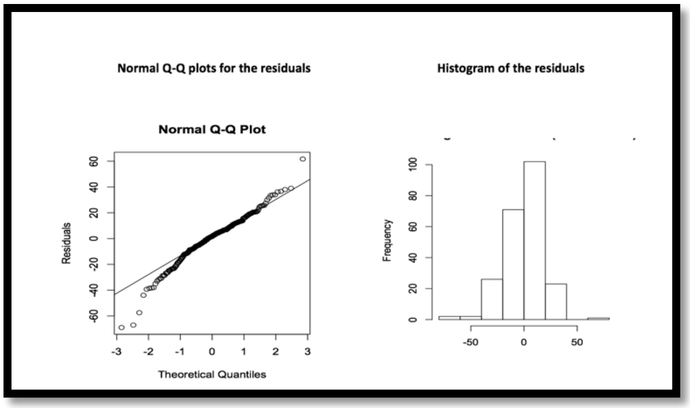


Figure 5: Normal Q-Q plots of the residuals and the histogram of the residuals.



11. Discussion

This study aim to report what extent dose motor impairment and mobility limitation will affect community participation at three months follow up. Six covariates were included in the final model to predicted community participation among stroke survivors. Results illustrate that gender, age and STREAM mobility were significant factors to explain the variation in community participation. Others covariates didn't show any significant contribution to the community participation. However, they kept in the model because they were clinically important. Also, including more covariates in the future studies could give a clear view about the variation among stroke survivors and facilitate generalizability of the findings. Keeping the model simple without data transformation or interaction term explained 53 % of the variance in the community participation. This report found that classic confounders like age and gender play important role in predicting community participation in stroke survivors. However, the number of comorbidities found not significant variable to explain the variation in community participation among stroke survivors. Also, assessing mobility in acute and long term rehabilitation programs post injury for stroke survivors found a helpful intervention to predict community participation [2]. As a limitation in this project, the presence of unilateral spatial neglect could be a possible cofounder that not taking into consideration at the level of study design as well as the sample size was recruited from one rehabilitation center. It would be recommended if the study has control group to compare the results and show the differences between the two groups in term of community participation.

12. Conclusion

The final model predicted community participation at three months after stroke using age, gender, comorbidity, STREAM, walking speed, 2-minute walking test within 72 hours after stroke onset. The findings help health care provider to understand which factors could improve community participation in stroke patients such as mobility. Also, it taking in consideration the factors that might improve stroke survivor mobility and community reintegration.

References:

1. Petrasovits, A. and C. Nair, *Epidemiology of stroke in Canada.* Health reports, 1993. **6**(1): p. 39-44.

2. Eng, J.J. and P.-F. Tang, *Gait training strategies to optimize walking ability in people with stroke: a synthesis of the evidence.* Expert review of neurotherapeutics, 2007. **7**(10): p. 1417-1436.
3. Hochstenbach, J. and T. Mulder, *Neuropsychology and the relearning of motor skills following stroke.* Int J Rehabil Res, 1999. **22**(1): p. 11-9.
4. Gresham, G.E., et al., *Residual disability in survivors of stroke – the Framingham study.* New England Journal of Medicine, 1975. **293**(19): p. 954-956.
5. Macko, R.F., et al., *Treadmill exercise rehabilitation improves ambulatory function and cardiovascular fitness in patients with chronic stroke.* Stroke, 2005. **36**(10): p. 2206-2211.
6. Organization, W.H., *International Classification of Functioning, Disability and Health: ICF*. 2001: World Health Organization.
7. Tse, T., et al., *Measuring participation after stroke: a review of frequently used tools.* Archives of Physical Medicine & Rehabilitation, 2013. **94**(1): p. 177-92.
8. Desrosiers, J., *Muriel Driver Memorial Lecture. Participation and occupation.* Can J Occup Ther, 2005. **72**(4): p. 195-204.
9. Duncan, P.W., et al., *The stroke impact scale version 2.0. Evaluation of reliability, validity, and sensitivity to change.* Stroke, 1999. **30**(10): p. 2131-40.
10. Hendricks, H.T., et al., *Motor recovery after stroke: a systematic review of the literature.* Archives of physical medicine and rehabilitation, 2002. **83**(11): p. 1629-1637.
11. Shearer, T. and S. Guthrie, *Facilitating early activities of daily living retraining to prevent functional decline in older adults.* Australian occupational therapy journal, 2013. **60**(5): p. 319-325.
12. Karatepe, A.G., et al., *Comorbidity in patients after stroke: impact on functional outcome.* Journal of rehabilitation medicine, 2008. **40**(10): p. 831-835.
13. Bowden, M.G., et al., *Validation of a speed-based classification system using quantitative measures of walking performance poststroke.* Neurorehabilitation and neural repair, 2008. **22**(6): p. 672-675.
14. Gibbons, W.J., et al., *Reference values for a multiple repetition 6-minute walk test in healthy adults older than 20 years.* Journal of Cardiopulmonary Rehabilitation and Prevention, 2001. **21**(2): p. 87-93.
15. Côté, R., et al., *Stroke assessment scales: guidelines for development, validation, and reliability assessment.* Canadian Journal of Neurological Sciences, 1988. **15**(3): p. 261-265.