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Original Research Article

Quantitative Analysis of Post-Stroke Fatigue by Salivary Alpha Amylase as a Biochemical Marker

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ABSTRACT

Objective: This Study was done to Objectively Quantify Post-Stroke Fatigue by Assessing Salivary Alpha Amylase Level as a Biochemical Marker and its relation to a Prescribed Exercise.
Method: Participants were grouped as Study Group (n=20) selected purposively according to Inclusion and Exclusion Criteria. For Control Group (n=30) were purposively selected according to Inclusion Criteria after the Mean and Standard Deviation of age constituting the Study Group. The groups were assessed for various Parameters and Pre- Salivary Sample was collected to assess Salivary Alpha Amylase Level and this was kept constant as Baseline Level. Each participant received Upper Limb and Lower Limb Exercise in successive day and Post-Salivary Samples were collected.
Results: Baseline Salivary Alpha Amylase release is higher among Stroke Survivors (26.75±32.81) than that of Control Group (10.51±6.30) with a mean difference of 16.24 which is Statistically Significant at ($p<0.02$). Stroke Survivors after Physiotherapy of Upper Limb release higher Salivary Alpha Amylase (40.51±38.95) than that of Control Group (15.83±11.05) with a mean difference of 24.68 which is Statistically Significant at ($p<0.002$). Stroke Survivors after Physiotherapy of Lower Limb release higher Salivary Alpha Amylase (38.63±43.68) than that of Control Group (22.05±18.86) with a mean difference of 16.58 which is Statistically Significant at ($p<0.07$).
Conclusions: These Findings indicate that Salivary Alpha-Amylase Activity in Subjects may be considered as a Significant Index of Stress in Individuals. Moreover, Salivary Alpha Amylase may be considered as a Biochemical Marker in Stroke Survivors for Assessment of Post Stroke Fatigue.

Keywords: Stroke, Post Stroke Fatigue, Salivary Alpha Amylase

INTRODUCTION

Stroke is a Global Health Problem. It is the second commonest cause of Death and Fourth Leading Cause of Disability Worldwide (Strong 2007). Post- Stoke Fatigue; the Symptom is a common and debilitating complaint among Stroke Survivors whereas Fatigue is a normal condition in Healthy Individuals-A Protective Mechanism that alerts the body when it is time to rest or modify activity. This type of Fatigue is usually related to One Cause and is short-lived. According To Ingles JL (1999), Staub F (2001) et Al. “Post-Stroke Fatigue, either cognitive and/or physical, often poses a barrier to return to Work and other Daily Activities, Quality of Life, and Rehabilitation, especially during the first year after Stroke onset". There are Multiple Potential causes of Post-Stroke Fatigue; Any Assessment of Fatigue must be Multidimensional. Till Present Qualitative Fatigue Scales are available and the proportion of Patients with Fatigue did not differ between the treatment groups at either Follow-Up Assessments.

SALIVARY ALPHA (α)AMYLASE AS A STRESS MARKER

SAA the most abundant Salivary Enzyme in Humans, best known for its Function as a Digestive Enzyme that Breaks Down Dietary Starch, Salivary Biomarkers are being researched extensively for various fields because they are easily accessible, are non-invasive, require little training for Researchers, can be measured quickly and repeatedly, and can be collected in the field (Rohleder&Nater, (2009)). The use of SAA has been proposed to reflect the activity of the Sympathetic Nervous System (SNS) during Stressful Situations. The idea of using SAA as a Stress Marker was originally proposed in the 1970's by Gilman et al. (1979) and since has been investigated by numerous Researchers (Chatterton, Vogelsong, Lu, Ellman, &Hudgens, (1996); Chatterton, Vogelsong, Lu, & Hudgens, 1997; D. A. Granger, Kivlighan, el-Sheikh, Gordis, & Stroud (2007); D A Granger et al. (2006); U. M. Nater, La Marca et al. (2006); Rohleder et al.(2004). The release of SAA is facilitated by the Autonomic Nervous System. The Autonomic Nervous System is responsible for the motility of the Cardiac Muscle, Smooth Muscle and Blood Vessels (Gabella, 1987). More SAA can be expected during stressful times when the activation of the Autonomic Nervous System is high. Chatterton et al (1996) Studies show that levels of SAA increase under a variety of physically (i.e., exercise, heat and cold) and psychologically (i.e., written examinations) stressful conditions in Human Subjects. Interestingly, Studies show that cortisol levels often do not correlate with α-amylase during stress, suggesting that individual differences in α-amylase represent a response to a stress signal independent of the LHPA axis. Thoma et.al (2012) has found that SAA responses significantly predict responses to the TSST for nor-epinephrine (NE) but not for epinephrine (E). The relationship between SAA and NE was stronger than the relationship between NE and E responses, indicating the predictive power of SAA is well within the expected range for different SNS markers.

Post Stroke Fatigue has been considered as an important factor impeding Rehabilitation. Clinically available, low cost, quantifiable biochemical markers for Patients with Stroke is lacking in the present scenario. Various clinical features associated with Stroke and their effect on Fatigue has not yet been studied. This Study may help to Quantify Post Stroke Fatigue by objectively Quantifiable Marker. And in-depth understanding to develop Effective Patient-Centered Post-Stroke Rehabilitation Program could be made. Important factors that may influence the Post Stroke Fatigue could be assessed and measures could be taken by the Therapist to manage the identified factors and the results of the Study could help the Therapist to monitor the prognosis of Customized Therapeutic Exercises and can give biofeedback to Patients in reducing Fatigue Level via Prescription Based Endurance Exercise. The results of this Study could also influence the Prescription of Orthotic Assistance by assessing the rate and extent of Fatigue while wearing the Orthotic Support. This could potentially benefit individuals looking for biomarkers to monitor the Sympathetic Nervous System in clinical settings, and for Generalized Population use.

MATERIAL & METHODOLOGY

Subjects &Assessment

The Stroke Patients who visited Study Center and further met the Inclusion Criteria selected as Participant during specified schedule. A total of 20 Stroke Patients who were diagnosed either Ischemic or Hemiplegic who can walk 10 meters were purposively chosen from the outpatient or inpatient department at MVG University were selected as subjects for the Study. For Control Group, individual those who visited Study Center and further met the Inclusion Criteria selected as Participant. A total of 30 matched Control Group having both, male and female from normal healthy population as per Rapid Assessment of Physical Activity, BMI i.e. less <30were purposively selected, it is formed and matched after the mean and standard deviation of age constituting the Study Group and were selected as participant for the Control Group. After necessary instructions and information about the Study, the Subjects had explained about the complete Study Procedure in his/her own language and his/her willingness to participate in the Study had recorded in a Consent Form dually signed by Participants. The Study was approved by Institutional Ethical Review Board (IRB). Ultimately, two groups were available for Study. The Study Group and Control Group had analyzed for various parameters in order to evaluate, compare, correlate and identify the significance of release of SAA may be correlated with the extent of Disability Post-Stroke, assess Exertion Fatigue after Exercise and considered as a Biochemical Marker for Assessment of Post Stroke Fatigue.

Subject groups

The Study Group(n=20) had analyzed for various Parameters in order to evaluate Ambulatory Activity by Wisconsin Gait Scale, Motor Recovery after Stroke-by Fugl-Meyer Assessment Scale, Fatigue by Fatigue Severity Scale, BMI by measuring Weight and Height. The Control Group(n=30) had analyzed for various Parameters in order to evaluate BMI by measuring Weight and Heightand their Level of Activity by assessing by "Rapid Assessment of Physical Activity>6 during examination. Participants were then asked to visit center again the next day and Participant were asked to give their Saliva after taking all Precaution in Salivary Collecting Aids by Passive Draining Method approximately 0.5ml of saliva were taken. Time was fixed for all participants at 10:00am due to diurnal pattern of SAA. Measurement of SAA level by Salivary Amylase Kit in Biochemistry Laboratory of MVG University was performed and the Baseline Level of SAA or Pre SAA was recorded.

After the baseline record of SAA Subjects were ask to perform 60-minute Structured Progressive *Task-Oriented Circuit Class Training for Lower Limb.* The Training Programmed includes 8 different Workstations, intended to improve meaningful tasks related to Walking Competency, such as Balance Control, Stair Walking, Turning, Transfers and Speed Walking. Graded Progression will be achieved by increasing the Difficulty of the Task by adding Weights or increasing the number of Repetitions. Workstation will be done for 3 minutes, followed by 3 minutes of rest and 1 minute to change to the next Workstation. After performing these Exercises, again the Participants were asked to give their Saliva within 10min of Post Exercise. Time was fixed for all Participants at 11:30 am. Measurement of SAA level was recorded.

Participants were then asked to visit Centre again the next day. Time were fixed for all participants at 10:00 am due to diurnal pattern of SAA and were ask to perform 60-minute Structured Progressive "*Upper Extremity Task-Oriented Training"* which was Individually Tailored to each Patient and constructed through a selection of Exercises from an "Exercise Bank" and Exercise will be done for 3 minutes, followed by 3 minutes of rest and 1 minute to change to the next Exercise. The number and complexity of the Exercises were adjusted for each Patient so that he or she was able to Practice Independently or with Assistance. After performing these Exercises, again the Participants were asked to give their Saliva within 10min of Post Exercise. Time was fixed for all Participants at 11:30 am. Measurement of SAA level was recorded.

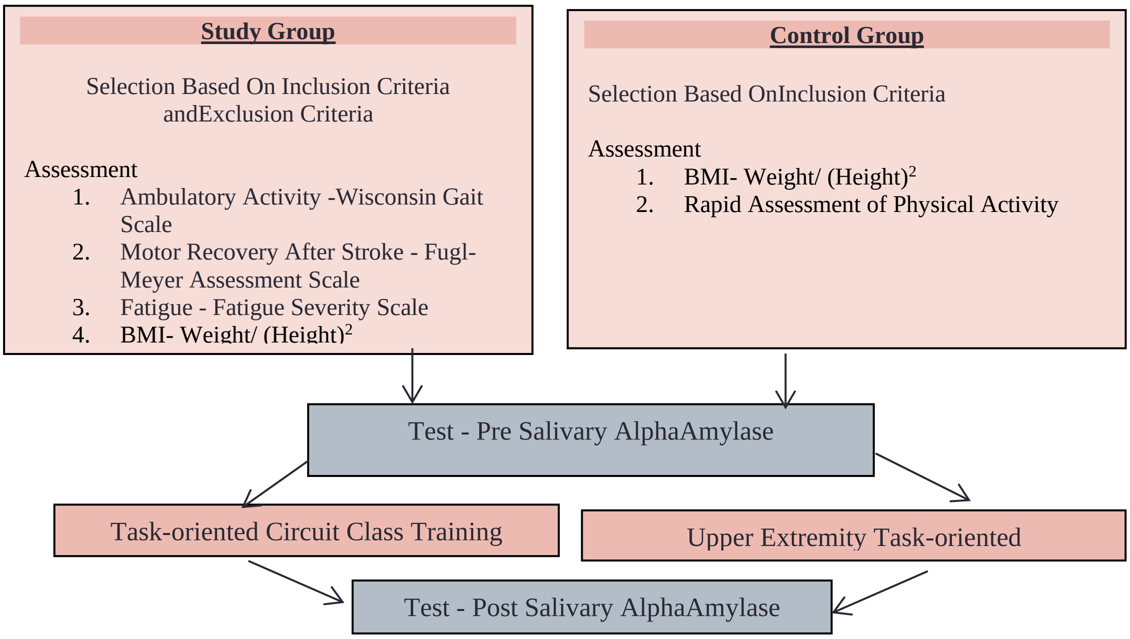

Figure 1:- Showing the Study Procedure

METHOD OF MEASURING SALIVARY ALPHA AMYLASE

Ultimately, Two Groups were available for Study. The Study Group and Control Group had analyzed for various Parameters in order to evaluate, compare, correlate and identify the significance of release of SAA may be correlated with the extent of Disability Post-Stroke, Assess Exertion Fatigue after Exercise and considered as a Biochemical Marker for assessment of Post Stroke Fatigue. The Method used to analyses the SAA level was *Colorimetric* which is based on the Principle where Concentration of Amylase is determined by its activity on starch to hydrolyze into maltose and dextrin. After incubation, end products are treated with iodine reagent and difference in color intensity is measured. Various parameters are set in *Erba chem-5* according to Amylase Kit Assay then in a cup 1000 milliliter of α-Amylase working Substrate is taken and 25 milliliter of Saliva is added to it and device is washed with distal water and difference in color intensity is measured through Erba chem-5 machine. It gives concentration of Amylase in U/milliliter on a printed paper.

Figure 2:-Showing Salivary Alpha Amylase Kit and Instruments, Erba Chem-5 Machine

STATISTICAL ANALYSIS

The responses of Frequencies were calculated and analyzed by using the raw data of 50 subjects. The raw data were entered into the computer database. Statistical software, SPSS version 17.0 was used for analysis. Prevalence of an outcome variable along with 95% confidence limits was calculated. Both, descriptive and inferential statistics were used to Study the release of SAA before and after Exercises in Stroke Patients and Control Group Individuals. Descriptive statistical analysis has used to depict the main features and characteristic of the collected samples. Results on continuous measurements are presented on Mean±SD (Min-Max) and results on categorical measurements are presented in numbers (%). A Parametric Test, Unpaired T-Test was used to identify the significance of difference in Fatigue Severity Score, Wisconsin Gait Scale (WGA), Fugl-Meyer Assessment Scale (FMA), Upper Extremities Measurement (UEM), Lower Extremities Measurement (LEM), Balance, Sensory, Joint Range of Motion (JROM) And Pain between Left and Right Site of Lesion and Ischemic and Hemorrhagic Stroke Patients.

Paired T-Test was used to identify the significance of difference between Pre SAA Activity Score with Post Upper and Lower Limb Test Scores in Study Group and Control Group. A Non-Parametric Test, Pearson's Chi-Square Test had used to associate the Type of Stroke, Affected Area, and Duration of Post Stroke with Fatigue Severity Category. The Karl Pearson's Coefficient of correlation had been used to identify the degree and direction of relationship of Pre SAA Activity score with Fatigue Severity Score, WGA, TFMA, average of Post Upper and Lower Limb Test Scores (motor impairment) in Study Group while Pre SAA Activity with Post Upper and Lower Limb in Control Group. The Probability Value, p>0.05 was considered as Statistically Insignificant but the probability Value from p<0.05 to p<0.10 was considered as suggestively or poorly Significant. The Probability Value from p<0.05 to p<0.01 was considered as Moderately Significant or Statistically Significant while from p<0.009 to p<0.001 was considered as statistically highly/ strongly Significant.

RESULTS

Sample Characteristics

Table 1 Summarizes the Demographic, Weight, Height, BMI Characteristics of the Intergroup Samples. The p>0.05 means there is statistical insignificant differences between the Two Groups.

Table 1: Inter Groups Participant Description

Variable	Study Group	Control Group
	N=20	N=30
	Mean± (SD)	Mean± (SD)
Age	50.95 ± (13.63)	46.90 ± (12.74)
Sex	65% Male, 35% Female	53.3% Male, 46.7% Female
Weight	65.77±7.64	66.23±9.35
Height	161.90±11.11 Cm	165.47±11.29
BMI	25.22±3.04 Kg/M^2	24.25±3.21 Kg/M^2

Table 2 summarizes the % of Ischemic Stroke vs. Hemorrhagic Stroke further involvement of % of Right vs. Left Side Stroke, Area of Lesion Involved, Duration Post Stroke, Fatigue Post Stroke Characteristics of the Intragroup Sample.

Table 2: Intra Group Participant Description

Variable	Study Group (N=20)
Type of Stroke	85% Ischemic Stroke, 15% Hemorrhagic Stroke
Side of Lesion Involved	60% Right Side Lesion, 40% Left Side Lesion
Area of Lesion Involved	70% (MCA)
Duration Post Stroke	55% (0-20 days), 20% (0-20 days)
Fatigue Post Stroke	30.0% (Low Fatigue), 70.0% (Serve Fatigue)

A) The Result of Inter- Comparison of Mean Difference between Study Group and Control Group for Pre and Post Salivary Alpha-Amylase Activity:

- SAA Activity at Pre Intervention/ Baseline Level was Statistically Significant (p<0.02) when compared to Subjects in Control Group.
- SAA Activity at Post Intervention of Upper Limb was strongly/ highly different (p<0.002) when compared to Subjects in Control Group.

- Salivary Alpha-Amylase Activity at Post Intervention of Lower Limb was poorly/suggestively Significant (p<0.07) at 93.0% Confidence when compared to Subjects in Control Group.

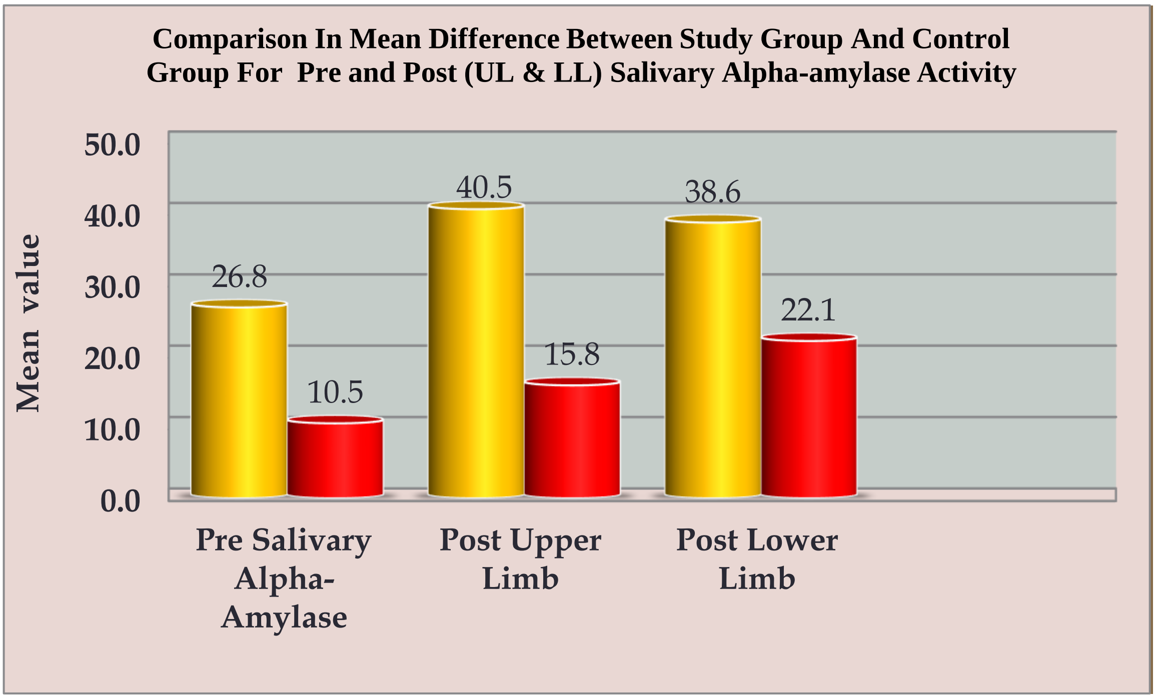

Figure 3:-Bar Diagram Showing Comparison In Mean Difference Between Study Group And Control Group For Pre and Post (UL & LL) Salivary Alpha-amylase Activity

Table 3 Highlighted that Subjects in Study Group had significantly different SAA activity at PreIntervention while after administration of Physiotherapy the Upper Limb was strongly different but the Lower Limb was different at an average and the Average of Limbs had strongly different when compared to Subjects in Control Group.

TABLE 3: Comparison in Mean Difference between Study Group and Control Group for Salivary Alpha-Amylase Activity

Parameter	Group	Spread Mean±SD	MD	t-value	LOS
Pre Salivary Alpha-Amylase Score	*Study*	26.75±32.81	16.24	2.65	p<0.02 *
	Control	10.51±6.31			
Post Upper Limb Score	*Study*	40.51±38.95	24.68	3.29	p<0.002 #
	Control	15.83±11.05			
Post Lower Limb Score	*Study*	38.63±43.68	16.58	1.85	p<0.07 ^
	Control	22.05±18.86			

B) The Results of Intra- Comparison of Mean Difference for Pre and Post SAA activity in Study and Control Groups:

- SAA activity at Pre Intervention/ Baseline Level was Statistically Insignificant (p>0.05) in Study Group, as compare to Post Intervention of Upper Limb SAA Activity. SAA Activity at Pre Intervention/Baseline Level was Statistically Insignificant (p>0.05) in Study Group, as compare to Post Intervention of Lower Limb SAA Activity. SAA activity at Post Intervention of Upper Limb was Statistically Insignificant (p>0.05) in Study Group, as compare to Post Intervention of Lower Limb SAA Activity.
- SAA Activity at Pre Intervention/ Baseline Level was and Strongly

Significant (p<0.001) in Control Group, as compare to Post Intervention of Upper Limb SAA Activity. SAA activity at Pre Intervention/Baseline Level was and Strongly Significant (p<0.001) in Control Group, as compare to Post Intervention of Lower Limb SAA Activity. SAA activity at Post Intervention of Upper Limb was and Strongly Significant (p<0.001) in Control Group, as compare to Post Intervention of Lower Limb SAA Activity.

Table 4 Highlights that Stroke Survivors in Study Group had not Significantly Different SAA Activity Scores when Pre Intervention SAA Activity Scores compared with Scores for Post Upper and Lower Limbs and may be due to the Higher Variation in the Recorded Scores for Study Elements but the Control Group Had Significantly Different SAA Activity Scores.

Table 4: Significance of Mean Difference for Pre Salivary Alpha-Amylase and Post Limbs Score instudy and Control Group

Group	Variable	Intervention stage	Spread Mean±SD	MD	t-value	LOS
Study Group Element	***Salivary Alpha-Amylase***	***Pre***	**26.75±32.81**	**13.76**	**1.59**	**p>0.05** ⊗
		Post Upper Limb	**40.51±38.95**			
		Pre	**26.75±32.81**	**11.88**	**0.93**	**p>0.05** ⊗
		Post Lower Limb	**38.63±43.68**			
		Post Upper Limb	**40.51±38.95**	**1.88**	**0.26**	**p>0.05** ⊗
		Post Lower Limb	**38.63±43.68**			
Control Group Element	***Salivary Alpha-Amylase***	***Pre***	**10.51±6.30**	**5.32**	**3.86**	**p<0.001** #
		Post Upper Limb	**15.83±11.05**			
		Pre	**10.51±6.30**	**11.54**	**4.33**	**p<0.001** #
		Post Lower Limb	**22.05±18.86**			
		Post Upper Limb	**15.83±11.05**	**6.22**	**2.76**	**p<0.001** #
		Post Lower Limb	**22.05±18.86**			

A) The Result of the Comparison in Mean Difference Between Study Subjects with Low, Moderate, Vigorous Activity Subjects in Control Group: Rapid Assessment of Physical Activity was Done in Control Group Individual’s and Sorted According to Low (N=17), Moderate (N=8) and Vigorous (N=5) Type of Activities and that Further Compared with all Stroke Patients for SAA Activity.

- SAA Activity at Pre and Post Upper and Lower Limb Intervention was at a Statistically Significant (P<0.05) when compared to Subjects in Low Physical Activity in Control Group.
- SAA Activity at Pre and Post Lower Limb Intervention was Statistically Insignificant (P>0.05) but only the Salivary Amylase Activity is Statistically Significant (P<0.05) After Upper Limb Intervention when compared to Subjects in Moderate Physical Activity in Control Group.
- SAA Activity at Pre and Post Upper and Lower Limb Intervention was Statistically Insignificant (P>0.05) When Compared to Subjects in Vigorous Physical Activity in Control Group.
- Table 5Highlights that the Stroke Survivors had Significantly Different SAA Activity at Pre Intervention Stage while after administration of Physiotherapy the Upper Limb was Strongly Different but the Lower Limb and the Average of Limbs was Significantly Different when compared to Subjects with Low Physical Activity in Control Group.

Table 5: Comparison in Mean Difference between Study Subjects and Low Activity Subjects in Control Group

Parameter	Group	N	Spread Mean±SD	MD	t-value	LOS
Pre Salivary Alpha-Amylase Score	***Study***	**20**	**26.75±32.81**	**17.53**	**2.17**	**p<0.05** *
	Control	**17**	**9.22±5.64**			
Post Upper Limb Score	***Study***	**20**	**40.51±38.95**	**27.94**	**2.87**	**p<0.007** #
	Control	**17**	**12.57±9.92**			
Post Lower Limb Score	***Study***	**20**	**38.63±43.68**	**23.41**	**2.14**	**p<0.05** *
	Control	**17**	**15.22±11.62**			

Table 6 Highlights that the Stroke Survivors hadn't Significantly Different SAA Activity at Pre Intervention Stage while after administration of Physiotherapy the Upper Limb was Poorly Significant but the Lower Limb and were not Significantly Different when compared to Subjects with Moderate Physical Activity in Control Group.

Table 7 Highlights that the Stroke Survivors hadn't Significantly Different SAA Activity at Pre Intervention Stage while after administration of Physiotherapy the Upper Limb, Lower Limb and the Average of Limbs was not Significantly Different when compared to Subjects with Vigorous Physical Activity in Control Group.

Table 6: Comparison in Mean Difference between Study Subjects and Moderate Activity Subjects in Control Group

Parameter	Group	N	Spread Mean±SD	MD	t-value	LOS
Pre Salivary Alpha-Amylase Score	***Study***	**20**	**26.75±32.81**	**16.46**	**1.40**	**p>0.05** ⊗
	Control	**8**	**10.29±4.12**			
Post Upper Limb Score	***Study***	**20**	**40.51±38.95**	**25.43**	**1.82**	**p<0.08** ^
	Control	**8**	**15.08±5.77**			
Post Lower Limb Score	***Study***	**20**	**38.63±43.68**	**15.87**	**1.01**	**p>0.05** ⊗
	Control	**8**	**22.76±7.43**			

Table 7: Comparison in Mean Difference between Study Subjects and Vigorous Activity Subjects in Control Group

Parameter	Group	N	Spread Mean±SD	MD	t-value	LOS
Pre Salivary Alpha-Amylase Score	*Study*	20	26.76±32.81	11.50	**0.77**	p>0.05 ⊗
	Control	5	15.24±9.80			
Post Upper Limb Score	*Study*	20	40.51±38.95	12.40	**0.69**	p>0.05 ⊗
	Control	5	28.11±14.10			
Post Lower Limb Score	*Study*	20	38.63±43.68	5.49	**0.26**	p>0.05 ⊗
	Control	5	44.13±33.68			

DISCUSSION

This Study was planned to evaluate the Usefulness of a Particular Enzyme SAA as a Biomarker of Stress in Chronically Stressed Stroke Individuals. Verbal Or Self-Reporting Questionnaires alone in Fatigue Evaluation provide highly inconsistent results according to Patient's Mood and Attitude. Many Individuals suffering from Fatigue related Problems have a tendency to either deny or exaggerate the real condition; this may lead to a bias in the Study and confounds with the Results. The Primary Aim of the Study was to "*Objectively Quantify Post-Stroke Fatigue by assessing Salivary Alpha Amylase Level as a Biochemical Marker and its relation to a Prescribed Exercise*". The most important observation in this Study was that Salivary Alpha Amylase Levels did increase significantly from Baseline Levels in Stroke Survivors (26.75±32.81) when compare with Control Group (10.51±6.30) with a mean difference of 16.24 which is Statistically Significant at (p<0.02). Salvolini et al., (1999) concluded that Basal SAA Levels do not change significantly over the adult life span. This baseline difference supports the hypothesis that Post Stroke Chronic Fatigue is sufficient to elicit a response in SAA level. This demonstrates the possible use of SAA as a Chronic Fatigue Marker in Stroke Studies. Furthermore, Stroke Studies could assess with respect to the Low Physical Activity Individual SAA level rather than a population-derived reference interval indicates that the analytic displays high individuality.

SAA synthesized in the acinar cell of Salivary Glands and stored in Secretory Granules inside the Cells and Production in the SAAGl and increase in response to Psychological and Physical and Mental Stress through interaction with Autonomic Nervous System. In the Present Study it was found that Individuals with Stroke had a significantly elevated level of SAA when assessed with age matched Control Group Subjects. It could be attributed to repeat stresses are common for Stroke Patients, such as that Sequel of an Upper Motor Neuron Lesion, Include Hemiparesis, Reduced Mobility, and Impaired Balance and in Coordination, And Diminished Proprioceptive Feedback. (M. J. MacKay-Lyons and J. Hewlett (2005) these repeated stresses may increase the Sympathetic Nervous System sensitivity to stress and therefore prolong the more release of SAA. Further Secondary Changes as changes in Muscle Physiology and Inflammation, Impaired Hemodynamic Response, Altered Metabolic Health, and, to a lesser extent, Respiratory Dysfunctions can also Negatively Influence Quality of Living and Increase Energy Expenditure after Stroke (C. E. Hafer-Macko et.al (2005); F. M. Ivey et.al (2004); C.L. Rochester and et.al (2002). Also Significant Disuse as well as Altered Neurological input to the periphery may alter skeletal muscle tissue composition in the Paretic Limb, Thereby, Contributing to Increase Stress Resulting in Early Fatigue (R. F. Macko et.al (1997); B. Y. Tseng et.al (2010))

The Study was further planned to evaluate the Usefulness of a Particular Enzyme SAA as a Biomarker of Acute Fatigue in Stroke Individuals. Verbal Or Self-Reporting Questionnaires alone in Fatigue Evaluation like Dutch Exertion Fatigue Scale (DEFS), Situational Fatigue Scale (SFS), and Borg's Rating of Perceived Exertion (RPE) etc. Provide highly inconsistent Results according To Patient's Mood and Attitude. SAA may prove to be a Valuable Stress Marker Due to the Saliva Glands Releasing Enzymes upon Stimulation of the Sympathetic Nervous System during Exercise (Proctor &Carpenter, 2007). These Studies believe that Amylase gives a more Accurate Reflection of Body Stresses during Situations Because Of Its Fast Acting and Easily Collectable Nature. There is Evidence that the increased SAA among Stroke Survivor when compare to Control Group Individual with a given Exercise which has a potent Physiological Stimulus which could induce a wide range of stimulation to Autonomic Nervous System which reported that Exercise Preferences after Stroke differ from those people without Stroke. In general, Salivary Alpha Amylase uptake at a given Functional Exercise Workload in Stroke Patients is greater than in Healthy Subjects, possibly because of reduced Mechanical Efficiency, The Effects of Spasticity, Or due to Direct and Secondary Conditions. As the Particular Exercise Design for Stroke Survivor "*Task-Oriented Circuit Class Training Programmed*" for *Lower Limb Exercise* and "*Upper Extremity Task-Oriented Training*" for *Upper Limb Exercise* though it has the potential to drive Brain Reorganization toward more Optimal Functional Performance but the Single Session had shown more Release of SAA in Stroke Patients.

In the Present Study it was found that Individuals with Stroke had a Significantly Elevated Level of SAA When Assessed with Age Matched Control Group Subjects and that had Low Activity Level. It could be attributed to stress of Exercise placed on already stressed Stroke Patients had shown more release of Salivary Alpha Amylase which could not be if it would be taken as a Therapeutic Exercise Program. Further Observation was noticed that uptake of SAA among Stroke Individual is differ after Upper Limb (UL) and Lower Limb (LL) Exercise Sessions. Thus, the result indicate that SAA release after UL Session shows Significant results when compare with Low and Moderate Activity Individual but SAA release after LL Session shows Significant results only with Low Activity Individual, indicates that UL is more in stressed after Exercise than LL Exercise. It could be due to as UL Exercise leads to Higher Blood Pressure (BP) And Heart Rate (HR) than LL Exercise due to a higher Work Component and Elevated Peripheral Resistance Caused by Reduced Active Muscle Mass in Normal. In Addition, UL Exercise also induces Greater Perceived Exertion Compared to leg Exercise at the Same Relative Workload. (KangJ., (1999); Volianitis S., (2004))

Indeed, after Stroke blood flow in the Paretic Limb is Significantly Lower at Rest and during Exercise, when compared to the Non-Paretic Limb. (S. Landin (1997)) Stroke-Related Changes in the Brain, Specifically in areas that regulate Autonomic Function, can have Significant Implications for Blood Pressure Control and Cardiac Function during Activity. (D. E. MohrmanandL. J. Heller (2006)) there was more pronounced Sympathetic Increase and Vagal Decrease for UL Exercise than for LL Exercise. Heloisa G. (2014). Evidence shows that in Training Upper Extremity Compared to that of Lower Extremity, Sympathetic Nervous Flux has increased because of Muscular Mass Tension whose Effect (Outcome) is the Contraction effect of this nerve on inactive Muscular Mass (Eston and Brodie., 1986) Because Arms get exhausted much sooner compared to Legs due to very small Muscular Mass (Michael Bond Et Al (1986)). These Stroke-Related changes due to Direct and Secondary Consequences Lead to Increased SAA More during UL Exercise than during LL Exercise. Taken together, it would seem sensible to ensure that Exercise Beliefs and preferences are taken into account when advising Stroke Survivors to be more Physically Active as in this Study we had seen that SAA increase more after UL Session than for the LL Session.

The Pre SAA was assessed and compared with That of Post UL Exercise Training and Post LL Exercise Training. It was found that Stroke Subjects did not show a Significant Difference in the SAA Value. Meanwhile the Control Group Individuals had shown Significance Difference between the Pre and Post UL and LL Exercise Training SAA Values. This could be attributed to an already raised Baseline Value of SAA Which Could Have Been the Reason for not showing any Statistically Significance Difference that was seen among Normal. While the comparison of SAA Post UL Exercise with Post LL Exercise. It was found that Stroke Subjects Did Not Show a Significant Difference in the SAA Value. Meanwhile The Control Group Individuals had shown Significance Difference between the Post UL and LL Exercise Training SAA Values. This could be attributed because Arms get exhausted much sooner compared to Legs due to very small Muscular Mass (Michael Bond Et Al., 1986). Thus SAA Level Post LL Exercise was higher as compare to Post UL Exercise in Control Group Individual’s and in Stroke Subjects both UL and LL are weak and already Baseline Levels are Elevated which could have been the reason for not showing any Statistically Significance Difference. Kandel ER Et Al. (1995) showed that interplay between various Physiological Control Systems that regulate Work Output. Work Output is a dependent Variable of applied effort that is controlled by Motivational Input (Internal and External) And Feedback from Motor, Sensory, and Cognitive Systems that Establishes the Level of Perceived Exertion.

Perceived Exertion is an important feedback control for the level of Applied Effort. Additional Control Systems that regulate work output are Environmental Factors such as Temperature and Internal Mileu (Homoeostasis and Autonomic Function). “Voluntary Effort as a controlled variable that is affected by many Control Systems” Typical Physical Activity depends on Structural and Functional Integrity of Sensory and Motor Systems. Stroke Patient Have interruption to this complex chain of events Sensory, Motor, Cognitive External

Input and Dissociation between the level of Internal Input (Motivational And Limbic) and the Environmental Factors could affect their level of Applied Effort and Perceived Exertion because of this some patient get easily Fatigue and some Patient respond with their Full Efficiency and thus release more Salivary Alpha-Amylase differ among Stroke Survivors. Henceforth, SAA in subjects may be considered as an Index of Stress in Individuals. Moreover, SAA may be considered as a Biochemical Marker in Stroke Survivors for Assessment of Post Stroke Fatigue.

CONCLUSION

Findings indicate that Salivary Alpha-Amylase Activity in subjects may be considered as a Significant Index of Stress in Individuals. Moreover, Salivary Amylase may be considered as a Biochemical Marker in Stroke Survivors for Assessment of Post Stroke Fatigue. The SAA Levels elevated significantly above Baseline Levels When Compare to the Control Group Individual. The Purpose of the Current Study was to determine level of SAA in Stroke and SAA Levels did increase significantly above Baseline Levels. There was significant increase in SAA concentration Post Exercise is believed to be due to the activation of the Flight-Or-Flight Response through the Sympathetic Nervous System. According to this study SAA Level did increase more in Stroke Patient before and after Exercise as their body is already in Fatigue State require more energy thus release of more SAA than Control Group Individuals. And the rate of release of SAA was not significant in Stroke Individuals as their Baseline Levels are already elevated.

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