



ASSOCIATION BETWEEN STRESS AND CORTISOL LEVEL WITH SEVERITY OF STUTTERING

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Abstract

Background: Stuttering is defined as a disturbance in the rhythm of speech. Stuttering is characterized by "a speech disorder in which the flow of speech is interrupted by involuntary repetitions and prolongations of sounds, syllables, words, or phrases, and involuntary silent pauses or blocks in which the stutterer is unable to produce sounds.

Objective: The objective of this research was to investigate the association between stress, cortisol levels, and the severity of stuttering.

Methodology: A Comparative Cross-Sectional study design was employed for this research. 65 The sample size 65 was calculated based on a previous study that was done in 2017 "Awareness about stammering and Self Therapy of Stutterers (Biomedical Research of Complex Word of Neurological Sciences) the online sample size calculated was used to evaluate the sample by using 95% confidence interval 8% level of significant. Children and adults of age from 4 to 30 years were included. Individuals with co-morbid conditions such as heart disease and endocrinology disorders were excluded from the study. A convenience sampling technique was used, and data was collected for 6 months from Children's Hospital Lahore and other private settings.

Results: Among 65 study respondents, 16 stammers showed high, 12 showed below and 37 people showed normal range means out of 100%. 56% of participants were normal 18.4% below and 24% showed high levels of serum cortisol. Co-relation was found but frequency was not as high as expected.

Conclusion: It is concluded that there was no significant relationship between stress and Cortisol levels among stutterers. The physical aspects and secondary behavior of stutterers were influenced directly and indirectly by stuttering.

Keywords: Stuttering, Stammering, Serum Cortisol, DASS

Introduction

Speaking is an important component of daily life by which one person communicates with other and share their thoughts. Although the majority of individuals have problems while communicating

shuttering is one of those speech disorder (1). Shuttering is defined as involuntary disturbances in speech and it is a complicated speech problem. It remarkably impedes and affects the capability of people to communicate. Shuttering is more common among children and teenagers. Its prevalence is 1% in adults and 5% among children. Neurological, cellular physiological, genetic, and psychological disorders have a close association with shuttering, and among all factors, the environmental components are significant. The social, cognitive, behavioral, and psychological aspects of an individual are also affected by shuttering. The affected individual often feels low self-esteem and remains depressed. Therefore, the stress levels of such individuals also increase which ultimately causes an increase in levels of cortisol which is a stress hormone. Neuroimaging tools and techniques have explicated that shuttering is a timing and motor disorder due to basal ganglion malfunctioning (2). Yekta et al in 2020 explained the relationship between shuttering disorder and steroid hormones. The study illustrated that sex hormones a closely associated with developing shuttering (3). According to a study, in case of extreme stress and anxiety, the body starts producing cortisol to overcome the stress levels. The hypothalamic-pituitary-adrenal axis (HPA-axis) is the main stress control center of the body that signals the adrenal gland to produce cortisol hormones under stressful conditions. Moreover, exposure to stress stimuli for longer periods leads to a decrease in the functioning of the HPA axis causing cardiovascular disease, adrenal fatigue, psychiatric issues, and decreased immune functioning due to the destruction of chronic excessive cortisol (4). Jarrett measures the cortisol levels of children with speech disorders. Children aged from 6 to 11 years were included and their cortisol levels were checked during the reading process. The findings of this study explained that children with slurred or stammering speech do have not much higher cortisol levels (5). Masoumeh et al in 2023 performed a study to understand the association between shuttering and anxiety. A close relationship has been found between stress, anxiety, and shuttering. A moderately significant correlation has been found between anxiety and shuttering among children (6). Another study carried out in 2023 demonstrated that neurodevelopmental disease is not only the cause of developmental shuttering, but social stress, embarrassment, and anxiety are also the main reasons for the progression of shuttering among children and teenagers. Speech motor control and skin conductance levels were measured during the study to evaluate stress levels. The outcomes of this research described that stress is a major component that affects the cognitive skills and other capabilities of stutterers (7). Noreen et al in 2017 investigated various levels of perception about awareness of shuttering and self-therapy among stutterers. Cross-sectional research was carried out and adult patients were included. Shuttering has been elaborated in various ways as a disturbed speech rhythm that is either a convulsive or intermittent repetition of sound. Various shutter therapies have been used by the researchers and among all regimes used by authors self-help therapy proved to be very useful (8). Almudhi and Gabr evaluated the relationship between cognitive skills and stress markers. Shuttering severity instrument was used by the authors to know the cognitive capabilities of stutterers. The results of this study showed that stress and cognitive skills have a close association among adults having speech problems (9). Another study explained the correlation of shuttering with anxiety. A case-control study design was used by the researchers to explore the levels of cortisol level in such patients. The level of severity of xerostomia had been studied along with cortisol levels. All affected individuals had dry mouths which is an indication of anxiety. Hence, the study described that there were raised levels of cortisol and xerostomia among patients (10). Bernard et al investigated the correlation between anxiety-like symptoms and shuttering. A systematic review was performed and 13 articles were included to know the possible moderators responsible for increasing the severity of shuttering among children and adults. Shuttering and non-shuttering children and adults were compared and depressive symptoms were evaluated. The outcomes of this study demonstrated that anxiety and depression increased among stutterers (11). Another previous study highlighted the association of shuttering with diabetes mellitus in the young population. The researchers found that both shuttering and diabetes mellitus type 2 are associated with alteration in the HPA-axis. This study concluded that shuttering is a risk factor for causing early onset of type 2 diabetes mellitus in males, but not in females (12). Individuals with speech disorders have to face behavior changes such as stress, anxiety, and depression which are very common among them. A high level of stress stimulates brain centers to

release cortisol and hence, increases the severity of shuttering. Exposure to stress stimuli for longer periods increases the threshold of cortisol. The purpose of this study is to find the association of stress and cortisol levels with the severity of shuttering. Previous studies have been conducted to determine the relationship between anxiety and depression with shuttering. The current study was found to be very effective in finding how stress and cortisol levels are related to shuttering. The study deduced that there is no association between stress and cortisol with that of shuttering. Furthermore, this study will also help future researchers in exploring the role of stress hormones and their role in shuttering.

Material and Methods

Participants

A comparative Cross-sectional study design was used for this research. Data was collected from Children's Hospital Lahore and other private settings using a Convenient sampling technique. The research was carried out for 6 months Males and females from 4 years to 30 years were included. Stammering with other comorbidities of heart disease, psychological disorders, and endocrinal disorder were excluded. The sample size of 65 was calculated based on a previous study that was done in 2017. the online sample size calculated(8) was used to evaluate the sample by using a 95% confidence interval and 8% level of significance.

The data was collected by using Performa. All the demographic information was collected in a confidential setting after taking informed consent and explaining the details of the research keeping in view all the ethical considerations on a questionnaire form. Stammering and stress levels were measured for assessment. Stuttering Severity Inventory (SSI-4), Depression Anxiety Stress Scale (DASS-21), and Serum cortisol level were calculated.

The data was statistically analyzed by application of descriptive statistics through SPSS21.

Results

The overall assessment was done by using SSI4 (Stuttering Severity Instrument_4), DASS (Depression Anxiety Stress Scale), and Serum Cortisol. SSI4 was used to determine the degree of severity of stuturer while DASS 21 was used for psychological measuring of depression, anxiety and stress and Serum Cortisol was used as a biomarker assessment of stress. The results of this study evaluate d the correlation of pathological findings with psychological conditions of stress and anxiety with communication in social settings. To assess the level of serum cortisol on stress, anxiety, and depression with stuttering in children and adults with a Comparative Cross-Sectional research design.

Table 1: Demographic Variables

Items	Description	Frequency	Percentage	
Gender	Male	44	67.7%	
	Female	21	32.3%	
Settlement	Urban	31	47.7%	
	Rural	34	52.3%	
Age	Childhood	4-9	28	43.1%
	Adolescence	10-15	12	18.5%
	Adulthood	16-20	3	4.6%
	Adulthood	21-25	11	16.9%
	Adult	26-30	11	16.9%

The frequency distribution of all demographic variables is shown in Table 1, Where it is prominent that most in this survey were male (n= 44, 67.7%) and female members (32.3%, n= 21). A major portion of participants belonged to rural areas (52.3%, n=34) and urban areas (47.7%, n=31). Most of the age of participants belonged to the category between 4 and 9 (n= 28, 43.1%). The employees between the age category of 10-15 were (n=12, 18.5%). The participants with the age category of 16-20 and 21-25 were (n=3, 4.6%) and (n=11, 16.9%) respectively. Only 11 respondents fell in the category of 26-30 and they were 16.9% of the total respondents.

Table 2: Depression, Anxiety, and Stress

	DASS-21				
	Normal	Mild	Moderate	Severe	Extremely Severe
Depression Percentage	23 35.4%	15 23.1%	12 18.5%	10 15.4%	5 7.5%
Anxiety Percentage	31 47.7%	8 2.3%	11 16.9%	8 12.3%	7 10.8%
Stress Percentage	16 24.6%	18 27.7%	14 21.5%	13 20.0%	4 6.2%

The above table demonstrates a detailed description of the components of DASS21 (depression, anxiety, stress). The degree of severity is been measured on a Likert scale including normal, mild moderate, severe, and extremely severe. In depression (n= 23. 35.5%) was the normal range and (n= 5, 7.5%) were found extremely severe. Levels of anxiety were found in (n=31, 47.7%) on normal range and (n= 7. 10.8%) on extremely severe. The degree of stress was normal (n=16, 24.6) and severe (n=13, 20.0).

Table 3: SSI4

SSI4			
	Frequency	Percentage	SD
Mild	23	35.3%	1.41421
Moderate	18	27.6%	1.76476
Severe	24	36.9%	2.4615
Total	65	100%	1.58190

The table demonstrates the degree of severity of SSI4 (Stuttering Severity Instrument4) in which(n=23, 35.3%) were found on mild, (n=18, 27.6%) moderate, and (n=24, 36.9%) severe. It is indicated that 36.9% of participants suffer from severe stuttering

Table 4: DASS-21 & SSI4

DASS-21 & SSI4					
	Normal	Mild	Moderate	Severe	Extremely severe
Depression Percentage	23 35.4%	15 23.1%	12 18.5%	10 15.4%	5 7.5%
Anxiety Percentage	31 47.7%	8 2.3%	11 16.9%	8 12.3%	7 10.8%
Stress Percentage	16 24.6%	18 27.7%	14 21.5%	13 20.0%	4 6.2%
SSI4 Percentage		23 35.3%	18 27.6%	24 36.9%	

The table represents the collective frequency percentage of DASS21 (depression, Anxiety, stress)with SSI4. It concluded that psychological markers were also risk factors for stuttering.

Table 5: Serum Cortisol Levels

SSI4							
	Mild	Moderate	Normal	Severe	Ext severe	Total	Percentage %
Serum cortisol							
Below	4	3	2	3	0	12	18.4%
Normal	10	7	10	6	4	37	56%
Above	4	4	4	4	0	16	24%
Total	18	14	16	13	4	65	100%

The outcomes of descriptive analysis of the variables show that in serum cortisol (n=12, 18.4%) participants lie below average and (n=37, 56%) participants were found in the normal range while (n=16, 24%) participants were lying above the average scores.

Figure 1: Cortisol Levels

Table 6: Stress Level and Cortisol

Stress	Below	Serum cortisol Normal	Above	Total
Mild	4	10	4	18
Moderate	3	7	4	14
Normal	2	10	4	16
Severe	3	6	4	13
Ext severe	0	4	0	4
Total	12	37	16	65

Table 8 demonstrates the chi-square analysis of stress and serum cortisol. The value indicated that (n= 37) normal range of the participants, and (n=16) above from the averagescores. The association with stress indicates that (n=18) was mild and (n=16) was lying in the normal range.

Discussion

Nonexperimental research was conducted in which 65 sample size was measured by using serum cortisol levels among 65 stutterers. It was concluded that 18.4% was below, 56% was normal and 24% was above the mean scores. On DASS21 results were measured on three scales including depression, anxiety, and stress. There 25.4% of participants got normal scores, 23.1% mild, 18.5% moderate, 15.4% severe and 7.5 % extremely severe. While on anxiety 47.7% got normal, 20.3% mild, 16.9% moderate, 12.3% severe and 10.8 were found extremely severe. Similarly, on the stress 24% of participants got normal, 27.7% mild, 21.5% moderate, 20.0% severe and 16.2% extremely severe from the total population. Baurely correlated social anxiety and shuttering and attentional biases were observed among the adults who shutter and those who did not shutter. The results of this study depicted that there was maladaptive behavior in those adults who had a shuttering problem (13). In the current research sample size was 65 stutterers. Anxiety was measured by using the DASS21 psychological tool. 47.7% lie in the normal range, 20.3% were mild, 16.9% were moderate, 12.3% were severe and 10.8% were extremely severe from the mean score. 52.3% of stutterers were suffering from anxiety and anxiety had a high risk of resiliency in speech. Mohammadi et al studied the relationship between steroidal hormones and developmental shuttering. The study found a positive association between cortisol and shuttering (14).

In our research serum cortisol was used as a biochemical marker in which 18.4% werelying below average, 56% were in normal range and 24% were below the average. It is concluded that the majority of stutterers lies in the normal range and there was no high-frequency evidence of biochemical markers were found among stutterers. A study in 2020 highlighted the physiological effects on speech motor practice and speech motor control among people who shutter. The Optotrak system was used by study participants for recording the lip’s movements. This research concluded that children who

shuttered explained less mature speech practice and control (15).

In our research, a correlational study was conducted and the sample size was not only adult. It was taken from all age ranges including childhood adolescence and adulthood. The sample was taken by blood test form but the majority of the sample lies between normal ranges only 24% population shows high results on serum cortisol. It means there was a correlation between stress and stuttering but frequency was not as high as was expected. A study in 2022 deduced that movement selection is very important in everyday life. Thirty-six young male adults were included and their psychological stress and movement pattern was observed. This study demonstrated that mobility is affected if the patient has some psychological stress (16).

In the current study, we just observed the frequency of depression, anxiety, and stress 25.4% of participants got normal scores, 23.1% mild, 18.5% moderate, 15.4% severe, and 7.5 % extremely severe. While on anxiety 47.7% got normal, 20.3% mild, 16.9% moderate, 12.3% severe and 10.8 were found extremely severe. Similarly, on the stress 24% of participants got normal, 27.7% mild, 21.5% moderate, 20.0% severe, and 16.2% extremely severe from the total population. A review study was carried out to understand the relationship between anxiety, depression, shuttering, and suicide. The results of this study illustrated that social depression and anxiety were significantly higher for people who shutter (17).

In current research correlation of general stress was measured by using a blood test (Serum Cortisol) and psychological test (DASS21) and concluded that stammer had biochemical evidence of stress by high degree of Serum Cortisol 16% had shown high level but frequency was not so much high and on DASS21 24.6% had shown normal stress level and 75.4% had shown stress in life it means that psychological stress had more influence on life than biological marker. Samson et al in 2023 explored how covert shuttering affects quality of life and self-image among females. Personal aspects, shuttering management, and the phenomenon of shuttering were identified as main themes. Hence, this study described that shuttering affects the quality of life and self-image of females who shutter (18).

In this study, demographic results showed that 44 male participants stutter and 21 female stutterers were found. Results showed 67.7% of males stutter and 32.3% were females stutter so our research also proved previous research that males were more stutter than females. Gerlach et al in 2019 highlighted the association between affective and cognitive changes and attending a Shuttering Support Organization (SSO) convention. The findings of this study concluded that SSO proved to be beneficial in decreasing the negative effects of shuttering (19).

In our correlational research stress was also found as a biochemical marker 24% of stutter shows above normal level normal level 56% and 18.4% was below the normal range. It means biochemical evidence had been proved by serum cortisol level but the frequency was not so much high as expected range. Another study was performed by Singh et al in 2018 to explore the effect of anxiety on shuttering. The outcomes of this study explained that there was a significant association between anxiety and shuttering. According to the study, 63.1% had shown no facial movements, while 36.9% had facial movements. Similarly, 66.9% had no hand movements and 33.1% had hand movements (20).

In our research, only 24% population showed high results 56% normal and 18.4% below which means most of the stutterers lay in the normal range in serum cortisol by blood sample. A study demonstrated the impacts of shuttering on listeners. The findings of this study illustrated that 60% of the study respondents were affected by speaking styles of shutters (21).

Our research was nonexperimental research 65 sample size was taken of stammers, 16 stammers showed high, 12 showed below and 37 people showed normal range means out of 100%. The 56% participants were normal 18.4% below and 24% showed high levels of serum cortisol. Co-relation was found but frequency was not as high as expected. Arushi et al in 2022 depicted different models for recognizing emotional stress. Virtual reality was used by researchers to make public speaking better (22). Another study of 2020 was conducted to identify levels of self-kindness in people who had or did not have a shutter problem. There were no prominent differences between those who had a shuttering problem and those who did not (23).

Conclusion

It is concluded that there was no significant relationship between stress and Cortisol levels among stutterers. An alternative hypothesis was rejected and the null hypothesis was accepted. Anxiety and depression were found as confounding variables. The physical aspects and secondary behavior of stutterers were influenced directly and indirectly by stuttering. The percentage of stuttering in males were found more frequent than female stutterer. Awareness of stuttering was found higher in rural areas as compared to urban areas.

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