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GENDER BASED COMPARISON OF GALVANIC SKIN RESPONSE (GSR) AMONG GENERALISED ANXIETY DISORDER (GAD) PATIENTS

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ABSTRACT
Autonomic nervous system (ANS) plays major role in regulating the various cardiac function through the interplay of sympathetic and parasympathetic branches. Many studies have concluded that Generalised Anxiety Disorder (GAD) results in imbalance of this interplay leading to cardiovascular morbidity and mortality. Our study was conducted on 60 patients of GAD, 30 patients each from both gender, to know if there is any gender based difference among this effect of GAD on autonomic nervous system by recording galvanic skin response (GSR). Our study concluded that disturbance in ANS was more among females compared to males at basal level and during Valsalva maneouvre (p value 0.045).

INTRODUCTION:
Some physical diseases are believed to have a mental component derived from the stresses and strains of everyday living for e.g. lower back pain and high blood pressure that appears to be partly related to stresses in everyday life. It is still difficult to classify some disorders as purely physical, purely somatoform or mixed psychosomatic disorders. The term "Physiological Psychology" was coined by Avicenna in regard of treatment of diseases involving emotions. During very early days Carl Jung found an association between changes in pulse rate and inner feeling, stating it as "association"[(1)]. Franz Alexander and Sigmund Freud pursued further studies, researching the possibility of treating physical disorders through psychological processes[(2,3)].
Negative emotions such as – anxiety, anger and depression have been implicated as risk factors for the incidence of coronary heart disease (CHD) [(4,5)]. Anxiety disorders have been associated with increased risk of cardiovascular morbidity and mortality. Several studies have predicted the increased risk of coronary artery disease (CAD) in patients with generalized anxiety disorder (GAD) or panic disorders[(6)]. This association has been found to be due to dysregulation of autonomic nervous system

control activity[7]. Possible mechanism of association of GAD with coronary vascular disease include changes in autonomic tone- either as decreased vagal or increased sympathetic tone[8,9].

Anxiety disorder is a blanket term covering several different forms of abnormal and pathological fear and anxiety which only came under the aegis of psychiatry at the very end of the 19th century[10]. Current psychiatric diagnostic criteria recognize a wide variety of anxiety disorders. Anxiety disorders are often debilitating chronic conditions, which can be present from an early age or begin suddenly after a triggering event. They are sensitive to flare up during high stress and are frequently associated with symptoms like headache, sweating, muscle spasms, palpitations and hypertension, and in some cases lead to fatigue[11].

Generalised Anxiety Disorder (GAD) is an anxiety disorder that is characterized by excessive, uncontrollable and often irrational worry about everyday things that is disproportionate to the actual source of worry. It often interferes with daily functioning, as individuals suffering from GAD typically anticipate disaster and are overly concerned about everyday matters such as health issues, money, death, family problems, friend problems or work difficulties[12].

Cardiac automaticity is intrinsic to various pacemaker tissues but heart rate and rhythm is mainly under the control of autonomic nervous system. Parasympathetic influence on heart is by vagus nerve via acetylcholine release. Sympathetic influence on heart is mediated by release of epinephrine and nor epinephrine. During resting conditions, vagal tone is the main regulator of variations in heart rate. Most organs of our body exhibit dual innervations from sympathetic and parasympathetic divisions of autonomic nervous system, often mediating opposite effects. The activity and relative balance between sympathetic and parasympathetic nervous system is regulated by afferent input directed primarily to the brain[13,14]. Fine spray type of nerve endings in carotid sinus and aortic arch, as the arterial baroreceptors, are the major contributors in regulation of blood pressure and heart rate. They get stimulated on stretching. Signals are transmitted from each carotid sinus through glossopharyngeal nerve and from aortic arch through vagus nerve to the nucleus tractus solitarius in the medullary area of the brain. From the nucleus tractus solitarius, secondary signals are sent to two centers- Inhibitory to vasomotor center and excitatory to the vagal center. Effects of stimulation of these receptors results in vasodilatation and decrease in heart rate thus decreases blood pressure by reducing peripheral resistance as well as cardiac output[15].

Increased blood pressure results in reflex slowing of the heart through baroreceptor reflex, the efferent limb of which is vagus nerve. Increase in heart rate in response to lowering blood pressure results from decreased vagal inhibition and increased sympathetic activity. The vagal effects are immediate one but the sympathetic effects are delayed until several seconds. Various disorders have their effect on autonomic nervous system. Impaired autonomic functions may result from diseases that affect either the CNS or peripheral autonomic nervous system. Various chronic disorders also have their effects on autonomic nervous system. Several studies have documented increased incidence of morbidity and mortality in patients suffering from various chronic disorders with autonomic irregularity[16].

Assessment of autonomic activity- Tests of autonomic functions are broadly divided into two categories: Invasive and Non-invasive tests. Non-invasive methods are commonly used due to ease of performing and nonrequirement of sophisticated instruments. A combination of these tests are generally employed in assessment of autonomic nervous system as some of these tests give information about the cardiac sympathetic functions whereas others give information about the cardiac parasympathetic functions[14,17]. Among many of non-invasive tests like heart rate variability, postural challnge test, sustained hand grip test, valsalva maneouvre & galvanic skin response, two parameters were included in ou study: Valsalva manoeuvre and galvanic skin response.

GALVANIC SKIN RESPONSE

Galvanic Skin Response (GSR) is a type of an electrodermal response that represents a change in the electrical conductivity of the skin caused by an increase in activity of sweat glands. Galvanic skin response instrument measures skin conductivity from the fingers or palms. The GSR is affected when the sympathetic nervous system is active, in particular when a person is anxious[18,19]. The activity of

sweat glands in response to sympathetic nervous stimulation results in increase in level of conductance which is measured from the fingertips. Fowler et al have recommended that recordings can be taken from electrodes placed on the middle or distal phalanges of two fingers (either index and middle finger or index finger and thumb) or on the thenar and hypothenar eminences of palmar surface[20].

There is a relationship between sympathetic activity and emotional arousal. Tonic skin conductance varies with psychological arousal, rises sharply when the subject awakens and there is further rise with activity, mental effort and especially in stress. GSR is an automatic response under so much control of cerebral cortex that it can be considered an indication of emotional status of the subject[21].

GSR is actually the measure of the resistance of skin to the passage of very small electric current. It has long been known that meditation and relaxation procedures lead to a rise in skin resistance. High and low skin resistance correlate directly with relaxation and stress respectively. High resistance indicates a pleasant relaxed state of mind and low resistance indicates tension. But in psychotherapy session reverse is true. Whenever repressed material comes to surface as in guilt or pain, the skin resistance will raise leading to the affect change in the form of tension. So, in therapy session high skin resistance indicates tension[21].

Suppressed emotional conflict leads to building up of stuck energy in mind. Whenever such material is restimulated by past events or by bringing up the topic again and again, as in the case of generalized anxiety disorder, there will be increase in basal resistance. The wave like increase in skin conductance is known as Phasic skin conductance. It begins 1-2 seconds after the onset of stimulus and peaks within 5 seconds[22].

VALSALVA MANOEUVRE

Valsalva manoeuvre (VM) is a noninvasive autonomic function test. During VM, there is an abrupt, transient, voluntary elevation of intrathoracic and intra-abdominal pressure caused by blowing against a pneumatic resistance maintaining a predetermined pressure[23]. Changes occurring in blood pressure and heart rate during and after the procedure reflect not only the mechanical effects on the heart and blood vessels (phase I, early phase II and phase III), but also ongoing reflex changes in autonomic activity (late phase II and phase IV)[24-26]. The normal response is increased heart rate during phase II in response to the fall in blood pressure, and the baroreflex response to the blood pressure overshoot in phase IV is transient bradycardia. Phase II can be divided into two phases: early and late phases. In early phase II, reduced preload and stroke volume lead to a fall in cardiac output despite the tachycardia caused by decreased vagal activity. Total peripheral resistance increases due to the increased sympathetic discharge. The fall in blood pressure is arrested and is termed as "Late Phase II"; in normal subjects there is actually a rise in blood pressure just before release[27].

MATERIAL AND METHODS:

The present study was conducted in Department of Physiology in collaboration with Department of Psychiatry, Pt. B. D. Sharma University of Health Sciences, Rohtak. The study was carried out on 60 patients of Generalised Anxiety Disorder (GAD), diagnosed as per ICD-10 guidelines with Hamilton Anxiety Scale score of 28 (i.e. moderate anxiety), of 18-45 years of age. The age and sex matched 30 patients each from both the genders (male & female) were studied and divided into the following two groups:

GROUP I - 30 male GAD patients.

GROUP II – 30 female GAD patients

EXCLUSION CRITERIA-The patients with the following history were not included in the study:

1. History of any other major illness (like diabetes, hypertension, myocardial infarction and hyperthyroidism) in the previous one year.
2. History of drug intake for any other ailments in last one month.

TESTS CONDUCTED- In each individual basal GSR was recorded. Then subjects were asked to perform valsalva maneouvre and GSR recording was taken.

APPARATUS USED

Recording of GSR was done by digitalised polygraph (POLYRITE D system, supplied by RMS India PVT. Ltd. Chandigarh, India). Individual customization of data was done after acquiring.
The following recommendations were followed to make the results reliable and interpretable.
Sampling Rate- The sampling rate in our machine was 256 Hz.
Filters- The machine was provided with different filters. Appropriate filters were chosen for GSR since the baseline shifting may affect the spectrum analysis. The recording unit of GSR is µMho or micro "gemmo" or micro reciprocal of ohm.
Filter For GSR
High Filter-2 Hz
Low Filter- 0.05 Hz
Sensitivity- Sensitivity knob was set on moderate high sensitivity (50µV).
Sweep speed- The screen speed was 30 mm/sec.

Valsalva manoeuvre: A sphygmomanometer connected with mouthpiece was used. The length of rubber tubing connecting sphygmomanometer to mouthpiece was of appropriate enough (35 cm) to keep an eye on the meter reading, while blowing through it. Subjects were trained to blow properly before performing the test.

PRELIMINARY PREPARATION

The subjects were informed about the whole procedure in detail in their own language to allay any fear or apprehension. Consent was taken from every individual to undergo the whole procedure. All the experiments were conducted in a particular time period (from 10 AM to 1 PM) to avoid the diurnal variations.

PROCEDURE

All the subjects and patients were tested under similar laboratory conditions. They were allowed to get familiar with the experimental and environmental conditions of the laboratory to allay any apprehension. After performing physical examination they were asked to lie down in supine position on a table. A wooden table was used to avoid any electromagnetic disturbances.. For recording GSR, two copper lined electrodes were attached on the palmar aspect of distal digit of the thumb and index finger of right hand after applying the conduction jelly. Then basal recording of GSR was taken for 5 minutes.
Then for valsalva manoeuvre, the subjects were asked to blow into a mouthpiece connected to a sphygmomanometer so that a pressure of 40 mmHg was maintained for about 15 seconds. It was carefully supervised to make sure that glottis remained close during the procedure and the subject was not merely blowing with his/her cheeks. The GSR was recorded during this manoeuvre and recording was continued for 5 minutes more (post VM recording).

STATISTICAL ANALYSIS OF DATA:

For interpretation of the results the data set of each group was analysed statistically and compared by unpaired student t test. The comparison was done among groups I & II. Significance of result was predicted based on the p value.

RESULTS:

Following observations and results were drawn from present study:

Table I: Comparison of basal GSR of Male GAD Patients (Group I) and Female GAD Patients (Group II)

PARAMETER	GROUP I (MEAN ± SD)	GROUP II (MEAN ± SD)	P VALUE
GSR (µ Mho)	1.813 ± 1.959	2.071 ± 1.555	0.574

As shown in Table I & Fig. 1, there is decrease in GSR among male patients of GAD when compared with female GAD patients at basal level recording. Though this difference is statistically not significant.

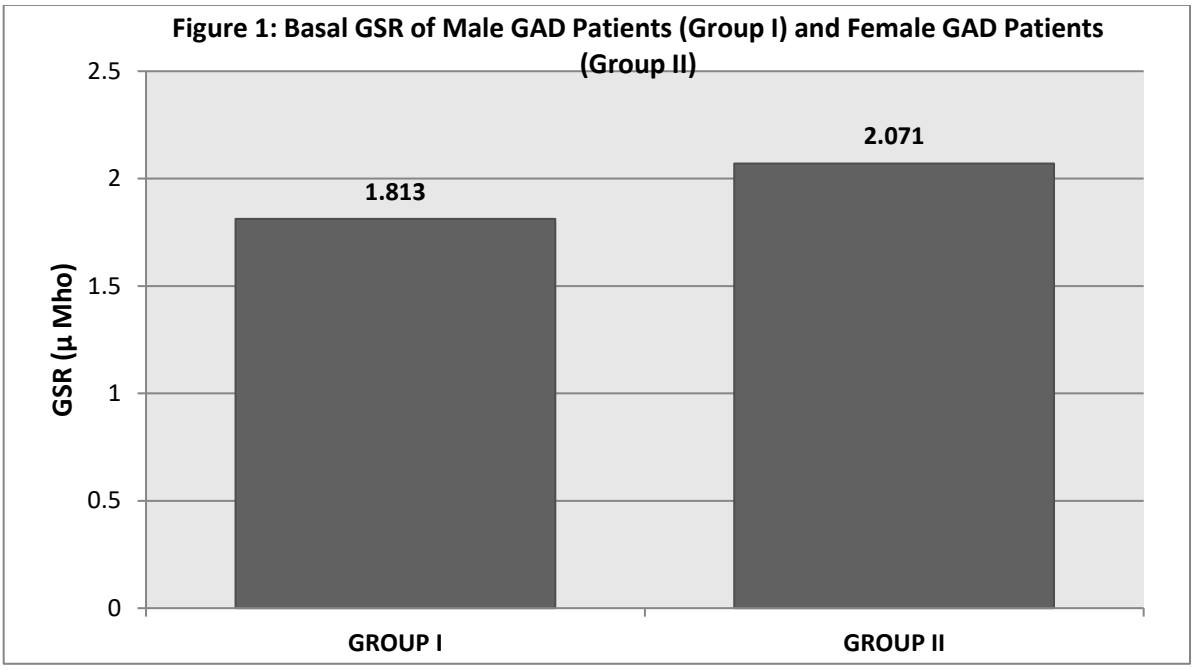
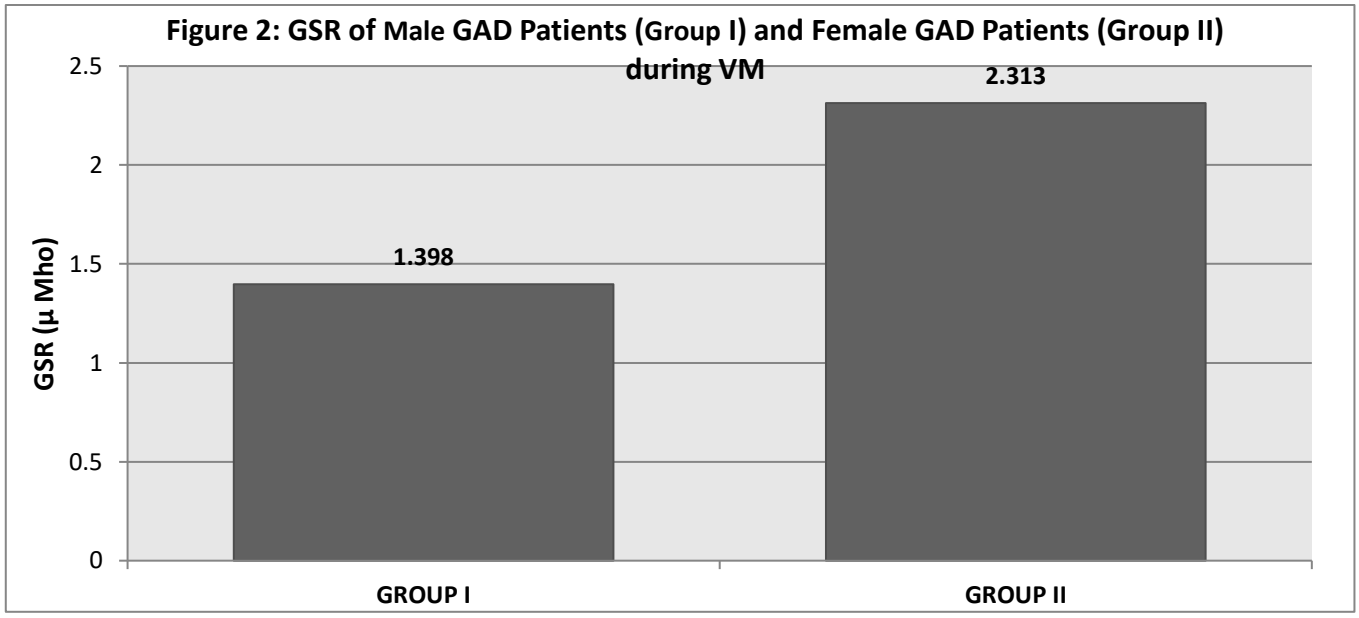


Table II: Comparison of GSR of Male GAD Patients (Group I) and Female GAD Patients (Group II) during Valsalva Manoeuvre

PARAMETER	GROUP I (MEAN ± SD)	GROUP II (MEAN ± SD)	P VALUE
GSR (µ Mho)	1.398 ± 1.636	2.313 ± 1.830	0.045

As shown in Table II & Fig. 2, there is decrease in GSR among male patients of GAD when compared with female GAD patients during 1724alsalva maoeuvre. This difference is statistically significant (p value <0.05).



DISCUSSION:

Autonomic Nervous System plays major role in determining heart rate, stroke volume and peripheral vascular resistance to meet the appropriate requirement of body. Numerous studies have demonstrated that the increased sympathetic and decreased parasympathetic nervous system activity hikes the risk of ventricular tachycardia, ventricular fibrillation and sudden cardiac death[28].

Valsalva maneouvre in a way is part of our daily routine activities as in the form of defecation, deglutition etc. During these routine activities our autonomic system responds to baroreceptor reflex. But in certain disease like generalised anxiety disorder having imbalance in basal level sympathetic and parasympathetic activity, the reflexive response of higher centers to baroreceptor afferents will be imbalanced. The resultant more than normal increase in reflexive sympathetic activity will further increase the cardiovascular morbidity.

This study was carried out to assess the gender based difference in severity of autonomic disturbance in GAD patients. Assessment and clinical evaluation of autonomic functions in present study was carried out by recording of basal GSR as well as changes in GSR during valsalva manoeuvre. The present study was conducted on 60 patients of generalised anxiety disorder. They were divided into two groups. Group I comprised of 30 male GAD patients and Group II comprised of 30 female GAD patients.

In our study first we compared the basal GSR recording among these two groups. As shown in table I & fig., there is increased GSR (2.071 ± 1.555) among group II as compared to group I (1.813 ± 1.959). As Scerbo et al & Wang et al has said that suppressed emotional conflict when restimulated by past events or by bringing up the topic again and again, as in the case of generalised anxiety disorder, there will be increase in basal resistance[20,22,29]. Our study reflects that there is more basal level sympathetic activity or less basal level parasympathetic activity among group II as compared to the group I. And when we exposed autonomic nervous system of the subjects to respond to the baroreceptor reflex, by asking the subjects to perform valsalva maneouvre, this difference is more enhanced. As shown in table II & fig. 2, GSR among group II (2.313 ± 1.830) is more as compared to group I (1.398 ± 1.636). And this difference is statistically significant.

Our study reflected the following result:

1. Basal sympathetic activity is more among female generalised anxiety disorder patients in comparison to male generalised anxiety disorder patients.
2. Sympathetic activity during valsalva maneouvre is significantly more among female GAD patients as compared to male GAD patients.

Our study concluded that generalised anxiety disorder is disturbing the balance in sympathetic and parasympathetic stem of autonomic nervous system more among female generalised anxiety disorder patients as compared to male generalised anxiety patients. And this disturbance becomes significantly enhanced when autonomic nervous system responds to baroreceptor reflex responses in day to day activities. Result of our study points towards more deleterious effects of GAD on cardiovascular morbidity among females in comparison to males though further studies involving other autonomic cardiac function tests need to be done to come to the final conclusion.

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