

Variations of Galvanic Skin Response (GSR) in Persons of Bilious and Phlegmatic Temperament

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Abstract

The galvanic skin response (GSR) is one of the several electro-dermal responses that refer to the changes in the electrical properties of human skin caused by an interaction between environmental events and the person's psychological state. Easily measured and relatively reliable GSR has been used as an index for providing measurable parameter to understand the psychological state of persons having different temperaments. The GSR reflects the sweat gland activity, which in turn corresponds to changes in the sympathetic nervous system. The present study has been designed to measure GSR during normal and stressful condition in healthy volunteers of bilious and phlegmatic temperament.

Volunteers were selected randomly from students of Aligarh Muslim University and other colleges of Aligarh city; preference was however given to the students of Ajmal Khan Tibbiya College. 100 volunteers of both sexes in the age group of 18-35 years having bilious and phlegmatic temperament were selected for the study. Their GSR was measured with the help of GSR meter and the findings were expressed numerically.

During normal (stress free) condition the mean GSR value was scored as 307.5 ± 25.214 and 289.24 ± 29.038 in bilious and phlegmatic subjects, respectively. While during stressful condition, the mean GSR value was found to be 206.08 ± 24.392 and 277.7 ± 29.039 in bilious and phlegmatic subjects, respectively. The findings indicated that individuals of bilious temperament have comparatively more GSR value than those of phlegmatic temperament during normal condition but during stressful condition bilious individuals have less GSR value than the persons of phlegmatic temperament. It was concluded therefore that bilious individual have higher tendency of anxiety and stress.

Keywords: GSR, *Mizaj*, Bilious, Phlegmatic, Unani medicine

Introduction

The Galvanic Skin Response (GSR) is a simple and reproducible method of capturing the autonomic nerve response as a parameter of the sweat gland function (Shahani *et al.*, 1984). Physically, GSR is a change in the electrical properties of the skin in response to different kinds of stimuli. Any stimulus capable of an arousal effect can evoke the response and the amplitude of the response is more dependent on the surprise effect of the stimulus than on the physical stimulus strength (Ranta-aho *et al.*, 2006 and Tarvainen *et al.*, 2000). The electrical resistance of the skin (which is typically large and varies slowly over time),

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fluctuates quickly during mental, physical and emotional arousal. These states of arousal are related to the activation of the sympathetic branch of autonomic nervous system. During a sympathetic response eccrine glands in the skin produce ionic sweat lowering the resistance of the skin and increasing conductivity. The change in conductivity can be used to infer differing arousal states in individuals (Westeyn *et al.*, 2006).

Biofeedback is the technique of self-regulation of awareness states by the subject. Biofeedback research has shown that meditation and relaxation techniques cause a greater degree of resistance, while stress and unpleasant emotions show a lowering of the resistance during such practices. When buried material begins to surface in the mind of the client under therapy, such as that caused by pain or negative emotions, the concomitant tension experienced by the client shows an increase of skin resistance. The GSR meter is a biofeedback monitoring device designed to detect a person's mental state or change of state. The GSR meter is based on the principle of the Wheatstone bridge- a type of ohm meter for measuring changes in electrical resistance. The GSR meter has been widely used for experimental and leading-edge psychotherapy and personal development purposes. Unlike classical biofeedback where the user is trained to produce a particular desired response, the GSR meter when used as a counseling or study aid is used purely for diagnostic purposes. It assists the facilitator in locating where the area of difficulty is, determining the efficacy of the technique being used or whether a different process or method may be more appropriate in solving the difficulty, and knowing when a desirable outcome has been achieved signaling a suitable point to end off (Rolph, 2009).

Mizaj (temperament) is a unique and characteristic feature of Unani medicine. It plays a major role in the diagnosis, prevention and treatment of diseases. According to Unani System of Medicine, there are four types of *mizaj* i.e. *safravi* (bilious), *damvi* (sanguine), *balghami* (phlegmatic) and *saudavi* (melancholic). The persons having these different temperaments greatly vary in their physical, physiological and psychological characteristics (Majoosi; 1902).

The *mizaj* is defined as the new state of a matter having quality different from that present in the elements or compound before coming into *imtizaj*; which results from the action and reaction among the diverse qualities and powers in the minute particles of different elements. When they are combined together the resultant new quality in a uniform state or the state of equilibrium emerges after the combination of more than one element is called *mizaj*. Every person has a unique temperament, which represents his physical characteristics, physiological profile, psychological and emotional status (Zaidi *et al.*, 1999). As per Unani description GSR variation should ideally be more in bilious persons than those having phlegmatic temperament because bilious persons are physiologically and

psychologically more active than the persons of phlegmatic temperament. The present study therefore was undertaken to find out the correlation between GSR and temperament, if any, in individuals having two different temperaments i.e. bilious and phlegmatic. The two groups of subjects on examination showed different types of features as their physiological, physical and psychological features were different to each other. It was hypothesized therefore that GSR will vary significantly in persons having bilious temperament than those of phlegmatic temperament.

Materials and Methods

This study was carried out in the Department of Kulliyat at Ajmal Khan Tibbiya College, Aligarh Muslim University, Aligarh.

Selection of Volunteers

One hundred (100) healthy male and female volunteers having bilious and phlegmatic temperaments were selected randomly from the student's fraternity of Ajmal Khan Tibbiya College and some other departments of studies of Aligarh Muslim University and colleges of Aligarh city. Preference was given however, to the students of Ajmal Khan Tibbiya College as they were easily available for the study.

Inclusion Criteria

Only healthy volunteers of bilious and phlegmatic temperaments of both the sexes in the age group of 18–35 years were included in this study. Since this age group lies in *Sin-e-Namu* and *Sin-e-Shabab* and the individuals in this age group are mostly healthy therefore this age group was selected for the study.

Exclusion Criteria

Following volunteers were excluded from the study:

- Those having melancholic and sanguine temperament.
- Volunteers below 18 years and above 35 years of age.
- Volunteers suffering from any physical, mental or psychiatric disorder.

For the selection of healthy volunteers, detailed clinical history, physical, general and local examinations were done (Annexure I).

Informed Consent

A multi-lingual informed consent form was provided to all the subjects included in the study. The purpose of the informed consent form was to obtain permission

from each of the volunteers and confirm their willingness to take part in the study. The form indicated exactly what the study demands, what the volunteers expect from the study, the risks and benefits of their participation, and guaranty of confidentiality. It stated clearly that a volunteer may withdraw himself/herself from the study at any time without citing any reason.

Determination of Temperament

The assessment of temperament (*miza*) of the volunteers was made on the basis of *Ajnas-e-Ashra* (ten determinants), mentioned in classical Unani literature. A tabular proforma designed to assess the temperament was given to the volunteers (Annexure-II). The assessment was made on the basis of information they filled in the proforma.

Categorization of Volunteers

After determination of the temperament, selected volunteers were divided into following two groups according to their temperament.

Group A: Bilious temperament (*Safravi Miza*)

Group B: Phlegmatic temperament (*Balghami Miza*)

After categorization of volunteers, the anxiety level and various physiological parameters were determined at two different points of time (i) when the volunteers had no exam (stress free condition) (ii) during the annual or sessional examination (stressful condition).

Measurement of GSR

GSR value was measured by an instrument namely GSR Biofeedback Meter (Mohan Electronics & Illuminator, Cochin). The volunteer were allowed to be seated in a comfortable chair. The procedure of assessment was explained to them. After connecting the instrument to main socket the electrode plugs were aligned to the respective sockets. Jelly was applied on the two electrodes which were fixed on the middle phalanges of the index and middle fingers, by means of Velcro tape attached to the electrodes (Fig 1). After this the instrument was switched on. The sensitivity was measured at 5%. The balance was then rotated in clock wise direction till the yellow bar started glowing. LCD panel meter shows balance value of GSR.

Observations and Results

Out of 100 volunteers, 50 each were of bilious (*safravi miza*) and phlegmatic (*balghami miza*) temperament.



Figure 1: GSR Biofeedback Meter

The mean GSR value of the of bilious subjects during stress free condition was found to be 307.5 ± 25.214 K& Ω , while those having phlegmatic temperament scored a value of 289.24 ± 29.038 K& Ω . During stressful condition the mean GSR value of the subjects of bilious temperament was found to be 206.08 ± 24.392 K&!, while that of the phlegmatic subjects it amounted to $277.729.039$ K& Ω ($p < 0.001$). The findings suggested that during stressful condition there is more fall of GSR value in individuals of bilious temperament than those of phlegmatic temperament (Table 1 & 2 and Fig 02).

Table 1: GSR Value (K&!) in Volunteers of Bilious and Phlegmatic Temperament Expressed as Mean \pm SD

Temperament	No. of Volunteers	Mean \pm SD*	
		Normal Condition	Stressful Condition
Bilious	50	307.5 ± 25.214	206.08 ± 24.392
Phlegmatic	50	289.24 ± 29.038	277.7 ± 29.039
Total	100	298.56 ± 28.480	241.89 ± 44.801

Table 2: Showing Significance of GSR Value in Volunteers of Bilious and Phlegmatic Temperament Expressed

GSR Value between	Significance
Bilious vs Phlegmatic during normal condition	$t = 3.255, p = 0.0016$
Bilious vs Phlegmatic during stressful Condition	$t = 13.354, p < 0.0001$
Bilious in Normal Condition vs Bilious in Stressful Condition	$t = 20.442, p < 0.0001$
Phlegmatic in Normal Condition vs Phlegmatic in Stressful Condition	$t = 2.083, p = 0.0398$

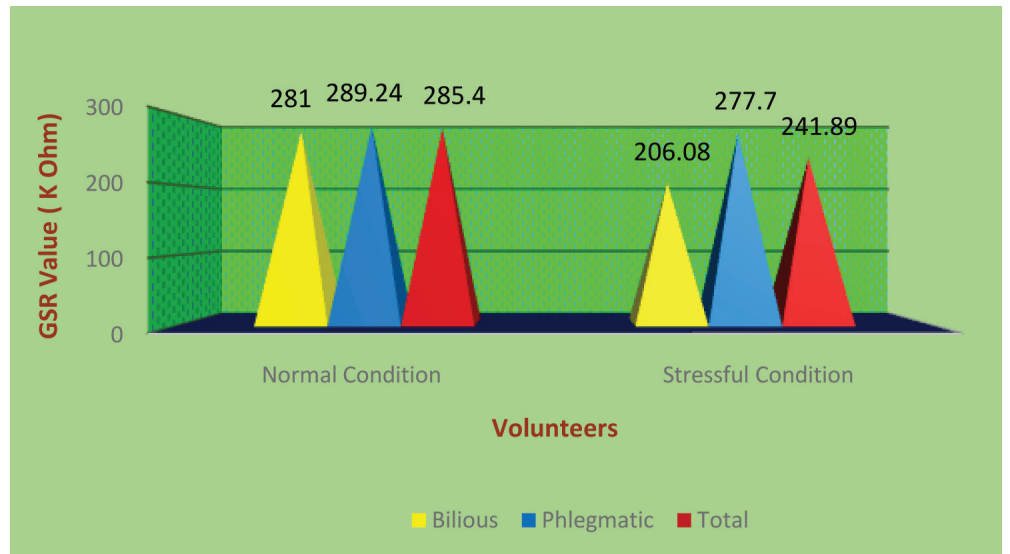


Figure 2: GSR Value in Volunteers of Bilious and Phlegmatic Temperament (Mean ± SD)

Proforma for Health Assessment

Name of Volunteer: _____ Father's Name: _____

Age / Gender: _____ Occupation: _____

Address: _____

Recent history of:

- | | | |
|--------------------------|-------------------|--------------------------|
| Sickle Cell Anaemia | Sarcoidosis | Any Psychiatric Disorder |
| Bacterial Endocarditis | Leukaemia | Pernicious |
| Anaemia | Leishmaniasis | Hodgkin Disease |
| Banti's Disease | Tumours | Glandular Fever |
| Hereditary Spherocytosis | Gaucher's Disease | Malaria |

Past history

- | | | |
|-------------------|-----------------|------------------|
| Diabetes mellitus | Hyperthyroidism | Hypothyroidism |
| Tuberculosis | Hiatus hernia | Poliomyelitis |
| Accident | Gastric Ulcer | Bronchial Asthma |

Treatment history

Radiotherapy	Chemotherapy	Surgery
Prednisone	NSAID _s	Steroids

Personal and Socioeconomic History

Diet	Sleep
Smoking	Alcohol
Heavy Exercise	Gymnasium
Athlete activity	Weightlifting
Mood	Habit

Physical Examination

Built	Weight
Obesity	Nutritional status
Anaemia	Jaundice
Cyanosis	Oedema

Systemic Examination

Cardio Vascular System

Inspection	Palpation	Percussion	Auscultation
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Respiratory System

Inspection	Palpation	Percussion	Auscultation
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Digestive System

Inspection	Palpation	Percussion	Auscultation
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Urinary System

Inspection	Palpation	Percussion	Auscultation
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Mizaj Assessment Proforma

Name of Volunteer: _____ Father's Name: _____

Age: _____ Gender: _____

Height: _____ Weight: _____

Occupation: _____ Mobile No.: _____

Address: _____

Parameter (Evidence)	Damwi (Sanguineous)	Balghami (Phlegmatic)	Safrawi (Bilious)	Saudawi (Melancholic)
MORPHOLOGICAL				
1. Skin texture/ Temperature Score: 01	Warm and smooth <input type="checkbox"/>	Soft and moist <input type="checkbox"/>	Hard and hot <input type="checkbox"/>	Rough and cold <input type="checkbox"/>
2. Complexion Score: 0.5	Reddish <input type="checkbox"/>	Whitish <input type="checkbox"/>	Pale <input type="checkbox"/>	Blackish <input type="checkbox"/>
3. Body built Score: 5	Muscular <input type="checkbox"/>	Fatty <input type="checkbox"/>	Moderate <input type="checkbox"/>	Lean and thin <input type="checkbox"/>
4. Texture of hairs Score: 0.5	Thick and lusty <input type="checkbox"/>	Thin and smooth <input type="checkbox"/>	Curly <input type="checkbox"/>	Straight <input type="checkbox"/>
5. Growth and distribution of hairs Score:0.5	Rapid, Average <input type="checkbox"/>	Slow, Scanty <input type="checkbox"/>	Moderate/ Profuse <input type="checkbox"/>	Excessive <input type="checkbox"/>
6. Colour of hairs Score:0.5	Blackish <input type="checkbox"/>	Brownish <input type="checkbox"/>	Yellow-black (Golden) <input type="checkbox"/>	Black and white (Mixed) <input type="checkbox"/>
PHYSIOLOGICAL				
7. Urine Score:01	Moderate in quantity <input type="checkbox"/>	White, more in quantity <input type="checkbox"/>	Yellow, less in quantity <input type="checkbox"/>	Turbid, less in quantity <input type="checkbox"/>
8. Tolerate Well Score:01	Dryness <input type="checkbox"/>	Summer <input type="checkbox"/>	Cold <input type="checkbox"/>	Dampness <input type="checkbox"/>
9. Remains well in Score:03	Spring <input type="checkbox"/>	Summer <input type="checkbox"/>	Winter <input type="checkbox"/>	Autumn <input type="checkbox"/>
10. Appetite Score:01	Strong appetite (can skip a meal) <input type="checkbox"/>	Less appetite (feel heaviness after eating) <input type="checkbox"/>	Strong appetite (can't skip a meal) <input type="checkbox"/>	Irregular appetite <input type="checkbox"/>

Parameter (Evidence)	Damwi (Sanguineous)	Balghami (Phlegmatic)	Safrawi (Bilious)	Saudawi (Melancholic)
11. Thirst Score: 01	Average (+++) <input type="checkbox"/>	Poor (+) <input type="checkbox"/>	Increased (++++) <input type="checkbox"/>	Low (++) <input type="checkbox"/>
12. Digestion Score:01	Average <input type="checkbox"/>	Slow <input type="checkbox"/>	Strong <input type="checkbox"/>	Irregular <input type="checkbox"/>
13. Movements and activities Score: 03	Average in physical activity <input type="checkbox"/>	Dull laziness <input type="checkbox"/>	Brisk, Hyper active <input type="checkbox"/>	Less <input type="checkbox"/>
14. Sleep Score:01	Average <input type="checkbox"/>	Excess sleep <input type="checkbox"/>	Disturbed sleep <input type="checkbox"/>	Insomnia <input type="checkbox"/>
PSYCHOLOGICAL				
15. Dream objects Score: 01	Blood, Red Snow <input type="checkbox"/>	Water, objects <input type="checkbox"/>	Fire, Yellow <input type="checkbox"/>	Black, Fearful dreams <input type="checkbox"/>
16. Anger/Joy Score:01	Comes on easily and easily lost <input type="checkbox"/>	Comes on hardly <input type="checkbox"/>	Frequent, Severe and persists for long <input type="checkbox"/>	Infrequent but persist <input type="checkbox"/>
17. Responsee to external stimuli in adverse condition Score: 01	Aggressively respond <input type="checkbox"/>	Weakly respond <input type="checkbox"/>	Bravely respond <input type="checkbox"/>	Cowardly respond <input type="checkbox"/>
18. Decision taking power Score: 01	Take boldly <input type="checkbox"/>	Hesitate in taking decisions <input type="checkbox"/>	Take quickly <input type="checkbox"/>	Afraid in taking decisions <input type="checkbox"/>
19. Memory Score:01	Good retention also good <input type="checkbox"/>	Not good <input type="checkbox"/>	Good but can't retain for long <input type="checkbox"/>	Don't learn easily but excellent retention <input type="checkbox"/>

Total Collection:

Damvi: _____ Safrawi: _____

Balghami: _____ Saudawi: _____

Diagnosed Temperament: _____

Signature of Investigator: _____

Discussion

GSR value was recorded in volunteers of bilious and phlegmatic temperament during normal and stressful condition to determine the psychological state of the subjects having two different temperaments. The findings of the study showed that mean GSR value during normal condition was higher in bilious temperament (307.5 ± 25.214 K& Ω) than phlegmatic temperament (289.24 ± 29.038 K& Ω). On comparison the GSR value was found to be significantly higher in bilious individuals as compared to their phlegmatic counter parts. However, contrary to the findings during stress free condition the GSR value during stressful condition was found to be lower in volunteers of bilious temperament (206.08 ± 24.392 K& Ω) than those having phlegmatic temperament (277.7 ± 29.039 K& Ω). The findings clearly indicated that the bilious persons have less resistance as compared to phlegmatic individuals.

The findings also showed that mean GSR value in the volunteers of bilious temperament during stressful condition was less (206.08 ± 24.392 K& Ω) than stress free condition (307.5 ± 25.214 K& Ω) showing a significant difference between the two values. Further, the mean GSR value in phlegmatic individuals during stressful condition was less (277.7 ± 29.039 K& Ω) than stress free condition (289.24 ± 29.0398 K& Ω). The difference in two diverse conditions was found to be significantly different.

The sweating is an important indicator of anxiety and it has an inverse relationship with GSR value because excessive sweating reduces the resistance of skin while increases the conductance resulting in low scoring of GSR (Shahani et al., 1984). Therefore individuals having the tendency of excessive sweating are likely to have low GSR value, and it has been described in Unani literature that bilious individuals have more sweating as compared to phlegmatic one. Since the bilious subjects showed lower GSR value in both the conditions therefore it may be inferred that this group of volunteers has higher tendency of anxiety (Majoosi, 1902). This finding is in consonance with the Unani theory that bilious individuals are more anxious as compared to the Phlegmatic population.

It may be concluded that bilious temperament is associated with low GSR value and the individuals having bilious temperament have higher anxiety index. It may be further concluded that GSR may be used as an important tool to determine the temperament.

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