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An insight into gender based variations of autonomic functions among young adults

Sudakshina Chatterjee[1], Subhadeep Patra[2,*], Kaberi De[1], Debarati Chanda[1], Prem Sagar Panda[3]

[1] *Dept. of Physiology, Jagannath Gupta Institute of Medical Sciences and Hospital, Kolkata, West Bengal, India*
[2] *Dept. of Pharmacology, Jagannath Gupta Institute of Medical Sciences and Hospital, Kolkata, West Bengal, India*
[3] *Dept. of Community Medicine, Kalinga Institute of Medical Sciences, Bhubaneswar, Odisha, India*

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ABSTRACT

Introduction: Since this is a vital developmental phase, studying the health patterns of young adults, particularly cardiovascular health, is critical. Autonomic function testing (AFT) is a crucial non-invasive procedure for determining the state of one's cardiovascular system. There are only a few studies on autonomic responsiveness in young people.

Aim and Objectives: To study the autonomic responses to various cardiovascular autonomic function tests among young adult subjects and to look into the gender-based variations.

Materials and Methods: Males made up 114 (50.67 percent) of the total 225 individuals, while females made up the rest. The study's target age group was 18-29 years old. The CANWIN analyser of genesis medical systems was used to investigate autonomic function tests such as resting heart rate, heart rate reaction to slow deep breathing (SDB), Valsalva Ratio (VR), 30:15 ratios response to standing, and blood pressure response to sustained handgrip. CANWIN is a state-of-the-art Cardiac Autonomic Neuropathy (CAN) Analysis System with interpretation for PC Windows*. The data was analysed statistically using STATA software (version 13.1).

Result: Dysautonomia was seen in 150 of the 225 participants (66.66 percent). The number of dysautonomia participants was not statistically different between males and females (P value=0.15).

Conclusion: Anxiety, stress, a poor diet, and a disrupted sleep cycle could all contribute to the high number of dysautonomia patients. There have been a number of reports linking dysautonomia to nutritional deficits. To investigate the causative factors, more longitudinal studies including nutritional status assessments are needed.

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1. Introduction

John Newport Langley coined the phrase "autonomic nervous system" in the early twentieth century to characterise nerves that are primarily concerned with the regulation of body activities. The actions of the two divisions of autonomic nervous system are often complementary, with sympathetic nerve activity stimulating the heart, narrowing blood vessels, slowing gastrointestinal motility, and constricting sphincters, whereas parasympathetic nerve activity has the opposite effect. Autonomic nerves play a crucial part in the regulation of the cardiovascular system, guaranteeing optimal performance throughout diverse cardiac activities as well as mediating several cardiovascular diseases.[1]

Internal homeostasis of cardiovascular, thermoregulatory, gastrointestinal, genitourinary, exocrine,

* *Corresponding author*.
E-mail address: dr.subhadeep.patra@gmail.com (S. Patra).

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and pupillary activities is maintained by the Autonomic Nervous System (ANS). This system is incredibly complex, and it plays a role in almost every organ system's function.

Blood pressure, cardiac output, heart rate, and other cardiovascular responses have been observed to differ between sexes. According to findings from a few previous studies, the discrepancies may be attributed to psychological, social, and hormonal changes. Shailaja Moodithaya et al discovered that female participants exhibit a parasympathetic predominance when compared to males.[2] Females had lower sympathetic activity than males, according to Ramaekers et al, which could explain why females have a decreased risk of cardiovascular disease.[3] These researchers came to the conclusion that gender variations in cardiac autonomic modulation are limited to the adolescent and adult age groups, implying a function for sex hormones in cardiac autonomic modulation. Because this is a vital developmental phase, studying the health patterns of young adults, particularly cardiovascular health, is critical. Autonomic function testing (AFT) is a technique for determining the state of one's cardiovascular system. Gender disparities in AFT may exist because to developmental differences or the effect of different levels of male and female sex hormones.

Previous research has found that sympathetic vascular regulation predominates in males, whereas cardiac parasympathetic regulation predominates in females. Furthermore, in the intended study population, there are very few recorded studies relating to autonomic function in young adults with gender differences. As a result, the current research has been undertaken.

2. Objectives

To study the autonomic responses to various cardiovascular autonomic function tests among young adult subjects and to look into the gender-based variations.

3. Materials and Methods

3.1. Study type

An observational descriptive comparison study.

3.2. Study area & setting

Department of Physiology, Kalinga Institute of Medical Sciences (KIMS), Bhubaneswar, Odisha.

3.3. Sample size

Total sample size 225 was taken for the study.

3.4. Sampling frame

Students of Kalinga Institute of Medical Sciences (KIMS), Kalinga Institute of Dental Sciences (KIDS), Kalinga Institute of Nursing Sciences (KINS) on the basis of inclusion and exclusion criteria was selected for the study.

3.5. Sampling method

Simple random sampling method.

3.6. Ethical permission

The study was approved by the Institutional Ethical committee of KIMS. Written informed consent of all subjects participating in the study was obtained through patient informed consent form (PICF).

3.7. Inclusion criteria

Healthy young adult male and female subjects of age group between 18-29 years were selected for this study.

3.8. Exclusion criteria

Subjects who did not give consent for participation and Subjects with any known Cardiovascular, Respiratory, Endocrine, Nervous and musculoskeletal abnormalities, or on prolong medication were excluded from the study.

Basic demographic parameters like age, sex, height, weight were measured and body mass index (BMI) was calculated. Volunteers who consented to participate in the study were briefed about the details of cardiac autonomic function tests. There after they were subjected to autonomic function testing.

3.9. Data collection method & period

Cross-sectional method of data collection was done from October 2015 to August 2017.

3.10. Study instruments

The tests were carried out with the help of CANWIN from Genesis Medical Systems. CANWIN is a state-of-the-art Cardiac Autonomic Neuropathy Analysis System with interpretation that runs on a Windows PC. It contains a large database that allows it to keep track of patient information, test retrieval, and comparisons. Because it is totally automated, it eliminates the need for human recording, reading, and calculating.

CANWIN examines the patient's autonomic nervous system responses, including sympathetic and parasympathetic. A battery of six tests is performed using TachoCardiogram (TCG) and automated Non-invasive Blood Pressure (NIBP). On the computer screen, not only quantitative findings, but also live real-time graphs with interpretation are presented.

3.11. Autonomic function tests

The individuals were instructed to stop smoking, drinking caffeinated beverages, or alcohol 24 hours before the test. After 2 hours of light meal, the individuals were instructed to report between 9am and 11 am (to prevent diurnal changes). Before beginning the exams, they were instructed to rest for 15-20 minutes. Each person completed a battery of six tests.

3.12. Statistical analysis

The mean parasympathetic and sympathetic parameters of 114 male and 111 female patients were examined to see if there were any gender differences. The mean BMI of the male and female individuals was also calculated. All of the individuals were split into two subgroups: normal BMI (18.5-24.9) and overweight BMI (25), to avoid the possible effects of BMI on the findings due to the considerable difference in BMI between the gender-based groups. The individuals in the normal and overweight BMI categories were split into two gender subgroups (males and females). The parasympathetic and sympathetic autonomic function parameters were compared, and the findings were statistically analysed.

Chi square and Fisher's test were applied. All the results were expressed in mean and standard deviation. P value of <0.05 was considered to be statistically significant. The data of the above-mentioned parameters was compiled, tabulated and entered into Microsoft Excel 2013 and statistically analysed by using STATA software (version 13.1).

3.13. CANWIN interpretation

Cardiovascular autonomic functions can be interpretated by considering the following values:[4]

Table 1:

Tests	Normal	Borderline	Abnormal
Tests reflecting parasympathetic function			
HR response to Valsalva maneuver (Valsalva ratio)	≥1.21	1.11-1.20	≤1.10
HR(R-R interval) variation during deep breathing(maximum –minimum HR)	≥15 beats/min	11-14 beats/min	≤10 beats/min
Immediate HR response to standing (30:15 ratio)	≥1.04	1.01-1.03	≤1.00
Tests reflecting sympathetic function			
Blood pressure response to standing (fall in SBP)	≤10mm Hg	11-29mm Hg	≥30mm Hg
Blood pressure response to sustained handgrip (increase in DBP)	≥16mm Hg	11-15mm Hg	≤10mm Hg

HR- Heart Rate, SBP- Systolic Blood Pressure, DBP- Diastolic Blood Pressure

4. Result

4.1. ns=not significant

N+N= normal parasympathetic + normal sympathetic

N+MI=normal parasympathetic + mild sympathetic

N+MO=normal parasympathetic + moderate sympathetic

MI+N=mild parasympathetic + normal sympathetic

MI+MO=mild parasympathetic + moderate sympathetic

MI+S=mild parasympathetic + severe sympathetic

MOD+S=moderate parasympathetic + severe sympathetic

MO+MI=moderate parasympathetic + mild sympathetic

MO+N=moderate parasympathetic + normal sympathetic

MI+MI=mild parasympathetic + mild sympathetic

MO+MO=moderate parasympathetic + moderate sympathetic

Table 2: Distribution and comparison of normal and dysautonomic subjects among males and females

Parameters	Male (n=114)	Female (n=111)	P value
N+N	43	32	0.2^{ns} (chi square test)
N+MI	8	4	0.4^{ns} (chi square test)
N+MO	18	16	0.91^{ns} (chi square test)
MI+N	14	23	0.13^{ns} (chi square test)
MI+MO	16	17	0.93^{ns} (chi square test)
MI+S	1	1	1.0^{ns} (fisher's test)
MOD+S	0	1	0.5^{ns} (fisher's test)
MO+MI	2	2	1.0^{ns} (fisher's test)
MO+N	5	5	0.97^{ns} (fisher's test)
MI+MI	5	5	0.97^{ns} (fisher's test)
MO+MO	2	5	0.3^{ns} (fisher's tests)

Table 2 reveals that 43 of the male patients had findings that were normal. Involvement of the sympathetic nervous system was observed in 52 patients, whereas parasympathetic involvement was found in 45. (In 26 patients, both sympathetic and parasympathetic activation was seen.) With adequate parasympathetic function, 8 patients showed normal sympathetic involvement. With a normal parasympathetic function, 18 people exhibited mild sympathetic involvement. In 16 of the participants, there was moderate sympathetic and mild parasympathetic activation. Two of the participants had mild sympathetic and moderate parasympathetic activation. 5 of the participants had mild sympathetic and parasympathetic activation. The involvement of the sympathetic and parasympathetic nervous systems was moderate in two of the patients. One patient had severe sympathetic and mild of parasympathetic activation.

In the majority of males, autonomic involvement was mild to moderate sympathetic involvement with appropriate parasympathetic regulation or modest parasympathetic involvement. Female participants, on the other hand, had primarily modest parasympathetic involvement and typical sympathetic regulation.

According to statistical analysis, there was no statistically significant difference between males and females, however there were more normal male participants (43) than normal female ones (32).

Anxiety and stress may be to blame for the dysautonomia reported among seemingly healthy patients with no history of syncope, cardiovascular, or respiratory problems. It may also be linked to a vitamin deficit. The number of dysautonomia participants among males (71) was substantially lower than the number of dysautonomic subjects among females (79).

5. Discussion

Dysautonomia was seen in 150 of the 225 individuals (66.66%) (sympathetic dysfunction among the males and parasympathetic dysfunction among the females). Dyautonomia was found in 71 of 114 men (62.28%) and 79 of 111 females (71.17%). With modest to moderate sympathetic function impairment, young adult males demonstrated superior parasympathetic regulation. With moderate parasympathetic impairment, the young adult females demonstrated superior sympathetic modulation. However, there was no statistically significant difference in the number of males and females with various forms of dysautonomia (chi-square test, P value=0.157). Gender variation of cardiovascular autonomic activity may be explained by the gonadal hormone factor.

Many previous scientific investigations have contradicted the conclusions of the current study. Neumann and Schmid published findings that contradicted those of the current study.[5] In their study, Dharwadkar et al. concluded that females have a decade earlier decline in cardiovascular parasympathetic functions than males.[6] Other researchers found that parasympathetic activity was lower in females and sympathetic activity was higher in men, and that age and, to a lesser extent, gender were the most relevant variables influencing autonomic nervous system activity.[7,8] Few studies have found that men had stronger sympathetic activity and responsiveness than women in the past.[9,10]These findings have ramifications for the fact that females experience fewer cardiovascular events than males. Female sex hormones have been linked to a protective impact on the cardiovascular system for a long time. Increased sympathetic nerve activity has also been linked to an increased risk of cardiovascular morbidity and mortality.[11] Sympathetic nerve activity is often higher in males than in women of the same age (though this is not always the case and might vary depending on the menstrual cycle phase).[12]Similar findings were found in the study by Joyce M. Evans showed that autonomic modulation was significantly different in men and women as revealed by the values of relevant indexes.[13] Men had greater sympathetic activity whereas women had parasympathetic dominance.[14–16]

Anxiety, stress, a poor diet, and a disrupted sleep pattern might all contribute to dysautonomia. The brain and heart have a rapid oxidative metabolism and are quickly influenced by any mechanism that diminishes oxidative efficiency, resulting in a chaotic state of the hypothalamic-autonomic-endocrine-axis.[13] Dysfunction might be caused by defective neurotransmission in the autonomic nerve distribution. The sympathetic nervous system stimulates both mental and physical activity, and its most well-known reflex is fight or flight. It is one of the several survival responses that the hypothalamus initiates and organizes. The sympathetic system is opposed by the parasympathetic or craniosacral outflow. Increased tone in one system is controlled by decreasing tone in the other system, resulting in homeostasis. There is no mention of malnutrition in the aetiology of numerous symptoms mentioned in literature. There is evidence that dysautonomia may be caused by a decrease of oxidative efficiency, notably in the limbic system and brain stem. There have been several examples of dysautonomia linked to dietary deficits. The imbalance occurs when calorie oxidation is impeded owing to a shortage of vitamins. Riley and Moore described a perplexing occurrence of dysautonomia in children that did not match the symptoms and indications thought required for this diagnosis.[14] The pathogenesis might be owing to a nutritional imbalance between caloric and non-caloric nutrients, resulting in functional dysautonomia. However, further longitudinal studies with nutritional status assessments are needed to investigate the causative aspects.

6. Conclusion

Dyautonomia was found in two-thirds of apparently healthy young adult participants (sympathetic among males and parasympathetic among females). Dysautonomia was found more commonly in females than males. Anxiety and stress may be to blame for the dysautonomia reported among seemingly healthy patients with no history of syncope, cardiovascular, or respiratory problems. It may also be linked to a vitamin deficit. Factors like anxiety, stress, a poor diet, and a disrupted sleep pattern might all contribute to dysautonomia. There have been several examples of dysautonomia linked to dietary deficits. The imbalance occurs when calorie oxidation is impeded owing to a shortage of vitamins. However, further longitudinal studies with nutritional status assessments are needed to investigate the causative aspects.

7. Conflict of Interest

None.

8. Source of Funding

None.

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Author biography

Sudakshina Chatterjee, Assistant Professor

Subhadeep Patra, Assistant Professor https://orcid.org/0000-0002-2034-5749

Kaberi De, Assistant Professor

Debarati Chanda, Associate Professor

Prem Sagar Panda, Assistant Professor

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