

# Assessment of Cardiac Autonomic Functions in Medical Students With Type D Personality

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## ABSTRACT

**Introduction:** Type D personality experiences joint occurrence of Negative Affectivity and Social Inhibition. It is an emerging risk factor for cardiovascular disease, with prevalence being 18-53% among cardiac patients. Type D personality people have exaggerated cardiovascular activity mediated by increased sympathetic drive and decreased vagal control of the heart which leads to enhanced risk of hypertension and is an independent risk factor for coronary heart disease.

**Aim:** To compare the cardiac autonomic function of Type D and non-Type D students. To compare cardiac autonomic functions among male and female students and students with and without family history of hypertension and coronary artery disease among Type D. To find the most affected test among Type D students.

**Materials and Methods:** Thirty Type D and 30 non-Type D medical students were identified by DS14. The Parasympathetic cardiac autonomic tests done assessed Heart Rate response to valsalva manoeuvre, immediate heart rate response to standing and heart rate variation during deep breathing. Sympathetic tests assessed BP response to standing and Sustained Hand

Grip. The heart rate and R-R interval measurement were got from lead II of ECG recordings on Polyrite D. Statistical analysis was done using SPSS software. Unpaired student's t-test was used and p-value <0.05 was considered to be statistically significant.

**Results:** Type D students showed slightly decreased parasympathetic activity and increased sympathetic activity when compared to non-Type D students even though there was no statistically significant difference between them. There is a statistically significant decrease in valsalva ratio among females ( $p < 0.01$ ) when compared to males. There is a statistically significant decrease in 30:15 ratio and BP response to handgrip ( $p < 0.05$ ) among students with family history of hypertension and coronary artery disease when compared with students with no family history of coronary artery disease. Valsalva ratio is the most affected test in Type D students.

**Conclusion:** Cardiac autonomic functions of Type D personality persons without cardiovascular disease is not different from that of non-Type D. Regular follow up studies over years are required to find if Type D personality is associated with cardiovascular risk in healthy individuals.

**Keywords:** DS14, Negative emotions, Parasympathetic activity, Sympathetic activity, Valsalva ratio

## INTRODUCTION

Type D personality is characterized by two personality traits negative affectivity (NA) and social inhibition (SI) [1]. Negative affectivity means to have negative thoughts, whereas social inhibition refers to suppress these emotions by avoiding social contact [1]. Type D personality people are around 21% in general population [1] and 18% to 53% in cardiac patients [2].

NA and SI are risk factors for the development of coronary heart disease (CHD). The risk of cardiac events was found to be 4.7 times greater for Type D than for non-Type D patients [1]. Type D personality have exaggerated cardiovascular activity in daily life, mediated by an increased sympathetic drive and decreased vagal control of the heart which leads to enhanced risk of hypertension and an independent risk factor for coronary heart disease [3-5], peripheral arterial disease, chronic heart failure [6] and in patients with life-threatening arrhythmias and patients treated with revascularization procedures [7].

Cardiac autonomic neuropathy is diagnosed by tests of autonomic reactivity based on Ewing's criteria [8]. The parasympathetic cardiovascular autonomic reflex tests include heart rate response to valsalva maneuver, immediate heart rate response to standing and heart rate variation during deep breathing. The sympathetic cardiovascular autonomic reflex tests include blood pressure response to standing and blood pressure changes during sustained hand grip. Type D scale (DS14), is a standardized 14 item questionnaire used to find whether a person has Type D personality or not [1].

Personality approach in the identification of patients at risk of cardiac diseases is very essential [9]. Studies have shown that there is increased cardiovascular mortality among people with Type D personality having established coronary heart disease. As there are no studies relating the cardiovascular autonomic functions in healthy and young individuals with Type D personality, this is the focus of present study. This study will help to identify subclinical autonomic hyperactivity in Type D individuals, so proper measures can be taken early to prevent or to reduce morbidity and mortality due to cardiac disease.

In this study we compare the cardiac autonomic function of Type D and Non-Type D medical students and also compare autonomic functions among male and female students and students with and without family history of hypertension (HTN) and coronary artery disease (CAD) among Type D.

## MATERIALS AND METHODS

The prospective case control study involving medical students of third and final year was conducted at Department of Physiology, PSG Institute of Medical Sciences and Research, Coimbatore (India) after getting Institutional Ethical clearance. The study was conducted for a period of 5 months from April to August 2014 after getting informed consent from the subjects.

Third and final year students were asked to fill DS14 questionnaire [1]. DS14 is a short and easy to use 14-item, 5-point Likert-type scale designed to assess NA, SI and Type D personality. It consists of two 7-item subscales assessing negative affectivity (e.g. "I often

feel unhappy”) and social inhibition (e.g. “I am a closed person”) respectively. For “Negative affectivity” scale, scores made by students for questions 2,4,5,7,9,12,13 were added and for “Social inhibition” scale, scores of questions 1,3,6,8,10,11,14 were added. Questions 1 and 3 were reversely scored as 4,3,2,1,0 i.e. If student circle 0, 4 was scored, if 1, 3 was scored and so on. These scores were added for NA and SI. If scoring was  $\geq 10$ , for both NA and SI then the persons were considered as Type D personality and others were considered as non-Type D [1] (Appendix 1).

Details regarding the disease of students, any cardiac illness or on any drugs were obtained. Family history of hypertension, coronary artery disease and sudden cardiac death were obtained. General examination including measurement of weight and height and systemic examination were done. The 30 Type D and 30 non-Type D subject selection was based on exclusive-inclusive criteria.

**Inclusion criteria:** Both male and female third and final year medical students of age between 20-23 years with Type D and non-Type D personality were included in the study.

**Exclusion criteria:** Students with asthma, hypertension or known cardiovascular diseases and known depression or psychiatric illness were excluded from the study. Students having the habit of smoking or alcohol were excluded from the study.

Cardiovascular autonomic functions were assessed by standardized, simple, noninvasive tests using cardiovascular reflexes [8].

### Tests for parasympathetic component

- 1) Heart rate response to valsalva manoeuvre.
- 2) Immediate heart rate response to standing.
- 3) Heart rate variation during deep breathing.

### Tests for sympathetic component

- 4) Blood pressure response to standing.
- 5) Blood pressure response to sustained handgrip.

The heart rate monitoring and R-R interval measurement was got from lead II of ECG recordings on the polygraph (RMS Polyrite D, Recorders and Medicare System, India) in the Department of Physiology. Other apparatus used for tests included Timer, Modified Mercurial Sphygmomanometer, Stethoscope and Hand grip dynamometer (25 kg model, IMI, Delhi). Basal BP and heart rate were measured in supine position after taking rest for 5 minutes.

**Heart Rate Response To Valsalva Manoeuvre:** The subject was allowed to take rest for 5 minutes and then instructed to exhale forcefully through the mouth piece attached to sphygmomanometer, to maintain expiratory pressure of 40 mmHg for 15 seconds. The ECG was monitored before, during and 30-40 seconds after the manoeuvre.

Valsalva ratio = Longest R-R interval after the strain / Shortest R-R interval during the strain.

The manoeuvre was repeated three times at brief interval of 5 minutes and the largest ratio of the three was taken. Valsalva ratio of less than 1.2 is regarded as abnormal [8].

**Immediate Heart Rate Response to Standing (30:15 Ratio):** The subject was asked to take rest for 5 minutes in supine position, the ECG was started. The subject was asked to assume erect posture as quickly as possible (within 3 Sec) with continuous ECG recording for 30 seconds.

30:15 ratio = Longest R-R interval around 30<sup>th</sup> beat after standing/ Shortest R-R interval around 15<sup>th</sup> beat after standing.

The ratio is normally greater than 1.04 and abnormal if less than and equal to 1.0 [8].

**Heart Rate Variation during Deep Breathing:** After 5 minutes of rest in sitting posture the subject was instructed to take deep inspiration for 5 sec followed by expiration next 5 sec completing 6 respiratory cycles in 1minute. The inspiratory and expiratory timings were synchronized by looking at the observer’s finger moving rhythmically up and down with a timer. The maximum and minimum heart rate with each respiratory cycle and mean variation were determined. Deep Breathing Difference (DBD) calculated as the mean of the differences between the maximal and minimal heart rate in 6 respiratory cycles. DBD more than 15 beats/minute is normal. It is abnormal if less than and equal to 10 beats/minute [8].

**Blood Pressure Response to Standing (Orthostatic Tolerance Test):** The subject was asked to take rest for 5 minutes in supine position, basal blood pressure was recorded and then the subject was asked to stand up and the BP was recorded immediately. The fall in systolic blood pressure between subject in supine position and at 30 second of standing was taken as the result of OTT. The fall in systolic blood pressure more than and equal to 30 mmHg is abnormal [8].

**Blood Pressure Response to Sustained Hand Grip:** Basal BP was recorded in sitting position and then the subject was asked to perform maximum grip of the hand grip dynamometer with his dominant hand and the maximum capacity was noted. Then after five minutes the subject was asked to hold his grip with 30% of his maximum capacity for 5 min and the BP was recorded at the end of performance just after release. The difference between, rise in diastolic blood pressure just after the release of the grip to the basal diastolic blood pressure was taken as the result of IHG. Increase in diastolic pressure less than and equal to 10 mmHg is abnormal [8] as per [Table/Fig-1].

	Normal	Borderline	Abnormal
<b>Test reflecting parasympathetic function</b>			
Heart rate response to valsalva manoeuvre (Valsalva ratio)	>1.21	1.11-1.20	< 1.10
Heart rate (R-R interval) variation during deep breathing (maximum- minimum heart rate)	>15 beats /mt	11-14 beats/mt	<10 beats /mt
Immediate heart rate response to standing (30:15 ratio)	>1.04	1.01-1.03	<1.00
<b>Test reflecting sympathetic function</b>			
BP response to standing (fall in systolic BP)	<10 mm Hg	11-29 mm Hg	>30 mm Hg
BP response to sustained handgrip (increase in diastolic BP)	>16 mm Hg	11-15 mm Hg	<10 mm Hg

[Table/Fig-1]: Ewing’s classification of cardiac autonomic function into normal, borderline and abnormal [8].

Analysis was done by SPSS Software. Unpaired student’s t-test was used and p-value of <0.05 was considered to be statistically significant.

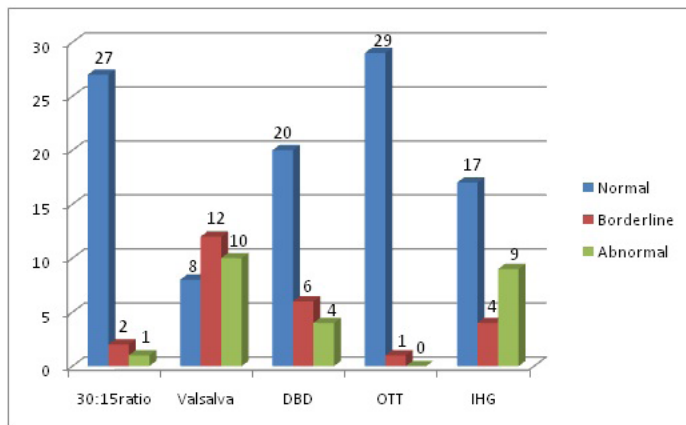
## RESULTS

Type D students showed decreased parasympathetic activity and increased sympathetic activity when compared to Non-Type D students even though there was no statistically significant difference (as the  $p > 0.05$ ) as per [Table/Fig-2]. Regarding the number of students falling in normal, borderline and abnormal category of cardiac autonomic function test in Type D students, more abnormal values are obtained in valsalva ratio (10 students) 33.3% and sustained handgrip (9 students) 30% as per [Table/Fig-3].

There were 10 male students and 20 female students in our study. Type D female students showed decreased parasympathetic activity and increased sympathetic activity when compared to male students, but there is only statistically significant difference in valsalva ratio ( $p < 0.01$ ) as per [Table/Fig-4].

Test	Group	Mean ± SD	p-value
30:15ratio	non-Type D	1.291 ± 0.281	0.147 (NS)
	Type D	1.230 ± 0.182	
Valsalva ratio	non-Type D	1.229 ± 0.364	0.244 (NS)
	Type D	1.190 ± 0.207	
HR response to Deep breathing (beats/mt)	non-Type D	22.667 ± 9.730	0.124 (NS)
	Type D	20.400 ± 7.504	
BP response to standing(mm Hg)	non-Type D	6.133 ± 5.250	0.880 (NS)
	Type D	5.433±5.223	
Isometric handgrip test(mm Hg)	non-Type D	16.066 ± 7.696	0.119 (NS)
	Type D	16.266 ± 10.514	

**[Table/Fig-2]:** Comparison of cardiac autonomic function test among Type D and non-Type D personality medical students. N= 30 in both Type D and non-Type D personality, values are expressed as Mean ± SD, p-values < 0.05 is taken as statistically significant. NS- Not significant



**[Table/Fig-3]:** Number of students of Type D personality showing normal, borderline and abnormal values in cardiac autonomic function tests according to Ewing's classification of values of cardiac autonomic function tests.

Test	Group	Mean ± SD	p-value
30:15ratio	Male	1.233 ± 0.162	0.892 (NS)
	Female	1.229 ± 0.195	
Valsalva ratio	Male	1.263 ± 0.316	0.004**
	Female	1.138 ± 0.115	
HR response to Deep breathing (beats/mt)	Male	22.266 ± 7.007	0.847 (NS)
	Female	19.6 ± 7.789	
BP response to standing(mm Hg)	Male	6.6 ± 6.535	0.208 (NS)
	Female	5.9 ± 4.655	
Isometric handgrip test(mm Hg)	Male	13.2 ± 6.679	0.070 (NS)
	Female	17.8 ± 11.839	

**[Table/Fig-4]:** Comparison of cardiac autonomic function test among male and female in Type D students. N=10 in male and N=20 in females, values are expressed as Mean ± SD, p-values < 0.05 is taken as statistically significant. NS-Not significant \*\* Highly Significant

There were 13 students with no F/H and 17 students with F/H of HTN and CAD. The 30:15 ratio showed statistically significant decrease in Type D students with F/H of HTN and CAD showing decreased parasympathetic activity ( $p < 0.05$ ). BP response to standing showed statistically significant decrease in Type D students with F/H of HTN and CAD showing increased sympathetic activity ( $p < 0.05$ ) when compared with students with no F/H of HTN and CAD as per [Table/Fig-5].

## DISCUSSION

The Type D personality is identified with the DS14 scale which shows a good test retest reliability as well as validity [1]. Altered functioning of the autonomic regulation of the heart can be a risk factor for cardiac events leading to increased probability of cardiac arrhythmias [10]. Type D patients implanted with an internal cardiac

Test	Group	Mean ± SD	p-value
30:15ratio	Without F/H	1.277±0.216	0.047*
	With F/H	1.169±0.104	
Valsalva ratio	Without F/H	1.921 ± 0.242	0.276 (NS)
	With F/H	1.164 ± 0.161	
HR response to Deep breathing (beats/mt)	Without F/H	21.470 ± 8.404	0.141 (NS)
	With F/H	19.000 ± 6.177	
BP response to standing(mm Hg)	Without F/H	6.588 ± 4.228	0.027*
	With F/H	5.538±6.488	
Isometric handgrip test(mm Hg)	Without F/H	14.153±8.224	0.231 (NS)
	With F/H	17.882±11.968	

**[Table/Fig-5]:** Comparison of cardiac autonomic function test among Type D students with and without F/H of cardiac disease and HTN. N=13 for Type D students without F/H of HTN or CHD and N=17 for Type D students with F/H of HTN or CHD, values are expressed as Mean ± SD, p-values < 0.05 is taken as statistically significant. NS- Not significant \* Significant

defibrillator (ICD) have low autonomic control of 24-hr cardiac function [11] and were at high risk for ventricular arrhythmias. This clearly shows that cardiac autonomic function is affected in Type D persons and our study involves the same.

We got slightly less mean values in parasympathetic tests in Type D when compared to non-Type D and got slight decrease in mean value of fall in systolic BP on standing in Type D students and slight increase in mean value of rise in diastolic BP in Isometric handgrip test in Type D students when compared to non-Type D students, suggesting decreased parasympathetic activity and increased sympathetic activity in Type D persons; but there is no statistically significant difference in cardiac autonomic sympathetic function tests between Type D and non-Type D (as  $p > 0.05$ ) as per [Table/Fig-2].

Kupper et al., examined the association of Type D personality with the hemodynamic and autonomic response to cold pressor test in undergraduate students, and found that Type D personality were associated with an exaggerated  $\alpha$ -adrenergic vasoconstriction and pressor response [12]. Nylíkcek et al., examined the association between Type D personality and 24-hour cardiovascular function in daily life in participants without any documented cardiovascular disease. No association was obtained for parameters of sympathetic and parasympathetic control of the heart [3]. Habre et al., did studies in Type D undergraduate students in a stressful laboratory protocol involving a mental arithmetic with harassment, students with Type D personality did not differ from students without Type D regarding the cardiovascular measures assessed [13]. William et al., investigated the relationship between Type D and cardiovascular reactivity to experimentally induced stress in young adults and found only in men, Type D personality was related to enhanced cardiac output response to the task, but not heart rate, blood pressure or peripheral resistance [14]. Martin et al., examined the relationship between Type D personality and heart rate variability during 3 imaginary experiences (baseline, stressful, uplifting) in non medical persons and did not find difference between Type D and non-Type D participants in their laboratory protocol, except in a stressful imaginary task, white American students with Type D personality showed lower high frequency heart rate variability compared to non-Type D [15]. Ours might be the first study that reports on both parasympathetic and sympathetic cardiac autonomic function tests in Type D medical students with no cardiovascular disease. Our results are similar to previous research [13-15] which did not find any differences in cardiac autonomic activity between healthy Type D and non-Type D participants.

Regarding the classification of cardiac autonomic functions into normal, borderline and abnormal in Type D students according to Ewing's criteria, we got 12 students (40%) borderline and 10 students (33%) abnormal in valsalva ratio, i.e. 27% have normal

values for valsalva ratio and 73% have values below normal level. About 4 students (13%) got borderline values and 9 students (30%) got abnormal values in Isometric hand grip, i.e. 57% have normal values and 43% have values below normal level. These two tests were more affected in our study. The most affected test in Type D students is valsalva ratio in our study. [Table/Fig-3].

On comparison of cardiac autonomic functions among male and female in Type D, female students showed a slightly less mean values of 30:15, Valsalva ratio, HR response to deep breathing than male students. There is statistically significant difference in valsalva ratio ( $p=0.004$ ). Considering the sympathetic tests even though we got slight decrease in mean value of fall in systolic BP on standing and slight increase in mean value of rise in diastolic BP in Isometric handgrip test in Type D female students when compared to Type D male students, suggesting increased sympathetic activity in Type D female students; but there is no statistically significant difference. Males have got borderline values for Isometric handgrip tests suggesting decreased sympathetic activity [Table/Fig-4].

Kupper et al., did cold pressor tests in medical students and found that Type D men showed parasympathetic and sympathetic coactivation, while women showed modest sympathetic response combined with vagal withdrawal [12]. Sabera Shabnam et al., did cardiac autonomic function tests in male and female college students and found females to have less tolerance to stress than males [16]. Hari Prasad et al., did valsalva manoeuvre and sustained handgrip in healthy males and females and found that females have lower parasympathetic and higher sympathetic activity [17]. These results are similar to our study which showed decreased parasympathetic and increased sympathetic activity in Type D females when compared to males even though it was not statistically significant except valsalva ratio in females. No studies have compared all 5 cardiac autonomic function tests between male and females in Type D persons.

There is decreased parasympathetic and increased sympathetic activity in people with F/H of HTN and CAD even though statistical significant difference is seen only in 30:15 ratio and in BP response to standing. Wright et al., studied heart rate variability in young men and women during 2 mental stress task and found individuals with a positive family history exhibited significantly greater diastolic BP reactivity and poorer systolic and diastolic BP recovery from stressors in comparison with family history negative individuals [18]. Studies have not been done involving cardiac autonomic function tests in Type D personality with and without F/H of HTN and CAD.

Type D personality persons with established heart disease have been found to have increased morbidity and mortality than non-Type D persons [19-21]. Studies done on cardiac patients with myocardial infarction and coronary heart disease, show that Type D personality is an independent risk factor for coronary heart disease [22,23]. The results of our study indicate that, cardiovascular function of Type D personality without a cardiovascular disease is not different from that seen in non-Type D persons. Based on previous studies discussed above, there is little evidence for cardiovascular autonomic nervous system abnormalities in still healthy Type D individuals.

The mechanisms by which cardiac autonomic function among Type D persons may be affected involve both behavioural and direct physiological pathways. Behavioural pathways include lifestyle factors and impaired interpersonal functioning, where as physiological factors include endothelial function, platelet function, altered lipid profile, altered activity of the hypothalamus-pituitary-adrenal cortex (HPA) axis, and enhanced inflammatory activity of the immune system [10,24,25].

Three observational studies investigated role of Type D personality in patients attending comprehensive cardiac rehabilitation in form of psychotherapy and pharmacotherapy. These studies demonstrated that Type D patients reported benefits in terms of improvements in health status [26-28]. Our study involving healthy young Type D

adults has potential clinical implications for both psychological and cardiovascular health. DS14 can be used as a screening tool in clinical research and practice to identify Type D personality persons. It is possible to identify subclinical autonomic reactivity in Type D persons by doing cardiac autonomic function tests, so persons at risk of developing HTN and CAD may be recognized at the earliest. Prompt identification of these persons will help in early intervention by behaviour therapy, relaxation training, pharmacotherapy and interpersonal therapy to prevent long term cardiovascular health risks.

## LIMITATION

The limitations of our study include less number of subjects which might be the reason for not getting significance in cardiac autonomic function tests and the subjects were undergraduate medical students, which represent a narrowly defined adult sample, hence the findings cannot be generalized.

## CONCLUSION

In our study we got mean values of cardiac autonomic function tests within normal range among Type D students except valsalva ratio which falls in borderline range in all our analysis but there was no statistically significant difference between Type D and non-Type D healthy students even though the mean values suggested decreased parasympathetic and increased sympathetic activity. We got statistically significant decrease in mean values of valsalva ratio in females suggesting decreased parasympathetic activity in females compared to males in Type D students. We got statistically significant difference in mean values of 30:15 ratio and BP response to standing in students with positive F/H of HTN and CAD among Type D students. Valsalva ratio is the most affected test in Type D students.

Our study indicates that, in general, cardiac autonomic functions in individuals of Type D personality without cardiovascular disease are not different from that seen in non-Type D persons. These studies can be followed up at regular intervals to find if Type D personality is associated with cardiovascular risk in healthy individuals.

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#### The D-Scale 14

According to Dr. Denollet and his colleagues, this brief questionnaire accurately identifies Type D individuals.

Below are a number of statements that people often use to describe themselves. Read each one and circle the appropriate number next to that statement to indicate your answer. There are no right or wrong answers: Your own impression is the only thing that matters.

0=false	1=rather false	2=neutral	3=rather true	4=true
1) I make contact easily when I meet people				0 1 2 3 4
2) I often make a fuss about unimportant things				0 1 2 3 4
3) I often talk to strangers				0 1 2 3 4
4) I often feel unhappy				0 1 2 3 4
5) I am often irritated				0 1 2 3 4
6) I often feel inhibited in social interactions				0 1 2 3 4
7) I take a gloomy view of things				0 1 2 3 4
8) I find it hard to start a conversation				0 1 2 3 4
9) I am often in a bad mood				0 1 2 3 4
10) I am a closed kind of person				0 1 2 3 4
11) I would rather keep people at a distance				0 1 2 3 4
12) I often find myself worrying about something				0 1 2 3 4
13) I am often down in the dumps				0 1 2 3 4
14) When socializing, I don't find the right things to talk about				0 1 2 3 4

**"Negative affectivity" scale:** Add scores for questions 2, 4, 5, 7, 9, 12, and 13

**"Social inhibition" scale:** Add scores for questions 1\*, 3\*, 6, 8, 10, 11, and 14

(\*For scoring questions 1 and 3, if you circled 0, enter 4; if 1, enter 3; if 2, enter 2; if 3, enter 1; if 4, enter 0.)

You qualify as a Type D personality if you scored 10 or higher on both negative affectivity and social inhibition scales.

Appendix 1[1]

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