Original Article

HRV changes in young adults with depression

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Abstract

Background and Aims: Depression is a common and debilitant mental health disorder that is very common among young adults of the age group of 18-25 years. There is evidence that autonomic nervous system dysfunction associated with depression may play an important role in cardiovascular disease among patients with depression. HRV that is used to assess ANS function is found to be altered in depression. Since the HRV findings associated with depression remain inconsistent, this study is aimed to find HRV changes associated with depression so that the use of HRV as a diagnostic tool for depression can be validated. **Methods:** A total of 42 newly diagnosed patients of depression of the age group (18-26) years and 89 non-depressed volunteers matched for age, BMI and sex proportions were included in the study. Heart rate variability was recorded using five-minute stationary RR interval of Lead II by 4-channel Power Lab System (AD Instrument Ltd). HRV findings are summarized into Time-Domain parameters, Frequency-Domain parameters and Non-Linear parameters. **Result:** All HRV parameters are significantly reduced and the LF/HF ratio is significantly raised ($P < 0.05$) in the group of depressive patients when compared to the group of healthy controls. The reduction of HRV parameters (SDRR, RMSSD, Total Power, SD1 and SD2) in the group of patients with depression is found to be highly significant ($P < 0.0001$). **Conclusion:** The findings of our study suggest that depression may be associated with alterations in ANS activities, which contribute to an increased risk of cardiovascular disease. Thus, HRV can serve as a potential bio-marker for depression.

Keywords: Autonomic nervous system, cardiovascular disease, depression, heart rate variability, young adults

Introduction

Depression is a common and debilitant mental health disorder characterized by persistent sadness and a loss of interest in activities that one normally enjoys, accompanied by an inability to carry out daily activities, for at least two weeks. Other symptoms include a change in appetite; loss of energy; reduced concentration; indecisiveness; restlessness; anxiety; sleeping more/less; feelings of worthlessness, guilt or hopelessness; and thoughts of self-harm or even committing suicide.[1,2]

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Approximately 3.8% of the world's population (nearly 280 million people) of all ages suffer from depression.[3] It is very common among young adults of the age group of 18–25 years.[4] Suicide as an outcome of major depression becomes the fourth leading cause of death among this age group.[5] For most people, 18–25 years is a transitional period when they can look forward to education, financial security, marriage and parenthood. Failure in achieving their desired goals in life and stood up to their family's and society's expectations makes them depressed. Also, females of this age group are likely to become a mother and it is found that 10% of pregnant women and women in their post-partum period suffers from depression.[6] The current prevalence of depression in India is 2.68%. The prevalence of depression among the young adult age group in India is found to be 1.6% (male – 1.2%, female – 2%).[7] Depression is found to be linked with an increased risk of cardiovascular disease. The pathophysiology of depression is complex and not fully

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understood, although there is evidence that autonomic nervous system dysfunction associated with depression may play an important role in cardiovascular disease among patients with depression.[8-13]

Heart rate variability (HRV) reflects the variation in time between successive heartbeats and is an important measure of ANS activity. It is a measure of the beat-to-beat changes in heart rate and is influenced by the balance between the sympathetic and parasympathetic branches of the autonomic nervous system. HRV has been used to assess ANS function in a wide range of physiological and pathological conditions. Depression is found to be associated with altered HRV.[14,15] Jangpangi D *et al*.[16] found that LF and LF/HF ratio parameters of HRV were significantly higher; HF parameter is significantly lower, while there is no significant difference in SDRR and RMSSD parameters between a group of patients suffering from depression when compared to a group of healthy controls. Nahshoni E *et al*.[17] found that SDRR was significantly lower in the group of depressive patients when compared to healthy controls.[17] Billman GE[18] found that cardio-sympathovagal balance is not measured accurately by the LF/HF ratio of HRV. In recent years, numerous studies have investigated the relationship between HRV and depression. Since the HRV findings associated with depression remain inconsistent, this study is aimed to find HRV changes associated with depression so that the use of HRV as a diagnostic tool for depression can be validated.

Material and Methods

This study was conducted in the Department of Physiology, and Department of Psychiatry, IGIMS, Patna, from December 2022 to April 2023.

Participants

Cases – 42 patients[7] of age group (18-26) years[4] (male – 20, female – 22) with depression were recruited from outpatient, Department of Psychiatry, IGIMS, Patna. The diagnosis of depression was made as defined by the 2013, fifth edition of the American Psychiatric Association's Diagnostic and Statistical Manual (DSM-V).[1,2]

Only newly diagnosed patients with depression who have not started antidepressant therapy were included. Subjects with substance abuse, prior history of coronary heart disease or any systemic illness or metabolic disorder known to affect HRV parameters were excluded.

Controls – A total of 89 non-depressed volunteers matched for age, BMI and sex proportions (male – 43, female – 46) with no reported medical conditions known to affect HRV parameters were included. Healthy controls had a normal ECG recording prior to being included in the study.

The research participants were measured for weight and height, and body mass index was calculated from the collected data. Height was measured by a portable stadiometer (Precision Model, Prime Surgical, New Delhi, India) to the nearest 1 mm. Weight is measured by Omron digital weighing scale HN 300T in kilograms. Heart rate variability (HRV), which serves as an index of autonomic function, was recorded using RR interval of Lead II by 4-channel Power Lab System (AD Instrument ltd) 15 T Model ML 818 in an equable environment. HRV values were derived by the LAB Chart Pro software version: v8.1.13. 12.

After excluding the artefacts and ectopics from the RR interval series, a stationary five-minute RR interval series was chosen and analysed using fast Fourier transformation and the results were given as spectral power in ms^2 including very low frequency (VLF; 0.003 Hz to 0.04 Hz), low frequency (LF; 0.04 Hz to 0.15 Hz), high frequency (HF; 0.15 Hz to0.4 Hz), total spectral power (TP = VLF + LF + HF) and LF/HF ratio (ratio of LF power to HF power) will be obtained.[16] In the time domain, HRV parameters are analysed for the average RR interval, standard deviation of RR interval (SDRR) and root mean square of successive differences (RMSSD) in ms. The Non-Linear HRV parameters include SD1 and SD2 in ms.

Statistical analyses

The arithmetic means and standard deviation (SD) of anthropometric and HRV parameters of both cases and the control group are calculated. The Chi-square test is used for the comparison of gender distribution between the case and control groups. The significance level, or *P*-value, is calculated using the *t*-test. The *P*-value less than 0.05 ($P < 0.05$) is taken as statistically significant, and the *P*-value less than 0.0001 ($P < 0.0001$) is taken as statistically highly significant. All statistical analyses were performed using SPSS26 (IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp).

Result

Forty-two newly diagnosed patients suffering from depression of age group (18–25) years (male – 20, female – 22) who have not started antidepressant therapy and 89 non-depressed volunteers (male – 43, female – 46) matched for age, BMI and sex proportions were studied.

The anthropometric parameters of the participants are shown in Table 1. HRV findings are summarized into Time-Domain parameters [Table 2], Frequency-Domain parameters [Table 3] and Non-Linear parameters [Table 4].

There is no statistically significant difference found in age ($P = 0.8772$), weight ($P = 0.8598$), height ($P = 0.1897$), BMI ($P = 0.2226$) and gender ($P = 0.9407$) between case and control groups.

Among Time-Domain HRV parameters, all three parameters taken into consideration; average RR ($P = 0.0059$), SDRR ($P < 0.0001$) and RMSSD ($P < 0.0001$) are found statistically significantly decreased in the case group when compared to the control group.

Table 1: Anthropometric comparison between case (depression) and control subjects

Parameters	Mean±SD		*P*
	Case	Control	
Age (Years)	21.79±2.05	21.85±2.08	0.8772
Weight (Kg)	62.48±10.91	62.79±8.54	0.8598
Height (meters)	160.20±8.18	162.08±7.34	0.1897
BMI (kg/m^2)	24.82±3.41	24.17±2.52	0.2226
Gender (M/F)	20/22	43/46	0.9407

BMI=Body Mass Index, M=Male, F=Female

Table 2: Time-Domain HRV parameters in case (depression) and control groups

HRV parameters	Mean±SD		*P*
	Case	Control	
Average RR (ms)	711.54±138.09	765.74±82.26	0.0059
SDRR (ms)	26.78±16.24	50.96±23.75	<0.0001
RMSSD (ms)	21.97±15.7	44.77±28.25	<0.0001

SDRR=Standard deviation of all the R-R=Intervals, RMSSD=Root mean square of successive R-R=Interval differences

Table 3: Frequency-Domain HRV parameters in case (depression) and control groups

HRV parameters	Mean±SD		*P*
	Case	Control	
LF (ms^2)	272.64±310.98	536.13±391.15	0.0002
HF (ms^2)	200.42±187.45	761.07±875.85	0.0001
LF/HF	1.51±0.89	1.22±0.73	0.05
Total Power	865.13±792.58	2286.36±1697.68	<0.0001

LF=Low-Frequency, HF=High-Frequency

Table 4: Non-Linear HRV parameters in case (depression) and control groups

HRV parameters	Mean±SD		*P*
	Case	Control	
SD1 (ms)	15.53±11.13	32.67±20.14	<0.0001
SD2 (ms)	37.56±16.10	65.31±28.08	<0.0001

When comparing depressed patients to healthy control participants, four Frequency-Domain HRV measures – LF ($P = 0.0002$), HF ($P = 0.0001$), LF/HF ratio ($P = 0.05$) and Total Power ($P < 0.0001$) – show that all four values are considerably lower in depressed patients.

The two Non-Linear HRV parameters SD1 ($P < 0.0001$) and SD2 ($P < 0.0001$) are also found significantly reduced in patients with depression when compared with healthy control subjects.

Discussion

In our study, it is found that all HRV parameters are significantly reduced and LF/HF ratio is significantly raised ($P < 0.05$) in the group of depressive patients when compared to the group of healthy controls. The reduction of HRV parameters (SDRR, RMSSD, Total Power, SD1 and SD2) in the group of patients with depression is found to be highly significant ($P < 0.0001$). These findings of our study partially correlate with the findings of Jangpangi *et al*.[16] in which they found that the LF/HF ratio is significantly higher and the HF parameter is significantly lower in the group of patients with depression as compared to the group of healthy controls. However, in our study, we found a significant reduction in LF, SDRR and RMSSD parameters in the group of patients with depression which contradicts the findings of Jangpangi *et al*.[16] in which they found that in the group of patients with depression LF parameter is significantly higher and there is no significant difference in SDRR and RMSSD parameters. The findings of our study also correlate with the findings of Nahshoni E *et al*.[17] in which they found that SDRR was significantly lower in the group of depressive patients when compared to the group of healthy controls. Also, LF/HF ratio is found significantly reduced in the group of depressive patients in our study, which contradicts the findings of Billman GE[18] which in their study found to be inconclusive.

Conclusion

The findings of our study suggest that depression is associated with reduced HRV parameters with an increased LF/HF ratio. It suggests that depression may be associated with alterations in ANS activities, which contribute to an increased risk of cardiovascular disease. Thus, HRV that can be assessed non-invasively and inexpensively can serve as a potential bio-marker for depression. However, further research is needed to clarify the mechanisms underlying this association and larger well-controlled studies are needed to further validate the use of HRV as a bio-marker for depression.

Limitations

The limitation of our study is first, the small sample size, which reduces its applicability to a larger population. Large well-controlled studies with longitudinal follow-up are needed to validate the use of HRV as a bio-marker for depression. Second, we were only able to examine Lead II ECG due to the limitation of our Power Lab data collection equipment. Standardization of methods is needed to validate the findings of HRV parameters.

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Ethics approval

The Institutional Ethical Committee (IEC) of IGIMS, Patna, approved the study with the approval letter 816/IEC/IGIMS/2022.

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Conflicts of interest

There are no conflicts of interest.

References

1. American Psychiatric Association. Diagnostic and Statistical Manual of Mental Disorders. 5th edn. Washington, DC: American Psychiatric Association; 2013.
2. Allen KL, Byrne SM, Oddy WH, Crosby RD. DSM-IV-TR and DSM-5 eating disorders in adolescents: Prevalence, stability, and psychosocial correlates in a population-based sample of male and female adolescents. J Abnorm Psychol 2013;122:720-32.
3. Institute of Health Metrics and Evaluation. Global Health Data Exchange (GHDx). Available from: https://vizhub.healthdata.org/gbd-results/. [Last accessed on 2023 Mar 04].
4. Smink FR, van Hoeken D, Oldehinkel AJ, Hoek HW. Prevalence and severity of DSM-5 eating disorders in a community cohort of adolescents. The International Journal of Eating Disorders, 2014;47:610-9.
5. Evans-Lacko S, Aguilar-Gaxiola S, Al-Hamzawi A, Alonso J, Benjet C, Bruffaerts R, *et al*. Socio-economic variations in the mental health treatment gap for people with anxiety, mood, and substance use disorders: Results from the WHO World Mental Health (WMH) surveys. Psychol Med 2018;48:1560-71.
6. Woody CA, Ferrari AJ, Siskind DJ, Whiteford HA, Harris MG. A systematic review and meta-regression of the prevalence and incidence of perinatal depression. J Affect Disord 2017;219:86-92.
7. Arvind BA, Gururaj G, Loganathan S, Amudhan S, Varghese M, Benegal V, *et al*. Prevalence and socioeconomic impact of depressive disorders in India: multisite population-based cross-sectional study. BMJ Open 2019;9:e027250. doi: 10.1136/bmjopen-2018-027250.
8. Severus WE, Littman AB, Stoll AL. Omega-3 fatty acids, homocysteine and the increased risk of cardiovascular mortality in major depressive disorders. Harv Rev Psychiatry 200;9:280-93.
9. Kemp AH, Brunoni AR, Nunes MA, Santos IS, Goulart AC, Ribeiro AL, *et al*. The association between mood and anxiety disorders and coronary heart disease in Brazil: A cross-sectional analysis on the Brazilian longitudinal study of adult health (ELSA-Brasil). Front Psych 2015;6:187.
10. Hare DL, Toukhsati SR, Johansson P, Jaarsma T. Depression and cardiovascular disease: A clinical review. Euro Heart J 2014;35:1365-72.
11. Carney RM, Freedland KE. Depression and coronary heart disease. Nat Rev Cardiol 2017;14:145-55.
12. Brown L, Karmakar C, Gray R, Jindal R, Lim T, Bryant C. Heart rate variability alterations in late life depression: A meta-analysis. J Affect Disord 2018;235:456-66.
13. Koch C, Wilhelm M, Salzmann S, Rief W, Euteneuer F. A meta-analysis of heart rate variability in major depression. Psychol Med 2019;49:1948-57.
14. Paniccia M, Paniccia D, Thomas S, Taha T, Reed N. Clinical and non-clinical depression and anxiety in young people: A scoping review on heart rate variability. Auton Neurosci 2017;208:1-14.
15. Koenig J, Kemp AH, Beauchaine TP, Thayer JF, Kaess M. Depression and resting state heart rate variability in children and adolescents-A systematic review and meta-analysis. Clin Psychol Rev 2016;46:136-50.
16. Jangpangi D, Mondal S, Bandhu R, Kataria D, Gandhi A. Alteration of heart rate variability in patients of depression. J Clin Diagn Res 2016;10:CM04-6. doi: 10.7860/JCDR/2016/22882.9063.
17. Nahshoni E, Aravot D, Aizenberg D, Sigler M, Zalsman G, Strasberg B, *et al*. Heart rate variability in patients with major depression. Psychosomatics 2004;45:129-34.
18. Billman GE. The LF/HF ratio does not accurately measure cardiac sympathovagal balance. Front Physiol 2013;4:26. doi: 10.3389/fphys. 2013.00026.