

Short Communications

Heart rate variability in junior high school students with depression and anxiety in Taiwan

Huang H-T, Wan K-S. Heart rate variability in junior high school students with depression and anxiety in Taiwan.

Background: The impact of depression and anxiety on heart rate variability (HRV) is not clear in adolescents. We hypothesised that HRV investigation in adolescents may early prevent the mental diseases occurrence.

Methods: Three hundred and thirty-three seventh grade students participated in this study programme. HRV instrumental analysis and spectral with scale of depression were measured respectively.

Results: It showed that among the participants, the depression score of female was higher than male. The population with lower depression score present with lower high frequency and higher low frequency/high frequency ratio but not statistically significant. Oppositely, participants with higher depression score were increased with heart rate and present with lower standard deviation of heart rate. However, it is also not statistically significant.

Conclusion: This study supported the positive relation between HRV and depression, especially in the female gender. Therefore, HRV in depression may be beneficial in the detection and prevention of mental disorder development, even suicide behaviour in teenagers.

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Significant outcomes

- A positive relationship between heart rate variability (HRV) is supported by the study results and there is a gender difference in the depression score of this study, where female is higher than male.

Limitations

- There was no antidepressant trial to evaluate their effectiveness on the HRV.
- The participant's depression scales were evaluated by using Tung's questionnaire, which is used only in Taiwan and some Asian countries.
- History of emotional problem of the participants was not clarified.

Introduction

The sympathetic nervous system innervates the cardioaccelerating centre of the heart, the lungs and the non-striated muscles. In opposite, the parasympathetic nervous system innervates the cardiomodulator centre of the heart, lungs and the non-striated

muscles. Sympathetic and parasympathetic divisions function antagonistically to preserve a dynamic modulation of vital functions (1). Reduced HRV seems to indicate decreased cardiac vagal tone and elevated sympathetic activity in anxious and depressive patients and would reflect deficit in flexibility of

emotional physiological mechanisms (1,2). Depression and anxiety disorders (ADs) are associated with significantly lowered HRV and it appears to be mainly driven by the effect of antidepressants (3). There is growing evidence showing that psychiatric disorders are associated with autonomic dysregulations and it is responsible for the increased mortality in patients with psychiatric disorders (4). Findings from several epidemiological studies have revealed that major depression is associated with an increased risk of developing cardiovascular diseases (CVD) and presenting complications and new events in subjects with already established CVD (5–8). Also, changes in measures of HRV have been associated with an increased risk for sudden cardiac death (9). A study showed that depressed mood is related to the magnitude of decrease in parasympathetic cardiac control during stressors in health man and women and similar phenomenon was observed among patients with cardiac disease (10). Therefore, HRV analysis in psychiatric patients before and during therapy elucidates the role of autonomic disturbances in such diseases and may help to optimise the treatment. In conclusion, we hypothesised that HRV investigation in adolescents may early prevent the mental diseases occurrence, even suicidal behaviour.

Materials and methods

This study project included 333 seventh grade students (mean age, 13.32 years; male 172 and female 161, respectively). The participant’s depression scales were evaluated by using Tung’s questionnaire (<5 = no depression, 6–10 = emotional lately, >12 = depression) and the HRV instrumental analysis [mean heart rate turbulence, standard deviation of all RR intervals, root mean square of successive differences, pressure stress index, total power, very low frequency, low frequency (LF), high frequency (HF) and LF/HF ratio] was performed in each participant. Consent for this study was obtained from all the participants who have been signed by the guardians. This project had been approved by the IRB of Bei-Tou Armed Forces Hospital.

The Statistical Package for the Social Sciences (SPSS™ version 12 for Windows™; SPSS, Inc., Chicago, IL, USA) computer software was used for statistical analysis. A *p*-value < 0.05 was considered statistically significant.

Results

The socioeconomic status of the participants showed that the age, ranking in the family, parents, economic condition, drug history and the history of psychiatric disorders have no significant differences (Table 1).

Table 1. The background data of the participated students

Study students	Female (n = 161)	Male (n = 172)	Total no. (n = 333)	
Age (years)	13.31 ± 0.46	13.33 ± 0.47	13.32 ± 0.47	<i>t</i> = 0.406; <i>p</i> = 0.685
<i>Ranking</i>				
Elder	59 (36.6%)	68 (39.5%)	127 (38.1%)	$\chi^2 = 0.983$; <i>p</i> = 0.912
Second	40 (24.8%)	45 (26.3%)	85 (25.5%)	
Third	19 (11.8%)	19 (11%)	38 (11.4%)	
Fourth	37 (27%)	36 (20.9%)	73 (21.9%)	
Single	6 (3.7%)	4 (2.3%)	10 (3%)	
Single parent	0 (0%)	0 (0%)	0 (0%)	
Economic status	Stable	Stable	Stable	
<i>Psychiatry history</i>				
Yes	0 (0%)	2 (1.2%)	2 (0.6%)	$\chi^2 = 1.9$; <i>p</i> = 0.38
No	140 (87%)	147 (85.5%)	287 (86.2%)	
Unknown	21 (13%)	23 (13.4%)	44 (13.2%)	
<i>Antidepressant</i>				
Yes	5 (3.1%)	6 (3.5%)	11 (3.3%)	$\chi^2 = 0.057$; <i>p</i> = 0.972
No	147 (91.3%)	156 (91.2%)	303 (91.3%)	
Unknown	9 (5.6%)	9 (5.3%)	18 (5.4%)	

The evaluation results revealed that the depression score of female was higher than male (Table 2). Moreover, the participants with lower depression scale usually associated with lower HF and higher LF/HF ratio but there were not statistically significant. The participants with higher depression scale would present with higher average heart rate and associated with lower standard deviation of heart rate, but it was also not statistically significant.

Discussion

Changes in the HRV are well-known among patients with depression, which alternates the cardiac autonomic tone towards decreased parasympathetic activity and increase sympathetic activity. It is possible that a common neurobiological dysfunction contributes to both depression and cardiac autonomic changes in the illness (11). It is hypothesised that there are anomalies in the functioning of the central autonomic neural network in subjects with major

Table 2. The analysing results of Tung’s questionnaire

	Female (n = 147) (%)	Male (n = 152) (%)
Depression score		
<5	45	54
6–11	37	34
>12	18	12

Female depression score is higher than male, especially in the score over 12, the emotion stable students are male predominance, and there are no statistic differences in the group of 6–11 score students between female and male (*p* < 0.05).

depression, and more specifically in the hippocampus, prefrontal cortex and the brain stem nuclei. Such abnormalities, in association with lower central levels of serotonin give rise to a predominance of the sympathetic flow and a loss of cardiac vagal tone (5). A study showed that the heart rate increases were attenuated in the depressed subjects compared with non-depressed controls and the effect was independent of sleep stage or baseline heart rate. All effects were independent of subject age. These findings point to a change in autonomic regulation of heart rate in depression (12). Moreover, there is evidence that these autonomic dys-regulations are partly responsible for the increased mortality in patients with psychiatric disorder (13). A more recent important study in Sweden showed that adolescent female psychiatric patients with AD and/or major depressive disorder reveal reduced HRV compared with healthy controls and medication with selective serotonin-reuptake inhibitors explained a part of this difference (14).

Loss of normal autonomic nervous system control of heart rate and rhythm is an important risk factor for adverse cardiovascular events. Several studies have shown a link between reduced HRV in post-myocardial infarction patients and increased risk for adverse cardiovascular events, including ventricular arrhythmias and sudden death. Recently, studies indicate that patients with depression and ADs exhibit abnormally low HRV compared with non-psychiatric controls. Reduced HRV seems to indicate decreased cardiac vagal tone and elevated sympathetic activity in anxious and depressive patients and would reflect deficit in flexibility of emotional physiological mechanisms (14).

HRV has become a popular method for the studies of physiologic mechanisms responsible for the control of heart rate fluctuations, in which the autonomic nervous system appears to play a primary role (15). HRV analysis and integration in the assessment and monitoring of psychiatric patients before and during therapy elucidate the role of autonomic disturbances in such diseases and may help to optimise treatment (13). Anxiety and antisocial behaviour showed distinct relationships to heart rate, and to autonomically mediated components of HRV from postural and respiratory sources. Spectral analytic techniques helped to elucidate these unique regulatory patterns, suggesting utility for future research in this area (16).

Treating depression with cognitive behaviour therapy (CBT) may reduce heart rate and increase short-term HRV. Thus, CBT may have a beneficial effect on a risk factor for mortality in depressed patients with coronary heart disease (17). However, a study showed that depressive disorder is associated with low systolic blood pressure and less hypertension, whereas the use of certain antidepressants

is associated with both high diastolic and systolic blood pressures and hypertension (18). Moreover, a recent study showed that depression without CVD is associated with reduced HRV, which decreases with increasing depression severity, most apparent with nonlinear measures decreases despite resolution of symptoms, highlighting that antidepressant medications might not have HRV-mediated cardioprotective effects and the need to identify individuals at risk among patients in remission (19).

This study showed that the depression score of females was higher than males in the junior high school students with depression and anxiety. Lower depression scale persons usually associated with lower HF and higher LF/HF ratio and higher depression scale persons would present with higher average heart rate and associated with lower standard deviation of heart rate, respectively. However, the above results are not statistically significant. In conclusion, there is positive relationship between HRV and depression or anxiety, especially in the female gender. Theoretically, HRV in depression or anxiety patients is an important risk factor for detecting and prevention of mental disorder development, even suicidal behaviour in teenagers but large group, randomised and controlled studies of the treatment with antidepressant is needed.

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