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Original Research Article**Effect of Classical music on heart rate variability between genders****R. Latha^{1*}, K.Tamilselvan¹, E.Susiganeshkumar² and H.Sairaman³**¹Department of Physiology, Sri Venkateshwaraa Medical College Hospital and Research Centre, Ariyur, Puducherry- 605 102, India²Department of Community Medicine, Sri Venkateshwaraa Medical College Hospital and Research Centre, Ariyur, Puducherry- 605 102, India³Final yr MBBS Student, Sri Venkateshwaraa Medical College Hospital and Research Centre, Ariyur, Puducherry - 605 102, India***Correspondence Info:**

Dr. R. Latha

Professor,

Department of Physiology,

Sri Venkateshwaraa Medical College Hospital and Research Centre,

Ariyur, Puducherry – 605 102, India.

E-mail: lathaphysio@yahoo.co.in**Abstract****Background:** Listening to music alleviates stress but the gender specific difference in the beneficial response elicited by the music on autonomic function is not clear. Therefore this study has been undertaken to look for the significant difference in the autonomic modulation between males and females on listening to a classical music, Rag Bilahari.**Aims & Objectives:** To assess the effect of music on autonomic modulation between genders.**Materials and methods:** 60 medical students between the age of 17 and 20 years were divided into study group of 30 students who were to be exposed to classical music and 30 for controls who were not exposed to music. Each group had 15 participants from each gender. The study group was exposed to the preselected music for half an hour for 30 days and 5 min HRV was recorded before and after the intervention, using PHYSIOPAC-PP₄ software (MEDICAID SYSTEMS, Chandigarh) for all the participants of both the groups and the basal cardiovascular parameters of heart rate, blood pressure and the time domain parameters of HRV such as mean RR interval, standard deviation of all normal RR intervals (SDNN), root mean square of differences between adjacent normal RR intervals (RMSSD), and the percentage of adjacent RR intervals with a difference of duration greater than 50 msec (PNN50) were analysed using Kubios analyser.**Results:** Significant difference in heart rate being lower in females (p=0.0006) and mean RR interval being higher in females (P=0.0004) was observed in music group while parasympathetic activity was increased in both genders.**Conclusion:** Music listening enhances parasympathetic activity which is more pronounced in females.**Keywords:** Gender, Heart Rate Variability, Music, Time domain**1.Introduction**

Cardiovascular mortality is more common in men than in women and equalizes in the latter population after menopause[1]. This inference underscores the silent factor, gender as an inevitable factor of influence in cardiovascular mortality. Among the many a variable that regulates cardiovascular health, autonomic regulation finds a prominent role in cardiovascular regulation which in

turn contributes to cardiovascular morbidity and mortality. Autonomic nervous activity differs between genders and the cardioprotection is favoured in females by the parasympathetic dominance as influenced by the gender specific hormones[2]. The susceptibility of men to cardiac conditions is favoured by vagal inhibition in addition to sympathetic activation[3]. The sympathetic activity

predominates during the periods of stress and the perception of stress as inferred from the autonomic modulation revealed that males are more susceptible to stress than females[4]. The present world is burdened with stress and many relaxation techniques are in practice to make better the condition and one among the effective measure is listening to music. The beneficial effect of music on cardiovascular health has been reported but the extent to which the response occurs between genders which further marks the natural predisposition of cardioprotection can add to the existing body of literature about the gender specific benefits of music[1]. Therefore this study has been designed to assess and compare the effects of music on various HRV parameters between genders.

1.1 Aim

This study had been planned to assess whether gender specific beneficial modulation of HRV exists for the classical music.

2. Materials and Methods

This experimental study was conducted on 60 medical students between the age of 17 and 20 years at Sri Venkateshwaraa Medical College Hospital and Research Centre in Puducherry, in the department of Physiology, after obtaining the Institutional ethical clearance. The recruited volunteers were divided on random basis into study and control group. The study group comprised of 30 students who were to be exposed to classical music and 30 for controls who were not exposed to music. Then questionnaire was administered to rule out anxiety, depression and systemic illness and aversion towards music.

Informed written consent was obtained from the participants and the procedure was explained to them. The anthropometric parameters were recorded to calculate BMI and ECG was recorded for 5 minutes using PHYSIOPAC- PP₄ software (MEDICAID SYSTEMS, Chandigarh) for all the participants of both the groups. Then intervention with classical Rag Bilahari was administered to the study group everyday for 30 min for a period of a month in sitting posture through earphones. At the end of one month of music administration HRV was once again recorded for both the groups and the basal cardiovascular parameters such as heart rate, blood pressure and the time domain parameters of HRV such as mean RR interval, standard deviation of all normal RR intervals (SDNN), root mean square of differences between adjacent normal RR intervals (RMSSD), and the percentage of adjacent RR

intervals with a difference of duration greater than 50 msec (PNN50) were measured. The HRV analysis was done according to International Guidelines and the RR time interval series were extracted from ECG records using Kubios HRV analysis software[5].

2.1 Statistical Analysis

The data were expressed as mean±SD. To test the significance between music and non music groups of each gender and to assess the significant difference between each groups of music and non-music groups between genders unpaired 't' test was done (using SPSS version 17). The statistical probability p<0.05 was considered to be significant.

3. Results

Table 1: The time domain indices of HRV in music and non- music groups in males expressed in mean ± SD

Parameters	Music group (Males)	Non- music group	P Value
HR (bpm)	61.36 ±5.24	73.79 ±14.78	< 0.0001
Mean RR (ms)	1165±108.82	845.54±162.18	< 0.0001
SDNN(ms)	61.4±24.95	33.7±13.89	0.0048
RMSSD (ms)	49.23±16.81	27.89±12.96	0.0023
PNN50 (%)	13.26±4.13	7.55±4.37	0.0034

HR: Heart rate; Mean RR: Mean RR interval; SDNN: Standard deviation of all normal RR intervals; RMSSD: Root mean square of differences between adjacent normal RR intervals; PNN50: Percentage of adjacent RR intervals with a difference of duration greater than 50 msec. Statistical analysis was done by students unpaired 't' test. P value <0.05 was considered statistically significant.

As evident from table 1, the music group of males showed a significant decrease in HR (P <0.0001) and a significant increase in mean RR (P<0.0001), SDNN (P=0.0048), RMSSD (P=0.0023) and PNN50 (P=0.0034) compared to non- music group.

Table 2: The time domain indices of HRV in music and non- music groups in females expressed in mean ± SD

Parameters	Music group(Females)	Non- music group	P Value
HR (bpm)	45.00 ±5.07	70.31 ±5.32	< 0.0001
Mean RR(ms)	1354.8±146.27	864.48±63.81	< 0.0001
SDNN(ms)	48.93±17.75	47.7±25.71	0.8282
RMSSD (ms)	55.19±11.56	43.68±14.26	0.3327
PNN50 (%)	18.12±11.43	9.90±5.08	0.0178

HR: Heart rate; Mean RR: Mean RR interval; SDNN: Standard deviation of all normal RR intervals; RMSSD: Root mean square of differences between adjacent normal RR intervals; PNN50: Percentage of adjacent RR intervals with a difference of duration greater than 50 msec. Statistical analysis was done by students unpaired 't' test. P value <0.05 was considered statistically significant.

The music group of females also showed a significant decrease in heart rate (P=<0.0001) and a significant increase in mean RR and PNN50 (P=0.0178) compared to non-music group. The SDNN and RMSSD values remain unchanged in females of music groups, compared to non-music group.

Table 3: The time domain indices of HRV of both genders in non- music group expressed in mean \pm SD

Parameters	Music group (Males)(Females)	Non- music group	P Value
HR (bpm)	73.79 \pm 3.81	70.31 \pm 1.37	0.39
Mean RR(ms)	845.5 \pm 41.88	864.5 \pm 16.48	0.67
SDNN(ms)	33.70 \pm 3.58	47.7 \pm 6.63	0.08
RMSSD (ms)	27.89 \pm 3.34	43.69 \pm 6.26	0.034
PNN50 (%)	7.55 \pm 1.12	9.90 \pm 1.31	0.185

HR: Heart rate; Mean RR: Mean RR interval; SDNN: Standard deviation of all normal RR intervals; RMSSD: Root mean square of differences between adjacent normal RR intervals; PNN50: Percentage of adjacent RR intervals with a difference of duration greater than 50 msec. Statistical analysis was done by students unpaired 't' test. P value <0.05 was considered statistically significant.

The inter-gender comparison of various times domain parameters of HRV are depicted in tables 3 and 4. In table 3, all time domain parameters of HRV between males and females of non -music group did not show any statistical difference except RMSSD, which seemed to be significantly higher in (P=0.034) in females than males.

Table 4: The time domain indices of HRV of both genders in music group expressed in mean \pm SD

Parameters	Music group (Males)(Females)	Non- music group	P Value
HR (bpm)	52.32 \pm 1.35	45.01 \pm 1.31	0.0006
Mean RR(ms)	1165 \pm 28.10	1355 \pm 37.77	0.0004
SDNN(ms)	61.40 \pm 6.44	48.93 \pm 4.58	0.1261
RMSSD (ms)	49.23 \pm 4.34	55.19 \pm 10.47	0.6032
PNN50 (%)	13.26 \pm 1.06	18.13 \pm 2.95	0.1324

HR: Heart rate; Mean RR: Mean RR interval; SDNN: Standard deviation of all normal RR intervals; RMSSD: Root mean square of differences between adjacent normal RR intervals; PNN50: Percentage of adjacent RR intervals with a difference of duration greater than 50 msec. Statistical analysis was done by students unpaired 't' test. P value <0.05 was considered statistically significant.

The inter-group comparison of HRV parameters in males or females of music group showed a significant difference in heart rate being lower in females (p=0.0006) and mean RR interval being higher in females (P=0.0004). The SDNN, RMSSD and PNN50 were all remained the same in both genders of music group.

4. Discussion

Stress is an inevitable component of the present day life and the effect of stress on health is always negative on the latter. The perception of stress and the response to stressors are different between the genders with men, being not vagally driven, perceive stress more than the female counterparts as inferred from the study of Lin *et al* who found that male interns have progressive depressive symptoms while no such effect of stress is

found in females[6]. The cause for females being less influenced by stress could be due to their natural vagal predominance that might lower their threshold for autonomic response to stress, under the influence of estrogen[7]. This observation could be validated from the observations of Pal *et al* who reported that prehypertensive state is mediated by vagal withdrawal especially in males and by the observation that hypertension is marked by sympoathovagal imbalance in female by Pavithran *et al*[8][9].

As cardiovascular morbidities due to stress are on the rise, many stress alleviating techniques are being practiced by the present generation and one among them with appreciable outcomes is listening to music. The rag administered, Bilahari, evokes the moods of joy, heroism and courage which makes it a suitable instrument to tackle stress when listened for a longer period[10].

The observations obtained revealed that heart rate and mean RR intervals showed significant changes between the music and non-music group in both genders and there was a significant decrease in the RMSSD, SDNN and PNN50 in the male population suggesting a shift towards enhanced vagal activity. From this it could be inferred that music has beneficial effect on the heart rate variability thus favouring cardiovascular health in its long run.

The comparison of time domain parameters between genders of non-music group did not differ much except for the values of RMSSD which is higher in females that could be due to natural vagal dominance in the females. When such changes were looked for between males and females of the music group, HRV of female subjects displayed changes suggestive of parasympathetic enhancement with significant decrease in heart rate and higher mean RR intervals in females when compared to males reflecting vagal enhancement in that population.

From the findings of our study it could be inferred that the vagal dominance in females gets further enhanced on listening to classic music with a reduction in sympathetic tone in males with overall vagal over-pronouncement in the females.

Limitations of the study

The limitations of the study would include lesser sample size, and the estimation of stress hormone (cortisol), plasma cytokines and catecholamines and stress scoring have not been done.

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