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Original Research Article.

To Compare the Cardiovascular Reactivity to Mobile Games Induced Stress In Medical Students

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ABSTRACT

Background: Students usually prefer to play games on their mobile phones to avoid stress which is a major cause of CVD nowadays. CVR to stress can be assessed through cardiovascular parameters such as blood pressure, heart rate and pulse transit time. The present study was conducted to compare the Cardiovascular Reactivity (Heart rate, blood pressure, pulse transit time) before, during and after playing mobile games and to compare cardiovascular parameters on the 1st day and last day of study.

Materials and Methods: This cross-sectional study was conducted among 100 MBBS students in the age group of 19 to 22 years at KD Medical College, Hospital and Research Centre, Mathura. Subjects over the period of 2 months were selected for the study. The subjects were asked to have a light breakfast. Then in the sitting position; cardiovascular parameters and anthropometric data of the subjects were taken 10 minutes before the game. All the rules of (CRASHLAND) mobile game were explained to the subjects before letting him/her to start the game. After taking these parameters the subject were asked to play the mobile game for 30 minutes. Then the game was withdrawal and within 10 minutes of interval; all these parameters were taken again. If any discomfort was reported by the subject then he/she was excluded from this study. Data was analyzed using SPSS version 20. Variation of Cardiovascular Reactivity before, during and after playing mobile games were accessed by Repeated Measure ANOVA. Comparison of cardiovascular parameters on the 1st day and last day of study of a subject was accessed by Paired "t" Test.

Results: A positive correlation was found between the BMI and various CVR parameters such as heart rate, SBP, DBP, MAP, pulse transit time, pulse wave velocity during and after playing the game. Repeated measure ANOVA analysed that there was no significant increase in pulse wave velocity of the subject before, during and after playing mobile game. One way ANOVA analysed that there was significant increase in SBP and DBP of the subject, suggesting increased stress associated with playing mobile games.

Conclusion: Our study concluded that a positive correlation was found between the BMI and various CVR parameters such as heart rate, SBP, DBP, MAP, pulse transit time, pulse wave velocity during and after playing the game.

Keywords: Cardiovascular Reactivity, Heart Rate, Blood Pressure, Pulse Transit Time.

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INTRODUCTION

High blood pressure is one of the most important risk factor for cardiovascular disease.[1] Cardiovascular diseases (CVD) are the number one cause of death globally. An estimated17.9 million people died from CVD in 2016, representing 31%of all global deaths.[2] Literature has reported an increase in the level of stress during medical training. It has been reported that they show depression.[3,4] Students usually prefer to play games on their mobile phones to avoid stress which is a major cause of CVD now a days. Mobile game induced stress usually affects the limbic system through Hypothalamic –Pituitary –Adrenal axis. Increased Cardiovascular reactivity (CVR) to stress is an indicator of developing hypertension.[5] Exaggerated CVR has become an additional risk for a range of cardiovascular outcomes such as high blood pressure, Carotid Atherosclerosis, Carotid Intima Thickness and Left Ventricular Mass.[6] CVR to stress can be assessed through Cardiovascular parameters such as Blood

Pressure (B.P), Heart Rate(H.R) & Pulse Transit Time. So this study is undertaken to find whether CVR and Anthropometric Characteristics are associated with mobile game induced stress in Medical Student. The present study was conducted to compare the cardiovascular Reactivity (Heart rate, blood pressure, pulse transit time) before, during and after playing mobile games and to compare cardiovascular parameters on the 1st day and last day of study.

MATERIALS AND METHODS

This cross-sectional study was conducted among 100 MBBS students in the age group of 19 to 22 years at KD Medical College, Hospital and Research Centre, Mathura. Subjects over the period of 2 months were selected for the study. Before the commencement of the study ethical approval was taken from the Ethical Committee of the institute. The sample was selected by convenient sampling. The subjects who were normotensive, non-alcoholic, non-smoker were included in the study. The subjects who were hypertensive, diabetic, with family history of CVD were excluded from the study. The subject has to report Physiology Department between 9am and 10 am with no intake of any caffeinated or carbonated drinks for at least 3hrs before the experiment. Complete procedure involved in the study was explained to them in vernacular language. Written consent forms were taken. The subjects were asked to have a light breakfast. Then in the sitting position; cardiovascular parameters and anthropometric data of the subjects were taken 10 minutes before the game. Anthropometric parameters such as age, sex, height (using a wall mount Standiometer), and body weight (in kilogram using weighing machine). Cardiovascular parameters such as Blood pressure (sphygmomanometer), Heart rate (polyoxymeter) and Pulse wave contour analysis using Polyrite which gave the Pulse transit time, Stiffness index, Reflection index. All the rules of (CRASHLAND) mobile game were explained to the subjects before letting him/her to start the game. After taking these parameters the subject were asked to play the mobile game for 30 minutes. Then the game was withdrawal and within 10 minutes of interval; all these parameters were taken again. If any discomfort was reported by the subject then he/she was excluded from this study. Data was analyzed using SPSS version 20. Variation of Cardiovascular Reactivity before, during and after playing mobile games were accessed by Repeated Measure ANOVA. Comparison of cardiovascular parameters on the 1st day and last day of study of a subject was accessed by Paired "t" Test.

Table 1: Association between BMI and the various cardiovascular reactivity parameters

	Pearson's correlation coefficient	p-Value
BMI × dHR	0.089	0.559
BMI × dSBP	0.141	0.256
BMI × dDBP	0.120	0.334
BMI × dMAP	0.142	0.252
BMI × dTransit time	0.025	0.839
BMI × dVelocity	0.265	0.030*

d Difference of various parameters before and during the game; *Statistically significant $p < 0.05$

Table 2: Association between BMI and the various cardiovascular parameters

	Pearson's correlation coefficient	p-Value
BMI × d'HR	0.089	0.559
BMI × d'SBP	-0.128	0.811
BMI × d'DBP	0.048	0.702
BMI × d'MAP	0.025	0.839
BMI × d'Transit time	0.021	0.867
BMI × d'Velocity	0.230	0.061

Table 3: Differences in the different variables before and after playing Mobile Game

Parameter	Pre- game (mean ± SD)	Post- game (mean ± SD)	*t-value*	*p-Value*
Heart Rate (bpm)	83.86 ± 13.20	82.27 ± 13.04	1.450	0.152
SBP (mmHg)	117.85± 15.63	113.33 ± 13.78	4.013	0.000*
DBP (mmHg)	77.61 ± 12.37	71.79 ± 9.94	3.594	0.001*
MAP (mmHg)	91.02 ± 12.33	84.97 ± 9.96	4.360	0.000*
Pulse Transit time (s)	0.083 ± 0.015	0.081 ± 0.019	0.800	0.427
Pulse Velocity(m/s)	9.16 ± 1.54	9.19 ± 1.53	-0.127	0.900

Table 4: Time effect on Cardiovascular Reactivity parameters when measured before, during and after playing mobile game by repeated ANOVA.

Wilks' lambda for	Value	F	Sig.	η2
HR	.945	1.862a		.055
SBP	.790	8.633a	.000*	.210
DBP	.824	6.935a	.002*	.176
Pulse Transit time	.988	.388a	.680	.012
Pulse Velocity	.998	.072a	.931	.002

Each F tests the multivariate effect of HR, SBP, DBP, Pulse Transit time and Pulse Velocity.

These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a Exact statistic; * Statistically significant $p < 0.05$

Table 5: Pairwise Comparison on Cardiovascular Reactivity parameters when measured before, during and after playing mobile game by repeated ANOVA.

(I)HR	(J)HR	Mean difference(I-J)	Std. error	Sig.[a]
1	2	-0.167	.872	1.000
	3	1.591	1.097	.456
2	3	1.758	.914	.177
(I)SBP	**(J) SBP**			
1	2	5.269*	1.960	0.027
	3	6.522*	1.625	0.000
2	3	1.254	1.989	1.000
(I)DBP	**(J)DBP**			
1	2	2.925	1.581	0.206
	3	5.821*	1.619	0.002
2	3	2.896	1.193	0.054
(I) Pulse transit time	**(J) Pulse transit time**			
1	2	0.000	0.002	1.000
	3	0.002	0.002	1.000
2	3	0.002	0.002	1.000
(I)Pulse velocity	**(J) Pulse velocity**			
1	2	0.038	.211	1.000
	3	-.027	.209	1.000
2	3	-.065	.169	1.000

Bases on estimated marginal means: a=Adjustment for multiple comparisons: Bonferroni;

*The mean difference is significant at the .05 level.

RESULTS

Our findings in the study showed the existing positive correlation between the BMI and the various reactivity measures of the heart such as heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, pulse transit time and pulse velocity during and after game. Although statistically nonsignificant, a definite trend of positive correlation was noted as except for SBP in table 2 which shows negative correlation before and after game.

The paired *t*-test of the collected data in table 3 shows the statistically significant differences in the variable assuring the changes before and after playing game that have come up with the intervention of the game in these subjects. The changes in systolic blood pressure, diastolic blood pressure and mean arterial pressure were very vivid with no change in heart rate, pulse transit time and pulse velocity indicating no change in parameters related to pulse.

Result of table 4 & 5 shows a one-way repeated measured analysis of variance (ANOVA) which was conducted to evaluate the null hypothesis that there is change in participants' HR when measured before, during and after playing mobile game (N=100). The results of the ANOVA not indicated a significant time effect, Wilk's Lambda =0.945, F=1.86, p>0.05, η2 =0.055. Thus, there is no significant evidence to accept the null hypothesis.

Follow up comparisons indicated that each pairwise difference was not significant, p >0.05. There was no significant increase in HR over time, suggesting that playing mobile game do not increase participants' level of HR. A one-way repeated measured analysis of variance (ANOVA) was conducted to evaluate the null hypothesis that there is change in participants' SBP when measured before, during and after playing mobile game (N=100). The results of the ANOVA indicated a significant time effect, Wilk's Lambda =0.79, F=8.63, p<0.05, η2 =0.21. Thus, there is significant evidence to accept the null hypothesis.

Follow up comparisons indicated that pairwise difference between group 1 and 3 was significant, p<0.05 but not between group 1 and 2 and also not between group 2 and 3, p>0.05. There was a significant increase in SBP over time, suggesting that playing mobile game increases participants' level of SBP. A one-way repeated measured analysis of variance (ANOVA) was conducted to evaluate the null hypothesis that there is change in participants' DBP when measured before, during and after playing mobile game (N=100). The results of the ANOVA indicated a significant time effect, Wilk's Lambda =0.824, F=6.935, p<0.05, η2 =0.176. Thus, there is significant evidence to accept the null hypothesis.

Follow up comparisons indicated that pairwise difference between group 1 and 3 was significant, p<0.05 but not between group 1 and 2 and also not between group 2 and 3, p>0.05. There was a significant increase in DBP over time, suggesting that playing mobile game increases participants' level of DBP.

A one-way repeated measured analysis of variance (ANOVA) was conducted to evaluate the null hypothesis that there is change in participants' Pulse Transit Time when measured before, during and after playing mobile game (N=100). The results of the ANOVA not indicated a significant time effect, Wilk's Lambda =0.988, F=.388, p>0.05, η2 =0.012. Thus, there is no significant evidence to accept the null hypothesis.

Follow up comparisons indicated that each pairwise difference was not significant, p >0.05. There was no significant increase in Pulse Transit Time over time, suggesting that playing mobile game do not increase participants' level of Pulse Transit Time.

A one-way repeated measured analysis of variance (ANOVA) was conducted to evaluate the null hypothesis that there is change in participants' Pulse Velocity when measured before, during and after playing mobile game (N=100). The results of the ANOVA not indicated a significant time effect, Wilk's Lambda =0.998, F=0.072, p>0.05, η2 =0.002. Thus, there is no significant evidence to accept the null hypothesis.

Follow up comparisons indicated that each pairwise difference was not significant, p >0.05. There was no significant increase in Pulse Velocity over time, suggesting that playing mobile game do not increase participants' level of Pulse Velocity.

DISCUSSION

Our study describes the CVR to mobile games in young adults with differing BMI. Studies conducted earlier have found CVR to acute psychological stress as a subclinical risk for coronary vascular disease in young adults. Majority of the studies have been conducted with psychological stress as a tool to assess the CVR. Here in this study we have used mobile games as the stressor. However, fewer studies have examined the role of CVR in coronary vascular disease during psychological stress. The association between the heart rate and BMI clearly showed a positive correlation. Reduced sympathetic and parasympathetic activities in children with obesity have been correlated to the increased body fat, which is considered to be an etiological factor for childhood obesity.

In our study the autonomic adjustment for an increased heart rate from the baseline was found to be higher in individuals with obesity than that in normal individuals or those with low BMI. The extent to which autonomic nervous system (ANS) of an individual with obesity is agitated by a moderate stress was clearly seen. And, this change was measured by the difference in the pre and post playing mobile game, heart rate, which was clearly found to have a greater value in case of individuals with obesity than in the normal subjects. Changes in blood pressure were correlated with BMI and were found to be again having a positive correlation [Table 2]. This was again in line with the findings of other studies that have reported individuals with obesity to have a reduced autonomic activity. Sympathetic nervous system (SNS) is reported to be the most important regulatory system for energy balance and hence altered SNS activity may affect the amount of fat mass in humans. Reduced or blunted sympathetic activity in adults with obesity has been reported in certain physiological conditions. Here in our study these subjects are of young adult age group and our findings are also similar to those of the other two.

Hence, we believe that obesity at all age has the same effect on ANS. The extent of dilatation and constriction depends on the property of the arterial wall elasticity. In atherosclerosis and arteriosclerosis this happens to be lost, and hence when a pre- and post-exercise difference in the elasticity achieved in an artery will be lesser to that in normal person with no earlier-mentioned changes in the artery. Therefore, the difference in the arterial elasticity nature decreases with the increase in BMI and obesity. It holds the same for the transit time of pulse, which depends on the velocity of blood flow that is directly dependent on the diameter of the blood vessel. As in these cases, the smaller the diameter of the blood vessel, the greater the velocity of blood flowing through, therefore the lesser will be the transit time. The statistically significant changes in the blood pressure were well appreciated by the mobile game executed by all the subjects.

Although the correlation exhibited by all the studied parameters showed a trend of either positive or negative correlation, they were statistically nonsignificant. Considering the previous studies, findings of our study are in line with them concluding that there is reduced autonomic activity or blunted sympathetic activity in the subjects with obesity.

CONCLUSION

Our study concluded that a positive correlation was found between the BMI and various CVR parameters such as heart rate, SBP, DBP, MAP, pulse transit time, pulse wave velocity during and after playing the game.

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