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Research Article

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# Does Physical Activity and Cell Phone Usage Affect Heart Rate Variability in Paramedic Students?

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## ABSTRACT

**Introduction:** Cardiovascular diseases (CVD) are a significant cause of morbidity and mortality. HRV, which reflects the modulatory capacity of the autonomous nervous system, plays a crucial role in influencing mortality.

**Aims/Objectives:** In this cross-sectional study, we investigate the impact of physical exercise and cell phone usage on HRV measures. The objective of this study is to find that physical activity and usage of cell phones influence heart rate variability in paramedical students.

**Method:** A total of 94 paramedical students (70 females and 24 males) aged 18-25 (mean age 20.4±1.5) volunteered for this study. Physical activity and duration of the mobile usage were measured using International Physical Activity Questionnaire (IPAQ-short form) and structured questionnaire respectively. A 5-minute short-term HRV measurement was obtained by Kubios HRV smart phone application. Each participant was rested in supine for 10 minutes before the HRV measurement and was instructed to remain relaxed, breathe normally, avoid talking and sleep during the measurement. Time domain (SDNN, RMSSD) and frequency domain parameters (LF power, HF power, and LF/HF ratio) were measured for HRV analysis.

**Result:** Study found no significant association between physical activity and smartphone usage with HRV measures in males and females.

**Conclusion:** This study concludes that there is no correlation of physical activity and mobile phone usage on heart rate variability parameters. However, due to increased cell phone usage and low physical activity among college students, assessing these factors can assist to prevent future negative events and enhance health awareness.

**Key Words:** HRV, Physical activity, Paramedical students, Stress, IPAQ, Screen time, Mobile usage

## INTRODUCTION

Heart rate variability (HRV) is the measure of variations between consecutive heartbeats. HRV is controlled by autonomic nervous system (ANS).[1] HRV analysis is generally used for evaluating autonomic nervous system functioning in cardiovascular research and in different human wellbeing related applications. HRV is known to be affected, e.g. by stress, certain cardiac diseases and pathological states. HRV is a result of ANS regulation of the sinoatrial (SA) node. [2] Heart rate variability is a non-invasive method to assess cardiac autonomic nervous system function. Low HRV is indicative of a shift towards sympathetic predominance, and has prognostic value for all-cause mortality and sudden cardiac death. [3]

The prevalence of physical inactivity has risen over the last decade; its association with coronary heart disease incidence is of growing importance. Studies of coronary heart disease risk and physical activity have predominantly focused on vigorous activity. Physical inactivity may lead to coronary heart disease via increased adiposity, reduced lean body mass, reduced cardiovascular fitness, raised blood pressure, reduced glucose tolerance, lowered insulin sensitivity and adverse lipid profile. However, the relative importance of each of these mechanisms is unclear and they do not totally explain the reduction in coronary heart disease observed in studies that include increased physical activity. Disturbances in autonomic function are associated with each of these potential mechanisms linking physical inactivity to coronary disease and may be an additional way in which physical activity reduces coronary heart disease morbidity. [4]

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Sedentary behaviours in college students are largely due to increased screen time, mainly including computer and internet usage. Screen time has been associated with obesity, unfavourable blood lipid, backache and headache, and poor school performance in children and adolescents. Recent evidence suggests there is an independent association between sedentary behaviour and all-cause mortality, including cardiovascular disease.[5] In fact, increased sitting time (i.e., > 8 h/day) or screen time (3–4 h/day) are associated with increased risk of all-cause mortality, regardless of the levels of physical activity and the deaths attributed to these unhealthy lifestyle behaviours are exponentially increasing in adults. [6]

The need for this study is to find that physical activity and usage of cell phones influence heart rate variability in paramedical students. Nowadays, there is increase in the sedentary behaviour in students. Physical activity is decreasing and on the other hand, the use of cell phones is increasing in students either for the study purpose or for the leisure activities.

## METHODOLOGY

This cross-sectional study design includes 94 college going paramedic student from the SPB Physiotherapy and Vatsalya Nursing College, Surat- Gujarat. Total 94 (n=94) students were randomly selected for the study. **Inclusion criteria:** 1. Age group: 18 to 25 Years 2.Gender: male and female 3. Paramedical students 4. Willing to participate. **Exclusion criteria:** 1. congenital heart disease 2. Cardiac Pacemaker 3. Cardiorespiratory disease 4. Refuse to participate. Each participants were approached individually for the study purpose and objective of the study was explained to them. Written consent form had been taken from every subject prior to the study.

Self -administration mode was used to measure physical activity. The IPAQ (International Physical Activity Questionnaire) – short version [7] was used to examine the participant's physical activity levels. The questionnaire consists of 7 questions pertaining to all kinds of physical activity related to job, everyday life and leisure and especially to the time spent on vigorous and moderate activities, on walking and sitting. Weekly physical activity was computed by multiplying time (minutes of given activity in the reported week) by intensity (in MET units) corresponding to that activity. Mobile usage of the participants were measured using the structured questionnaire.

HRV parameters were measured using the Polar H10 and Kubios HRV smartphone application version 1.4.1(200080) (iPhone $X_R$). This app has good reliability (ICC=0.868) and excellent validity (r=0.94). [8] All recordings were performed in quite, bright room. Each relaxed, breathe normally, and refrain to talk and sleep during the measurement. Following a 10-minute rest, the participant's chest was fastened with a Polar H10 chest strap that had been moistened with water at the level of the xiphisternum and Kubios HRV participants were rested in supine for 10 minutes before the measurement and were instructed to remain smart phone application pair up with the iPhone through the Bluetooth for recording. Before the measurement, there was a 30-second interval of relaxation, and a total of 5 minutes was recorded. Both time domain and frequency domain parameters were recorded for HRV measurement.

### Time domain:

1. Mean RR: Average between R-R interval
2. SDNN (ms): Standard deviation of all NN intervals (NN interval i.e. all intervals between adjacent QRS complexes resulting from sinus node depolarisations).
3. RMSSD (ms): The square root of the mean of the sum of the squares of differences between adjacent NN intervals.

### Frequency domains:

1. LF power ($ms^2$) : Power in low frequency range (0·04–0·15 Hz)
2. HF power ($ms^2$) : Power in high frequency range( 0·15–0·4 Hz)
3. LF/HF ratio


**Image 1:** HRV measurement.

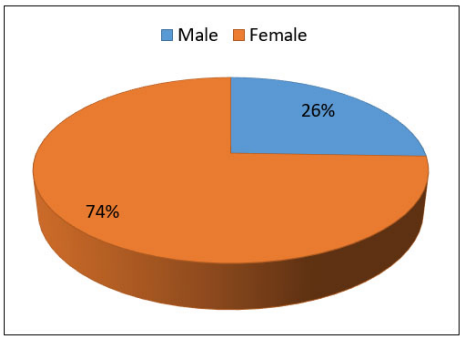
## RESULT

Statistical analysis was done by using SPSS version 20. Confidence interval was kept at 95% and level of significance was kept at 0.05. Kolmogorov-smirnov test was used to analyse the data as the data was not normally distributed. Non-parametric test spearman's rank correlation was used to analyse the data.

**Table 1: Demographic Details**

| Parameters | Mean ± SD |
|---|---|
| Age | 20.38 ± 1.54 |
| Height | 159.99 ± 7.97 |
| Weight | 55.49 ± 14.77 |
| BMI | 21.66 ± 5.36 |
| RHR | 90.95 ± 13.05 |

Table 1 showed demographics details of participants. Mean age 20.38 ± 1.54, mean Height 159.99 ± 7.97, mean Weight 55.49 ± 14.77, mean BMI 21.66 ± 5.36, RHR 90.95 ± 13.05




**Graph 1:** Gender distribution.

**Table 2: Descriptive statistics of female and male**

| PARAMETERS | MEAN ± SD (FEMALE) | MEAN ± SD (MALE) |
|---|---|---|
| Age | 20.5±1.5 | 19.9 ± 1.4 |
| Height | 157.3 ± 6.06 | 167.87 ± 7.7 |
| Weight | 54.3 ± 14.5 | 58.9 ± 15.4 |
| BMI | 21.9 ± 5.4 | 20.9 ± 5.4 |
| Mobile usage per day | 3.2 ± 1.1 | 3.8 ± 0.9 |
| Mobile usage per week | 22 ± 7.9 | 26 ± 6.4 |
| IPAQ | 322.8 ± 818.6 | 1786.8 ± 2489.63 |
| RR | 673.9 ± 89.6 | 668.05 ± 97.89 |
| SDNN | 44.2 ± 19.9 | 43.9 ± 17.3 |
| RMSSD | 41.1 ± 21.1 | 41.3 ± 22.47 |
| HF | 874.1 ± 808.1 | 829.92 ± 618.68 |
| LF | 960.4 ± 948.45 | 825.15 ± 464.80 |
| LF/HF | 1.62 ± 1.3 | 1.4 ± 0.98 |
| RHR | 90.7 ± 12.8 | 91.7 ± 14.03 |

Table 2 showed the Descriptive statistics of female and male

**Table 3: Correlation between Physical Activity and HRV Parameters in Female**

| Parameters | r -value | p- value |
|---|---|---|
| Mean RR | -0.075 | 0.536 |
| SDNN | 0.036 | 0.767 |
| RMSSD | -0.029 | 0.815 |
| LF/HF | 0.164 | 0.175 |

Table 3 showed the correlation between physical activity and HRV parameters in female. The correlation coefficient indicated that there is no association between physical activity and HRV parameters in females.

**Table 4: Correlation between Physical Activity and HRV Parameters in Male**

| Parameters | r- value | p –value |
|---|---|---|
| Mean RR | -0.039 | 0.855 |
| SDNN | 0.012 | 0.957 |
| RMSSD | 0.044 | 0.837 |
| LF/HF | -0.185 | 0.387 |

Table 4 showed the correlation between physical activity and HRV parameters in male. The correlation coefficient indicated that there is no association between physical activity and HRV parameters in male.

**Table 5: Correlation between Mobile Usage and HRV Parameters in Female**

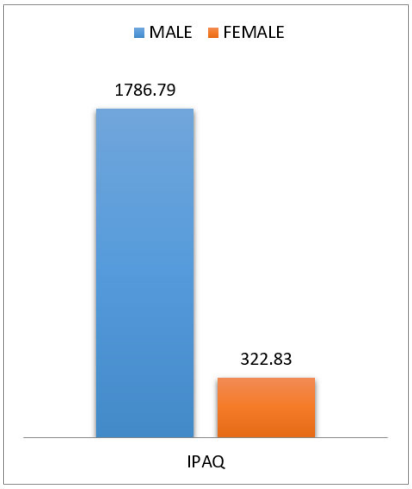
| Parameters | r-value | p- value |
|---|---|---|
| Mean RR | 0.095 | 0.436 |
| SDNN | 0.068 | 0.575 |
| RMSSD | 0.040 | 0.743 |
| LF/HF | 0.016 | 0.898 |

Table 5 showed correlation between mobile usage and HRV parameters in female. It was found from the correlation coefficient that there is no association between mobile usage and HRV parameters in female.

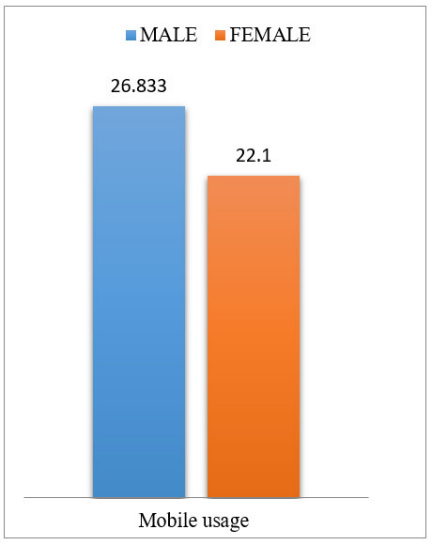
**Table 6: Correlation between Mobile Usage and HRV Parameters iIn Male**

| Parameters | r- value | p- value |
|---|---|---|
| Mean RR | -0.014 | 0.949 |
| SDNN | -0.036 | 0.868 |
| RMSSD | -0.003 | 0.988 |
| LF/HF | 0.039 | 0.858 |

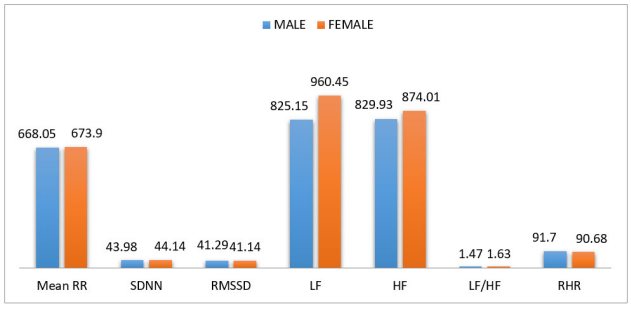
Table 6 showed correlation between mobile usage and HRV parameters in male. It was found from the correlation coefficient that there is no association between mobile usage and HRV parameters in male.




**Graph 2:** IPAQ.




**Graph 3:** Mobile usage (per week).




**Graph 4:** HRV parameters in male & female.

## DISCUSSION

The present study was conducted to evaluate physical activity and usage of cell phones influence. The results showed that there was no statistical significant difference between effect of physical activity and cell phone usage on HRV.

Our finding was contradictory to the previous studies, which investigated the effects of physical activity on heart rate variability in children and adolescents. There was a medium-sized association between physical activity and HRV in children and adolescents. It showed that participation in moderate-to-vigorous physical activity (MVPA) will increase parasympathetic nerve activity and decreased sympathetic nerve activity. The confounding factors and the testing tools will influence the relationship between PA and HRV. [9] The researchers has analysed the literature that were published from 2000 which generally used accelerometer and pedometer. Our research is based on IPAQ. It relies on self-reported information about physical activity levels. Participants may overestimate or underestimate their activity, leading to inaccuracies. Recall bias can affect the accuracy of reported activity patterns.

Berkay Ekici (2016) who investigated the effects of the duration of mobile phone use on heart rate variability parameters in healthy subjects supported our study. The results of the study demonstrate that a long-term duration of mobile phone use may influence HRV and alter the autonomic balance in favour of higher sympathetic tone. Long-term mobile phone users showed an increase in sympathetic tone while decreasing parasympathetic tone, as evaluated indirectly by HRV analysis. There was no statistically significant difference between the groups in this investigation.

Ali Tamer et al. also studied the cardiac effects of a mobile phone positioned closest to the heart in which the effects of mobile phones (on, off and ringing mode) on cardiac electrical activity, including P wave and QT dispersion analysis, HRV, HR, and BP parameters were evaluated at the position closest to the heart in healthy adult subjects and concluded that mobile phone has no effect on hemodynamic (heart rate, blood pressure) and cardiac electrical activity (P-wave and QT dispersions) parameters when it is positioned on the chest in immediate proximity to the heart, and it does not cause cardiac autonomic dysfunction examined by HRV analysis in healthy adult subjects.[10]

There is difference in the level of physical activity in male and female. Many factors are responsible for this such as biological factors, social and cultural factors, psychosocial, environmental factors, **Life Transitions** i.e. puberty and adulthood, and lack of awareness. Societal expectations often shape behaviour. Historically, physical activity has been associated with masculinity, while femininity has been linked to more sedentary roles. Boys are often encouraged

to participate in sports from an early age, leading to higher physical activity levels. Girls may face barriers or lack opportunities to engage in sports. Cultural ideals of beauty and body shape influence physical activity. Some girls may avoid exercise due to body image concerns. Hormonal changes during puberty can affect energy levels and preferences for physical activity. Women often juggle multiple roles (work, household tasks), leaving less time for exercise.

Women are **19% less likely** than men to use mobile internet. Societal expectations and gender roles influence mobile phone usage. Female are more tend to do household chores as compared to male.

## CONCLUSION

This study concludes that there is no correlation of physical activity and mobile phone usage on heart rate variability parameters. Lifestyle related factors such as sleep, nutrition, hormonal changes etc. can affect HRV that were not controlled in our study. Although precautionary measures can be taken to avoid future cardiovascular risks.

## LIMITATIONS

- Data cannot be generalised due to small sample size
- Assessor error could be counted.

## FUTURE RECOMMENDATIONS

- Can be done with greater sample size
- Can be done with more accurate methods to assess mobile usage
- Objective measurement can be used to assess

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**Conflicts of Interest**

The authors declare no conflict of interest.

**Author's Contribution:**

**Vishwa Thaker**, **Drashti Shiroya**, **Hemanshi Shiroya**, **Mileni Godhani**: Conceptualization, methodology, data collection, Writing –review & editing.

**Vaishali Gabani:** Conceptualization, methodology, data analysis &interpretation, writing-original draft preparation.

**Ethical Clearance:** The study did not receive any ethical clearance, as it is a part of ongoing research project.

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