AN EX VIVO STUDY ON THE ANALYSIS OF THE VARIATION IN THE INTERARM PULSE RATE AMONG YOUNG INDIVIDUALS

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Abstract

INTRODUCTION: Pulse rate is the rate of heartbeats per minute. The variability of pulse rate can be detected by non-invasive methods. Pulse rate variability measures indices for sympathovagal interaction including the prediction of morbidity and mortality of cardiovascular diseases. The present study aimed at evaluating the interarm pulse rate among young individuals and determined the variation in pulse rate.
MATERIALS AND METHODS: The study included 20 participants [10 male and 10 female] of age group 18 to 20 years of Saveetha dental college and hospitals. Pulse rate was measured using a pulse oximeter on both left and right hand on the index finger. The pulse rate was recorded between 6 pm to 8 pm. The collected data were analyzed using an independent sample t-test in SPSS and the results were represented as tables and graphs.
RESULTS AND DISCUSSION: The mean right-hand pulse rate is 103.65 and the mean left-hand pulse rate was 109.45. An independent t-test was used to observe the significance of the difference between the variables. A probability value less than 0.05 was considered significant. The test showed a p-value of 0.705>0.05 which showed no difference and was statistically insignificant
CONCLUSION: From this study, it was concluded that the right-hand pulse rate and left-hand pulse rate do not show any significant difference.
KEYWORDS: Pulse rate; Inter arm; Innovative technique, Pulse oximeter

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INTRODUCTION

Pulse rate or heart rate is the rate at which the heartbeats. That normal pulse rate for adults ranges from 60 to 100 beats per minute. Pulse rate variability is an important noninvasive method for the assessment of autonomic nervous control of the heart (Wong *et al.*, 2012). Pulse variation with time stretches between pulses, is perhaps the most encouraging and generally utilized quantitative marker of autonomic action (Dehkordi *et al.*, 2013), though the interarm difference is common it is related to cardiovascular diseases (Madhira *et al.*, 2019). An often ignored complication of cardiovascular disorders, such as heart failure, coronary artery disease, and diabetes mellitus, is autonomic dysfunction in the surgical population(Vinik and Ziegler, 2007). Due to its correlation with perioperative hemodynamic instability, postoperative outcome, increased mortality, autonomic dysfunction can have major clinical and prognostic implications (Suarez *et al.*, 2005). Pulse rate variability measurements have also been used as indices for sympathovagal interaction in a variety of clinical settings, including the prediction of morbidity and mortality after an acute myocardial infarction (Kleiger, Stein and Thomas Bigger, 2005; Preethikaa and Brundha, 2018; Timothy, Samyuktha and Brundha, 2019)
Investigation of pulse fluctuation has been standardized by using R-R intervals of the electrocardiogram as the source signal(Hayano *et al.*, 2005). Many alternative methods were investigated to calculate the pulse rate variability like photo-plethysmography which showed (Schnettler and Wallace, 1991) a significant difference in inter-arm pulse rate(Khandoker, Karmakar and Palaniswami, 2011). Using a smartphone as a tool to check pulse rate variability was done in previous articles which were more user-friendly than previous ECG measurement techniques(Bánhalmi *et al.*, 2018). But in the present article pulse oximeter is used as a tool for checking the pulse rate. Pulse rate variability is considered a feasible parameter in identifying childhood obstructive sleep apnea(Choi and Hong, 2006). The decrease in heart rate variability is related to coronary artery disease, congestive heart failure, aging and diabetic

neuropathy(Kleiger *et al.*, 1987). Heart rate variability reduction is also related to high visceral adiposity(Kleiger *et al.*, 1987; Triggiani *et al.*, 2019). Thus a regular check of pulse rate is mandatory. Manual or commercial wrist or belt sensors are widely used to determine pulse rate. Pulse-rate monitoring has recently become more convenient due to mobile technology, this optical technology has many advantages. In the present study, a Pulse oximeter is used as a tool to determine pulse rate. Pulse oximetry technology has made major advancements in the medical field, but its use in dentistry has been largely unexplored. A pulse oximeter was discovered to show pulse rate and oxygen saturation readings for critical analysis. Pulse oximetry needs no heating time, calibration, or other preparation; hence, its signals should be recorded without delay, making it better suitable. Studies have reported that pulse oximeters are one of the effective tools in determining the pulse rate but face scanners and fingertip scanners were more effective (Cheatham, Kolber and Ernst, 2015). This technique determines arterial oxygen saturation of functional hemoglobin (SO2) by comparing the pulsatile changes in light transmission through tissue at two wavelengths (Huch, Huch and Rooth, 2013). The registration of the pulsatile tissue blood volume changes over the cardiac cycle also allows the heart rate (HR) to be determined.

As the variability of pulse rate is related to most of the autonomic actions it is an important tool to be investigated. The majority of the articles have investigated pulse rate variability using a standardized method but in this article, a pulse oximeter is used as a tool to calculate pulse rate variability. Our team has extensive knowledge and research experience that has translate into high quality publications (Neelakantan *et al.*, 2011; Felicita, Chandrasekar and Shanthasundari, 2012; Jain, Kumar and Manjula, 2014; Kamisetty *et al.*, 2015; Lakshmi *et al.*, 2015; Keerthana and Thenmozhi, 2016; Mootha *et al.*, 2016; Kumar, 2017; Azeem and Sureshbabu, 2018; Chen *et al.*, 2019)
This study aims to analyze the inter-arm pulse rate among young individuals and determine the variation in pulse rate.

MATERIALS AND METHODS

The study was conducted in Saveetha Dental College and hospitals. The study conducted was approved by the institutional review board. The pulse rate is an important tool in determining the autonomic function of the body but as the study is done using pulse oximeters which can show error while the change in the position of the hand or calculating pulse rate in different time gaps. Twenty healthy subjects (10 women and 10 men) aged 18 to 20 years were included in this study. The sample was collected in an unbiased manner by using simple random sampling. The validity of the procedure for recording pulse rate with pulse oximeter was done. Internal validation was done by the guide and principal investigator. The present study was approved by the Institutional research committee. Informed consent was obtained from all the participants. Participants who were willing to participate with the age group of 18-20 years, unmarried were taken in this study. Age group beyond the criteria, patients with systemic illness were excluded from the study. Confidentiality of data was maintained. The pulse rate was recorded using a pulse oximeter in both the left and right hand on the index finger. The pulse rate was recorded between 6 pm to 8 pm. The time gap between recording right and left-hand pulse rate was 2 minutes.
Data were analyzed using SPSS. Data were presented as Mean and Standard deviation. An independent t-test was used to observe the significance of the difference between the variables. A probability value less than 0.05 was considered significant. The pulse rate variance depends on the age and gender of the individual while it is independent. Healthy and willing participants were recruited for the study. Participants with systemic diseases were excluded from the study.

Figure 1: Pulse oximeter

Figure 2: Representing right-hand pulse rate using a pulse oximeter

Figure 3: Representing left-hand pulse rate using a pulse oximeter

RESULTS

The results obtained from recording the pulse oximeter were tabulated and analyzed statistically. As shown in Table 1, the calculated pulse rate of the Right hand was 103.65 ± 38.90 with a mean value of 103.65 b/m, and the calculated pulse rate of 109.45± 36.09 with a mean value of 109.45 b/m. Independent sample t-test results were shown in Table 2. It shows that the pulse rate between the right hand and the left hand has a mean difference of 5.8b/m and a p-value of 0.705. (Table 2)

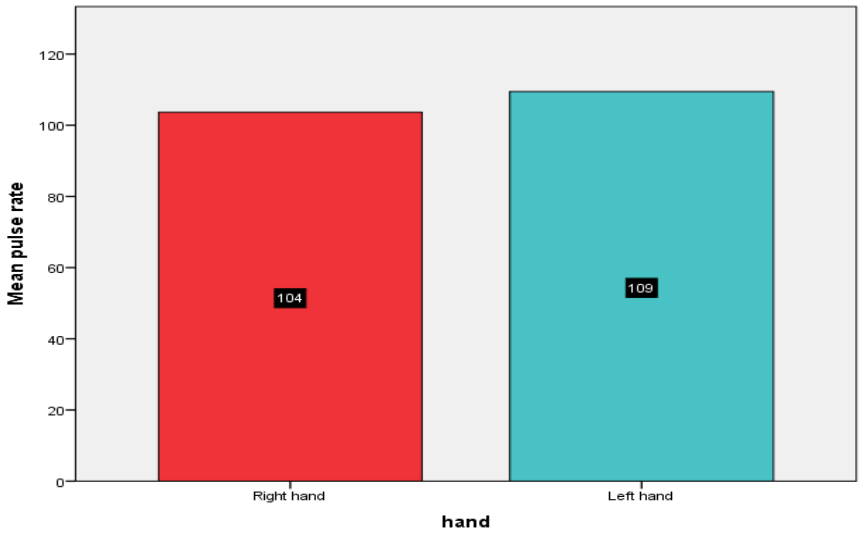
Table 1: Representing the mean and standard deviation of right and left-hand pulse rate.

	Hand	N	Mean	Std.Deviation	Std.error mean
Pulse rate	Right hand	20	103.65	19.462	4.352
	Left hand	20	109.45	18.019	4.029

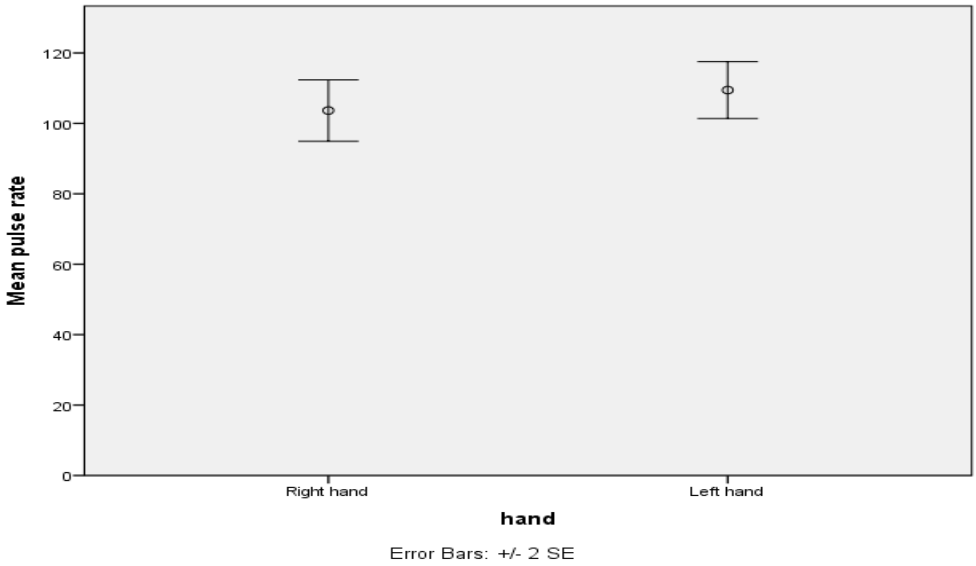
Table 2: Representing the significant difference in right and left-hand pulse rate. A significant difference, the P-value is 0.705 which is > 0.05 which is statistically insignificant. The right and left-hand pulse rates do not show any significant difference.

		F	Sig	t	df	sig(2-tailed)	Mean difference	Std error difference	95% confidence interval of difference (lower)	95% confidence interval of difference (upper)

Pulse rate	Equal variances assumed	0.145	0.705	0.978	38	0.334	-5.800	5.931	-17.806	6.206
	Equal variances not assumed			0.978	37.777	0.334	-5.800	5.931	-17.808	6.208



Graph 1: Representing the mean right and left-hand pulse rate and significant difference. The X-axis represents the right and left hand while Y-axis represents the mean pulse rate. Red colour represents the right hand and the blue colour represents the left hand. The mean pulse rate of the right hand is 104 while the mean left hand pulse rate is 109.



Graph 2: Representing the error bars. The X axis represents the right and left hand while the Y axis represents the mean pulse rate. The graph represents ±2 standard errors.

The present study is about the comparison of left and right arm pulse rate. An independent sample t-test was done to compare the interarm pulse rate. The independent variable test showed a significant difference of 0.705 > 0.05. This showed that there is no significant difference between left and right-hand pulse rates. Previous studies done on similar

comparisons showed different results. A study by (Lipsett *et al.*, 2006)showed a significant heart rate variability but the study was done on patients with coronary artery disease. Coronary artery disease reduces the compatibility of the cardiac function and may reduce the rate and produce a difference between right and left side pulse rate.

The study detected a decrease in heart rate variability and is associated with exposure to airborne particulate matter. The air particulate matter in the lungs like pollen or any infective materials in the alveolar spaces and interstitium of the lungs may result in functional impairment and reduce the blood flow to the left-sided heart and may reduce the pulse rate of the left side. There was also a significant difference in pulse rate variability seen in smokers. Depressed smokers showed a change in pulse rate but the difference in right and left hand was not determined(Harte *et al.*, 2013; Harsha and Brundha, 2017).

In previous studies to calculate pulse rate variability traditionally ECG is preferred but in a study done by (Chou *et al.*, 2018)the barrier for collecting the large samples necessary to maintain the statistical power between subject psychophysiological comparisons. An alternative to ECG optical pulse sensor or photoplethysmograph run from a smartphone or similar portable device is used, similarly in a present study pulse oximeter is used for rapid readings and is also portable.

In previous studies, heart rate variability and pulse rate variability were checked for correlation (Bulte *et al.*, 2011; Prashaanthi and Brundha, 2018)and HRV and PRV showed excellent levels of agreement. So in the present study pulse rate variability is comparable to heart rate variability. Similar comparative studies (Dadashova, 2015)the age was correlated with heart rate and results showed that an increase in age showed an increase in HRV indices. A correlation with age and blood pressure indices with heart rate was done in previous studies and the present study showed a correlation for right and left-hand pulse rate. Contradictorily to the present study in a present study done by(Chuang *et al.*, 2006) the right and left pulse were not the same, in that the total power of the right pulse was higher than that of the left pulse in healthy subjects. Similarly, in a study done by (Tarvirdizadeh *et al.*, 2017)the heart rate was measured using Photoplethysmography signals in both left and right hands and the results showed that the heart rate showed a high level of correlation.

In the present study, only 20 individuals were examined for the study which is a small sample size. Correlation of pulse rate was not done with age or gender. In future studies, if the same correlation is done with a large sample size a significant difference could be seen between right and left-hand pulse rate. The significant difference can also be seen with gender correlation and different age groups. The pulse rate in the present study was taken during the time of 6 PM to 8 PM. In future studies, if it was taken in the morning to avoid diurnal rhythm it may show a different result.

CONCLUSION

The present study was done to analyze the difference in inter-arm pulse rate. From this study, it was concluded that the right-hand pulse rate and left-hand pulse rate does not show any significant differences statistically even though the left-sided pulse rate is higher than the right-sided pulse rate in the normal persons of age group 18-20 years at a particular time with regular diet and exercises.

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CONFLICT OF INTEREST

The author declares that there were no conflicts of interests in the present study.

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REFERENCES

1. Azeem, R.A. and Sureshbabu, N.M. (2018) 'Clinical performance of direct versus indirect composite restorations in posterior teeth: A systematic review', *Journal of conservative dentistry: JCD*, 21(1), pp. 2–9.
2. Bánhalmi, A. *et al.* (2018) 'Analysis of a Pulse Rate Variability Measurement Using a Smartphone Camera', *Journal of healthcare engineering*, 2018, p. 4038034.
3. Bulte, C.S.E. *et al.* (2011) 'Level of agreement between heart rate variability and pulse rate variability in healthy individuals', *European*

journal of anaesthesiology, 28(1), pp. 34–38.
4. Cheatham, S.W., Kolber, M.J. and Ernst, M.P. (2015) 'Concurrent Validity of Resting Pulse-Rate Measurements: A Comparison of 2 Smartphone Applications, the Polar H7 Belt Monitor, and a Pulse Oximeter With Bluetooth', *Journal of Sport Rehabilitation*, pp. 171–178. doi:10.1123/jsr.2013-0145.
5. Chen, F. *et al.* (2019) '6-shogaol, a active constiuents of ginger prevents UVB radiation mediated inflammation and oxidative stress through modulating NrF2 signaling in human epidermal keratinocytes (HaCaT cells)', *Journal of photochemistry and photobiology. B, Biology*, 197, p. 111518.
6. Choi, S. and Hong, S. (2006) 'P441 Does sleep heart rate reflect heart rate variability in patients with obstructive sleep apnea?', *Sleep Medicine*, pp. S106–S107. doi:10.1016/j.sleep.2006.07.250.
7. Chou, Y. *et al.* (2018) 'Comparison Between Heart Rate Variability and Pulse Rate Variability for Bradycardia and Tachycardia Subjects', *2018 International Conference on Control, Automation and Information Sciences (ICCAIS)* [Preprint]. doi:10.1109/iccais.2018.8570697.
8. Chuang, S.-S. *et al.* (2006) 'Power Spectral Analysis of Finger Plethysmographic Waveform in Patients With Coronary Artery Disease and After Coronary Artery Bypass Graft Surgery', *Circulation Journal*, pp. 1337–1343. doi:10.1253/circj.70.1337.
9. Dadashova, G.M. (2015) 'Gender- and age-related characteristics of heart rate variability in apparently healthy individuals', *Profilakticheskaya meditsina*, p. 54. doi:10.17116/profmed201518254-58.
10. Dehkordi, P. *et al.* (2013) 'Pulse rate variability compared with Heart Rate Variability in children with and without sleep disordered breathing', *Conference proceedings: ... Annual International Conference of the IEEE Engineering in Medicine and Biology Society. IEEE Engineering in Medicine and Biology Society. Conference*, 2013, pp. 6563–6566.
11. Felicita, A.S., Chandrasekar, S. and Shanthasundari, K.K. (2012) 'Determination of craniofacial relation among the subethnic Indian population: a modified approach - (Sagittal relation)', *Indian journal of dental research: official publication of Indian Society for Dental Research*, 23(3), pp. 305–312.
12. *Harsha, L. and Brundha, M.P. (2017) 'Prevalence of Dental Developmental Anomalies among Men and Women and its Psychological Effect in a Given Population', Journal of Pharmaceutical Sciences and Research; Cuddalore, 9(6), pp. 869–873.*
13. *Harte, C.B. et al. (2013) 'Association between smoking and heart rate variability among individuals with depression', Annals of behavioral medicine: a publication of the Society of Behavioral Medicine, 46(1), pp. 73–80.*
14. *Hayano, J. et al. (2005) 'Assessment of pulse rate variability by the method of pulse frequency demodulation', Biomedical engineering online, 4, p. 62.*
15. *Houghton, F. (2021). Easter eggs & 'easter eggs': Alcohol branded chocolate eggs & intoxigenic environments in ireland. South Eastern European Journal of Public Health, 16 doi:10.11576/seejph-4395*
16. *Houghton, F. (2022). Researching gambling: Have we learned nothing from big Tobacco's overt manipulation of science? South Eastern European Journal of Public Health, 19(6) doi:10.11576/seejph-5769*
17. *Houghton, F. (2021). The athena swan process to promote gender equity in third-level education in ireland. South Eastern European Journal of Public Health, doi:10.11576/seejph-4799*
18. *Huch, A., Huch, R. and Rooth, G. (2013) Continuous Transcutaneous Monitoring. Springer Science & Business Media.*
19. *Jain, R.K., Kumar, S.P. and Manjula, W.S. (2014) 'Comparison of intrusion effects on maxillary incisors among mini implant anchorage, j-hook headgear and utility arch', Journal of clinical and diagnostic research: JCDR, 8(7), pp. ZC21–4.*
20. *Kamisetty, S.K. et al. (2015) 'SBS vs Inhouse Recycling Methods-An Invitro Evaluation', Journal of clinical and diagnostic research: JCDR, 9(9), pp. ZC04–8.*
21. Keerthana, B. and Thenmozhi, M.S. (2016) 'Occurrence of foramen of huschke and its clinical significance', *Research Journal of Pharmacy and Technology*, 9(11), pp. 1835–1836.
22. Khandoker, A.H., Karmakar, C.K. and Palaniswami, M. (2011) 'Comparison of pulse rate variability with heart rate variability during obstructive sleep apnea', *Medical engineering & physics*, 33(2), pp. 204–209.
23. Kleiger, R.E. *et al.* (1987) 'Decreased heart rate variability and its association with increased mortality after acute myocardial infarction', *The American journal of cardiology*, 59(4), pp. 256–262.
24. Kleiger, R.E., Stein, P.K. and Thomas Bigger, J. (2005) 'Heart Rate Variability: Measurement and Clinical Utility', *Annals of Noninvasive Electrocardiology*, pp. 88–101. doi:10.1111/j.1542-474x.2005.10101.x.
25. Kumar, S. (2017) 'The emerging role of botulinum toxin in the treatment of orofacial disorders: Literature update', *Asian journal of pharmaceutical and clinical research*, 10(9), p. 21.
26. Lakshmi, T. *et al.* (2015) 'Azadirachta indica: A herbal panacea in dentistry - An update', *Pharmacognosy reviews*, 9(17), pp. 41–44.
27. Lipsett, M.J. *et al.* (2006) 'Coarse particles and heart rate variability among older adults with coronary artery disease in the Coachella Valley, California', *Environmental health perspectives*, 114(8), pp. 1215–1220.
28. Madhira, D. *et al.* (2019) 'Inter Arm Difference in the Blood Pressure and Pulse Rate in Young Adults', *Indian Journal of Public Health Research & Development*, p. 571. doi:10.37506/v10/i12/2019/ijphrd/192017.
29. Mootha, A. *et al.* (2016) 'The Effect of Periodontitis on Expression of Interleukin-21: A Systematic Review', *International journal of inflammation*, 2016, p. 3507503.
30. Neelakantan, P. *et al.* (2011) 'The impact of root dentine conditioning on sealing ability and push-out bond strength of an epoxy resin root canal sealer', *International endodontic journal*, 44(6), pp. 491–498.
31. Prashaanthi, N. and Brundha, M.P. (2018) 'A Comparative Study between Popplet Notes and Conventional Notes for Learning Pathology', *Research Journal of Pharmacy and Technology*, 11(1), pp. 175–178.
32. Preethikaa, S. and Brundha, M.P. (2018) 'Awareness of diabetes mellitus among general population', *Research Journal of Pharmacy and Technology*, 11(5), pp. 1825–1829.
33. Schnettler, J.M. and Wallace, J.A. (1991) 'Pulse oximetry as a diagnostic tool of pulpal vitality', *Journal of endodontia*, 17(10), pp. 488–490.
34. Suarez, G.A. *et al.* (2005) 'Sudden cardiac death in diabetes mellitus: risk factors in the Rochester diabetic neuropathy study', *Journal of neurology, neurosurgery, and psychiatry*, 76(2), pp. 240–245.
35. Tarvirdizadeh, B. *et al.* (2017) 'An assessment of a similarity between the right and left hand Photoplethysmography signals, using time and frequency features of heart-rate-variability signal', *2017 IEEE 4th International Conference on Knowledge-Based Engineering and Innovation (KBEI)* [Preprint]. doi:10.1109/kbei.2017.8324868.
36. Timothy, C.N., Samyuktha, P.S. and Brundha, M.P. (2019) 'Dental pulp Stem Cells in Regenerative Medicine--A Literature Review', *Research Journal of Pharmacy and Technology*, 12(8), pp. 4052–4056.
37. Triggiani, A.I. *et al.* (2019) 'Heart rate variability reduction is related to a high amount of visceral adiposity in healthy young women', *PloS*

one, 14(9), p. e0223058.
38. Vinik, A.I. and Ziegler, D. (2007) 'Diabetic cardiovascular autonomic neuropathy', *Circulation*, 115(3), pp. 387–397.
39. Wong, J.-S. *et al*. (2012) 'A comparative study of pulse rate variability and heart rate variability in healthy subjects', *Journal of Clinical Monitoring and Computing*, pp. 107–114. doi:10.1007/s10877-012-9340-6.