ISSN: 2091-2331 (Print) 2091-234X (Online)

Journal of Nobel Medical College

Volume 13, Number 01, Issue 24, January-June 2024, 40-44

Original Article

Comparison of Workplace Posture on Heart Rate Variability between Exercising and Non-Exercising Traffic Police

Nisha Ghimire*, Soumitra Mukhopadhyay, Rekha Limbu

Department of Physiology, Nobel Medical College and Teaching Hospital, Biratnagar, Nepal

Article Received: 17th May, 2024; Accepted: 26th June, 2024; Published: 30th June, 2024

DOI: https://doi.org/10.3126/jonmc.v13i1.68101

Abstract

Background
This study aimed to investigate heart rate variability among traffic police officers and compare these parameters between exercising and non-exercising groups. Heart rate variability is an important marker of cardiac autonomic function. Understanding the impact of exercise on heart rate variability among traffic police officers can provide valuable insights into strategies for improving their cardiovascular well-being.

Materials and Methods
This comparative cross-sectional study was conducted among forty-two healthy traffic police officers. The participants were divided into exercising and non-exercising groups based on their physical activity levels. Heart rate variability was measured using standard technique. Data was analysed using Microsoft Excel and SPSS version 16. The heart rate variability values were non parametric. So, data were expressed as median interquartile range and comparison between two groups was done with Mann-Whitney U test. $p<0.05$ was considered significant.

Results
The results revealed that a higher proportion of traffic police officers were in the exercising group. Heart rate variability analysis showed significantly higher median values of RMSSD (58.42 ms vs. 41.30 ms), NN50 (80.00 vs. 24.00), pNN50% (36.56% vs. 11.820%) and HF power (1079.40 ms^2 vs. 368 ms^2) in the exercising group. Additionally, the exercising group exhibited a lower LF/HF ratio (0.61 vs. 1.60). Although not statistically significant, heart rate was less in exercising group (73.61±6.93 bpmvs. 72.93± 7.79bpm).

Conclusion
The study suggests that even with prolonged workplace posture, exercise among traffic police can have higher heart rate variability and parasympathetic dominance, a positive indicator for cardiovascular health.

Keywords: *Exercise, Heart rate, Posture, Workplace*

***Corresponding Author:**
Dr. Nisha Ghimire
Associate Professor
E-mail: nishaghimire3681@gmail.com
ORCID: https://orcid.org/0009-0007-6370-6421

Citation
Ghimire N, Mukhopadhyay S, Limbu R, Comparison of Workplace Posture on Heart Rate Variability between Exercising and Non-Exercising Traffic Police, JoNMC. 13:1 (2024) 40-44. DOI: https://doi.org/10.3126/jonmc.v13i1.68101

Introduction

Workplace posture like prolonged sitting and sedentary lifestyles are associated with cardiovascular disease [1, 2]. Prolonged standing at work is also linked to cardiovascular outcomes, possibly due to increased leg blood pooling, hydrostatic pressure, and oxidative stress [3-8]. Research in Nepal showed that traffic police, who stand for long hours and work over 12-hour shifts, frequently experience anxiety, depression [9], and musculoskeletal discomfort [10]. Heart rate variability (HRV) measures beat-to-beat fluctuations in the cardiac rhythm, reflecting autonomic nervous system and cardiovascular health. [11,12]. HRV can be used to assess cardiac health in high-pressure work settings like tactical environments [13]. Traffic police have shown lower HRV compared to controls [14]. So, it is plausible to study effect of workplace posture on HRV and compare exercising and non-exercising traffic police.

The studies conducted on heart rate variability among traffic police are limited in Nepal. Studying how exercise affects the HRV of traffic police officers can offer important insights into enhancing their cardiovascular health.

So, our objective is to find out heart rate variability in traffic police officers due to prolonged standing posture and to compare HRV between exercising and non-exercising traffic police officers.

Material and Methods

This comparative cross-sectional study was conducted in Physiology department of Nobel Medical College and Teaching Hospital from 2021 to July 2022 among healthy traffic police officers posted in Biratnagar. Study was carried out after obtaining ethical clearance from Institutional review committee of Nobel Medical College. Informed consent was taken from all the subjects. The subjects with mean age of 32.38±5.79 years and BMI of 22.02±2.16kg/m^2 were selected. Subjects with history of any cardiovascular diseases, diabetes, or psychiatric illness, or under medication for any diseases, were excluded from the study. For sample size calculation we considered a mean and standard deviation of the heart rate from a closely related article [14], standard deviation (σ)=10.70. Sample size was calculated using the formula: $n = Z^2\sigma^2/d^2$ Where, n= Total sample size, Z= 1.96 for a 95% confidence level, Population Standard Deviation (σ) =10.70, Margin of Error(d) = 3.25 beats/min, $n=1.96^2 \times 10.7^2/3.25^2$, $n \approx 41.77 = 42$. Hence the minimal required sample was 42. Convenient sampling technique was done.

The tests were conducted during the morning before 12:00 pm on days off. Before recording the heart rate variability (HRV), participants were instructed to come with light breakfast two hours earlier. Upon arrival, a resting period of 15 minutes was observed, after which their blood pressure (BP) and heart rate (HR) were measured [11,12]. HRV was recorded using a Polar V800 for 5 minutes in supine position. The strap with the electrodes was moistened with water and placed around the chest. The signals from the electrocardiogram (ECG) were captured by polar watch wore on the wrist of subject. The R-R interval calculated by the polar watch was analysed by HRV software (Kubios HRV version 3.2 standard). The participants were also asked about history of exercise. Those who are doing moderate-intensity aerobic exercise for 30 minutes a day for five days a week or vigorous-intensity aerobic exercise 25 minutes a day for three days a week along with muscle-strengthening activities on two or more days per week who are doing combination of these were taken as exercising group (AHA guidelines) [15].

Data were analysed using Microsoft Excel and SPSS version 16. Anthropometric and cardiovascular variables were presented as mean ± standard deviation. The comparison between exercising and non-exercising groups was done using independent t-tests. HRV was expressed as time domain analysis and frequency domain analysis. HRV variables, being non-parametric, were expressed as median interquartile range and variables between exercising and non-exercising groups were compared using the Mann-Whitney U test. All data were considered statistically significant at $p<0.05$.

Results

Table 1 displays the mean ± Standard Deviation (SD) of anthropometric and cardiovascular variables. Table 2 presents the median interquartile range of heart rate variability parameters. Figure 1 illustrates the distribution of exercising and non-exercising traffic police groups. In Table 3, no significant differences were observed in anthropometric and cardiovascular variables between the two groups. However, Table 4 indicates significantly higher median interquartile ranges for RMSSD, NN50, pNN50%, HF and TP, along with a lower LF/HF in the exercising group compared to the non-exercising group in heart rate variability parameters.

Table1: Anthropometric and cardiovascular variables of traffic police expressed as Mean ±SD

Variables	Mean ±SD
Age (years)	32.38±5.79
Height (cm)	170.90±4.48
Weight (kg)	65.81±4.47
BMI (kg/m²)	22.02±2.16
SBP (mm Hg)	112.14±8.98
DBP (mm Hg)	65.81±4.72
HR (bpm)	73.61±6.93

BMI-body mass index, SBP-systolic blood pressure, DBP-diastolic blood pressure, HR-heart rate, bpm-beats per minute

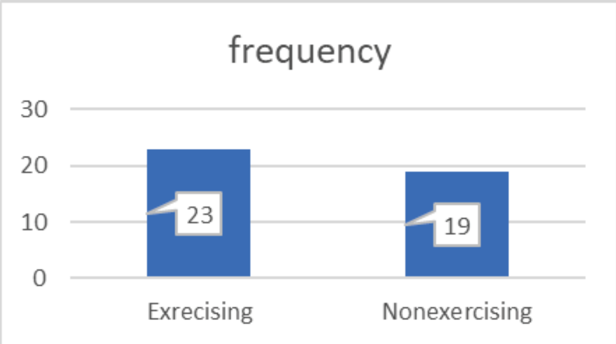

Figure 1: Graph illustrating the frequencies of exercising and non-exercising traffic police

Table 2: Heart rate variability of traffic police expressed as median interquartile range

Variables	Median interquartile range (25-75percentile)
R-R (ms)	817.90(758.45-880.87)
RMSSD (ms)	49.420 (38.20 - 64.85)
NN50	62.000 (23.25 - 87.00)
pNN50%	27.709 (11.10 - 40.91)
SDNN	46.966 (38.86 - 58.06)
VLF (ms²)	66.255 (23.51 - 127.72)
LF(ms²)	671.470 (475.15 - 1164.32)
HF (ms²)	782.445 (347.23 - 1372.82)
LF/HF	1.085 (0.56 - 1.52)
Lfnu	52.377 (36.04 - 60.13)
Hfnu	47.004 (38.46 - 63.31)
TP (ms²)	1517.750 (1029.00 - 2816.80)

SDNN = standard deviation of RR interval, RMSSD= root mean square of differences of successive RR intervals, NN50 = number of RR intervals that differ by ≥50 ms, pNN50 = percentage of NN50, VLF = very low frequency, LF = low frequency, HF = high frequency, power expressed in ms2 (millisecond), nu = normalized units, TP= total power.

Table 3: Comparison of anthropometric variables between non- exercising and exercising groups of traffic police

Variables	Non exercising traffic police Mean ±SD	Exercising traffic police Mean ±SD	p-value
Height (cm)	169.90±4.48	170.96 ± 4.90	0.90
Weight (kg)	66.81±4.47	65.17 ± 4.94	0.14
Age (yrs)	32.86±5.79	31.90± 5.54	0.06
SBP (mm Hg)	113.68±9.99	110.87±8.48	0.90
DBP (mm Hg)	65.81±4.72	65.17 ±4.94	0.14
HR (bpm)	73.61±6.93	72.93± 7.79	1.08

BMI-body mass index, SBP-systolic blood pressure, DBP-diastolic blood pressure, HR-heart rate, bpm-beats per minute, mm Hg-millimetre of mercury, P<0.05- significant

Table:4. Median interquartile range of heart rate variability among non-exercising and exercising traffic police traffic police

Variables	Non exercising group Median interquartile range(25-75percentile) n=19	Exercising group Median interquartile range (25-75percentile) n=23	p-value
R-R (ms)	800.86 (753.80 - 842.80)	832.05 (787.95-896.34)	0.21
RMSSD (ms)	41.30(29.5 - 49.8)	58.42 (47.93-72.44)	0.013 *
NN50	24.00 (12.0 - 45.0)	80.00 (65.00-94.00)	<0.001 **
pNN50%	11.82 (6.13 - 21.84)	36.56 (27.85-48.41)	<0.001 **
SDNN	45.86 (29.59 - 48.82)	52.52 (42.06-58.80)	0.53
VLF (ms²)	52.46 (21.46 - 90.78)	73.70 (23.59-156.50)	0.21
LF (ms²)	630.73(476.00 - 1090.00)	715.07 (472.63-1222.60)	0.53
HF (ms²)	368.00(263.22 - 765.00)	1079.40 (750.16-1738.40)	0.002 *
LF/HF	1.60 (1.21 - 1.96)	0.61 (0.4150-1.09)	0.002 *
Lfnu	60.78 (54.90 - 66.47)	37.94 (29.18-52.21)	<0.001 *
Hfnu	38.05 (31.63 - 45.06)	58.66 (46.92-67.36)	0.002 *
TP (ms²)	1089.40 (816.0 - 1670.4)	1821.70 (1356.80-3230.40)	0.013 *

SDNN = standard deviation of RR interval, RMSSD= root mean square of differences of successive RR intervals, NN50 = number of RR intervals that differ by ≥50 ms, pNN50 = percentage of NN50, VLF = very low frequency, LF = low frequency, HF = high frequency, power expressed in ms^2 (millisecond), nu = normalized units, TP= total power. p<0.05- significant* p<0.01- highly significant**

Discussion

Our study was conducted among 42 healthy police officers from Biratnagar aged 32.38±5.79 years with a body mass index (BMI) of 22.02±2.16kg/m^2 focusing on heart rate variability. We aimed to find out normative value of HRV for traffic police who often maintain prolonged standing postures due to the nature of their job. We also compared HRV parameters between exercising and non-exercising groups. We chose a narrow age range and BMI range because past studies have shown that heart rate variability can vary with age and BMI [16, 17]. By focusing on traffic police within these specific age and BMI categories, we aimed to reduce the confounding factors.

We observed that more traffic police were in the exercising group (figure 1), which is in line with findings in Kathmandu [9]. There were no significant differences in age, BMI, or cardiac variables between the exercising and non-exercising groups (Table 3), indicating that both groups were similar and comparable in these respects. In time domain analysis significant increase in RMSSD, NN50, and pNN50% were observed among traffic police who were exercising compared to those who did not (Table 4). According to Shaffer and Ginsberg, RMSSD is a time-domain measure of heart rate variability that reflects parasympathetic nervous system activity, specifically influenced by respiratory sinus arrhythmia. It is linked to better cardiovascular health. NN50 is another HRV parameter that measures the number of successive RR intervals that differ by more than 50 milliseconds, indicating parasympathetic control over heart rate variability and reflects vagally mediated influences on the heart and is sensitive to short-term variations in HRV. pNN50% is the percentage of successive RR intervals that differ by more than 50 milliseconds, providing a measure of parasympathetic nervous system activity over time [11,12]. Overall, our study suggested increase in parasympathetic activity among exercising traffic policers. The findings in our study are in line with research demonstrating that regular exercise enhances parasympathetic activity, their study showed mainly increase in RMSSD in time domain analysis.[18]. This may be due to difference in subject characteristics of the studies. However, there was no significant change in SDNN in our study. SDNN reflects the overall variability in heart rate and is influenced by both sympathetic and parasympathetic activities. The non-significant change in SDNN between exercising and non-exercising groups may be due to the short duration of HRV measurement for 5 minutes [12].

While comparing frequency domain variables, higher HF (high frequency) and HFnu (normalized unit) were observed which indicate enhanced parasympathetic activity. LF power increased but did not change significantly in exercising group. This also aligns with the study done by Hegde V et al. [18]. LF power in HRV analysis reflects the modulation of heart rate influenced by both sympathetic and parasympathetic nervous systems [11,12]. Our study revealed significantly lower LF/HF ratio and LFnu in the exercising group, indicating higher parasympathetic activity. Similar findings have been reported in another study, although they were not statistically significant in their findings [19, 20]. This disparity could be due to from differences in instrumentation or characteristics of the study subjects. Additionally, our study demonstrated an increase in total power, which signifies overall increased heart rate variability [12]. Overall, our study suggests exercise promotes a favourable sympatho-vagal balance, increasing parasympathetic influence on heart rate regulation which indicates good cardiac health. We could not determine the optimal type, intensity and duration of exercise which is the limitation of our study. Long-term analysis of HRV in traffic police offers valuable insights into their autonomic and cardiac health status.

Conclusion

Our study reveals that exercise has beneficial effects on cardiac autonomic function in traffic police. The exercising group exhibited higher time-domain parameters such as RMSSD, NN50, and pNN50%, along with increased frequency-domain parameters including HF power, HFnu, and TP. Moreover, they showed a decreased LF/HF ratio compared to the non-exercising group. This suggests that regular exercise can enhance heart rate variability and promote a shift towards parasympathetic dominance even among traffic police who maintain prolonged standing postures

Acknowledgement: We would like to acknowledge, the traffic police team of Biratnagar to take part in study and lab staffs of our department for technical help.

Conflict of interest: None.

References

[1] Owen N, Healy GN, Matthews CE, Dunstan DW, Too much sitting: the population health science of sedentary behavior. Exerc Sport Sci Rev. 38:3 (2010)105-13. DOI: 10.1097/JES.0b013e3181e373a2.PMID: 20577058.

[2] Uffelen JGZ, Wong J, Chau JY, Ploeg HPVD, Riphagen I, Gilson ND, et al. Occupational sitting and health risks: a systematic review, Am J Prev Med. 39:4 (2010) 379-88. DOI: 10.1016/j.amepre.2010.05.024. PMID: 20837291.

[3] Krause N, Lynch JW, Kaplan GA, Cohen RD, Salonen R, Salonen JT, Standing at work and progression of carotid atherosclerosis. Scand J Work Environ Health. 26:3 (2000) 227-36. DOI: 10.5271/sjweh.536. PMID: 10901115.

[4] Antle DM, Vézina N, Messing K, Côté JN, Development of discomfort and vascular and muscular

changes during a prolonged standing task. Occup Ergonomics. 11:1 (2013) 21-33. DOI: 10.3233/OER-130205.
[5] Ngomo S, Messing K, Perrault H, Comtois A, Orthostatic symptoms, blood pressure and working postures of factory and service workers over an observed workday. Appl Ergon. 39:6 (2008) 729-36. DOI: 10.1016/j.apergo.2007.11.004. Epub 2008 Jan 8. PMID: 18184605.
[6] Tuchsen F, Hannerz H, Burr H, Krause N, Prolonged standing at work and hospitalisation due to varicose veins: a 12-year prospective study of the Danish population, Occup Environ Med. 62:12 (2005) 847-50. DOI: 10.1136/oem.2005.020537. PMID: 16299093.
[7] Flore R, Gerardino L, Santoliquido A, Pola R, Flex A, Campli C Di, et al. Enhanced oxidative stress in workers with a standing occupation, Occup Environ Med. 61:6 (2004) 548-50. DOI: 10.1136/oem.2003.008805. PMID: 15150396.
[8] Smith P, Ma H, Glazier RH, Gilbert-Ouimet M, Mustard C, The Relationship Between Occupational Standing and Sitting and Incident Heart Disease Over a 12-Year Period in Ontario, Canada. Am J Epidemiol. 187:1 (2018) 27-33. DOI: 10.1093/aje/kwx298. PMID: 29020132.
[9] Yadav B, Kc A, Bhusal S, Pradhan PMS, Prevalence and factors associated with symptoms of depression, anxiety and stress among traffic police officers in Kathmandu, Nepal: a cross-sectional survey, BMJ Open. 12:6 (2022) DOI: 10.1136/bmjopen-2022-061534. PMID: 35672072.
[10] Dhakal M, Shah RK, Sainju NK, Manandhar N. Health status of traffic police in Kathmandu Valley: findings from a cross-sectional study, Int J Occup Saf Health. 7 (2017) 2-6. DOI: 10.3126/ijosh.v7i1.22759.
[11] Heart rate variability: standards of measurement, physiological interpretation, and clinical use. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology, Circulation. 93:5 (1996) 1043-65. PMID: 8598068.
[12] Shaffer F, Ginsberg JP, An Overview of Heart Rate Variability Metrics and Norms, Front Public Health. 5 (2017) 258. DOI: 10.3389/fpubh.2017.00258. PMID: 29034226.
[13] Tomes C, Schram B, Orr R, Relationships Between Heart Rate Variability, Occupational Performance, and Fitness for Tactical Personnel: A Systematic Review, Front Public Health. 8 (2020) 583336. DOI: 10.3389/fpubh.2020.583336. PMID: 33240835.
[14] Kuppusamy S, Niraimathi D, John NA et al, Assessment of heart rate variability and reaction time in traffic policemen, Int J Med Res Rev. 4:11 (2016) 1958-1964. DOI: 10.17511/ijmrr.2016.i11.09.
[15] Eckel RH, Jakicic JM, Ard JD, Jesus JM de, Miller NH, Hubbard VS, et al. 2013 AHA/ACC guideline on lifestyle management to reduce cardiovascular risk: a report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines, J Am Coll Cardiol. 2960-84 (2013). DOI: 10.1016/j.jacc.2013.11.003. PMID: 24239922.
[16] Bonnemeier H, Richardt G, Potratz J, Wiegand UK, Brandes A et al, Circadian profile of cardiac autonomic nervous modulation in healthy subjects: differing effects of aging and gender on heart rate variability. J Cardiovasc Electrophysiol. 14:8 (2003) 791-9. DOI: 10.1046/j.1540-8167.2003.03078.x. PMID: 12890036.
[17] Abhishekh HA, Nisarga P, Kisan R, Meghana A, Chandran S, Trichur Raju S et al. Influence of age and gender on autonomic regulation of heart, J Clin Monit Comput. 27:3 (2013) 259-64. DOI: 10.1007/s10877-012-9424-3. Epub 2013 Jan 8. PMID: 23297094.
[18] Hegde V, Borade NG, Naveen S, Devarakonda BV, Heart rate variability in trained athletes and sedentary individuals - A Comparative study. Indian J Clin Anat Physiol. 5:2 (2018) 237-240. DOI: 10.18231/2394-2126.2018.0055.
[19] Parmar DJ, Dinkar M, Chauhan H, Ninama R, Ghugare B, Campvala S, Effect of regular exercise training on heart rate variability parameters: A cross-sectional study. Natl J Physiol Pharm Pharmacol. 10:9 (2020) 731-734. DOI: 10.5455/njppp.2020.10.05126202023052020.
[20] Tulppo MP, Hautala AJ, Makikallio TH, Laukkanen RT, Nissila S, Hughson RL, et al. Effects of aerobic training on heart rate dynamics in sedentary subjects, J Appl Physiol (1985). 95:1 (2003) 364-72. DOI: 10.1152/japplphysiol.00751.2002. PMID: 12651862.