

ORIGINAL RESEARCH ARTICLE

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# Heart rate variability among gym-goers and age-matched sedentary individuals

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## Abstract

**Background:** The physiological phenomenon of variation in relation to the time interval between two consecutive heartbeats is described as heart rate variability (HRV). Any increase in HRV is associated with good fitness and health and vice versa. The aim of this study is to find and compare the HRV, sympathetic and parasympathetic nervous system dominance in gym-goers, and sedentary individuals.

**Methodology:** A cross-sectional study was conducted among 10 gym-goers and 10 sedentary individuals, aged 18–22 years. The HRV was determined by the elite HRV (mobile application) and Kubios software.

**Outcome measure:** HRV

**Result:** The median values of HRV and LF/HF (Low Frequency/High Frequency) ratio for Gym goers is 57.5 & 1.85 whereas for a sedentary individual is 54.5 & 2.6.

**Conclusion:** This study concluded that age-matched sedentary individuals have more SNS dominance than in gym-goers. Likewise, PNS dominance is higher in gym-goers than sedentary individuals, but it is not statistically significant ( $p > 0.05$ ).

**Keywords:** Heart rate variability, Sympathetic and parasympathetic nervous system, Elite HRV, Kubios software

## Introduction

The physiological phenomenon of variation in relation to the time interval between two consecutive heartbeats is described as heart rate variability (HRV). Any increase in HRV is associated with good fitness and health. Similarly, a low HRV indicates negative health outcomes and stress [1]. The calculation of HRV can be done in two ways, namely the time domain analysis (TDA) and frequency domain analysis (FDA). Each have their own merits and demerits. Despite its simple calculation method, quantification of autonomic balance or information on the temporal distribution of power in different branches of autonomic nervous system (ANS) is not done by TDA. On the other hand, FDA allows quantification of

autonomic balance at any given time by giving information regarding the distribution of power as a function of frequency. Hence, ANS activity is calculated only by FDA. Total power (TP), very low frequency (VLF), high frequency (HF), low frequency (LF), and LF/HF ratio are all frequency domain parameters [2–5].

Low frequency is described as a band power spectrum which ranges from 0.04 to 0.15 Hz. This measure represents both sympathetic and parasympathetic activities. A band of power spectrum which ranges from 0.15 and 0.4 Hz is high frequency, which represents parasympathetic (vagal) activity. The ratio expressed between powers of LF and HF bands is termed as the LF/HF ratio. It is this which denotes overall balance between sympathetic and parasympathetic systems. The normal value of LF, HF, and LF/HF ratio is  $591 \pm 291 \text{ ms}^2$ ,  $657 \pm 777 \text{ ms}^2$ , and  $2.8 \pm 2.6$ , respectively [2, 6]. If the LF/HF ratio value is higher, it denotes SNS domination, and if the value is lower, it denotes PNS domination.

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Thus, the overall balance between the sympathetic and parasympathetic systems is quantified by this ratio [7]. Homeostasis, the body's function at rest, and the digestion are controlled by the PNS. The body's flight and fright responses are controlled by the SNS.

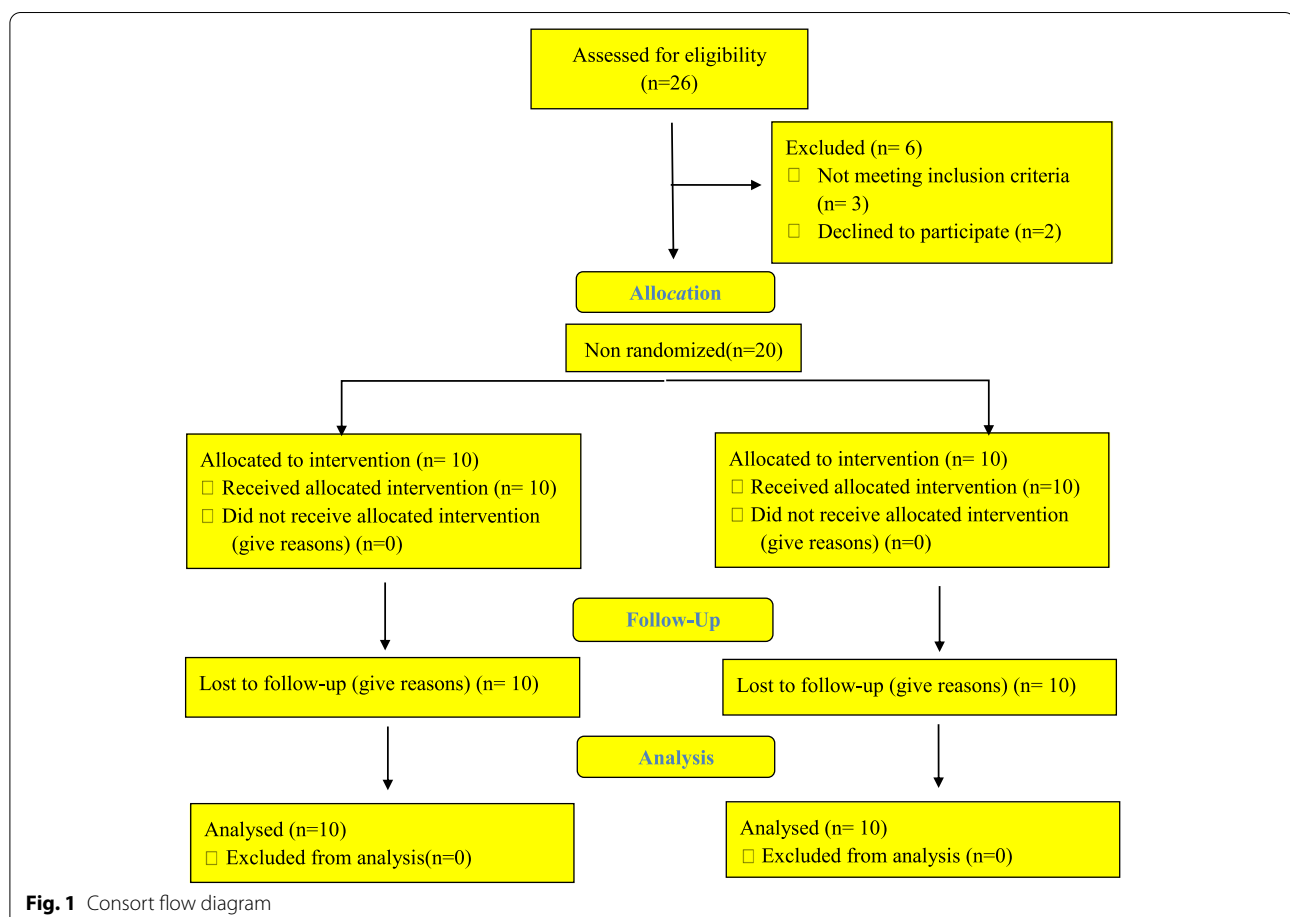
Physical activity may be defined as bodily movement which is produced by skeletal muscle that causes energy expenditure, while “exercise” is a subset of this physical activity. Inadequate amounts of physical activity which does not meet the formulated guidelines of physical activity are termed as “physical inactivity” [8–10]. Irrespective of the metabolic risk factors, the risk of cardiovascular disease (CVD) mortality is considerably lowered for the individuals who are engaged in light, moderate, or vigorous levels of physical activity. On contrary, despite the age and gender, physical inactivity leads to abdominal and visceral fat gain which in turn leads to a greater risk of type 2 diabetes mellitus [11, 12].

Physical inactivity is increasing even in younger age group due to advent of technological development. But inclination towards sports and physical activity among few young adults cannot be denied. Though it is established the difference between risk factors prevailing among sedentary

individuals [13, 14], there are very limited published articles on autonomic dysfunction between physically active and sedentary individuals. Hence, this study was done. The aim of the study is to find and compare the HRV, sympathetic and parasympathetic nervous system dominance in gymgoers, and age-matched sedentary individuals.

### Methodology

This study was approved by the Institutional Ethical Committee of SRM Medical College Hospital and Research center (IECN- 2898/IEC/2021) and was conducted to conform to the recommendations of the Declaration of Helsinki (Fig 1). Twenty-six healthy subjects were approached, and 6 were excluded. Hence, 20 subjects aged 18–22 years, with BMI 18 to 25 kg/m<sup>2</sup>, were conveniently selected and divided equally into two groups (Table 1). Group A ( $n = 10$ )—gymgoers for minimum 1 h/day, 4 days/week, and regular for at least 1 year, Group B ( $n = 10$ )—age matched sedentary individuals were selected for this study. Women, Group A subjects irregular to gym, and subjects with musculoskeletal pain and cardiorespiratory disorders were excluded from the study. All 20 members were instructed about the procedure, and written informed consent was obtained.



**Table 1** Demographic data

Characteristics	N	
Subjects	20 (group A = 10, group B = 10)	
	Median	IQR
Age (in years)	20.5	2.5
BMI	21.8	3.6

The HRV was collected by using a polar H10 HR monitor and by properly fitting the chest strap at the xiphoid process as a resting HRV after the subject woke up in the morning in the sitting posture. During the measurement, the subjects were instructed, “maintain comfortable sitting position, don’t move or talk, don’t close the eyes or fall asleep, respiration in the normal and resting state, don’t control the breathing intentionally.” For each individual, 5 min of recording was done. Results were recorded in elite HRV mobile application and tabulated in the Kubios software [15–17]. The HRV measurement with the use of polar H10, elite HRV mobile application, and the Kubios software is found to have good to excellent reliability [18]. Outcome measures considered for statistical analysis were HRV, LF, HF, and LF /HF ratio.

#### Data analysis

The collected demographic and outcome measures were assessed for normality using Kolmogorov–Smirnov test. Since the data deviated from normality, the descriptive statistics was expressed in median (95% Confidence Interval) and IQR and non-parametric tests (Mann-Whitney test) was used to demonstrate the statistical significance. The collected data was analyzed using Statistical Package for Social Science software version 20.

According to Alberto M. et al. ANS balance is assessed by LF/HF ratio. Increased LF/HF ratio (Table 2) reflects increased sympathetic activity, and decreased LF/HF ratio indicates decreased sympathetic activity. The median values (Fig. 2) of LF/HF ratio of Group A are 1.85 which is less when compared to that of Group B which is 2.6 which is not statistically

significant ( $p > 0.05$ ). This shows that Group A has more PNS dominance, and Group B has more SNS dominance. The median values (Fig. 3) of HRV in Group A are 57.5 which is greater than Group B which is 54.5 but not statistically significant ( $p > 0.05$ ). This shows that Group A subjects are more healthier than Group B.

#### Discussion

The aim of this study is to find and compare the dominance of the sympathetic and parasympathetic nervous system between gym-goers and the subjects with a sedentary lifestyle. Through both the divisions of ANS influence, HRV is primarily influenced by the vagal activity. Many of the cardiovascular dysfunctions can be predicted, diagnosed, managed, and also be prevented by using the state of sympathovagal balance. The present study states that Group A has more PNS dominance than Group B, and it is statistically not significant ( $p > 0.05$ ). Hence, Group A has the capability of coping with stress and homeostasis, whereas Group B subjects have more SNS dominance fight and fright response in the early morning itself, which is not good for their daily life routine and health.

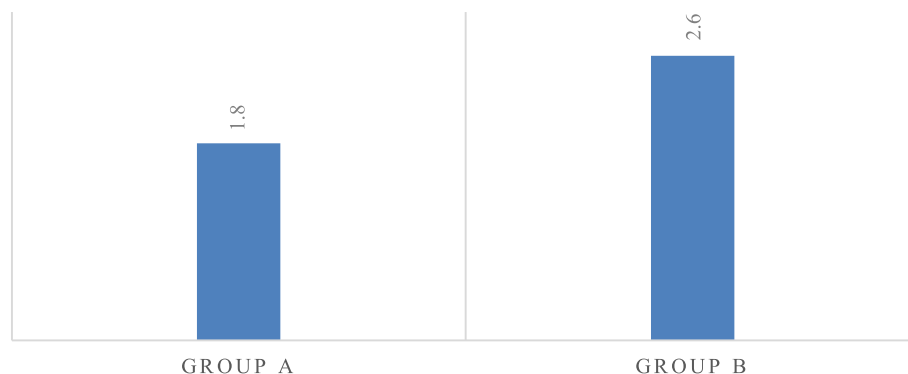
The median values of HRV are higher in gym goers than when compared to sedentary individuals, but it is not statistically significant ( $p > 0.05$ ). The ANS insufficiency seen as abnormal adaptation corresponds to lower values of HRV, while higher values of HRV denote good adaptation and efficient autonomic mechanisms. Andre E. Aubert et al. described that HRV is affected by chronic exercise, more effectively in endurance training athletes, thereby implying that aerobic exercising has beneficial effects on Cardiovascular Risk Profile [19, 20].

Petros C. Dinas et al. stated that acute and chronic effects of both active and passive smoking have implications in the normal functioning of autonomic system which is characterized by an increase in sympathetic drive, reduced HRV, and modulation of parasympathetic response [21]. Anupama Tyagi et al. elaborated the effects of increased HRV and vagal dominance to be associated with autonomic regulation which can be modulated by Yoga [22].

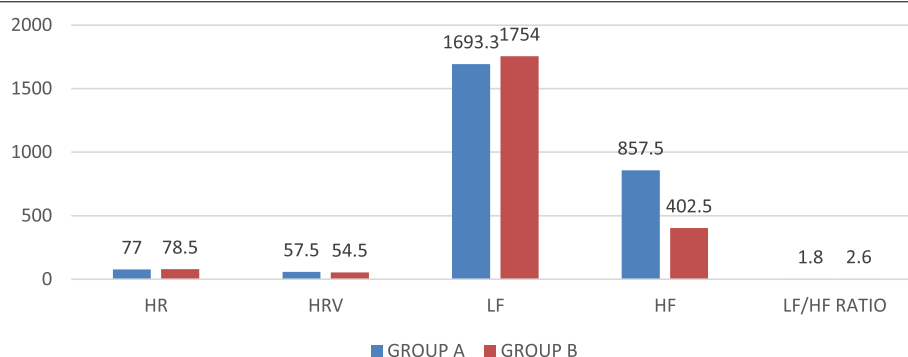
**Table 2** Comparison of median values of HR, HRV, and frequency domain parameters of HRV for both groups with normal values

Characteristics	Group A		Group B		Normal values	Mann-Whitney U	Assymp. sig. (2-tailed)
	Median	IQR	Median	IQR			
HR	77	7	78.5	8.5	60–80	32.5	0.18
HRV	57.5	9	54.5	7.25	68.68 ± 8.52	32.5	0.185
LF	1693.3	1471.5	1754	1512	519 ± 291	47	0.82
HF	857.5	1300	402.5	399.2	657 ± 777	30	0.13
LF/HF ratio	1.85	1.1	2.6	2.3	2.8 ± 2.6	27.0	0.08

### LF/HF RATIO



**Fig. 2** Median values of LF/HF ratio of group A and group B



**Fig. 3** Median values of HR, HRV, and frequency domain parameters of HRV for groups A and group B

Limitations of this study are small sample size, women subjects not assessed, and HRV is not assessed during exercise period. We recommend further research on HRV measurement can be done in children and older individuals. Twenty-four hours of measurement can be much more effective to compare the SNS and PNS dominance in gym-goers and age-matched sedentary individuals.

### Conclusion

This study concludes that people who are all living in a sedentary lifestyle have more SNS dominance than in gym-goers. However, gym-goers have more PNS dominance than sedentary individuals, and people with a sedentary lifestyle are more at the risk of developing autonomic dysfunction like hypertension than gym-goers.

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### Authors' contributions

AC facilitated the design, compliance associated to investigate, ensured statistics high-quality, manuscript writing, and tactics. AD helped in data compilation, statistical analysis and interpretation for the study. JB and JV helped in collecting the records and knowledgeable consent. All authors read and approved the very last manuscript.

### Funding

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### Availability of data and materials

The findings and information of the research are available with the corresponding author upon affordable request.

### Declarations

#### Ethics approval and consent to participate

This study was approved by the Institutional Ethical Committee of SRM Medical College Hospital and Research center (IECN- 2898/IEC/2021). This study was conducted only after fully explaining the nature of study and also after getting a written consent from the participants.

#### Consent for publication

We affirm that all authors have endorsed the original copy and concurred with its accommodation to this diary.

#### Competing interests

There was no conflict of interest during the course of conduction of study.

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