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SHORT COMMUNICATION

Baroreflex Sensitivity and its Association with Physical Activity in Elderly Population

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ABSTRACT

Baroreflex sensitivity is a negative feedback mechanism that is responsible for buffering or maintaining blood pressure in its normal range. The literature indicates that baroreflex sensitivity naturally declines with age, leading to a higher risk of developing hypertension. Therefore, the study aimed to measure the frequency of sensitivity and determine its association with physical activity among the elderly. The study duration was 6 months (February - July 2019) with 201 participants from Rawalpindi/Islamabad. The sample size was calculated using Raosoft. Healthy elderly participants aged above 60 years, both sedentary, and active elderly participants were included and the Physical Activity Readiness Questionnaire (PAR-Q) was used as a pre-screening tool to exclude high-risk populations. The International Physical Activity Questionnaire (IPAQ) categorized physically active to sedentary participants. Baroreflex sensitivity was assessed via the Valsalva maneuver. Pre and post-values of Blood pressure, pulse, Oxygen saturation, and Valsalva Maneuver were obtained. Out of 201 participants, according to IPAQ categories, 139(69.2%) participants were vigorously active, 48(23.9%) were moderately active and 14(7.0%) were not active (Sedentary). The Spearman's-Rho test was applied to find the correlation among all variables, which showed that only pulse and physical activity had a significant association between each other. The study concluded that there was no significant association between physical activity and baroreflex sensitivity except pulse.

Keywords: Baroreflex, Elderly, Valsalva's Maneuver.

Introduction

According to various research, the prevalence of hypertension, diabetes, and heart disease increases with age among the elderly population.[1] Also, comorbidities are likely to have adverse effects on the overall health status of elderly individuals.[2] These co-morbidities are not only a threat to the life of the patient but also a major threat to the patient functional status. A very common co-morbidity in the older population is HTN, which in simple terms means blood pressure changes in the body which requires medication to be controlled.[3]. Baroreflex sensitivity is a negative feedback mechanism; that buffers these blood pressure changes. It is a kind of fastest response of our body to fluctuating blood pressure. It is considered an indicator of many lethal diseases most importantly of cardiovascular risks in post-MI patients and heart failure.[4] Numerous studies support that with decreased BRS there is an increase in the prevalence and incidence of arrhythmias. So BRS provides important prognostic information in such cases as congestive heart failure, sudden cardiac death, Post myocardial infarction patients, and arrhythmic dysfunction also.[5, 6] Baroreflex sensitivity has been considered a diagnostic tool for the disorders of the cardiovascular system. Multiple pieces of evidence have indicated a connection between blood pressure and heart rate concerning the baroreflex mechanism, regardless of gender.[3], [7] There is a relation between baroreflex sensitivity with heart rate and blood pressure. Evidence shows that there is a positive correlation between heart rate and baroreflex sensitivity. While a negative correlation exists between blood pressure and baroreflex sensitivity due to denervated sympathetic activity.[8]

Valsalva maneuver is a breathing technique that can be helpful in conditions like tachycardia.[9] As a result of BRS testing and orthostatic challenge, the baroreflex sensitivity is increased in the physically active old population as compared to sedentary or physically inactive older population. Along with increased baroreflex sensitivity, there is stimulation of parasympathetic system and increased vagal tone of the heart in physically active individuals which shows that hypertension can be controlled by exercise training due to improved baroreflex sensitivity. This shows that baroreflex sensitivity can serve as protective factor in future prevention of cardiac diseases.[10]

Since, Baroreflex sensitivity (BRS) is a critical negative feedback mechanism that helps regulate blood pressure, ensuring it remains within a normal range. Research indicates that BRS naturally declines with age, which can lead to an increased prevalence of hypertension among older adults. Given the significant role of physical activity in cardiovascular health, it was essential to explore the relationship between BRS and physical activity levels in the elderly. Therefore, the study aimed to assess the frequency of baroreflex sensitivity and its association with physical activity, providing insights that could inform strategies for managing blood pressure and improving overall health in aging populations.

Methodology

This cross-sectional correlational survey was carried out at Fauji Foundation Hospital and Shifa Eye Trust Hospital in Rawalpindi over six months, from February to July 2019. A non-probability convenience sampling method was used for participant selection. The sample size was 201, calculated using Raosoft with a margin of error of 5%. Confidence level was 84.5% and response distribution of 50%. Participants were Included as Healthy Physically active and sedentary elderly population of 60 years and above and excluded based on PAR-Q, for the high-risk population. Data Collection Tools used were a Peer-reviewed self-structured questionnaire (including age, gender, employment status, residence, and comorbidities of the participants. Then IPAQ was used to categorize the participants into three physical activity categories i-e. High, moderate, and low. Data was collected through a peer-reviewed self-structured questionnaire after obtaining informed consent. Through PAR-Q, the individuals were screened first (for high-risk) then IPAQ was used to categorize physically active individuals from sedentary. Participants who fell in the inclusion criteria were asked to perform the Valsalva maneuver (for assessing BRS) i-e. Was performed the moderately forceful exhalation against a closed airway, using a closed mouth and pinched nose (using own fingers) while expelling air out as if blowing up a balloon. Blood pressure, pulse, and SPO2 were taken before and after the maneuver to find the differences. Data was analyzed on SPSS v. 21

Results

This table outlines the gender distribution and age statistics of the study participants. Measurements taken before and after the Valsalva maneuver (systolic and diastolic blood pressure, pulse, and SPO2) were recorded but are not included in the demographic table. (Table I)

Table I: Gender distribution and age statistics of the study participants (n=201)

Variable	Frequency (n)	Percentage (%)
Gender		
- Males	105	52.2%
-Females	96	47.8%
Mean Age ± SD	67 ± 07 years	

Pre and post-Valsalva maneuver measurements of variables (Systolic and diastolic blood pressure, pulse, and SPO2) were measured. To analyze the distribution of the variables Kolmogorov-Smirnov test was applied as the sample size was greater than 50 the p-value more than .05 means normal distribution of data and less than .05 shows non-normal distribution of data. As most of our variables showed p-values less than .05 except Pulse, (Table II) that's why the test of choice for the next step used was the Spearman-rho test to find out the correlation between the independent and dependent variables, (Table III)

Table II: Distribution of Variables Based on Normality Testing Using the Kolmogorov-Smirnov Test

Variables	p-value
Systolic Blood Pressure	0.004 (non-normal)
Diastolic Blood Pressure	0.00(non-normal)
Pulse	0.08*(normally distributed)
SPO2	0.00(non-normal)

***p-value is significant at > 0.05*

The correlation coefficients (r) for systolic and diastolic blood pressure were -0.116 and 0.056, respectively. Whereas the value of r for pulse was 0.136 and for SPO2 it was 0.062. Systolic blood pressure showed a weak negative correlation (r= -0.116) with physical activity whereas diastolic BP, SPO2, and pulse demonstrated a weak positive correlation (r= 0.056, r=0.136, r=-0.062). (Table III)

Table III: Correlation of variables with Physical Activity.

Variables	Correlation coefficient (r)	p-value	Significance
Systolic Blood Pressure	-0.116	0.101	Non-Significant
Diastolic Blood Pressure	0.056	0.430	Non-Significant
Pulse	0.136	0.05	Borderline Significant (p ≈ 0.05)
SPO2	0.062	0.382	Non-Significant

**p-value is significant at < 0.05*

Table IV: Mean Scores of IPAQ.

Physical Activity Category	N	%	Mean MET-min/week ± SD
Vigorously Active	139	69.2%	1200
Vigorously Active	48	23.9%	600
Sedentary (Not Active)	14	7.0%	0

Discussion

Depending upon the results, most of the dependent variables i-e Blood pressure and SPO2 showed no significant relation with the independent variable except for pulse. The correlation of two variables i.e. SPO2 and diastolic blood pressure showed a weak positive correlation between the independent and dependent variables. Systolic blood pressure on the other hand had a negative correlation and the only variable with a strong positive correlation was Pulse.

The results for pulse strongly supported the results of previous research. One study conducted in cardiac patients with left ventricular assisted devices revealed that exercise had an impact on heart rate and vo2 max.[11] Another study also stated that physical activity delayed adverse effects in patients with chronic renal disease by modulating the heart rate.[12] According to another study, moderate exercise for a long period causes a lowering of pulse rate in older adults.[13] In another research; the influence of physical activity was detected using ECG monitoring by measuring R-R interval. 10 physically fit participants performed exercise after their R-R interval was checked which showed a noticeable change as compared to pre-exercise, this also shows the difference in heart rate as well. [14] The results of these studies coincide with this study which also shows a significant relation between pulse with physical activity as most of the elderly population was physically active. Hence, we deduced from all the previous research that clinically physical activity has a relation with baroreflex sensitivity. Although, the variables like blood pressure, SpO2, and pulse improve with the Valsalva maneuver. As, according to a survey also there exists a positive influence of physical activity on the autonomic nervous system. It plays an important role in regulation and improvement of pulse rate, systolic blood pressure, diastolic blood pressure and oxygen saturation i.e. SpO2 while patients having impairment in autonomic nervous system were found to be sedentary. In another research, physical activity was found to be an important intervention of hypertension and a crucial factor in the prevention of high blood pressure and cardiac autonomic disease.[15]

Limitations and Recommendations: The study only assessed general physical activity levels, which may not capture the specific intensity or type of exercise required to influence baroreflex sensitivity. Some confounding factors that could affect BRS besides physical activity levels might include diet, stress, or genetic predisposition, were not controlled or measured, which could affect the results.

Conclusion

In conclusion the study found no significant correlation between baroreflex sensitivity and general physical activity, aside from a potential link with pulse rate. This lack of association might be because regular physical activity alone may not be sufficient to delay the decline in baroreflex sensitivity. Instead, structured exercise training of specific duration and intensity could be necessary. Since our population did not engage in any formal exercise training, no meaningful correlation between physical activity and baroreflex sensitivity was observed.

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