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An Investigation of Physiological Function Variations between Athletes with Total Blindness and Partial Vision

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Abstract

The present study explored the physiological differences among athletes with visual impairments, specifically focusing on those who are totally blind and those with partial vision. A total of eighty visually impaired children from Tamil Nadu were deliberately selected for the study, with forty participants representing each level of vision. Three key physiological parameters were analyzed: pulse rate, systolic blood pressure, and diastolic blood pressure. Physiological assessments were conducted to collect the necessary data. To determine the statistical significance of any differences between the two distinct groups, a 'Mann-Whitney U test' was employed. The results indicated no significant differences in both systolic and diastolic blood pressure. However, a significant difference in pulse rate was observed between the partial vision and totally blind groups, with findings exceeding the 5% probability threshold.

Keywords: *Visual Impairment*, *Total Blind*, *Partial Vision*, *Physiology*.

1. INTRODUCTION

A person's ability to perform everyday activities is significantly limited or completely hindered by visual impairment, which may involve either severely reduced or retained vision. The loss of sight affects an individual's ability to engage with their surroundings, necessitating adjustments to maintain independence. Currently, over 2.2 billion people worldwide live with some form of visual impairment. Notably, half of these cases could be prevented or better managed through effective public health strategies and improved access to healthcare services **(WHO)**. Athletes with visual disabilities, including those who are either completely blind or partially sighted, exhibit impressive athletic abilities despite encountering distinct challenges. Vision plays a crucial role in movement control, equilibrium, and coordination; the absence or reduction of vision compels the body to undergo physiological adaptations to achieve optimal sports performance. For athletes who are entirely blind, the absence of visual information leads to greater dependence on proprioceptive and vestibular systems, which may impact cardiovascular and muscular endurance

differently compared to athletes with partial sight (Lieberman & McHugh, 2001). Studies indicate that athletes with total blindness develop heightened proprioceptive abilities to offset the lack of visual cues, which affects their balance and motor coordination during physical activity (Schinazi et al., 2016).

On the other hand, athletes with partial sight can still utilize their remaining vision, providing them with certain physiological benefits in areas like spatial awareness and coordination, influencing their overall athletic performance. Variations in visual ability often necessitate tailored training approaches based on the degree of impairment. For instance, completely blind athletes may rely heavily on auditory and tactile signals for spatial orientation, while partially sighted athletes benefit from training methods that maximize their residual vision. These adaptations shape key physical traits such as reaction time, agility, and stamina, which subsequently influence their physiological responses during exercise. Additionally, the psychological effects of visual impairment, including motivation and stress, can further affect these athletes' physiological performance, altering their endurance and energy management. Investigating the physiological differences between athletes with total blindness and partial vision provides valuable knowledge for creating more effective and specialized training programs. This study aims to examine these differences, particularly focusing on critical physiological factors such as pulse rate (PR), systolic blood pressure (SBP), and diastolic blood pressure (DBP), with the goal of enhancing athletic performance.

2. REVIEW OF LITERATURE

Sedentary behavior increases the risk of hypertension and cardiovascular diseases, particularly among visually impaired individuals (Eelke & Folmer, 2015). Engaging in physical activities, such as competitive sports, can mitigate the negative cardiovascular effects associated with visual impairment (Kakiyama, 1999). Research suggests that over 20% of adult athletes are either hypertensive or at risk of developing hypertension, emphasizing the need for ongoing blood pressure monitoring and interventions within this demographic to prevent severe health complications (Teck-Hock et al., 2011). During stressful situations, visually impaired individuals often exhibit heightened heart rate variability, which may impair their ability to cope with everyday tasks (Moreno et al., 2019). Comparative analysis revealed no significant differences in blood pressure levels between volleyball and football players (Soren & Bag, 2019). Visually impaired individuals generally exhibit lower levels of physical activity, leading to potential cardiovascular issues. Moreover, visual impairment has been associated with reduced aortic distensibility, suggesting potential blood pressure problems (Kakiyama, 1999). Athletes in handball and volleyball demonstrated distinct physiological differences (Singh, H., 2015). Volleyball players competing at district and state levels exhibited comparable heart rates (Bedi, S. P., 2019). Male athletes competing at the all-India level in both contact and non-contact sports displayed significant differences in heart rates but no variations in diastolic and systolic blood pressure (Singh, T. & Kaur, H., 2016). The study indicated considerable differences in systolic blood pressure between batters and bowlers (Thomas, G., 2017). At the 0.05 significance level, comparisons revealed a substantial difference in vital signs among keepers and batters. However, there were no notable variations in heart rate and blood pressure across all player positions (Kumar et al., 2013). Another study found minimal differences in SBP and DSP among sports persons and non-sports persons, although a notable disparity in heart rate (Wankhade, V. R., 2017). Normal blood pressure levels were recorded. In various sports, the average heart rate for male and female athletes was slightly above 70 beats per minute, though it did not reach a statistically significant level (Nande et al., 2009).

3. NEED OF THE STUDY

Investigating the physiological function variations between athletes with total blindness and those with partial vision is crucial for several reasons. First, understanding these differences can inform tailored training programs that enhance performance and minimize injury risk in visually impaired athletes. Second, this research can provide insights into the unique adaptations required for effective sports participation, thereby improving overall physical fitness and health outcomes. Furthermore, exploring the physiological impacts of varying visual

impairments can highlight potential disparities in SBP, DBP, and PR. Addressing these issues is essential for promoting inclusivity and optimizing the competitive experience for all athletes. Additionally, the findings could contribute to developing guidelines for coaches and trainers working with visually impaired individuals, ensuring they receive appropriate support. Ultimately, this study seeks to address a void in the existing research and contribute to the broader understanding of the interplay between visual impairment and athletic performance.

4. AIM OF THE STUDY

This comparative assessment endeavors to scrutinize the physiological disparities between athletes with total blindness and those with partial vision. The focus will be on identifying variations in key parameters, including SBP, DBP, and PR.

5. OBJECTIVES OF THE STUDY

- Identify athletes with complete blindness as well as those with partial vision.
- Collect relevant data on the physiological parameters of interest.
- Analyze the differences in the selected parameters between the athletes with different degrees of vision.

6. HYPOTHESES

- No considerable variations in SBP were detected between the athletes with partial vision and those with complete blindness
- No considerable variations in DBP were detected between the athletes with partial vision and those with complete blindness
- No considerable variations in PR were detected between the athletes with partial vision and those with complete blindness

7. METHODOLOGY

7.1. Sample

A purposive sampling technique was employed to select 80 visually impaired male athletes from Tamil Nadu. The sample was separated into two equal groups of 40, with one group consisting of athletes with total blindness and the other comprising athletes with partial vision.

Table-1: Variables Choosing

S.no	Variable	Measured by	Measured in
1	SBP	Sphygmomanometer	mmHg
2	DBP	Sphygmomanometer	mmHg
3	PR	Pulse oximeter	Beats per minute (BPM)

7.2. Research design

For this study, a comparative design with static groups was employed. Potential differences were assessed by analyzing test results from two separate participant groups.

7.3. Statistical technique

To assess and examine the physiological traits of athletes with total blindness and those with partial vision, the following statistical methods were utilized. To determine the statistical significance of any disparities between the two groups, a 'Mann-Whitney U test' was employed. This test analyzes whether the averages of the two groups vary significantly. Hypotheses were tested with a significance threshold set at 0.05 in all cases.

8. RESULT AND ANALYSIS

Table-2: Average scores of total blind and partial vision on systolic blood pressure

Group	n	Average	SD	Mean rank	Sum of ranks
Total Blind	40	122.25	11.49	39.99	1599.50
Partial Vision	40	122.32	11.76	41.01	1640.50

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Test statistics[a]

	VAR00001
Mann-Whitney U	779.50
Wilcoxon W	1599.50
Z	0.19
Asymp. Sig. (2-tailed)	0.84

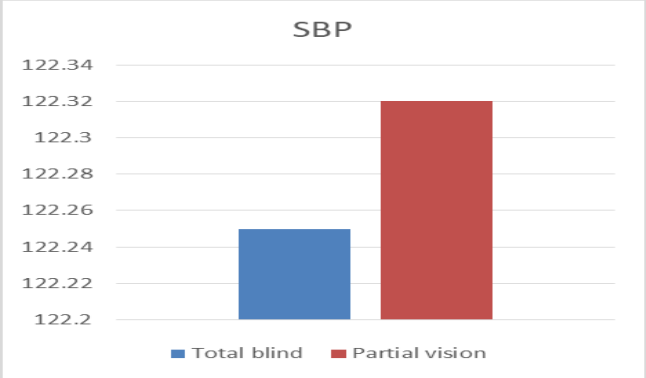

Fig-1: Average SBP for individuals who are completely blind and those with partial sight

Table II shows the average value of total blind and partial vision was 122.25 and 122.32. The mean rank and sum of ranks of the total blind were 39.99 and 1599.50 respectively. The mean rank and sum of ranks of partial vision were 41.01 and 1640.50 respectively.

Since the significance (2-tailed) value is 0.84, which is higher than the 0.05 standard significance level, it can be deduced that there is no meaningful disparity between total blind and partial vision values. Consequently, a null hypothesis is accepted.

Table-3: Average scores of total blind and partial vision on Diastolic blood pressure

Group	n	Average	SD	Mean rank	Sum of ranks
Total Blind	40	80.77	9.75	44.18	1767.00
Partial Vision	40	78.82	12.88	36.83	1473.00

Test statistics[a]

	VAR00001
Mann-Whitney U	653.00
Wilcoxon W	1473.00
Z	1.41
Asymp. Sig. (2-tailed)	0.15

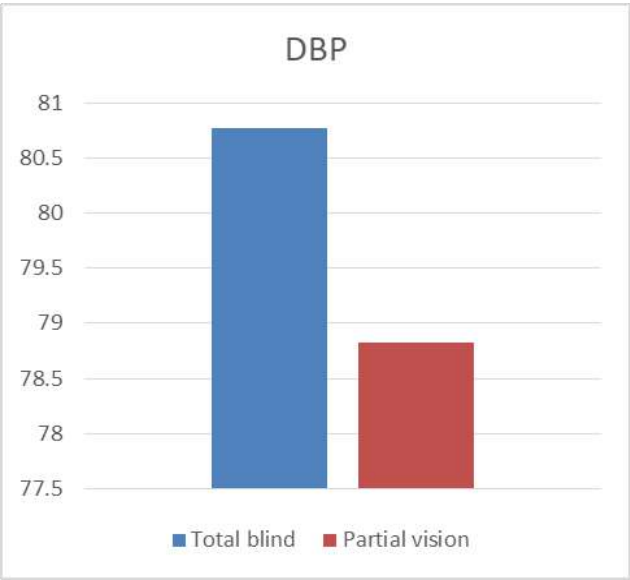

Fig-2: Average DBP for individuals who are completely blind and those with partial sight

Table III shows the average value of total blind and partial vision was 80.77 and 78.82. The mean rank and sum of ranks of the total blind were 44.18 and 1767.00 respectively. The mean rank and sum of ranks of partial vision were 36.83 and 1473.00 respectively.

Since the significance (2-tailed) value is 0.15, which is higher than the 0.05 standard significance level, it can be deduced that there is no meaningful disparity between total blind and partial vision values. Consequently, a null hypothesis is accepted.

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Table - 4: Average scores of total blind and partial vision on Pulse rate

Group	n	Average	SD	Mean rank	Sum of ranks
Total Blind	40	90.25	8.43	47.21	1888.50
Partial Vision	40	84.72	12.92	33.79	1351.50

Test statistics[a]

	VAR00001
Mann-Whitney U	531.50
Wilcoxon W	1351.50
Z	2.58
Asymp. Sig. (2-tailed)	0.01

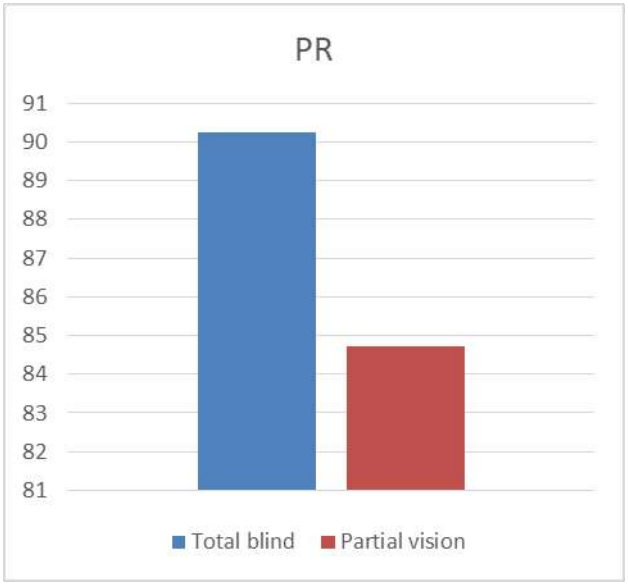

Fig-3: Average PR for individuals who are completely blind and those with partial sight

Table IV shows the average value of total blind and partial vision was 90.25 and 84.72. The mean rank and sum of ranks of the total blind were 47.21 and 1888.50 respectively. The mean rank and sum of ranks of partial vision were 33.79 and 1351.50 respectively.

Since the significance (2-tailed) value is 0.01, which is lower than the 0.05 standard significance level, it can be deduced that there is a meaningful disparity between total blind and partial vision values. Consequently, a null hypothesis is rejected.

9. DISCUSSION

The present study aimed to investigate variations in physiological functions, specifically focusing on SBP, DBP, and PR among athletes with complete blindness and those with partial vision. The outcomes demonstrated no notable differences in SBP and DBP across the two groups, indicating that visual impairment whether complete or partial might not significantly influence these cardiovascular metrics. This is consistent with previous research, which also reported no meaningful variations in blood pressure among athletes with different degrees of visual impairment **(Singh & Kaur, 2016)**. These results suggest that training programs tailored for visually impaired athletes can effectively maintain blood pressure within healthy limits, irrespective of their visual capabilities.

In contrast, the study found a notable difference in pulse rate between the groups. This finding implies that total blindness may affect autonomic regulation, potentially resulting in increased variability in heart rate responses during physical activity. Previous studies have indicated that individuals with total blindness may demonstrate greater heart rate variability, likely due to their heightened reliance on proprioceptive and vestibular inputs during exercise **(Moreno et al., 2019)**. Such variations in pulse rate could also indicate different levels of physical conditioning, psychological stress, or the body's adaptive mechanisms to the absence of visual cues. Athletes with partial vision might leverage their remaining sight for enhanced spatial awareness and coordination, allowing them to better regulate their heart rate during exertion.

Moreover, these results may suggest that visual impairment has differential effects on cardiovascular and autonomic functions. Research conducted by **Kakiyama (1999)** highlighted diminished aortic distensibility in individuals with visual impairments, which could explain variations in physiological responses such as pulse rate, but not necessarily in blood pressure. This underscores the need for focused physical training and monitoring for athletes with visual impairments to promote cardiovascular health, especially in relation to heart rate regulation.

Additional studies are required to further investigate the mechanisms underlying pulse rate variations in athletes with total blindness and to explore whether targeted training interventions could alleviate this issue. Overall, while blood

pressure regulation appears similar between athletes with complete and partial vision, pulse rate emerges as a significant physiological factor influenced by the degree of visual impairment.

10. CONCLUSION

In summary, this study highlights important physiological function variations between athletes with total blindness and those with partial vision, specifically focusing on SBP, DBP, and PR The findings indicate that while blood pressure remains consistent across both groups, significant differences in PR suggest that total blindness may influence autonomic regulation and heart rate variability during physical activity. These results underscore the importance of individualized training approaches adjusted to cater to the individual needs of visually impaired athletes, as their physiological responses to exercise can differ based on the extent of their visual impairment.

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