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Examining the Relationship between Balance and Audio-Visual Reaction Time in the Elderly Population of Gurugram District

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ABSTRACT

Introduction: Absolutely, falls leading to osteoporotic fractures are indeed a significant concern among the elderly population. Various factors contribute to this risk, including balance issues, poor gait, lower limb muscle weakness, and slowed reaction time. Identifying and addressing these factors are crucial in reducing the risk of falls and maintaining the overall health and well-being of elderly individuals.

Method: The study was carried out for period of 4 months i.e., January 2022 to April 2023. Hundred participants' volunteers willing to participate in study between the age group of 65 – 75 years were screened. Ninety-four participants meeting the inclusion criteria were selected for the study. Outcome measure; Balance will be measured by Berg balance scale (BBS) and Reaction time was measured by Audio visual reaction time instrument.

Result: The main finding of this study was that there was significant negative correlation between BBS and Audio-visual reaction time among elderly population.

Conclusion: From the observation it is concluded that as the ageing process advances in the individuals it leads to the negative co relation among the balance and audio-visual reaction time. So, it is the need to formulate the exercise regimen for the old age individuals to improve the balance capability.

Key Words: Elderly, fall, osteoporotic, BBS and audio-visual reaction time.

INTRODUCTION

Population ageing is a global phenomenon, and India is no exception. In 2009, the population aged 60 years and above in India was approximately 88 million. Projections indicate a significant increase, with this demographic expected to surpass 315 million by the year 2050. This rapid growth in the elderly population highlights the importance of addressing health and social needs associated with ageing in India. Indeed, certain states in India, particularly those in the southern region such as Kerala, Tamil Nadu, and Karnataka, along with Punjab, Himachal Pradesh, and Maharashtra, have undergone demographic transitions earlier than others. As a result, these states are experiencing accelerated ageing of their populations compared to the national average. This demographic trend underscores the need for tailored policies and interventions to address the unique challenges associated with an ageing population in these regions.[1]

Indeed, falls leading to osteoporotic fractures are a significant concern among the elderly population. These fractures can result in prolonged recovery times, loss of independence, decreased quality of life, and increased mortality rates. Preventative measures, such as regular exercise, maintaining a healthy diet, ensuring safe living environments, and addressing underlying medical conditions, are essential in reducing the risk of falls and fractures in older adults. Additionally, early detection and treatment of osteoporosis can help mitigate the impact of falls on bone health.[2]

Absolutely, the incidence of falls tends to increase exponentially with age among the elderly population. Furthermore,

research indicates that women are at a higher risk of experiencing falls compared to men. Several factors contribute to this gender difference, including differences in bone density, muscle strength, and balance, as well as hormonal changes associated with menopause. Therefore, it's crucial to implement targeted fall prevention strategies, especially for older women, to reduce the risk of falls and their associated complications.[3] Epidemiological research indicates that falls are prevalent among older individuals, with approximately 30% of those aged 65 and above experiencing a fall annually. Furthermore, within this group, 12% have recurrent falls.[4] Balance issues, impaired gait, weakness in lower limb muscles, and slowed reaction time have all been recognized as independent risk factors for falls among the elderly.[5,6] The physical changes associated with aging can vary significantly due to genetic predisposition and environmental influences.[7] In advanced age, many elderly individuals experience age-related changes that inevitably lead to limitations in independent movement and balance loss.[8] Motor coordination and balance are skills that diminish during the aging process, partly due to the deterioration of proprioception.[9]

Measuring reaction time to stimuli is among the most frequently used assessments of neurological function. Various types of reaction times can be evaluated, such as responses to visual, auditory, and tactile stimuli.[10] There are some factors affecting which delay in response with increase in age, Axonal degeneration and axonal shrinkage with advance age, Loss of co-ordination and decrease in motor skill with increase all these factors led to increase in audiovisual.[11]

As we know that the incidence of fall is very common among the elderly population either due to poor balance or due to some related pathology. This study will help to determine the correlation between balance and audio-visual reaction time, so that some clinical protocol can be set in relation with reaction time and balance for elderly population.

The aim of the study is to determine the correlation between balance and audio-visual reaction time, so that a criterion can be set depending on reaction time and balance for elderly population.

METHODOLOGY

Research Design: The study is descriptive qualitative co-relation study.

Sampling Method: Convenient Random sampling method was used. Hundred participants' volunteers willing to participate in study between the age group of 65 – 75 years were screened.

Sample Size: Ninety-four participants meeting the inclusion criteria were selected for the study.

Outcome Measures: Balance will be measured by Berg balance scale and Reaction time was measured by Audio visual reaction time instrument.

SELECTION CRITERIA:

Inclusion Criteria

1. Subject with in age group of 65 -75
2. Subject both male and female.
3. Systolic Blood pressure < 220 mmHg and diastolic Blood pressure < 100 mmHg.

Exclusion Criteria

1. Musculoskeletal conditions (Pain in lower limb, Low back pain)
2. Neurological condition (Stroke, Spinal cord injury, Vestibular problem, Head injury, Alzheimer).
3. Dizziness
4. Systolic Blood pressure > 220 mmHg and diastolic Blood pressure > 100 mmHg.

PROCEDURE

The study was conducted at Vardan Hospital, Gurugram after the due approval from the Departmental Research Committee of the GD Goenka University. A written consent was taken from every subject after procuring their genuine interest. The study was carried out for period of 4 months i.e. January 2022 to April 2023. Then the weight (kg) and height (cm) of the subject were assessed using a weighing machine and anthropometric rod respectively. Then the Berg Balance Scale (BBS) score was calculated based on performance-oriented in a task. The selected subject assigned to all the 14 components of BBS in an appropriate and orderly manner. After the completion of performance-oriented balance task the subjects were subjected to the Audio- visual reaction time apparatus to measure their audio-visual reaction time. The subject was seated to one side and examiner to other side of the

instrument. Black shade (iron plate) in between the machine was used so that the subject could not see any movement of examiner hand. Auditory reaction time was measured using stimuli of low, medium, and high tone frequency sounds. Visual reaction time stimuli consisted of red, green, and yellow lights. Subjects were instructed to respond immediately as soon as the stimuli (audio- visual) was perceived by him or her. When examiner pressed the specific color switch as visual stimuli, same was appeared at the subject's side. The time taken by the subject to respond to the visual stimuli was measured automatically by the apparatus. The auditory and visual reaction time stimuli were assessed three times, and the average of these three readings was calculated as the value for the reaction time task. This value was then recorded in the subject's record file.

RESULTS

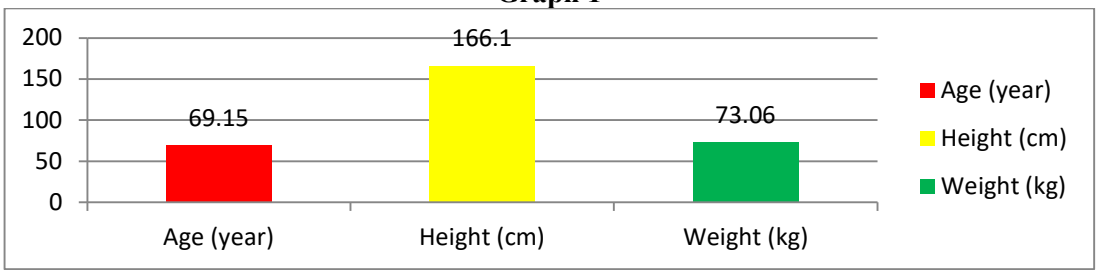
The mean value of age, height and weight of the both male and female elderly population are shown in table 1. Mean of Age, height and weight is 69.15±3.56, 166.10±7.77 and 73.06±10.65 respectively.

Table 1: Mean and SD of Age, Height, and Weight for the subjects included in the study.

Demographic	Mean	SD
Age(year)	69.15	3.56
Height(Cm)	166.10	7.77
Weight(kg)	73.06	10.65

Table 2 shows correlation between Berg balance scale and audio in elderly population. From this study it was revealed that Analysis of coefficient of correlation suggests significant negative correlation between BBS and Audio among elderly population. From Table 3 it was also observed that Analysis of coefficient of correlation suggests significant negative correlation between BBS and Visual among elderly population.

Graph 1

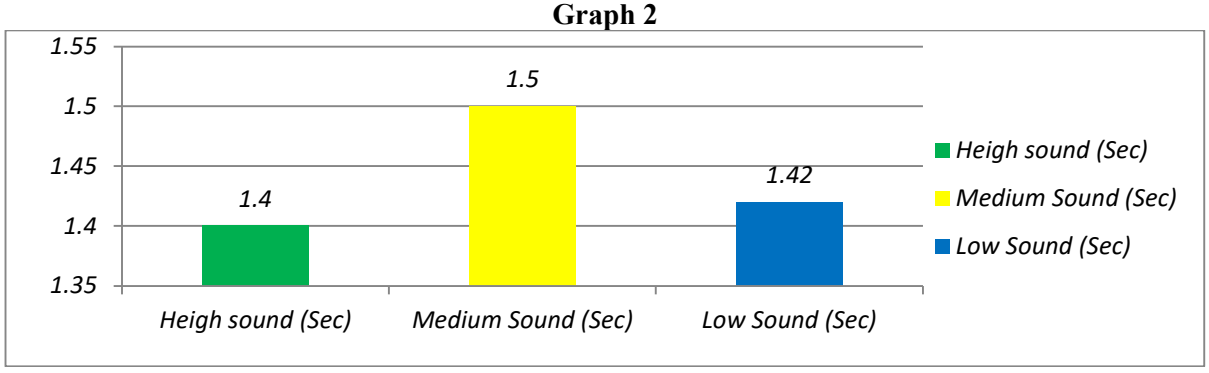


Graph 1 shows the mean and standard value of demographic data of subject, age weight, and height.

Table 2: Correlation between BBS and Audio Variables

Correlation	High Sound		Medium Sound		Low Sound	
	r value	P value	r value	P value	r value	P value
BBS	-0.487	**P < 0.05**	-0.505	**P < 0.05**	-0.318	**P < 0.05**

Graph 2

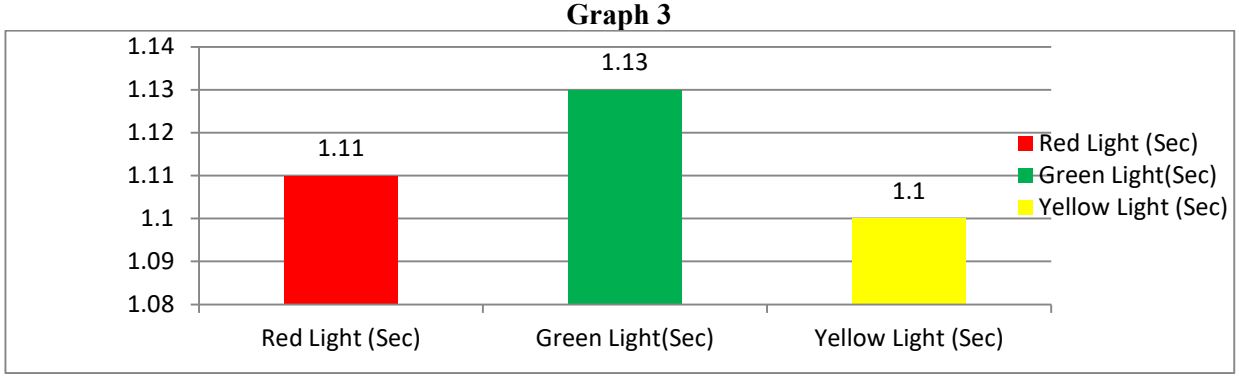


Graph 2 shows the mean and standard deviation of high sound, medium sound, low sound response in sec.

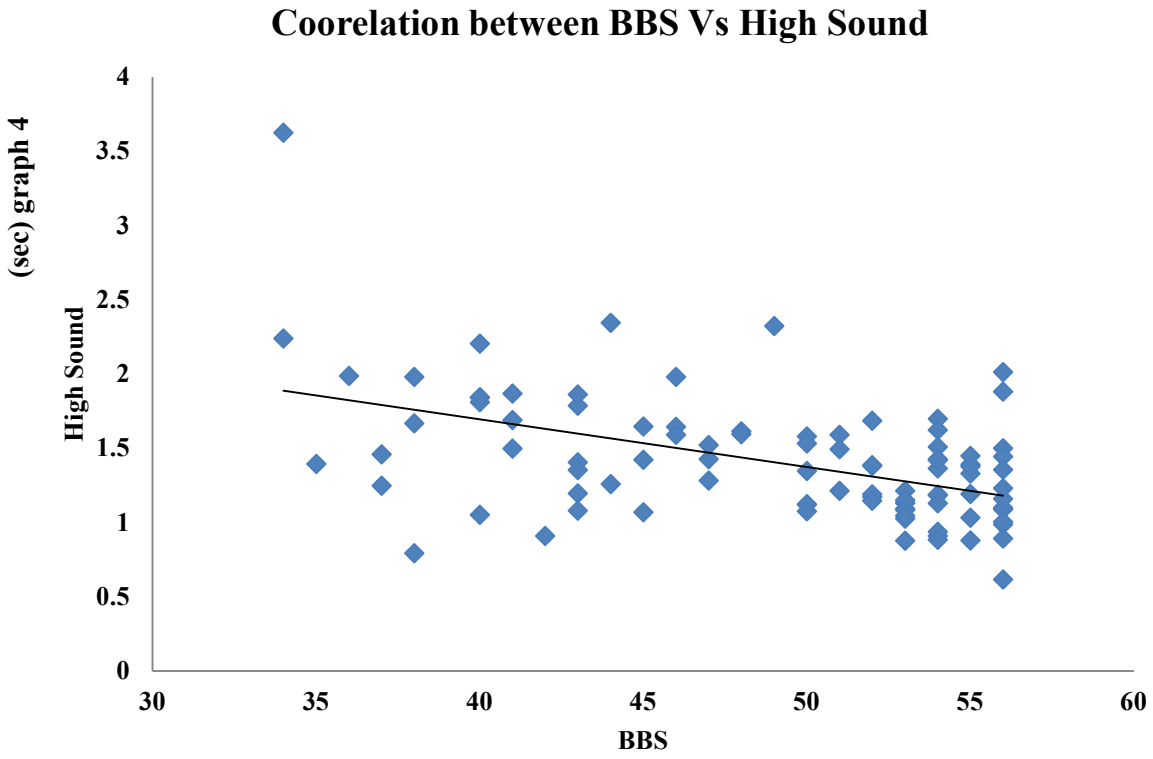
Table 3: Correlation between BBS and Visual Variables

Correlation	Red Light		Green Light		Yellow Light	
	r value	P value	r value	P value	r value	P value
BBS	-0.321	P < 0.05	-0.225	P < 0.05	-0.283	P < 0.05

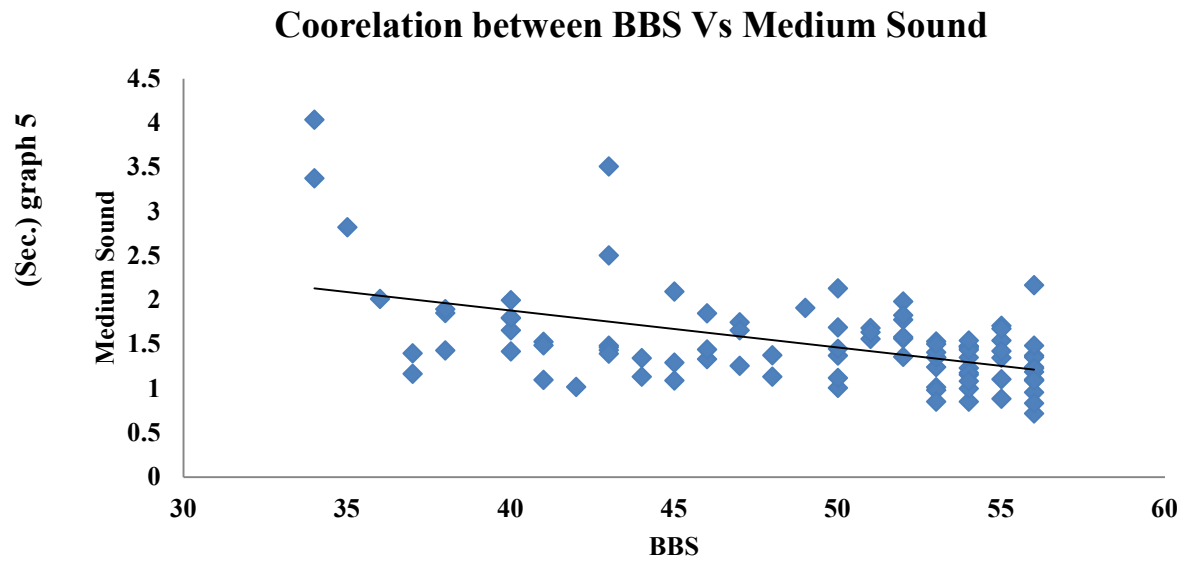
Graph 3



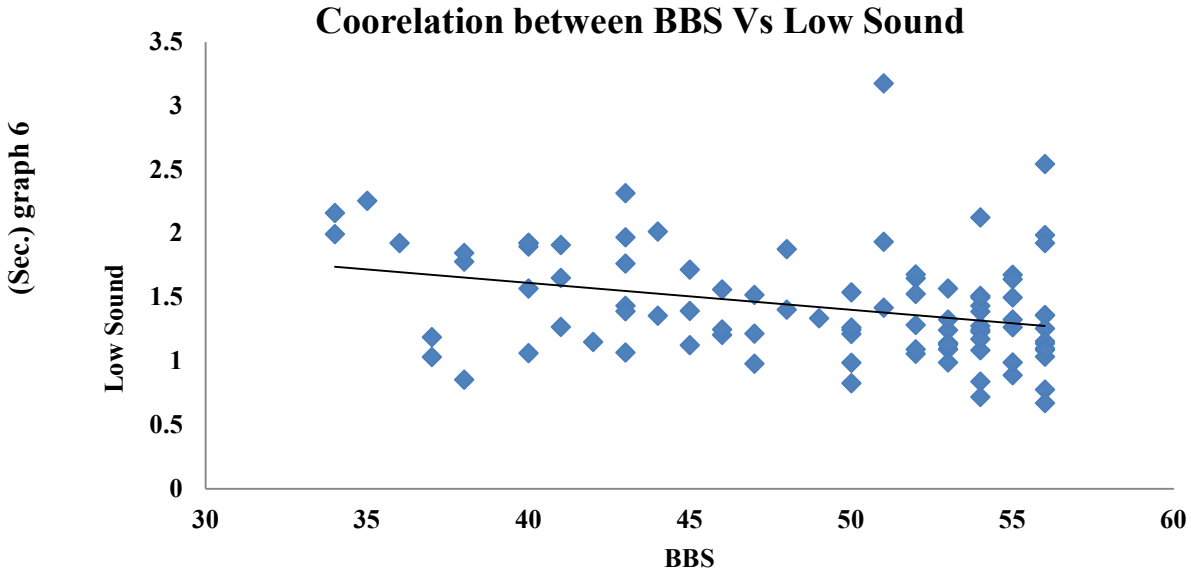
Graph 3 shows the means and standard deviations of three different visual output red light, green light, and yellow light response in second respectively



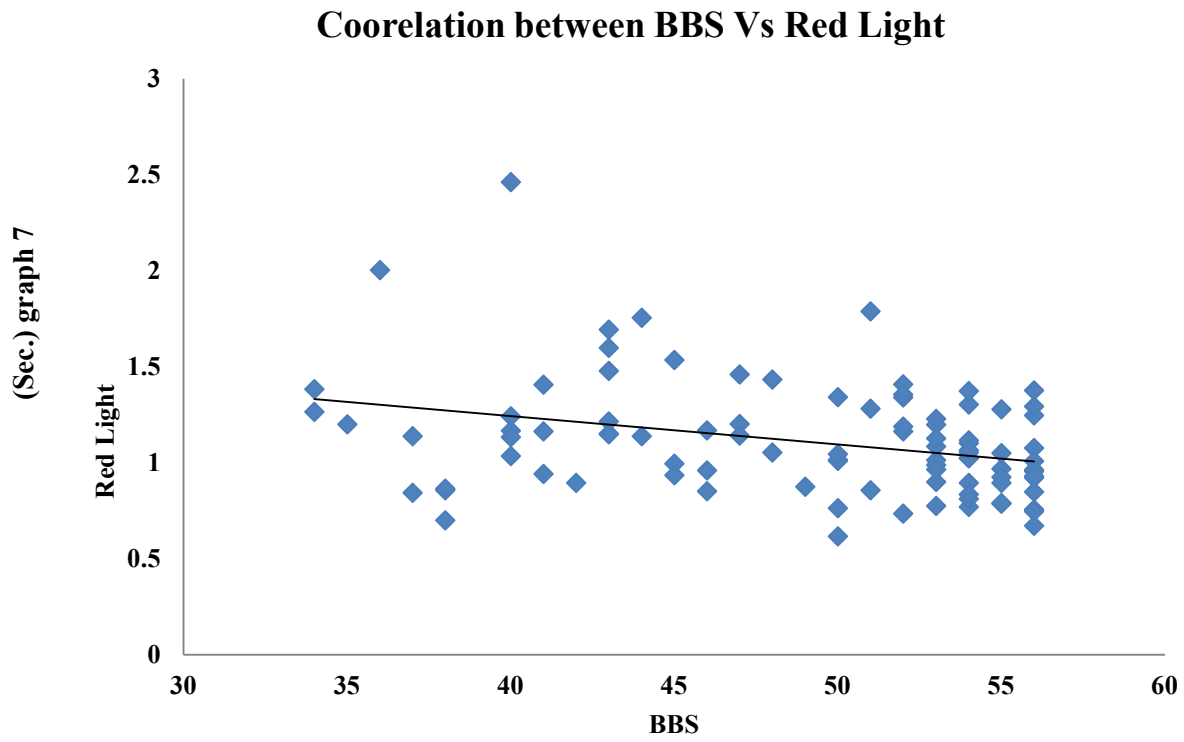
Graph 4 shows Correlation of berg balance scale and High sound response in (sec) among elderly population.



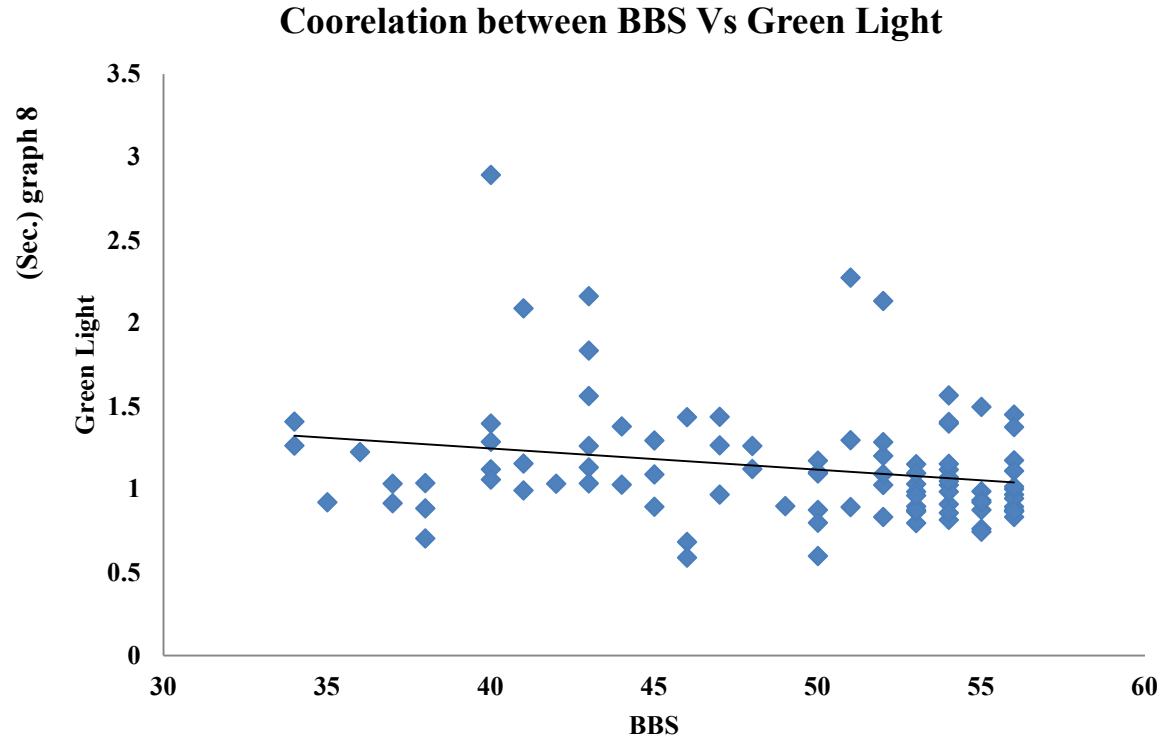
Graph 5 shows that Correlation of berg balance scale and Medium sound response in (sec) among elderly population.



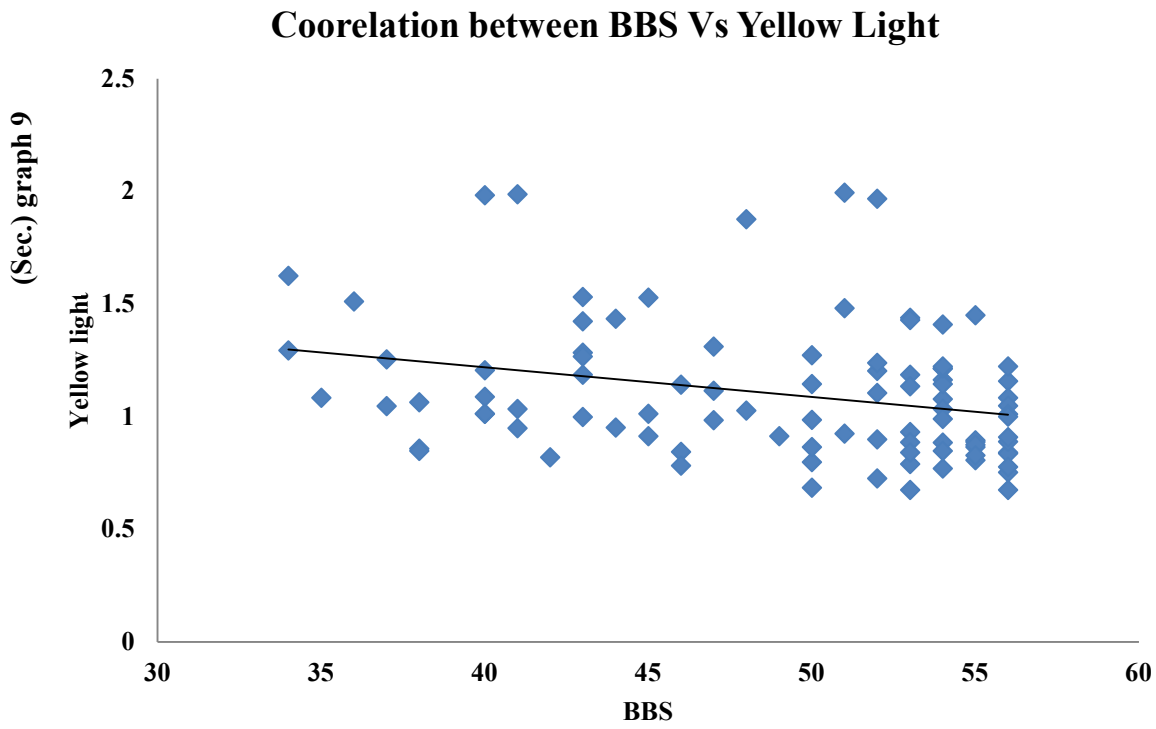
Graph 6 shows that Correlation of berg balance scale and low sound response in (sec) among elderly population.



Graph 7 shows Correlation of berg balance scale and red-light response in (sec) among elderly population.



Graph 8 shows Correlation of berg balance scale and green light response in (sec) among elderly population.



Graph 9 shows Correlation of berg balance scale and yellow light response in (sec) among elderly population.

DISCUSSION

As individuals age, many experience a natural decline in the ability to move independently and maintain balance.[8] Miles demonstrated that the reaction time of adults tends to increase with age, with the rate of increase notably accelerating during senescence compared to middle age.[12] Although mostly older individuals' exhibits prolonged reaction time, some show reaction time similar to those of younger individuals.[13] Chandak and Makwana concluded that aging has a more pronounced impact on slowing down visual reaction time compared to auditory reaction time.[14] Piotrowski and Cole demonstrated that balance becomes a significant concern in aging populations, as deterioration in balance significantly contributes to the increased frequency of falls among the elderly.[15] The incidence of falls steadily increases after the age of 65, and it has been estimated that between 20% and 50% of elderly individuals are at risk of falling within one year period.[16,17]

Lajoie and Gallagher, and Lord et al., concluded that the fall is very common in the elderly population so that reaction time was one of the best predictors of postural sway in aging population.[18,19] In the present study the majority of BBS components were found to be inversely co related with the high sound as well as medium sound audio response at 95 % of confidence level except one component i.e. sitting with back unsupported but feet supported on floor or on stool which found to be non-significant to the high and medium sound. On the same note the various components of BBS were also found to be inversely co related with the red light, green light, yellow light response time at 95 % of confidence level. The study conducted by Nikam and Gadkari, as well as Fozard et al., revealed that both visual and auditory reaction times were significantly higher in older individuals compared to the younger counterparts for both sexes. This difference was attributed to the slowed processing rate of the central nervous system in older individuals. Aging was found to disrupt the decision-making process and higher cortical function.[20,21] The present study the coefficient of correlation for BBS indicated a significant negative correlation between high sound r (-0487), medium sound r (-0.505), and low sound r (-.0318) whereas correlation of BBS with visual light, red light r (-0.321), Green light, r (-0.225), yellow light r (-0.283) also yields negative co relation.

LIMITATIONS OF THE STUDY

- The study was significantly constrained by the limited time period available.
- The study's potential could be enhanced by including a larger elderly population from the entire state rather than solely focusing on the Gurugram District.
- The absence of funding from any organization limited the scope of the study.
- Pathological findings among the subjects were not excluded during the study, potentially affecting the outcome of the results.

CONCLUSION

From the observation it is concluded that as the ageing process advances in the individuals it leads to the negative co relation among the balance and audio-visual reaction time. It shows that as the person's age advances the balance of the individual gets impaired while the reaction time to any stimuli increases. It is quite familiar that the falling tendency among the old age is very common because the balance and reaction time in old age got unusual hampered, so it is the need of an hour to formulate the exercise regimen for the old age individuals to improve the balance capability which may in turn can improve the reaction time to any stimuli in old persons which may reduce the chances of fall and their subsequent injuries.

This study is not sponsored by any funding agency and authors are not having any conflict of interest amongst them related to the study.

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AUTHOR'S CONTRIBUTION

All authors contributed significantly to this work. Divya Goyal was involved in conceptualization, data collection, and manuscript drafting. Sheetal Malhan contributed to data analysis, manuscript editing, and critical revisions. Aashi Bhatnagar conducted the literature review, curated data, and prepared figures. Vishakha contributed to data interpretation and methodology development. Manish Kumar performed statistical analysis and reviewed the findings. Aksh Chahal provided oversight of research activities and assisted with manuscript review and editing. Nishchint Banga supported manuscript drafting and coordinated efforts among the research team. Vishwajeet Trivedi supervised the project, provided administrative support, and gave final approval for the manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest related to this work.

FINANCIAL DISCLOSURE

This study is not sponsored by any funding agency.

ETHICS APPROVAL

This study was approved after review and presentation in the Departmental Research Committee GD Goenka University (DRB/2022-23/1776-PT-07).

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