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EFFICACY OF COMPUTER-AIDED BALANCE TRAINING VERSUS THE THERAPEUTIC BALANCE TRAINING EXERCISES IN ELDERLY

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INTRODUCTION

Balance is defined as “the ability to maintain the body’s center of mass (COM) over its base of support (BOS)”. Balance and posture are very important in geriatric population because there is an overall deterioration in balance control system resulting in increased fall risk. The poor control system of posture is significantly related to reduction in mobility, physical performance and elevated fear of falling. ⁽¹⁾ Body balance and postural reactions are essential components of a healthy life and precise interaction with the surrounding environment. Balance performance decreases continuously with age. As a consequence, the risk of being injured in a fall is higher among older people. ⁽²⁾

Balance control is a foundation of our ability to move and function independently. A deterioration of balance function, as a consequence of disease or simply increasing age, will increase the occurrence of clinical balance problems as well as the risk of balance loss and falls. Falls are the leading cause of accidental death in the elderly population with more than 11,000 deaths as a result of falls each year and hip fractures the leading fall-related injury that causes prolonged hospitalization ⁽³⁾

Balance and gait are important considerations in the health of elderly subjects. It is estimated that 13% of adult’s self-report imbalance for elderly and this proportion increases to 46% in those aged 85 and older. Similarly, it is estimated that the prevalence of gait disorders in community-residing elderly adults aged 70 and older is 35%. Abnormal gait has been associated with a risk of institutionalization and death that is 2.2 times that seen in elderly adults without gait disorders. Additionally, impairments of balance and gait have been implicated in increased risks of falls ⁽⁴⁾. Falls are a major health problem for older people, with 30-35% of those who live in the community falling at least once a year. ⁽⁵⁾ Mancini et al. stated in their study that 30-65% elderly and above have a few balance problems. Similarly, Sibley et al. Reported that in individuals with 75 years and above, at least 75% have postural stability problems.

The computer-aided or Biodex Balance System (BBS) has been designed to meet the needs of everyone looking to improve balance, increase agility, develop muscle tone and treat a wide variety of pathologies. Featuring easy-to-follow “touch screen” operation, the Balance System is simple to learn and operate, leading the user step-by-step through testing protocols and training modes in both static and dynamic formats. Extremely versatile, it is the only system that provides a fast, accurate Fall Risk Screening and Conditioning Program for older adults, closed chain, weight-bearing assessment and training for lower extremity patients, and adds the objective balance assessment component to a concussion management program. ⁽⁶⁾



The Balance System utilizes sensors under its platform to detect postural sway. The platform can be set disallowing movement (i.e., static); or where it can tilt (i.e., dynamic) to further challenge the patient. For a productive patient session, practice the adjustments and display selections that will be needed, and review the patient history. For a New Patient:

- Touch the keyboard or keypad icon to enter text and values in the fields.
- If the patient setup screen is being used, touch the appropriate Height icon for this patient.
- Touch the appropriate gender icon.



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- If the Additional information icon is enabled, touch the icon to display the Additional Information screen. Enter the information required by the site and touch <OK>.
- If Training or Testing mode has already been selected, touch <Next>to continue to specify the session, otherwise, touch<OK>⁽⁶⁾

Therapeutic balance training programme for elderly including dual and multi-task exercises, was designed and developed based on well-established principle of exercise and on the knowledge that balance control relies on the interaction of several physiological system, as well as interaction with environmental factors and the performed task. Balance training appears to be necessary to improve balance control. Balance demanding exercises, specific to the various components of balance control and to situations in daily life, were performed in sitting, standing and walking at three different levels of progression (basic, moderate and advanced)of increasing difficulty and complexity.⁽⁷⁾ Falls prevention exercise is currently considered the best approach for primary and secondary fall prevention at a population level, and well-designed exercise programs have been evidenced to prevent falls and injuries for community –dwelling elderly.⁽⁸⁾

Balance and postural instability are common problem in Elderly. Computer-aided Biodex system is used as an assessment tool in a range of different populations, but it has recently gained attention in balance training. It is a relatively new instruments and there is only a limited amount of published data regarding it use.⁽¹⁰⁾Therapeutic balance training exercises are used for balance training. There is rarely a comparative study between Biodex balance trainer and therapeutic training. Hence, I carried out this study.

METHODOLOGY

1. Study design: experimental pre and post comparative study
2. Location: Indian Head Injury Foundation (IHIF) New Delhi
3. Sampling method-Convenient sampling
4. Gender-both male and female
5. **Sample size:** 25 and each in every group

Criteria for sample selection

Participants of age group 60-70 with balance problem 25 is giving computer-aided balance trainer and 25 is giving therapeutic balance training.

Inclusion criteria.

1. Older adult with 60-70 age groups both male and female.
2. Older adult with balance problem.

Exclusion criteria,

1. Older adult with injury and acute pain.
2. Older adult with any acute fracture cases and other medical complications.

Materials/Instrument Used

1. Biodex Balance Trainer
2. Chair
3. Stop-watch
4. Step or stool

OUTCOME MEASURE

Fall Risk Test (Screening Tool)

The Fall Risk test identifies potential fall candidates. The test measures the patient's postural sway velocity to predict risk. Velocity is the speed of an individual's sway as balance is maintained. Test results are compared to age-dependent normative data. A high sway velocity when a patient is attempting to stand motionless suggests a deficit in postural control and assessment for lower extremity strength.

Berg Balance Scale (BBS)

The Berg Balance Scale (BBS) is a 14-item objective measure that assesses static balance and fall risk in adults. Items include static and dynamic activities of varying difficulty. Item-level scores ranges from 0-4, determined by ability to perform the assessed activity. Item scores are then summed. Maximum score=56.Equipment required for testing are a stopwatch or watch with a second hand, and a



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ruler or other indicator of 2,5 and 10 inches. Chairs used during testing should be of reasonable height. Either a step or a stool may be used for item#12. 15-20 minutes time is required. Interpretation,

41-56=low fall risk

21-40=medium fall risk

0-20=high fall risk

Timed UP and Go (TUG) Test

The Timed Up and Go (TUG) Test measure of function with correlates to balance and fall risk. Equipment required is stopwatch, standard chair, measured distance of 3 meters. Patient Instructions “My commands for this test are going to be ready, set, and go. You may use the arms of the chair to stand up or sit down. Therapist Instructions; Start timing on the word “Go” and stop timing when the subject is seated again correctly in the chair with their back resting on the back of the chair. Interpretations,

<_10 seconds=normal

<_20 seconds=good mobility, can go out alone, mobile without gait aid

<_30 seconds=problems, cannot go outside alone, requires gait aid.

❖ A score >_14 seconds has been shows to indicate high risk of falls.

PROCEDURE

- The proposal was approved by the Ethical Committee.
- Permission was taken from hospital for data collection.
- Patient was screened by the Fall risk test in Biodex balance trainer
- Informed consent was taken from patients.
- Firstly, patients were screened by screening tool (Fall risk test).
- Then selected patients were assessed with Berg Balance Scale, Time up and Go test.
- All participants at the beginning of the study were instructed in detail on how to perform the activities.
- Patients with balance problem with age 60-70 years were randomly allocated one of the two groups.
Group A-25 patients (Biodex Balance Trainer)
Group B-25 patients (Therapeutic Exercises)
- After the selection of subject, the program for each subject was 12 sessions with 3 sitting per week.
- After the completion of the 12 session each subject was re-assessed with Berg Balance Scale and Time Up and Go test.
- The data thus obtained was statistically analyzed.

TREATMENT PROTOCOL

Sessions-12 session of 30minutes was provided, 3days a week.

- **Exercises for Group A (Biodex Balance Trainer):**
- 1. Weight bearing training,
- 2. Weight shift training,
- 3. Postural stability training,
- 4. Motor control training,
- 5. Maze control training



- Exercises for Group B (Therapeutic Balance Training Exercises)
- 1. Weight bearing exercises,
- 2. Weight shift exercises,
- 3. Postural stability exercises,
- 4. Motor control exercises,
- 5. Maze control exercise





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DATA ANALYSIS

Data analysis was accomplished with the following software: SPSS (version-18), Microsoft Excel (Excel 2010). Unpaired-t-test was used to compare the efficacy of computer-aided (Biodex Balance Trainer) balance training versus therapeutic balance training exercises in elderly.

Paired -t-test for pre, post experimental, was used to determine, significant difference in balance training with Biodex balance-trainer. Paired-t –test for pre post experimental was used to determine significant difference in therapeutic balance training exercises.

Mean and standard deviation prior and after intervention were also calculated. The statistical analysis, a P- value equal to less than 0.05 was significant.

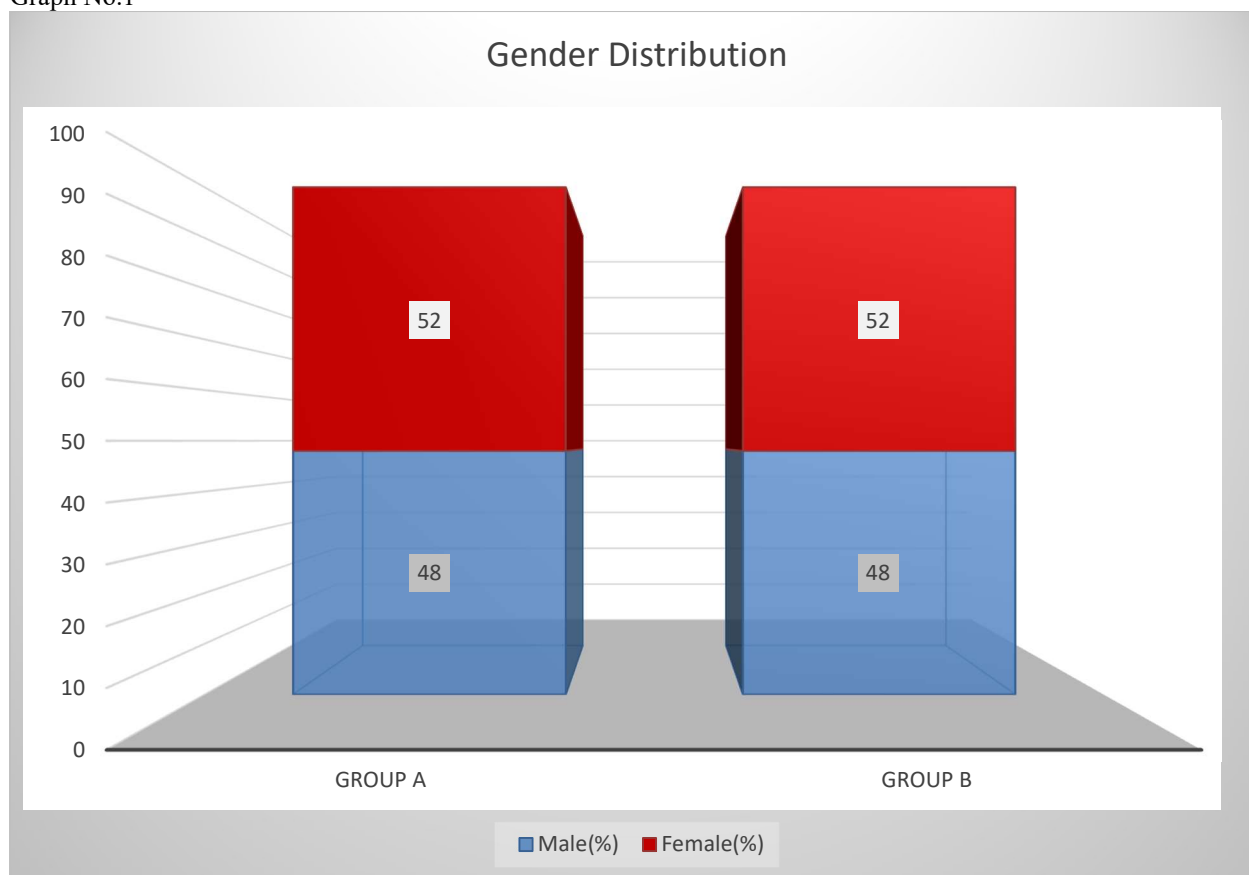
RESULT

25 subjects in both groups. 12 male and 13 female in both group A & group B. Paired-t-test was used for pre-post experimental group A group B. P value is <0.001. So, result is significant in both groups.

The comparison of both group A & group B done by using Unpaired –t-test was found statistically not-significant with P value greater than 0.05. It supports null-hypothesis. There is no difference between therapeutic balance exercises and computer-aided (Biodex) balance trainer both have same recovery.

GENDER DISTRIBUTION

Graph No.1



Graph-1 Compare the gender distribution between group-A & group-B

Group-A & Group-B has 48% male, 52% female. Both groups have 12 male and 13 female subjects.

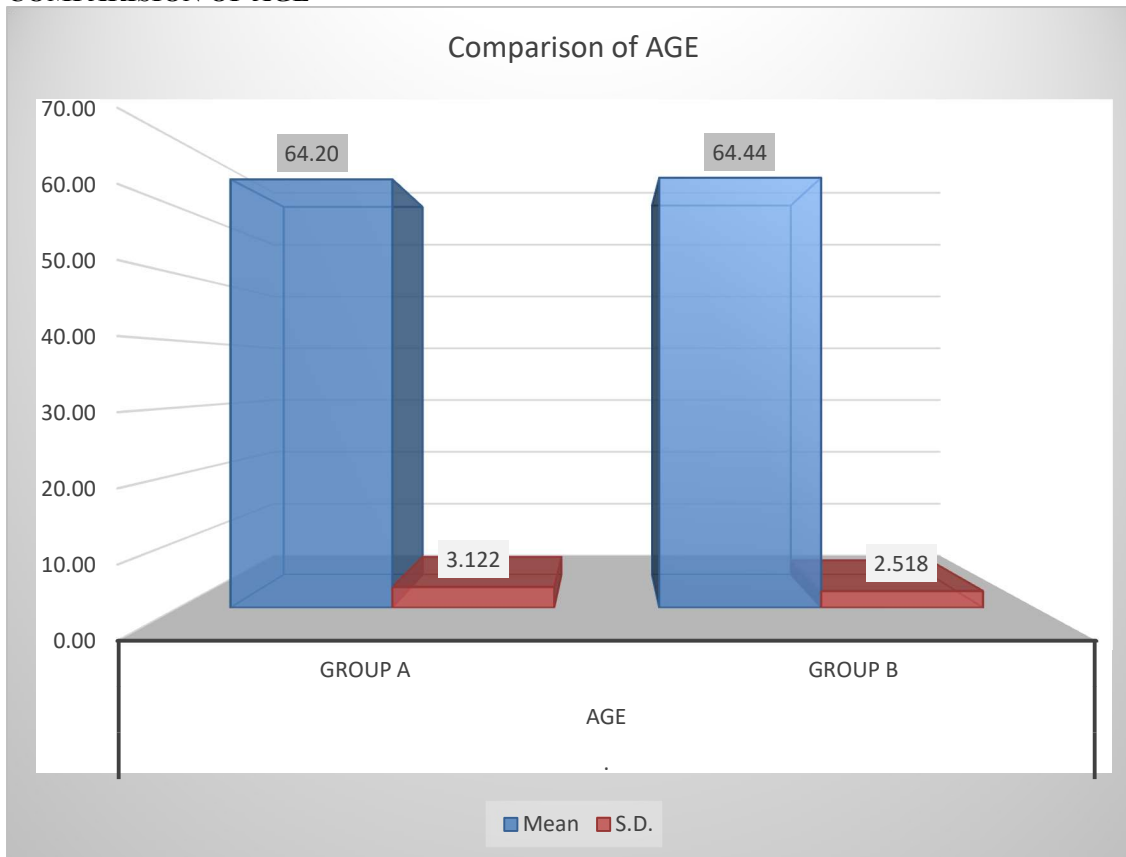


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COMPARISION OF AGE



Grpah-2 Comparison of age between the group-A & group-B

Group-A has mean value=64.09 & Group-B has mean value=64.30, and S.D value of group A has =3.232 & group-B has 2.420. P value=0.7975 p-value is greater than 0.05. So, comparison of is not significant.

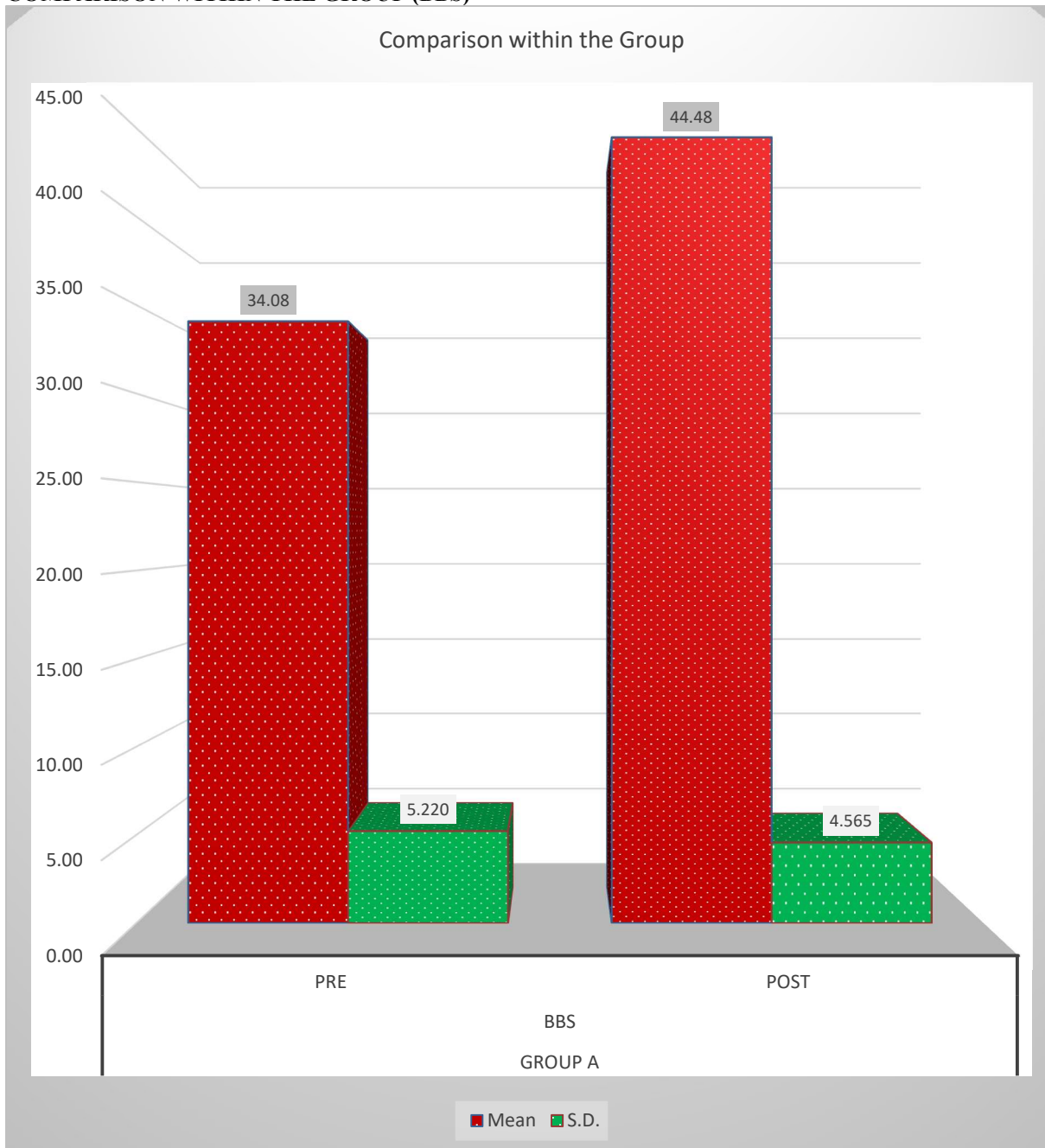


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COMPARISON WITHIN THE GROUP (BBS)



Graph-3 Comparison of group-A Pre & Post of Berg Balance Scale (BBS)

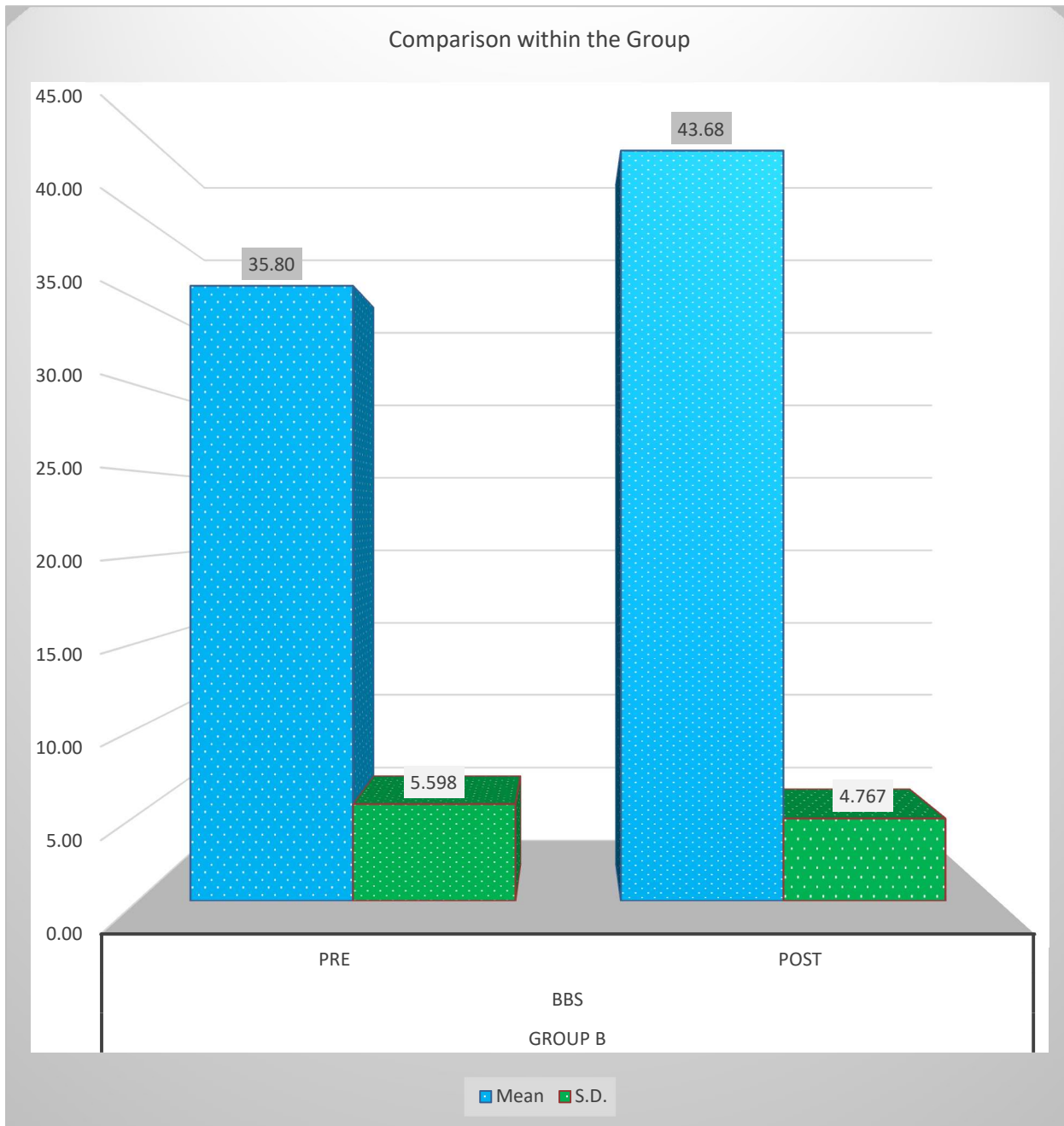
Paired-t-test is used for pre, post experiment. In this table pre mean score has=34.08 & post mean score has = 44.48 S. D pre score has = 5.220 & S.D post score is=4.565 P value=0.001. Result is significant.



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Graph-4 Comparison of group-B pre & post of Berg Balance Scale (BBS)

Paired –t-test is used for pre, post experiment. BBS shows a mean pre score 35.80&post score is 43.68 and pre S.D score 5.598&post S.D score 4.767.Pvalue is<0.001. Result is significant.



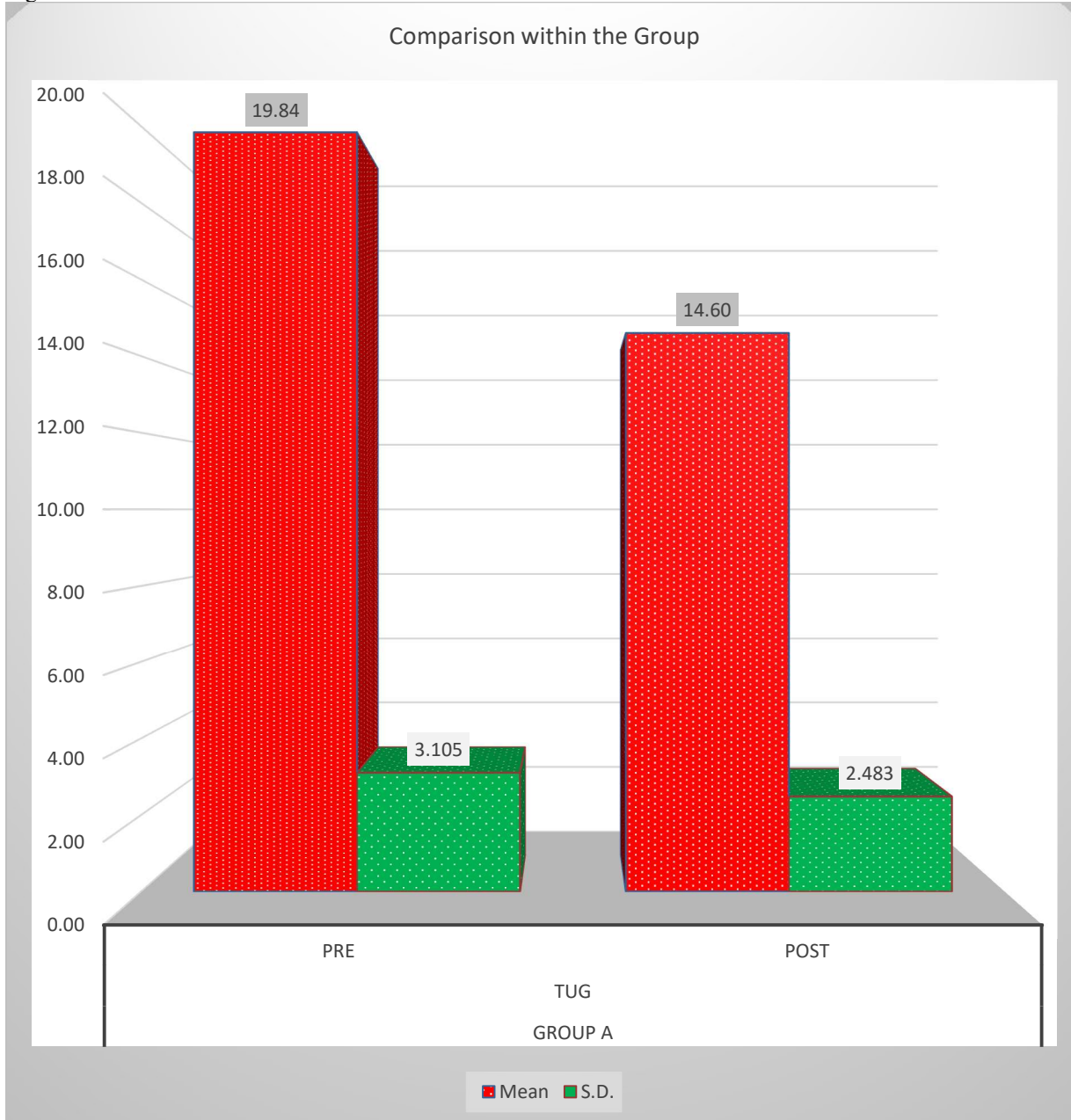
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COMPARISON WITHIN THE GROUP(TUG)

Figure No:



Graph-5, Comparison of group-A pre & post of Time Up and Go (TUG)test.

Paired-t-test is used for pre, post experiment. TUG shows a mean pre score 19.84, post score is 14.60& pre-S. D score is 3.105, post S.D score 2.483.P value is <0.001. Result is significant.

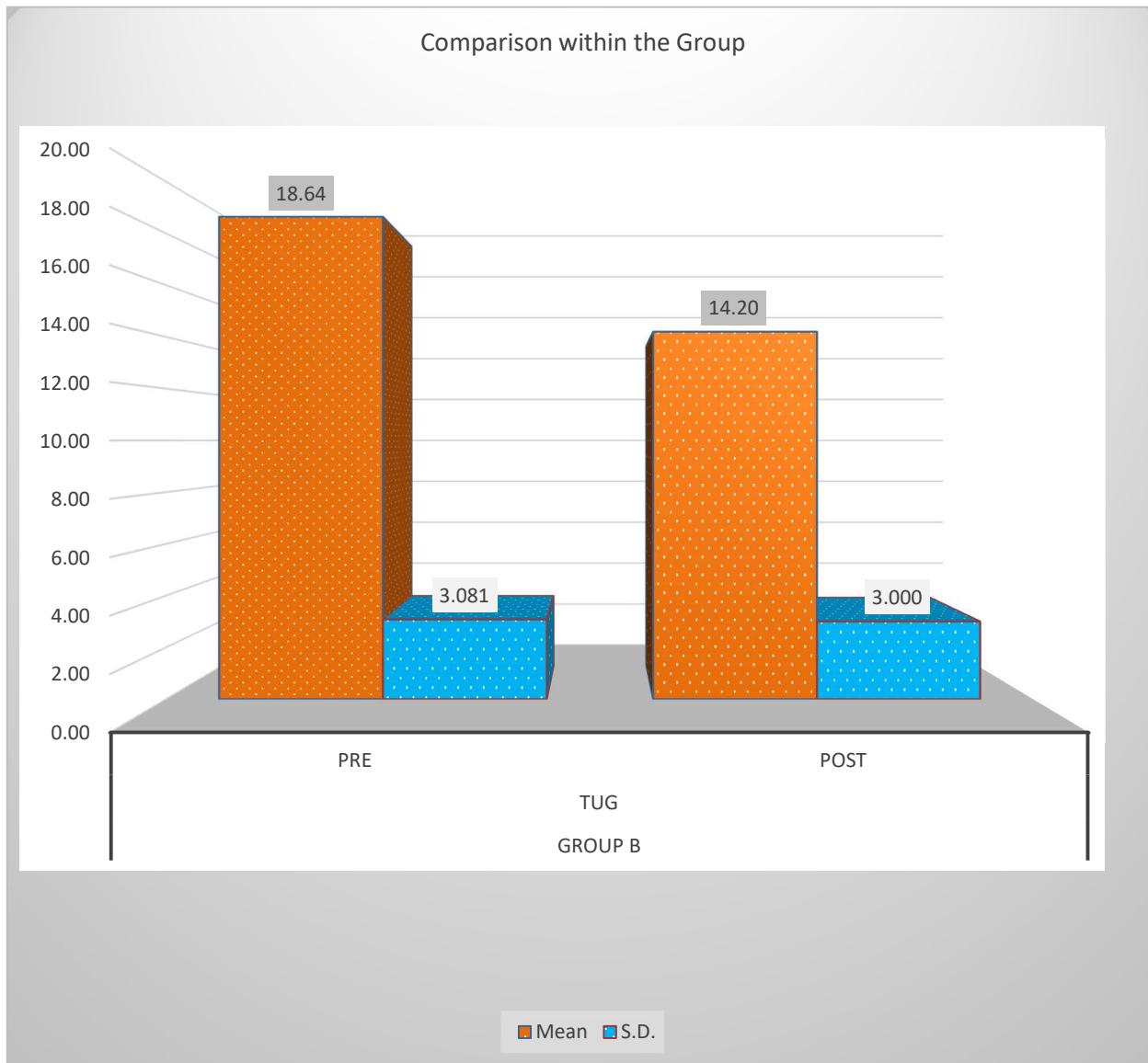
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Graph-6 Comparison of group-B pre & post of Time Up and Go (TUG) test.

Paired-t-test is used for pre, post experiment. TUG shown a mean pre score 18.64, post score is 14.20 and S.D pre score 3.081, post score 3.000. P value is <0.001. Result is significant.



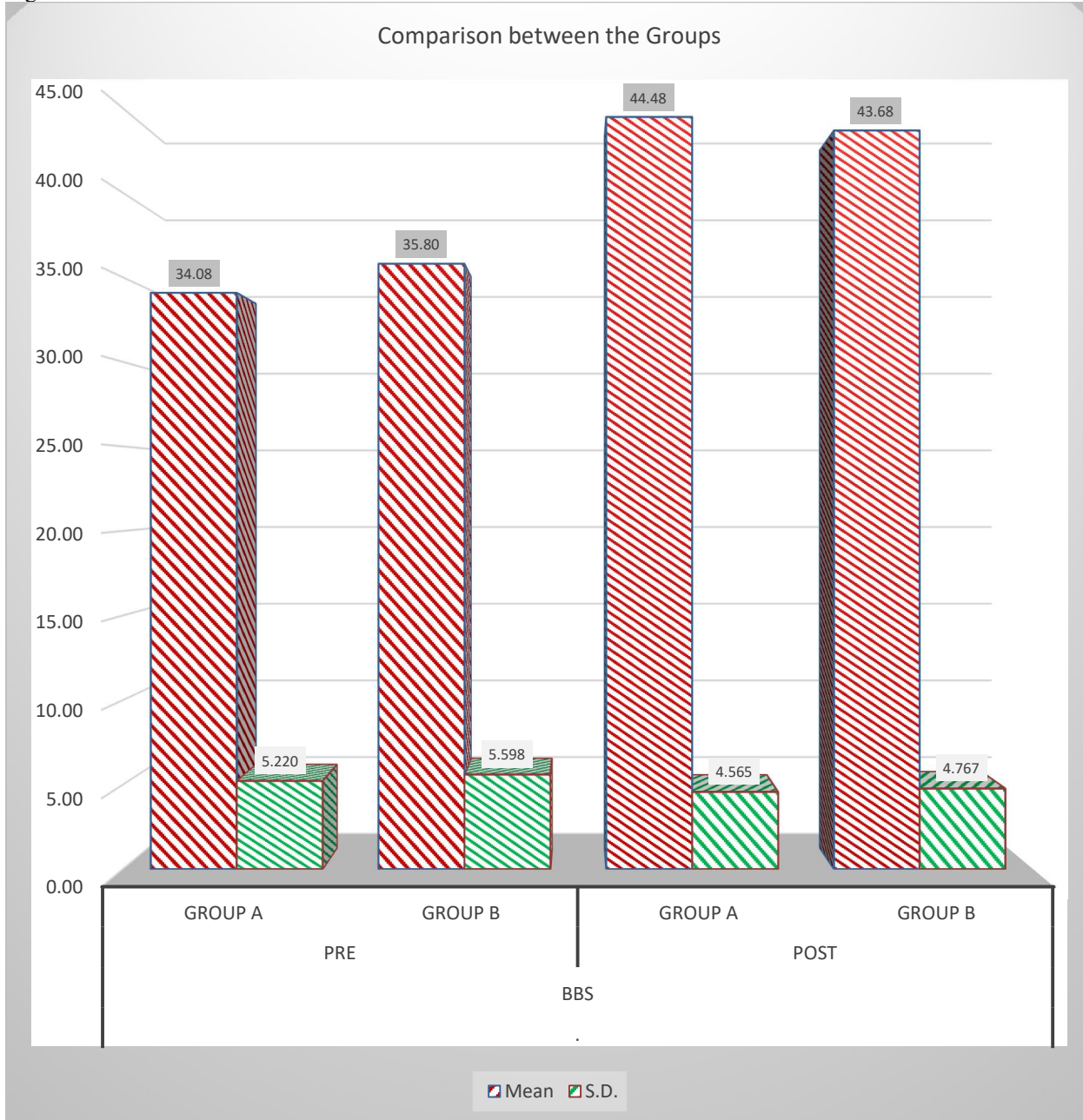
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COMPARISON BETWEEN THE GROUPS(BBS)

Figure No:

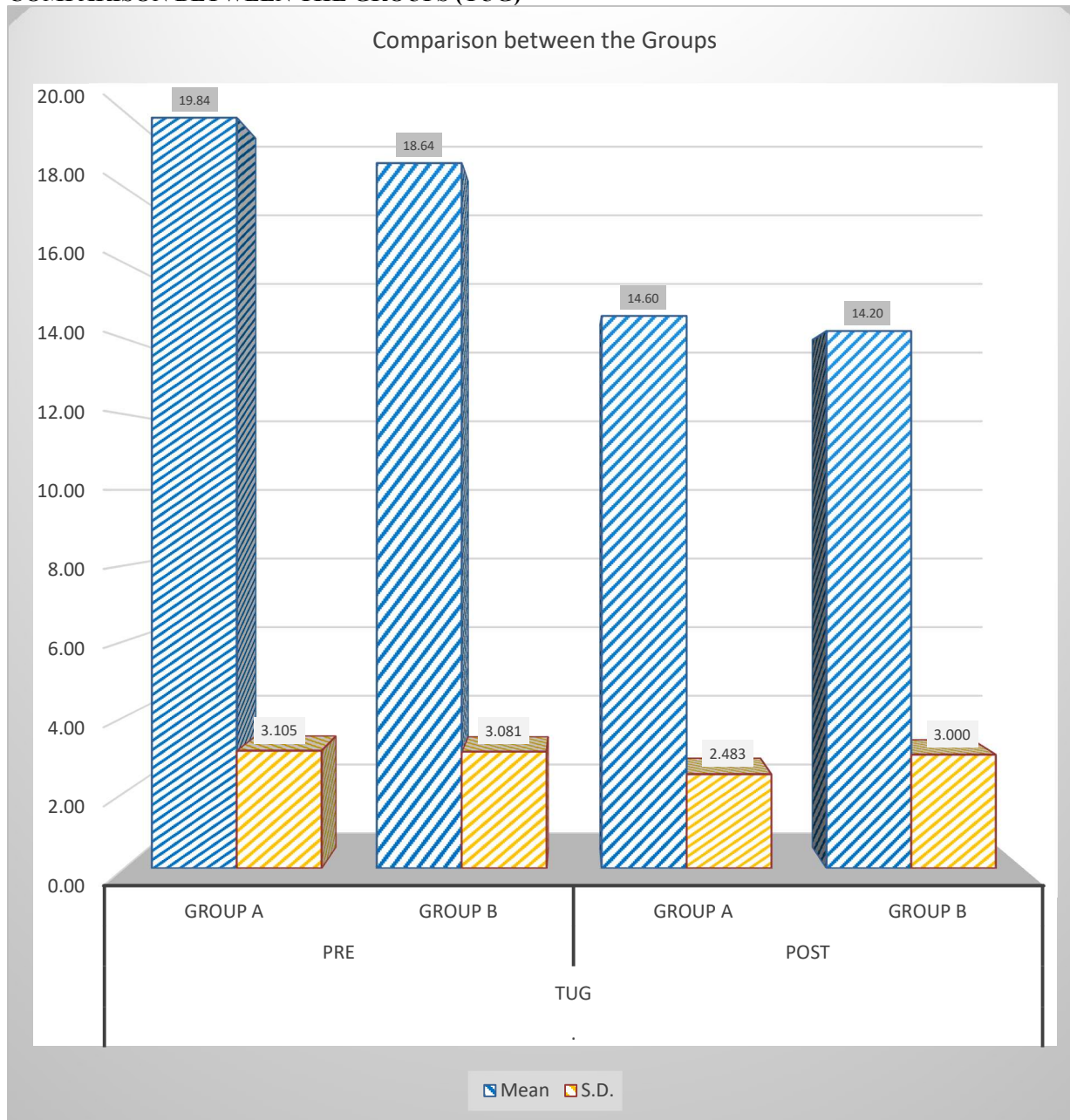


Graph no-7 Comparison between the group A group B (BBS)

Unpaired –t-test is used for comparison of both group A & group B. BBS pre mean score group A 34.08 and group B 35.80 and BBS post mean score group A 44.48 and group B 43.68. SD pre score group A 5.220, group B 5.598 and post SD score group A 4.565, group B 4.767. P –value for group A & B pre 0.2667 & post p-value for both group 0.5474. Result is not significant.



COMPARISON BETWEEN THE GROUPS (TUG)



Graph-8 Comparison between the group-A & group-B (TUG)

Unpaired-t-test is used for comparison of both groups. TUG pre mean score group A 19.84 & group B 18.64 and post group A 14.60, group B 14.20. TUG, S.D pre score group A 3.105 & group B 3.081 and post S.D score (TUG) group A 2.483, group B 3.000. Pre-P-value for group A & B 0.1765 and post P-value for group A & B 0.6099. Result is not significant.

DISCUSSION

The study was done on The Efficacy of Computer-Aided Balance Training Versus Therapeutic Balance Training Exercises in Elderly. Study population was 60-70 years elderly with balance issues. The result of this study shows not significant difference between the recovery of computer-aided (Biodex) balance trainer and therapeutic balance exercises. Both have almost same recovery



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with no significant difference. Computer-aided (Biodex) balance trainer has only slightly more recovery than therapeutic balance training exercises which was negligible.

In this study firstly patient age 60-70 years screening by the fall risk test in Biodex balance trainer. After that patient who are fall in this category with balance issues are selected and asses with Berg Balance Scale and Time Up and Go test. Between age group 60-70 years above 65 years have slightly more balance problem, and in compare to male, females are slightly more balance problem. Group A has 25 patients and group B has 25 patients with balance issue. They randomly allocated in both of the group. In both group 12 male and 13 female patients was there. In this study the group A given (Biodex Balance Trainer) and group B (Therapeutic Balance Training) exercises for 30 min, 12 session 3 days a week.

The results of the study were analyzed on SPSS version-18, paired-t-test were used by the statician. Both group A and B have same mean age. Group A 64.09 and group B 64.30, P value is greater than 0.05, comparision is not significant.

Group A (Biodex Balance training) Berg Balance Scale and Time Up and Go test score increase. Paired-t-test used for this experimental group result is significant with p value 0.001, supported by this article Bina Eftekhari Sadat, Roghayeh Azizi et al (2015)⁽¹¹⁾ & Maayken van den Berg, Maria Crotty et al (2016)⁽⁷⁾ Biodex Balance trainer increase the Berg Balance Scale and Time Up and Go score.

Group B (Therapeutic Balance training) Berg Balance Scale and Time Up and Go test score increase. Paired-t-test used for this experimental group result is significant with P value is <0.001, result is significant supported by article Anna Hafstrom, Eva-Maj Malmstrom et al (2016)⁽¹⁰⁾ & Ninik Murtiyani, Hartin Suidah et al (2019)⁽²⁾ balance exercises increase the Berg Balance Scale and Time Up and Go score.

Comparison between the group A and group B is done by Unpaired-t-test both outcome measure Berg Balance Scale and Time Up and Go test has p-value more than 0.05, result is not significant. Computer-aided (Biodex) balance trainer has only slightly more recovery than therapeutic balance training exercises which was negligible. Supported by article Manal. S. Ibrahim, Ayman. G. Matar et al (2016)⁽⁹⁾ & Tarek M. El-gohary, Fatma A. Hegazy et al (2017)⁽⁴⁾. Interest of the patient is altering between the session patient interest is high in starting of session in group A (Biodex Balance Training) but increase with session interest decrease. But in Group B (Therapeutic Balance Training) exercises interest was same and its increase with session and patient take more interest and actively participated in therapeutic exercises. Supported by article Alexendar Halvarsson, Ing-Mari Dohrn et al (2015)⁽¹⁶⁾ & Manal S Ibrahim, Ayman G Matar et al (2015)⁽⁹⁾.

LIMITATIONS OF STUDY

- Small sample size
- Duration of study was short
- Interest of the patient alter between the therapy session

CONCLUSION

Balance training with Biodex balance trainer and Therapeutics balance exercises improved Berg Balance Scale (BBS) and Time Up and Go (TUG) test and decrease the risk of falling in elderly age group 60-70 with balance problem. Both Biodex balance trainer and therapeutic exercise have almost same recovery in the elderly patient age group 60-70 with balance problem. Patients have earlier taken interest in the computer-aided balance trainer (Biodex) later then interest decrease with increase number of sessions. Vice versa Patient's interests are less in therapeutic balance training but increasing with number of sessions.

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