

**EFFECTS OF PROPRIOCEPTION TRAINING ON NECK
JOINT POSITION SENSE AND MUSCLE ACTIVITY AMONG
MALE MOTOR CYCLE RIDERS – A RANDOMISED
CONTROLLED TRIALS**

Dissertation Submitted to the

UTKAL UNIVERSITY

Bhubaneswar, Odisha

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In Partial fulfilment of the requirements for the degree of

MASTER OF PHYSIOTHERAPY (M.P.T)

In

ORTHOPEDICS

Under the guidance of

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ASSOCIATE PROFESSOR, HOD



ABHINAV BINDRA SPORTS MEDICINE & RESEARCH INSTITUTE

Bhubaneswar, Odisha

2022-2024



DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled “**EFFECTS OF PROPRIOCEPTION TRAINING ON NECK JOINT POSITION SENSE AND MUSCLE ACTIVITY AMONG MALE MOTOR CYCLE RIDERS – A RANDOMISED CONTROLLED TRIALS**” is a bonafide and genuine research work carried out by me under the guidance of **Dr. Asifiuzzaman Shahriyar Ahmed**, Associate Professor, HOD Abhinav Bindra Sports Medicine and Research Institute, Odisha.

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ACKNOWLEDGEMENT

First and foremost, I would like to sincerely thank God, my family, and my friends for their continuous support, compassion, and love. Throughout this academic path, their support has been a continual source of strength.

I would like to extend my gratitude to Dr. Apjit Singh Bindra, the esteemed chairman of ABSMARI. Many thanks to Padma Bhushan Shri. Abhinav Bindra, the founder of the Abhinav Bindra Sports Medicine and Research Institute in Bhubaneswar. I express my gratitude to Dr. Dighpal Singh Ranawat, our Executive Director of ABSMARI, as well as all those who have helped and mentored me during this dissertation process. This effort would not have been feasible without the invaluable inputs they provided.

I am also immensely grateful to Dr. Joseph Oliver Raj, the Dean, and Dr. Chinmaya Kumar Patra, the Principal, Abhinav Bindra Sports Medicine and Research Institute, Bhubaneswar. Your encouragement and belief in my abilities have been a source of motivation and confidence.

I would like to express my deepest gratitude to my dissertation guide, Associate Prof. Asifiuzzaman Shahriyar Ahmed, HOD, Abhinav Bindra Sports Medicine and Research Institute, Bhubaneswar. Your unwavering support, expert guidance, and insightful feedback have been instrumental in shaping this research. Your dedication to excellence in academia has inspired me to strive for higher goals in my academic pursuits.

I am also thankful to all the faculty members, staff, fellow students and subjects who have contributed to my academic growth and provided a stimulating environment for learning.

Last but not least, I want to sincerely thank my Family members whose efforts helped me get here. The basis of my journey has been their unfailing support and encouragement. A particular word of thanks also goes out to Dr. Debasis Behera, my best friend, whose friendship, guidance, support, and motivating presence have all helped greatly to develop my path and achievements.

In conclusion, this dissertation stands as a testament to the collaborative efforts of the individuals mentioned above, and I am deeply grateful for their contributions to my academic success.

Thank you.

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LIST OF ABBREVIATIONS

- SCM – Sternocleidomastoid muscle
- SPL – Splenius capitis muscle
- SSC – Semispinalis capitis muscle
- JPE – Joint position error
- EMG – Electromyography
- CS – Cervical spine
- MVC – Maximum voluntary contraction
- NPRS – Numeric pain rating scale
- BMI – Body mass index
- JPSE – Joint position sense error
- JPS – Joint position sense

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ABSTRACT

BACKGROUND- Motorcycle has been one of the vital modes of transportation worldwide. Neck pain and deficit in neck proprioception among motorcyclists shows 43% out of all the musculoskeletal problems faced by motor cycle riders during 25-32 years of age. In order to improve the neck proprioception various traditional neck exercises as well as proprioception exercises are proven successfully.

PURPOSE- The purpose of the study is to find out the effects of proprioception training on neck joint position sense and muscle activity among motor cycle riders.

METHOD- The study included 32 motor cycle riders and they were divided into two groups of Group A, Group B. The subjects in Group A were treated with neck exercises only, Group B were given neck exercises along with proprioception exercises. The treatment was given for 3 sessions per week for 4 weeks. All the subjects were assessed pre and post intervention program for joint position sense by JPE test and muscle activity by EMG study.

RESULT- Significant difference was seen within both the groups ($p < 0.05$). When compared between the groups, there was significant difference in cervical extension & cervical rotation to right ($p < 0.05$), but there was no significant difference in cervical flexion and cervical rotation to left between the two groups ($p > 0.05$) for JPE test. EMG study between two groups showed that there was significant difference among sternocleidomastoid muscle (SCM) both sides, semispinalis capitis muscle (SSC) both the sides and splenius capitis muscle (SPL) right side that is $p < 0.05$, however there was no significant difference found in splenius capitis muscle (SPL) left side that is $p > 0.05$.

CONCLUSION- The study concluded that both the traditional neck exercise and proprioception training improves neck joint position sense and muscle activity among male motor cycle riders. However, proprioception training showed more effective than traditional neck exercises in improving SCM, SPL (right), SSC muscle activity and joint position sense in extension and right rotation direction, but both exercises have equally effective in improving SPL (left) muscle activity and joint position sense in flexion and left rotation direction.

KEYWORDS- Cervical proprioception, surface EMG, Joint position sense, proprioception training

EFFECTS OF PROPRIOCEPTION TRAINING ON NECK JOINT POSITION SENSE AND MUSCLE ACTIVITY AMONG MALE MOTOR CYCLE RIDERS – A RANDOMISED CONTROLLED TRIALS

INTRODUCTION

Often referred to as a bike, the motorcycle is acknowledged as a significant mode of transportation because it can be used for off-road riding, long-distance riding, and racing, among other activities. Two-wheelers are the most popular means of transportation in Indian cities and rural regions because the country is still expanding and has congested streets, a shortage of parking spots, rising fuel prices, and limited spending power for transportation.¹ When it comes to sitting posture hazards, motorbike riders are comparatively more vulnerable than drivers of automobiles. Because the current motorcycle designs on the market lack elements that support riders in back-leaning postures, riders often experience lower back pain. The heavy weight of helmets and how they compress the rider's head can also be uncomfortable.

^{1,2}

We spend a significant amount of time driving because we are engrossed in life's bustle. A variety of health issues are also exacerbated by our uneven, pothole-filled roads, where the bitumen layer vanishes with even a little downpour. They particularly harm the musculoskeletal system, which includes the spine, neck, and back. Bad roads can lead to neck and back issues, especially for people who commute long distances every day. As it is, younger people are more impacted than the elderly, especially those in the IT sector and other outlying industries where people travel by car and use two-wheelers frequently.⁴ Worldwide, musculoskeletal disorders are a prevalent health issue that affects both the general public and those in the industrial sector. A serious health issue that lowers quality of life and increases morbidity, costs, and demand for medical care is musculoskeletal disorders. All age groups are affected by musculoskeletal discomfort, which typically recurs and becomes more frequent as one matures.³ To conclude, a high prevalence of musculoskeletal disorders exists among the occupational motorcyclist which affects the day-to-day activities of more

than one-third of them. The commonly affected area of the body is neck (42%), lower Back (51%), wrist (26%), upper back (22%), other areas that are involved while riding a motorcycle that causes discomfort are shoulders (20%), hip region (3%), knees (2%) and ankles (18%).^{1,3} Prevalence of neck proprioception among bike riders is very high. Considering the demanding nature of bike driving, where precise head and neck movements are required, evaluating neck proprioception is of considerable importance.⁵

Proprioception is the awareness of one's own body's position during movement, encompassing both movement and position sensation. Proprioception is a vital part of the sensorimotor system that plays a major role in balance and movement control. Balance is dependent on intricate connections between the proprioceptive, visual, vestibular, and other sensory systems. Different kinds of mechanoreceptors play specific roles for proprioceptive input in muscles, tendons, ligaments, joints, and skin.^{6,7}

The afferent pathway that contributes to movement and postural neuromuscular control is how ascending proprioceptive information gets to the central nervous system. Because of their rich proprioceptive system and considerable muscle spindle density, the cervical muscles are crucial for maintaining both static and dynamic postures with efficient motor control. This improved sensorimotor performance is a result of their rich proprioceptive system. Research has demonstrated that cervical position perception is essential for preserving joint stability in both static and dynamic situations, and that a compromised proprioceptive system predisposes patients to develop clinical discomfort.^{8,9,10}

Joint position error (JPE) is a measure of cervical proprioception expressed in degrees. It is more likely that position sensibility in cervical spine (CS) is impacted first by impairment in cervical muscles, joints, or capsules and then, secondarily, by changes in afferent proprioceptive tuning and integration if the non-specific nature of issues is combined with poor cervical proprioception. Impaired mechanoreceptor feedback in CS may lead to cervical muscle atrophy and degenerative changes in the joints, which could cause unpredictable "giving away."^{6,11}

Surface electromyography (sEMG) is the most popular and well accepted technique for obtaining muscle activation and, consequently, assessing its function. It assesses

the nerve-muscle response to both dynamic and static movements.¹² The signal collected during motion can be compared either to the maximum signal level collected during maximum voluntary contraction (MVC). One benefit of surface electromyography is that, unlike needle EMG, it is non-invasive, thus physiotherapists can use it without needing any further training. Nevertheless, sEMG can only be used on the surface muscles. Although some researches additionally examined the anterior scalene and neck extensors, sEMG can be used to evaluate the trapezius and sternocleidomastoid muscles in the neck region.^{12,13}

The primary responsibility of the therapist is to appropriately screen the athlete and treat the neck pain as well as neck proprioception in accordance with the bike riders. Some studies suggested that neck pain and proprioception can be rehabilitated by various physiotherapy intervention such as neck exercises, manual therapy, proprioception training, Craniocervical flexion training. However, there is a paucity of literature related to the effects of proprioception training to improve the proprioception and joint position sense among motorcycle riders.

NEED OF THE STUDY

- Motorbike riders are relatively more exposed to sitting posture hazard. Studies have shown that neck pain and impaired neck proprioception occurs in about 23.1% during motor cycle riding.
- Due to long distance driving, the load acting on cervical spine is higher which leads to impaired proprioception of neck. Studies suggested that people who suffer from impaired neck proprioception due to driving can leads to chronic and recurrent injury as the time progresses.
- Hence the need arises to study the effects of proprioception training to improve the proprioception and joint position sense among motorcycle riders.
- Once the effects of proprioception training have been identified, therapists may treat the ailment with ease using these manual approaches, which has superior results than using conventionally different techniques on the neck proprioception treatment.

AIM

To study the effects of proprioception training on neck joint position sense and muscle activity among motor cycle riders.

OBJECTIVES

- To find out the effects of neck exercises with proprioception training on joint position sense and muscle activity among motor cycle riders.
- To compare the effects of neck exercises with proprioception training to neck exercises alone on joint position sense and muscle activity among motor cycle riders.

HYPOTHESIS

- Null Hypothesis (H_0) - There will be no significant effects of proprioception training on joint position sense and muscle activity among motor cycle riders
- Alternate Hypothesis (H_1) - There will be significant effects of proprioception training on joint position sense and muscle activity among motor cycle riders

REVIEW OF LITERATURE

1. **Ullah Q F et al (2022)** in Research Square journal conducted a cross-sectional study, whose primary objective is to identify the musculoskeletal disorders among the occupational motorcyclists that affect muscular discomfort among motorcyclist. A total of 377 occupational motorcyclist having age 18 years above were included in the study. From the study they concluded that there is high prevalence of musculoskeletal disorders exists among the occupational motorcyclist which affects the day-to-day activities of more than one-third of them. The prevalence of neck pain and proprioception ranges 42% of total population.
2. **Siddapur T et al (2022)** in Acta Scientific Orthopaedics journal conducted a correlation study to find out the correlation between Pain and Disability in Cervical and Lumbar Spine in Two- Wheeler Riders Among Physiotherapy Profession. A total of 30 young adults with neck and low back pain between 20-30 years, Riding bike more than 1 year were assessed based on Neck Disability Index (NDI), Oswestry Disability Index and Numeric Pain Rating Scale (NPRS). From the study they concluded that There is a significant positive correlation between pain and disability of cervical and lumbar spine.
3. **Cheng C H et al (2009)** in Journal of Electromyography and Kinesiology conducted a observational study To investigate the position accuracy and corresponding cervical electromyographic (EMG) responses of the neck pain subjects during sagittal head-to-neutral tasks. A total 24 individuals were included in the study and divided into 2 groups. One group with chronic neck pain and second group with healthy subjects. The position accuracy was measured by the constant error, variable error, and root mean square error of joint angles during head-to-neutral tasks in flexion and extension directions. Surface EMG of neck flexors and extensors were analyzed by the voluntary response index, including the similarity index (SI) and electromyographic magnitude (MAG) of muscle groups. The results showed: (1) significantly larger constant error and root mean square error but similar variable error in patients compared with controls, (2) smaller SI but similar MAG in patients compared with controls, (3) greater synergistic/antagonistic NAIEMG in patients than controls. The findings suggested that young adults with

chronic neck pain exhibit proprioceptive dysfunction and altered EMG pattern during voluntary sagittal neck motions. This study provides guidelines which could lead to the development of therapeutic exercise programs

4. **Kumar S and Prasad N (2010)** in *Disability and Rehabilitation Journal* conducted a study to investigate EMG signals of cervical muscles in five directional from chronic neck pain patients and compare them with those of the healthy individuals. A total of 63 individuals with age group 18-65 included and divided into 2 groups. Both patients and controls performed the experimental activities of flexion, left anterolateral flexion, left lateral flexion, left posterolateral extension and extension. The controls consisted of 30 male and 33 female subjects with no history of neck pain in the past 12 months. Both patients and controls performed the experimental activities of flexion, left anterolateral flexion, left lateral flexion, left posterolateral extension and extension. The patients exerted to their 20% maximum voluntary contraction (MVC), pain threshold and pain tolerance levels in three separate contractions. Similarly, the control subjects exerted to their 20% MVC, 60% MVC and MVC in random order. The descriptive statistics for strength, normalised peak EMG, median frequency (MF), 10% frequency bands and their power were calculated. From the study they concluded that the patients of neck pain demonstrate lower muscle strength than normal. The EMG responses in patients are pronounced in some muscles than those of controls.
5. **Zuniga A F and Cote J N, (2016)** in *Journal Human factors* conducted an observational study to investigate effects of performing a 90-minute computer task with a laptop versus a dual monitor desktop workstation were investigated in healthy young male and female adults. Twenty-seven healthy participants (mean age = 24.6 years; 13 males) completed a 90-minute computer task while using a laptop or dual monitor (DualMon) desktop. Electromyography (EMG) from eight upper body muscles and visual strain were measured throughout the task. Neck proprioception was tested before and after the computer task using a head-repositioning test. EMG amplitude (root mean square [RMS]), variability (coefficients of variation [CV]), and normalized mutual information (NMI) were computed. The study concluded that compared to laptop, DualMon work is effective in reducing cervical muscle activity, dissociating cervical connectivity, and

maintaining more typical neck repositioning patterns, suggesting some health-protective effects.

6. **Abdelkader N A et al, (2020)** in Journal of Musculoskeletal and Neuronal Interactions conducted a study to examine the changes in pain, the severity of the neck disorder, craniovertebral angle, and muscle activity in young adults with forward head posture. Forty-five male and female subjects were evaluated pre, immediate after induction of fatigue, and after recovery. Isometric neck flexor muscle endurance test (NET) was used for the induction of cervical flexor muscle fatigue. Cervical proprioception was assessed by cervical joint position error test (JPET) via overhead laser pointer while postural stability was assessed by using (a) biodex balance system measuring “Overall stability index (OSI), Anterior/posterior (A/P) index and medial/ lateral (M/L) index,” (b) multidirectional reach test. The study concluded that neck posture correction exercises paired with kinesio taping or proprioceptive training are more effective at addressing pain, neck disorder, craniocervical angle, and muscle activity.
7. **Yoo H J et al (2018)** in Journal of International Academy of Physical Therapy Research conducted a study to examine the changes in pain, the severity of the neck disorder, craniovertebral angle, and muscle activity in young adults with forward head posture. A total of 37 University students in their 20s with forward head posture, including both male and female participants. Measurement of pain, NDI (neck disorder index) craniovertebral angle, and muscle activity were taken before and after the 6-week intervention period. The pain was measured using the visual analog scale. The severity of the neck disorder was measured using the NDI The craniovertebral angle was measured by taking a photo. The muscle activity was measured using surface electromyography. The study concluded that neck posture correction exercises paired with kinesio taping or proprioceptive training are more effective at addressing pain, neck disorder, craniocervical angle, and muscle activity.
8. **Afreen A et al (2023)** in Journal of Multidisciplinary Healthcare conducted a cross-sectional study to assess the connection between cervical ROM, neck proprioception, CVA, and QOL in bike drivers with neck pain compared to those

without neck pain so that the targeted interventions can be developed to enhance their well-being. A total of 100 bike drivers aged 20–50 years was conducted, split into two groups: those with neck pain (n=50) and those without neck pain (n=50). Cervical ROM was measured using a smartphone, neck proprioception was assessed through a head repositioning test, and CVA was determined using lateral-view photographs with a plumb line. The Short Form-36 (SF 36) questionnaire was employed to evaluate QOL. The study concluded that neck pain in bike drivers is linked to decrease cervical ROM, compromised neck proprioception, and reduced CVA. These factors correlate with a lower quality of life, both physical and mental domains. Interventions addressing these aspects may enhance the quality of life for bike drivers experiencing neck pain.

9. **Brindle T J et al (2005)** in *Journal of Electromyography and Kinesiology* conducted a study to determine if simple, shoulder movements use the dual control hypothesis strategy, previously demonstrated with elbow movements, and to see if this strategy also applies in the absence of visual feedback. Twenty subjects were seated with their right arm abducted to 90° and externally rotated in the scapular plane. Subjects internally rotated to a target position using a custom shoulder wheel at three different speeds with and without visual feedback. Kinematics were collected with a motion analysis system and electromyographic (EMG) recordings of the pectoralis major (PECT), infraspinatus (INFRA), anterior and posterior (ADELT, PDELT) deltoid muscles were used to evaluate muscle activity patterns during movements. The study concluded that EMG activity suggests no major difference in CNS control strategies in movements with and without visual feedback. Greater resolution with visual feedback enables the implementation of a dual control strategy, allowing greater movement velocity while maintaining accuracy.
10. **Kuroda N and Teramoto W (2021)** in *Experimental Brain Research* journal conducted to investigate the effect of kinematic parameters under a bike-riding situation and dynamic cues in proprioceptive/motor information of self-motion on PPS representation. A total of 24 students were participated in the study. Experiment 1 compared two conditions where participants did or did not pedal the

bike at a constant speed while observing an optic flow that simulated forward self-motion (pedalling and no pedalling). Experiment 2 investigated the effect of pedal resistances (high and low) while presenting the same optic flow as in Experiment 1. The study results suggested that proprioceptive/motor cues can contribute to the modulation of PPS representation, but dynamic information included in these cues may have little influence.

METHODOLOGY

Method of data collection

- **Study design:** A Randomized control trial study
- **Duration:** 4 months
- **Target population:** Male Motor cycle riders
- **Sources of data:** Utkal signature
- **Sample size:** 32 by using G*power 3 program with a power of 80%, effect size of 0.8, error probability of 0.05
- **Sampling design:** Probability sampling
- **Sampling method:** Simple random sampling method

INCLUSION CRITERIA

- Age – 21-35 years
- Only Male motor cycle riders
- Joint angle interpretation 7 cm
- Motor cycle riding experience ≥ 3 years
- Daily riding ≥ 20 Km

EXCLUSION CRITERIA

- Post surgical case (Neck)
- History of trauma, fracture
- Patient with neck pain (NPRS >4)

PROCEDURE OF DATA COLLECTION

After the approval from institutional ethical committee of Abhinav Bindra Sports Medicine and Research Institute (ABSMARI) Bhubaneswar, 32 subjects were selected according to the inclusion and exclusion criteria. Written consent was taken from all subjects. Subjects completed a baseline assessment of the following outcome measures; 1) Joint Position Error (JPE) test, 2) electromyography data (EMG), and 3) Numerical pain rating scale (NPRS). After the baseline evaluation, subjects were divided into two treatment groups by simple random method. Group A received neck exercise only whereas Group B received neck exercise with proprioception training. Subjects in all two groups were received the treatment for 3 days per week for a total duration of four weeks. After the 4th week of exercise program, subjects underwent reassessment of all outcome measures. The collected data was subjected to statistical analysis.

Application of Neck exercise

1. Static stretching of the neck



Figure 1: Static stretching of neck flexion



Figure 2: Static stretching of neck left side flexion



Figure 3: Static stretching of neck right side flexion

2. Active range of motion exercises of neck



Figure 4: Active range of motion of neck extension



Figure 5: Active range of motion of neck flexion



Figure 6: Active range of motion of neck rotation



Figure 7: Active range of motion of neck side flexion

3. Wall exercise- subjects were instructed to stand with one leg placed in front of the other. The arms and torso will be levelled and the chest faced towards the wall. The front knee is bent and the back leg is kept straight. Subjects were instructed to take turns with both sides for 30 repetitions are conducted for each side for a total of 60 repetitions.



Figure 8: Wall exercise

4. Head exercise- subjects were instructed to lie prone with the stomach on a gym ball and forearms placed on the ground. In this position, subjects were asked to extend their heads as much as possible so that the folding of the cervical vertebra could be felt for 30 repetitions.



Figure 9: Head exercise

5. Roll exercise- subjects were instructed to lie supine with a gym ball underneath their backs and legs extended straight. This posture was maintained for 10 minutes without change.



Figure 10: Roll exercise

OUTCOME MEASURES

1. Measuring Joint Position Error (JPE) test

- The subject was asked to sit with back support. The Target paper of the test was fixed on the wall about 90 cm from the subject's seat. The laser pointer was fixed on the highest point of the subject head.
- The subject was asked to fix his head at the center of target paper, initially with opened eyes, then the subject was asked to move his head in four directions to the right, left, upward & downward as much as he/she could and to attempt to return to the beginning point. Then with closed eyes.
- Then the distance between the starting center point and the point which subject reached was measured using a ruler by the therapist. The normal relocation is within 7 cm or less than 4.5 degrees (horizontal) from the starting point.



Figure 11: Measurement of JPE test

2. Application of EMG

For the study Octopus 8 Amplifiers, version 5.03 was used. Before application of EMG the skin surface was shaved and cleaned with alcohol swabs, and then the surface adhesive disc electrodes (10 mm diameter, and 20 mm inter-electrode distance) were applied. The reference electrode was placed on the acromion process

- For sternocleidomastoid (SCM), (major neck flexors) the electrodes were placed at lower 1/3 of the line connecting sternal notch and mastoid process
- For splenius capitis (SPL) (neck extensor) the center of the electrodes was located at the intersection of the C7-Ear line and the line of action for splenius muscles (posterior to the SCM)
- For semispinalis capitis (SSC) (neck extensor), the electrode pairs were centered around C2 level over the belly of the muscle



Figure 12: Application of EMG

MATERIALS USED

1. Examination couch
2. Pen and data collection sheet
3. Laser pointer light
4. EMG

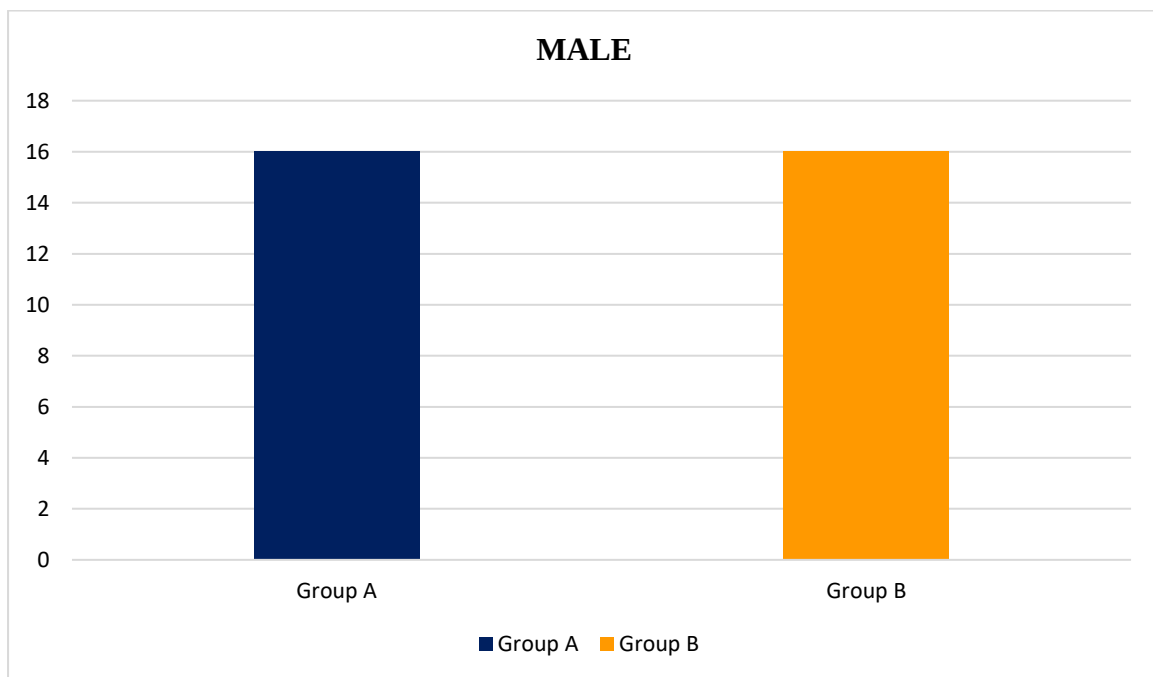
DATA ANALYSIS

1. GENDER DISTRIBUTION

A total number of 32 subjects were included for the study; all the subjects were male and divided into two groups each 16.

Table 1: Gender Distribution

Gender	Group A	Group B	Total
Males	16	16	32



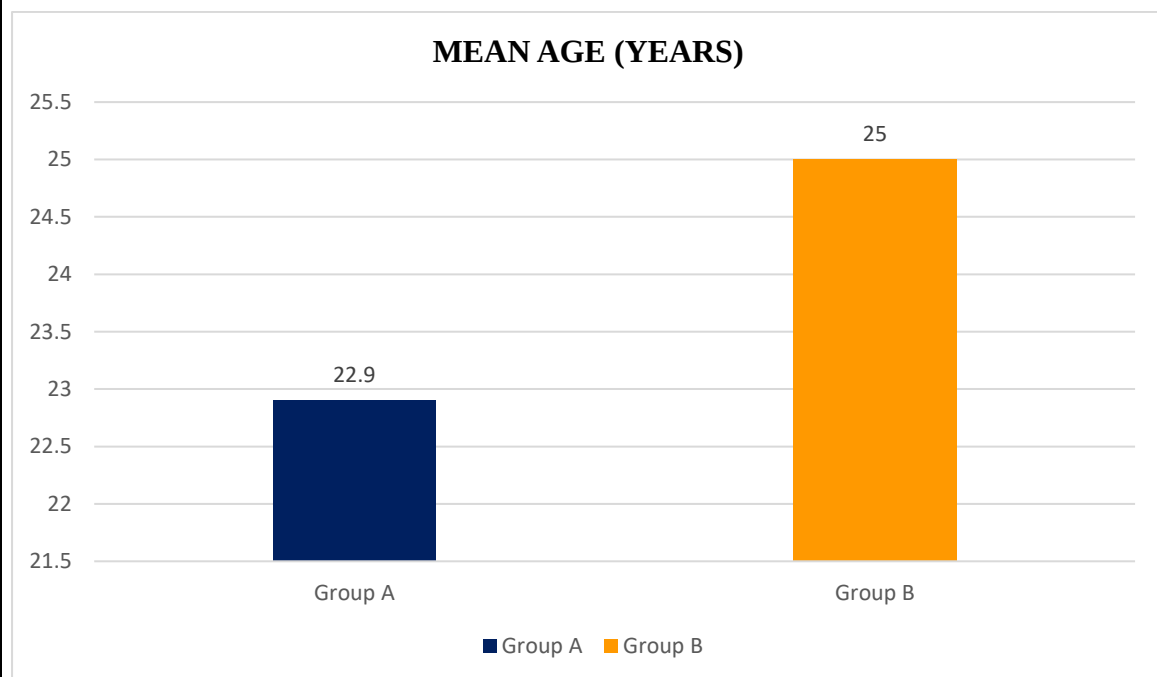
Graph 1: Gender Distribution

2. AGE DISTRIBUTION

Age group of all participants ranged between 21-35 years with the mean age among two groups was 23.9 ± 1.90 . There was no significant difference between two groups ($p = 0.946$).

Table 2: Age Distribution

Groups	Mean age (years) $\pm$ SD	P Value
Group A	22.9 ± 1.67	0.946
Group B	25.0 ± 1.51	



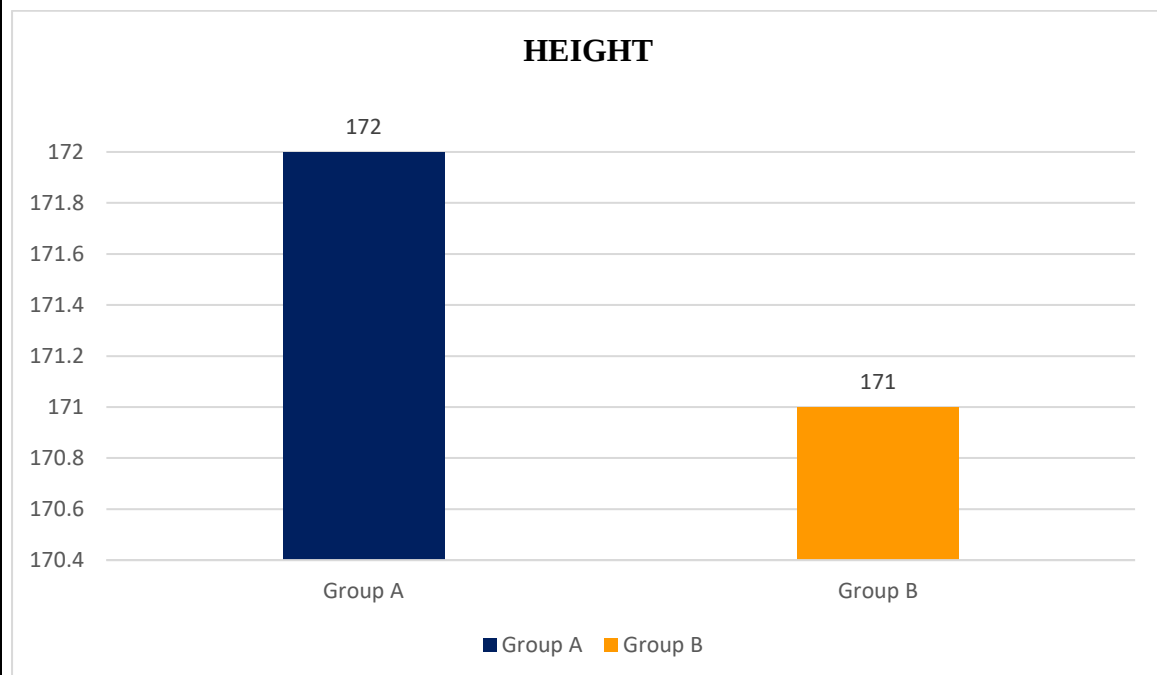
Graph 2: Age Distribution

3. HEIGHT DISTRIBUTION

Mean height of group A was 172 cm and group B was 171cm. There was no significant difference between two group (p= 0.953).

Table 3: Height Distribution

Groups	Height in cm	P Value
Group A	172 ± 6.08	0.953
Group B	171 ± 5.33	



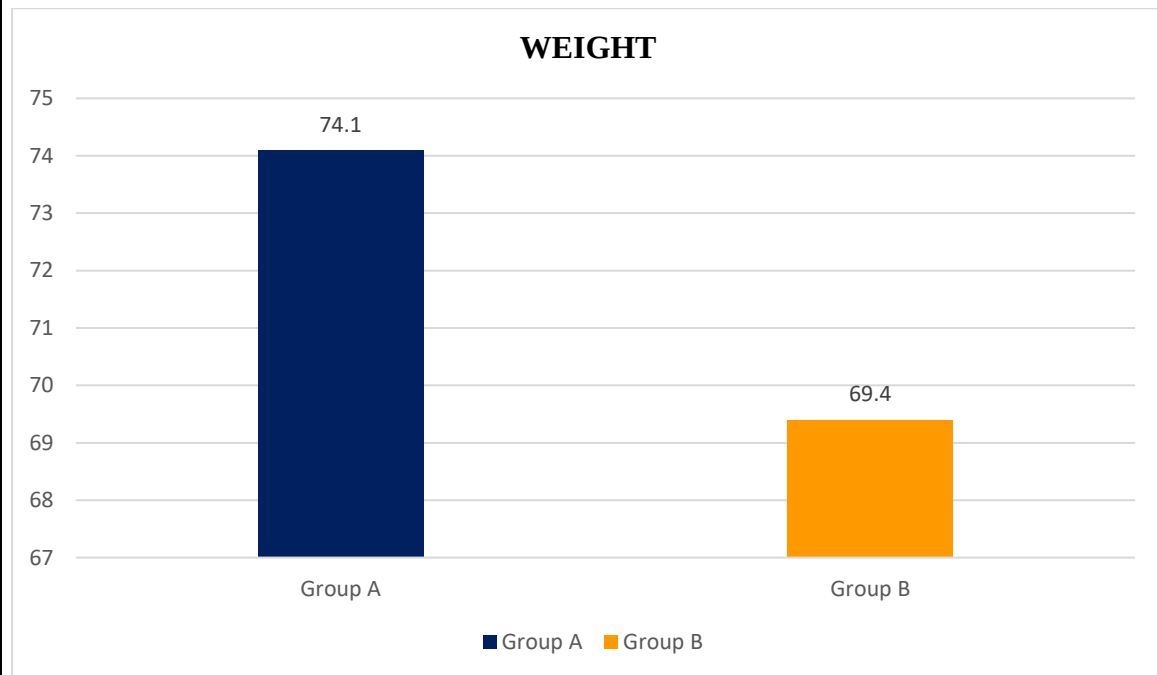
Graph 3: Height Distribution

4. WEIGHT DISTRIBUTION

Mean weight of group A was 74.1 ± 11.9 Kg and group B was 69.4 ± 10.8 Kg. There was no significant difference between two group ($p= 0.964$).

Table 4: Weight Distribution

Groups	Weight in Kg	P Value
Group A	74.1 ± 11.9	0.964
Group B	69.4 ± 10.8	



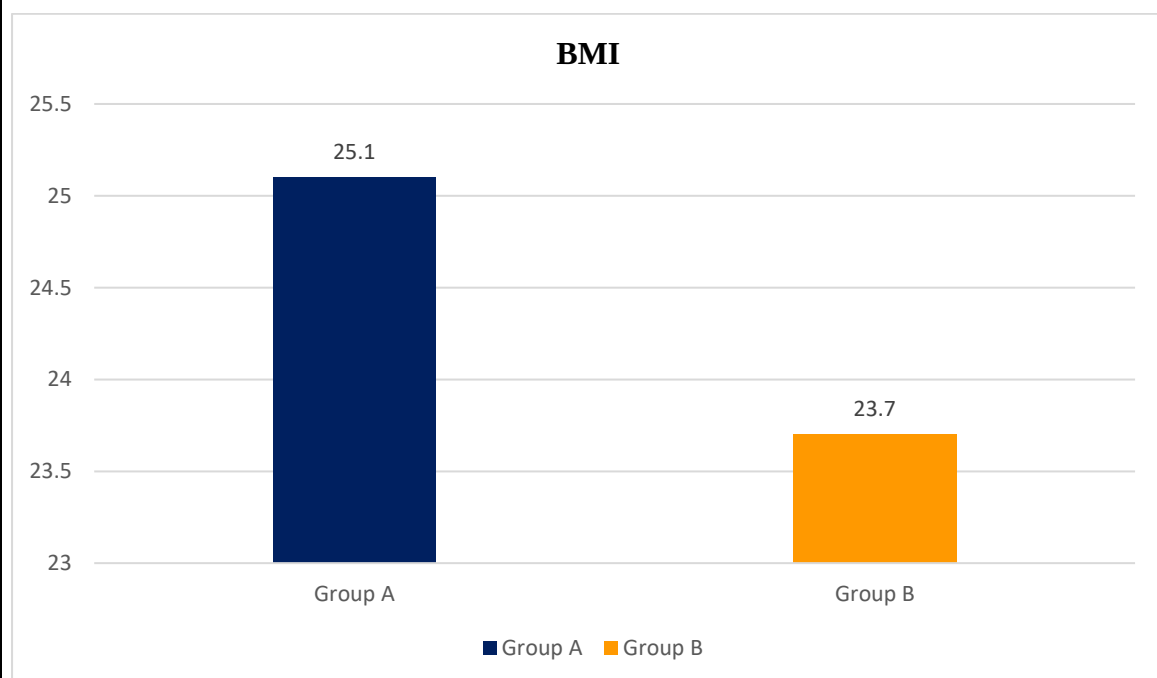
Graph 4: Weight Distribution

5. BMI DISTRIBUTION

Mean BMI of group A was 25.1 ± 3.38 and group B was 23.7 ± 2.84 . There was no significant difference between two group ($p= 0.959$).

Table 5: BMI Distribution

Groups	BMI	P Value
Group A	25.1 ± 3.38	0.959
Group B	23.7 ± 2.84	



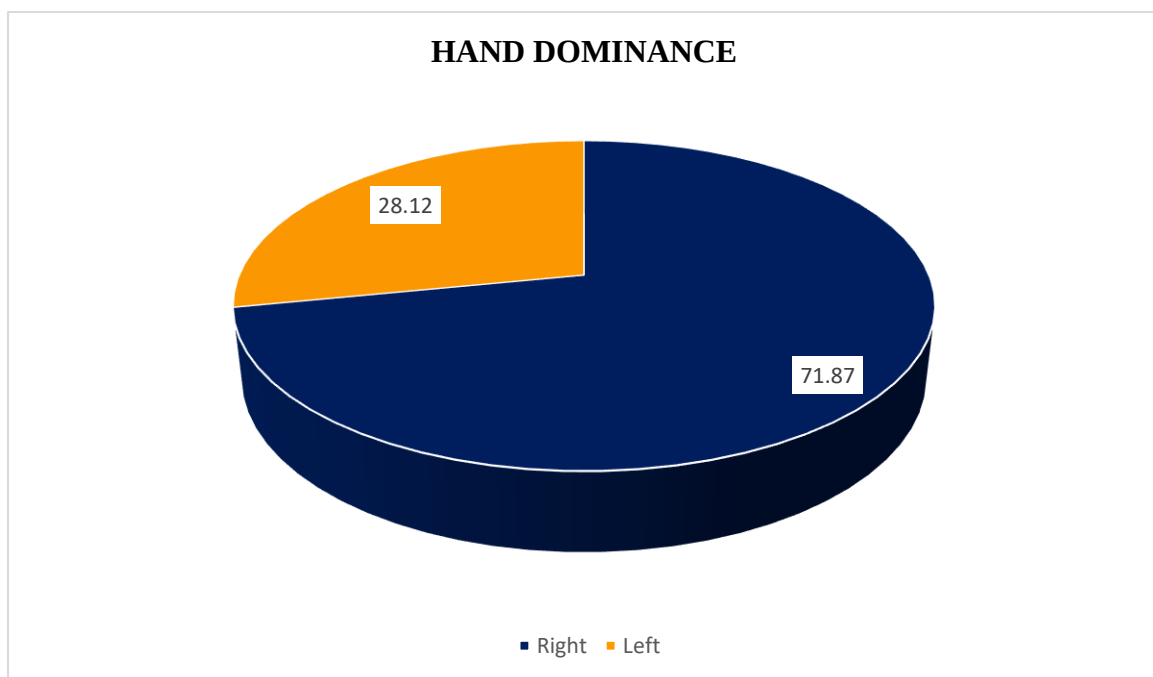
Graph 5: BMI Distribution

6. HAND DOMINANCE DISTRIBUTION

From total of 32 participants, there were 23 subjects with right arm dominant and 9 participant was left dominant. There was no statistically significant between three groups ($p=0.591$).

Table 6: Hand Dominance Distribution

Side	Group A	Group B	Total	Percentage	P Value
Right	11	12	23	71.87	0.591
Left	05	04	09	28.12	
Total	16	16	32	100	



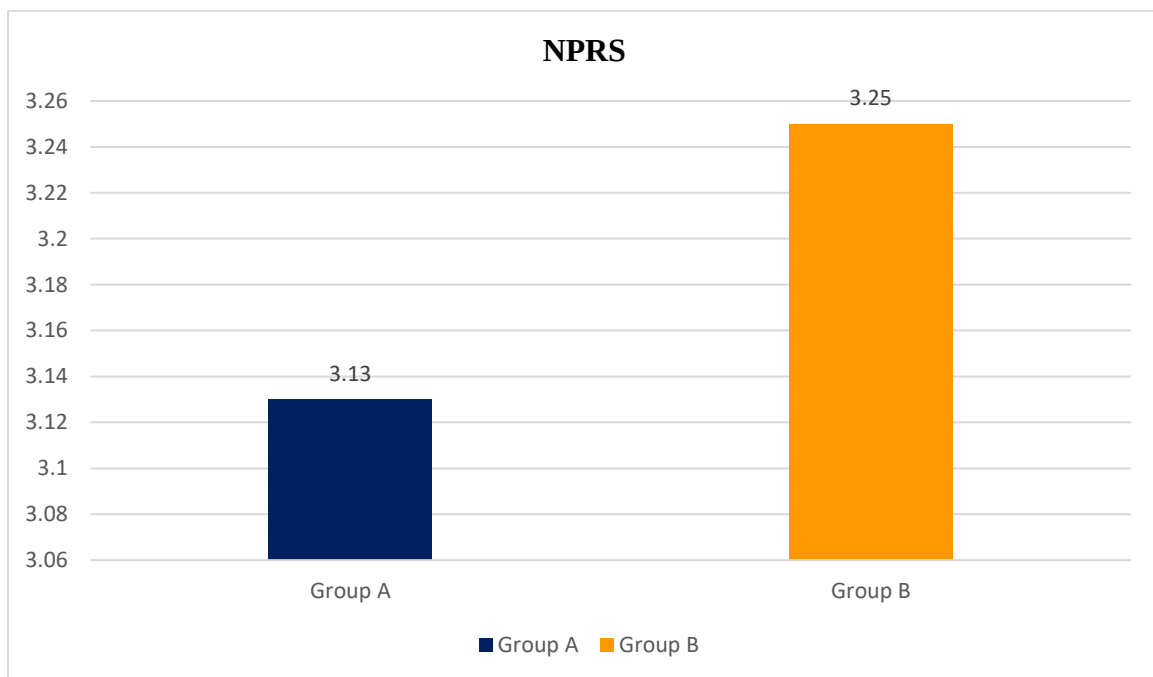
Graph 6: Hand Dominance Distribution

7. NPRS DISTRIBUTION

Mean NPRS of group A was 3.13 ± 0.719 and group B was 3.25 ± 0.577 . There was no significant difference between two group ($p= 0.542$).

Table 7: NPRS Distribution

Groups	NPRS	P Value
Group A	3.13 ± 0.719	0.542
Group B	3.25 ± 0.577	



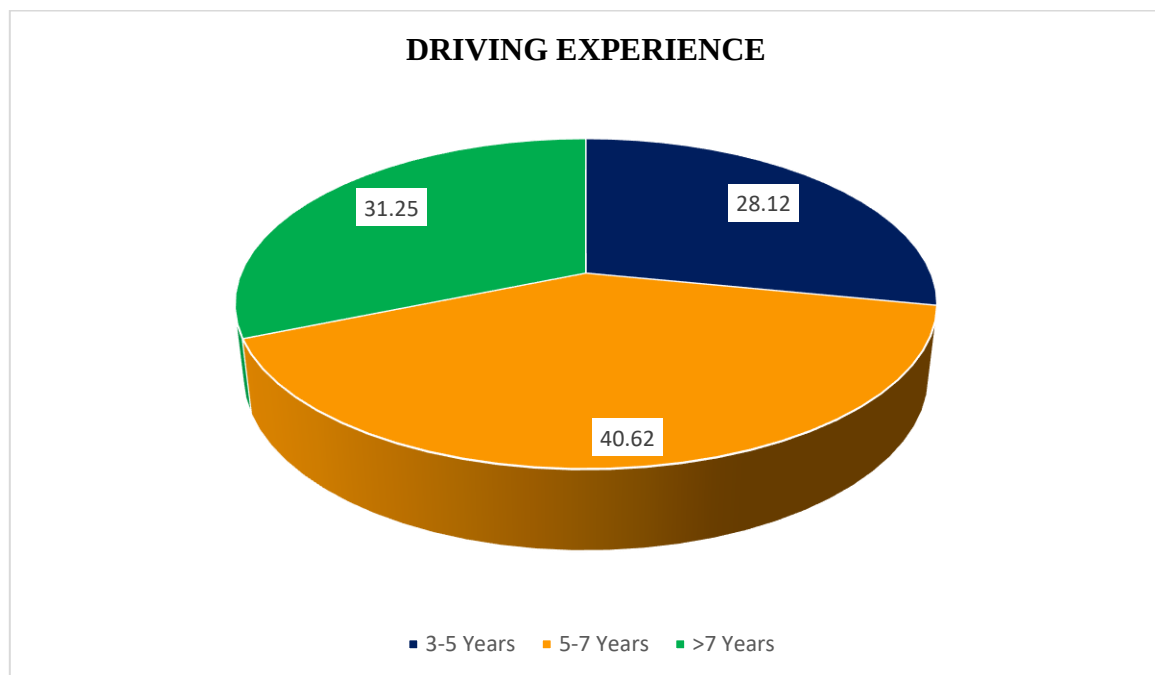
Graph 7: NPRS Distribution

8. DRIVING EXPERIENCE DISTRIBUTION

Mean driving experience of group A was 6.25 ± 1.61 and group B was 6.75 ± 1.65 . There was no significant difference between two group ($p = 0.940$).

Table 8: Driving Experience Distribution

Driving Experience	Group A	Group B	Total	Percentage	P Value
3-5 years	05	04	09	28.12	0.940
5-7 years	07	06	13	40.62	
>7 years	04	06	10	31.25	
Total	16	16	32	100	



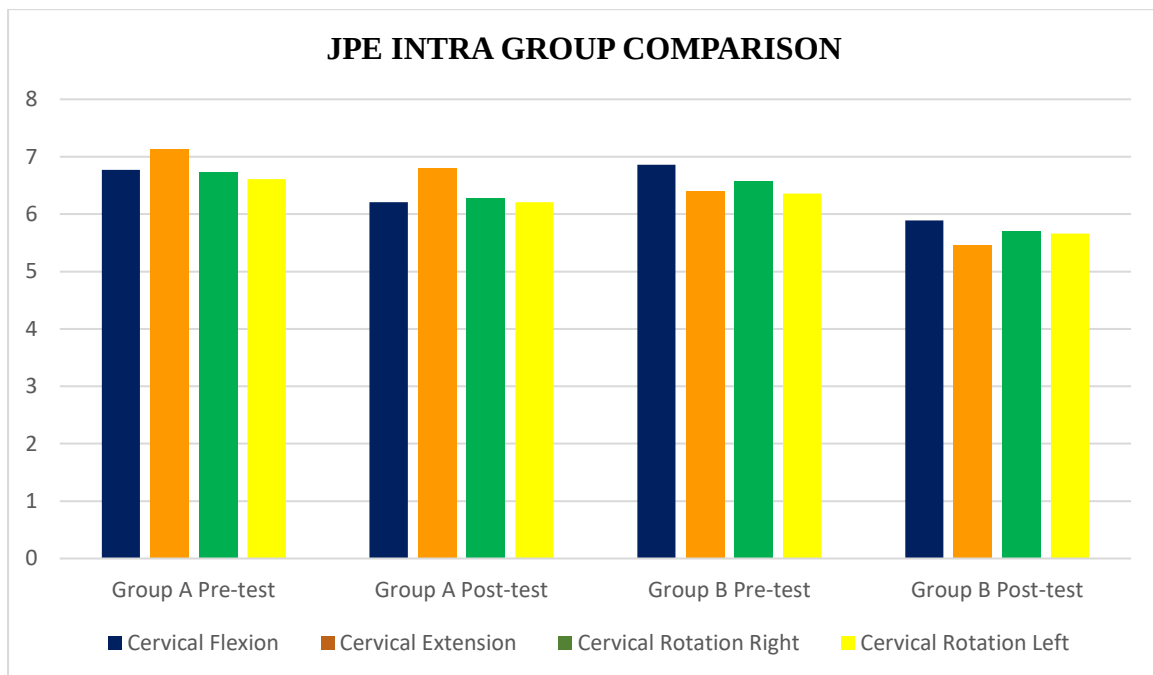
Graph 8: Driving Experience Distribution

INTRAGROUP COMPARISON

9. JPE TEST INTRA GROUP COMPARISON

Table 9: Paired t test for JPE test intra group comparison

Outcome Measure		Group A			Group B		
		Pre-test	Post-test	P Value	Pre-test	Post-test	P Value
Cervical flexion		6.77 ± 0.93	6.213±0.782	0.000	6.86±0.63	5.89±0.47	0.000
Cervical Extension		7.13 ±1.32	6.80 ± 1.90	0.002	6.4±0.63	5.46±0.33	0.000
Cervical rotation	Right	6.74±1.25	6.28±1.12	0.001	6.58±1.02	5.71±0.64	0.000
	Left	6.61±1.44	6.21±1.20	0.005	6.36±0.63	5.66±0.50	0.000



Graph 9: Paired t test for JPE test intra group comparison

The table and graph shows the comparison of mean and standard deviation of pre and post test vlues of two groups for JPE test.

In Group A, the mean cervical flexion on pre-test was 6.77 ± 0.93 which was increased to mean of 6.213 ± 0.782 post-test. The p-value was 0.000 which is extremely significant. The mean cervical extension on pre-test was 7.13 ± 1.32 which was

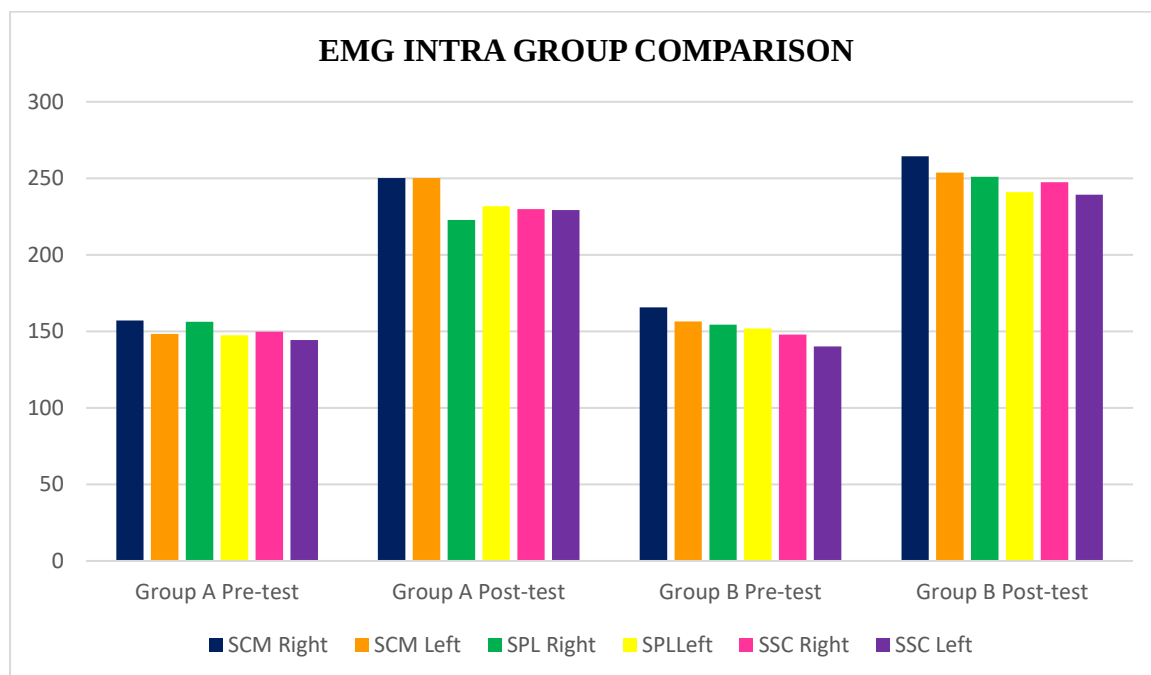
increased to mean of 6.80 ± 1.90 post-test. The p-value was 0.002 which is extremely significant. Similarly, the mean value of cervical rotation to left and right 6.61 ± 1.44 and 6.74 ± 1.25 respectively which were increased to 6.21 ± 1.20 and 6.28 ± 1.12 respectively in post-test. The p-value for cervical rotation left and right were 0.005 and 0.001 respectively which showed significant improvement.

In Group B, the mean cervical flexion on pre-test was 6.86 ± 0.63 which was increased to mean of 5.89 ± 0.47 post-test. The p-value was 0.000 which is extremely significant. The mean cervical extension on pre-test was 6.4 ± 0.63 which was increased to mean of 5.46 ± 0.33 post-test. The p-value was 0.000 which is extremely significant. Similarly, the mean value of cervical rotation to left and right 6.36 ± 0.63 and 6.58 ± 1.02 respectively which were increased to 5.66 ± 0.50 and 5.71 ± 0.64 respectively in post-test. The p-value for cervical rotation left and right were 0.000 and 0.000 respectively which showed significant improvement.

10. EMG INTRA GROUP COMPARISON

Table 10: Paired t test for EMG intra group comparison

Outcome measure		Group A			Group B		
		Pre-test	Post-test	P-value	Pre-test	Post-test	P-value
SCM	Right	157.06 ± 20.16	250.19 ± 21.03	0.000	165.75 ± 18.36	264.38 ± 8.63	0.000
	Left	148.38 ± 17.89	250.19 ± 21.03	0.000	156.50 ± 26.92	253.69 ± 9.27	0.000
SPL	Right	156.31 ± 18.65	222.69 ± 33.24	0.000	154.31 ± 15.70	251.0 ± 12.26	0.000
	Left	147.50 ± 18.39	231.75 ± 27.60	0.000	151.81 ± 32.51	240.88 ± 8.96	0.000
SSC	Right	149.81 ± 12.14	229.88 ± 38.33	0.000	147.94 ± 10.69	247.50 ± 9.27	0.000
	Left	144.44 ± 12.59	229.25 ± 39.10	0.000	140.25 ± 7.57	239.25 ± 5.55	0.000



Graph 10: Paired t test for EMG intra group comparison

The table and graph shows the comparison of mean and standard deviation of pre and post test values of two groups for EMG.

In Group A, the mean SCM right and left side EMG on pre-test were 157.06 ± 20.16 and 148.38 ± 17.89 which increased to mean of 250.19 ± 21.03 and 250.19 ± 21.03 post-test respectively. The p-value was 0.000 which is extremely significant. The mean SPL right and left side EMG on pre-test were 156.31 ± 18.65 and 147.50 ± 18.39 which increased to mean of 222.69 ± 33.24 and 231.75 ± 27.60 respectively in post-test. The p-value was 0.000 which is extremely significant. Similarly, the mean value of SSC right and left EMG on pre-test 149.81 ± 12.14 and 144.44 ± 12.59 which were increased to 229.88 ± 38.33 and 229.25 ± 39.10 respectively in post-test. The p-value was 0.000 which showed significant improvement.

In Group B, the mean SCM right and left side EMG on pre-test were 165.75 ± 18.36 and 156.50 ± 26.92 which increased to mean of 264.38 ± 8.63 and 253.69 ± 9.27 post-test respectively. The p-value was 0.000 which is extremely significant. The mean SPL right and left side EMG on pre-test were 154.31 ± 15.70 and 151.81 ± 32.51 which increased to mean of 251.0 ± 12.26 and 240.88 ± 8.96 respectively in post-test. The p-value was 0.000 which is extremely significant. Similarly, the mean value of SSC right

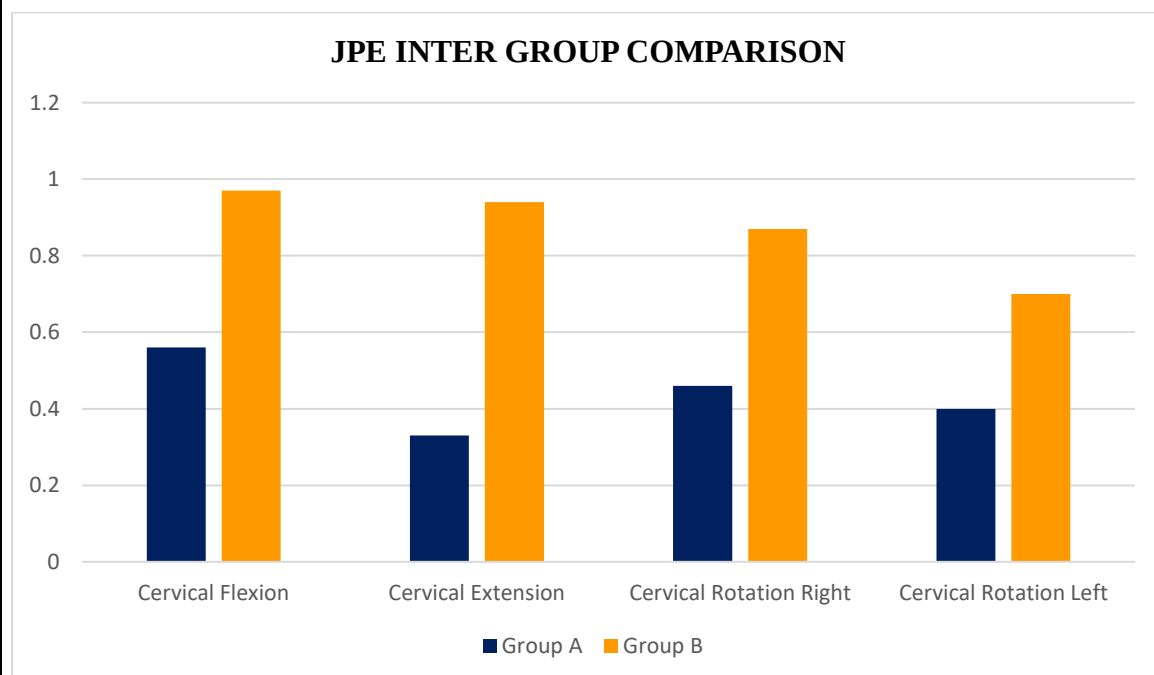
and left EMG on pre-test 147.94 ± 10.69 and 140.25 ± 7.57 which were increased to 247.50 ± 9.27 and 239.25 ± 5.55 respectively in post-test. The p-value was 0.000 which showed significant improvement.

INTER GROUP COMPARISON

11.JPE INTER GROUP COMPARISON

Table 11: Independent t test for JPE inter group comparison

Outcome measure	Group	Mean difference	P-Value
Cervical flexion	Group A	0.56	0.068
	Group B	0.97	
Cervical extension	Group A	0.33	0.000
	Group B	0.94	
Cervical rotation (right)	Group A	0.46	0.016
	Group B	0.87	
Cervical rotation (left)	Group A	0.4	0.230
	Group B	0.7	



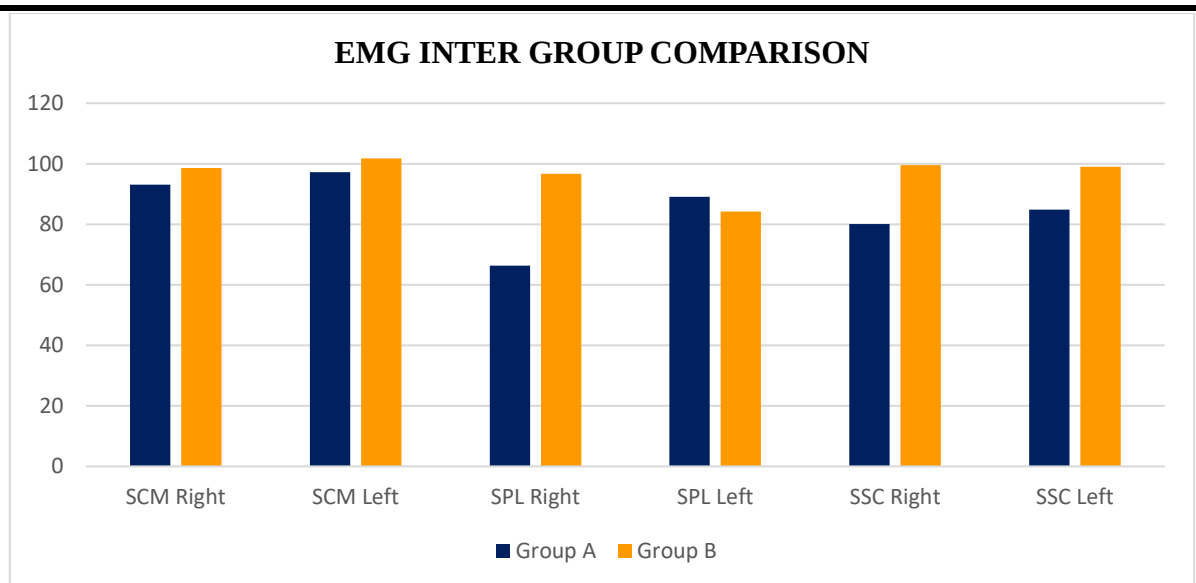
Graph 11: Independent t test for JPE inter group comparison

The table shows mean difference of mean values and standard deviation of JPE test for cervical in Group A and Group B. The mean difference among each group has been mentioned in the table. The values were compared by applying independent t test. From the statistical analysis it showed that there is no significant difference on cervical flexion and cervical rotation to left as per JPE measurements ($p > 0.05$) whereas there is significant difference on cervical extension and cervical rotation to right according to JPE test ($p < 0.05$).

12. EMG INTER GROUP COMPARISON

Table 12: Independent t test for EMG inter group comparison

Outcome measure	Group	Mean difference	P-Value
SCM (right)	Group A	93.13	0.000
	Group B	98.63	
SCM (left)	Group A	97.19	0.000
	Group B	101.81	
SPL (right)	Group A	66.38	0.002
	Group B	96.69	
SPL (left)	Group A	89.07	0.078
	Group B	84.25	
SSC (right)	Group A	80.07	0.000
	Group B	99.56	
SSC (left)	Group A	84.81	0.000
	Group B	99.0	



Graph 12: Independent t test for EMG inter group comparison

The table shows mean difference of mean values and standard deviation of EMG test for cervical in Group A and Group B. The mean difference among each group has been mentioned in the table. The values were compared by applying independent t test. From the statistical analysis it showed that there is no significant difference on left side SPL muscle as per EMG measurements ($p > 0.05$) whereas there is significant difference on both side of SCM muscle, both side of SSC muscle and right side of SPL muscle according to EMG test ($p < 0.05$).

RESULTS

In the study demographic data were found to be similar between the two groups. In our study Group A received neck exercises only whereas Group B received neck exercises along with neck proprioception training for a duration of three days per week for four weeks. Study results showed that there was significant difference pre and post scores in outcome measures within the two groups calculated by paired t test ($p < 0.05$). Independent t test was used to calculate pre and post significance between the groups in neck joint position sense through JPE test and muscle activity through EMG study. The results showed that there was significant difference in cervical extension & cervical rotation to right ($p < 0.05$), but there was no significant difference in cervical flexion and cervical rotation to left between the two groups ($p > 0.05$) for JPE test. EMG study between two groups showed that there was significant difference among sternocleidomastoid muscle (SCM) both sides, semispinalis capitis muscle (SSC) both the sides and splenius capitis muscle (SPL) right side that is $p < 0.05$, however there was no significant difference found in splenius capitis muscle (SPL) left side that is $p > 0.05$.

DISCUSSION

The present study was conducted to find out the effects of proprioception training on neck joint position sense and muscle activity among male motor cycle riders between 21-35 years age group. To our knowledge, this will be the first study to evaluate effects of the proprioception training on neck joint position sense and muscle activity among male motor cycle riders between 21-35 years age groups.

The baseline data were homogeneous with respect to gender, age, height, weight, BMI, hand dominance, Numerical pain rating scale (NPRS) and driving experience between both groups that is $p > 0.05$. A total of 32 male motor cycle riders included in the study and were divided into two groups ($n=16$). The mean age of participants in group A was 22.9, group B was 25. In the present study out of 32 participants, there were 23 subjects with right arm dominant and 9 subjects were left dominant. The mean BMI in group was 25.1 and in group B was 23.7. Out of 32 participants 9 subjects were having driving experience of 3-5 years, 13 subjects were having 5-7 years and 10 subjects were having >7 years of driving experience.

Our result showed that both the neck exercise group (Group A) as well as neck exercise with neck proprioception exercises group (Group B) improves the neck position sense and muscle activity among male motor cycle riders. However, the neck proprioception with neck exercises group (Group B) gave better results compared with neck exercises group (Group A) in improving cervical joint position sense for cervical extension & cervical rotation to right and cervical muscle activity scores for sternocleidomastoid muscle (SCM) both the sides, semispinalis capitis muscle (SSC) both the sides and splenius capitis muscle (SPL) right side but both group showed equal effectiveness in cervical flexion and cervical rotation to left for joint position sense and splenius capitis (SPL) left side muscle activity. However, even with the successful outcome of many studies the exact cause and effect is difficult to pinpoint. It could be suggested that proprioceptive training addresses pain indirectly by reinstating healthy neuromuscular motor patterns as well as increasing the sensory input. ^{14,15}

In our study, we used Joint Position Error test (JPE) to evaluate cervical joint position sense and cervical proprioception which is expressed in centimetres. The Joint Position Sense Error (JPSE) is considered the mainly essential measure to clinically operationalize cervical proprioception. Cervical Joint Position Error (JPE), is the ability to relocate the head to a beginning position following a dynamic active cervical range of motion. The JPE showed good reliability (ICC: 0.85) for right rotation and excellent reliability (ICC: 0.93) for flexion. Validity was weak to strong (r range: 0.26–0.83) and moderate to very strong (r range: 0.47–0.93) for absolute and constant error respectively, when tested in sitting. It was found that a laser strategy for assessing JPSE had a good test-retest reliability and a strong correlation for measuring JPSE.

16,17,18

Neck proprioception, crucial aspect of neck health, refers to the body's ability to perceive the position and movement of the neck. This sensory feedback mechanism is vital for maintaining balance, coordinating movements, and preventing injuries. Any impairment in neck proprioception can lead to a lack of precision in movements, increase the risk of injury, and exacerbate existing neck pain. Considering the demanding nature of bike driving, where precise head and neck movements are required, evaluating neck proprioception is of considerable importance.^{5,19,20} A number of studies have indicated that patients with chronic neck pain and neck proprioception may be associated with alterations in cervical motor behavior (timing and activation), a decrease in cross-sectional area of cervical muscles as well as muscular functional deficiencies in strength, endurance, precision and acuity, and range of motion. Neck pain may cause maladaptive strategies, change the neck muscle coordination, and reduce the specificity of neck muscle activation, for instance, through reduced activation of the deep segmental muscles and increased activation of the superficial muscles. As mentioned above, muscle spindles densely packed in the deep neck muscles are the main source of proprioception afferents in the neck. These structural and functional changes in the cervical deep and superficial muscles can change the discharge of muscle spindles, which affects the afferent input and leads to alterations in proprioception.^{21,22,23,24}

A randomized clinical trial evaluated the impact of balance training on JPS in patients with chronic neck pain, and found that joint repositioning accuracy was improved and

pain was reduced in the intervention group, while no effect was observed in the control group.²⁵

Another randomized control trial revealed that proprioceptive training with a gaze direction recognition exercise combined with conventional physical therapy was more effective than conventional physical therapy for patients with chronic neck pain in improving neck disability and balance.²⁶

In a doubleblind, randomized controlled trial, Saadat et al. demonstrated that sensorimotor training combined with traditional physical therapy exercises could be more effective than traditional exercise alone in improving JPS, endurance, dynamic balance, and walking speed in patients with chronic neck pain.²⁷

Izquierdo T G et al. 2016, in a comparative study demonstrated that cranio-cervical flexion training and proprioception training had a comparable effect on performance on the cranio-cervical flexion test. These results indicate that proprioception training may have positive effects on the function of the deep cervical flexors among patients with cervical neck pain.²⁸

The reasons for the poor position sense and abnormal EMG pattern in subjects with neck pain and proprioception among bike riders could be explained by the following mechanisms. The perception of egocentric space in adults includes kinesthetic information from visual input and vestibular afferents, as well as abundant muscle spindles and mechanoreceptors of the facet joint capsules in the neck region.²⁹ With normal visual and vestibular afferents, the peripheral proprioceptive inputs are relayed to the central nervous system for regulating joint movements through the activation of muscles. Recurrent episode of neck pain has reported to induce changes in the cervical mechanoreceptor function and to affect the muscle spindle sensitivity. A modified interpretation of neck proprioceptive signals in the center nervous system could also result in an offset in the egocentric reference frame and interfere with the central control over the activation of muscles.^{27,28,29}

CONCLUSION

The study concluded that both the traditional neck exercise and proprioception training improves neck joint position sense and muscle activity among male motor cycle riders. However, proprioception training showed more effective than traditional neck exercises in improving SCM, SPL (right), SSC muscle activity and joint position sense in extension and right rotation direction, but both exercises has equally effective in improving SPL (left) muscle activity and joint position sense in flexion and left rotation direction. Hence the study suggested that incorporation of proprioception training along with conventional therapy may be considered when designing a rehabilitation program for motor cycle riders.

LIMITATIONS

- Sample size of the study population was small (n=32)
- Only male motor cycle riders were included in the study

RECOMMENDATIONS

- Future studies can be done in large sample size
- Both gender motor cycle riders can be included in future studies
- Other form of proprioception can be included

SUMMARY

The study was conducted to find out effects of proprioception training on neck joint position sense and muscle activity among motor cycle riders. The study included 32 motor cycle riders and they were divided into two groups of Group A, Group B. The subjects in Group A were treated with neck exercises only, Group B were given neck exercises along with proprioception exercises. The treatment was given for 3 sessions per week for 4 weeks. All the subjects were assessed pre and post intervention program for joint position sense by JPE test and muscle activity by EMG study. After analyzing the data following conclusions were drawn:

Results showed that there was significant improvement in joint position sense and muscle activity in both the groups. However, proprioception training showed more effective than traditional neck exercises in improving SCM, SPL (right), SSC muscle activity and joint position sense in extension and right rotation direction, but both exercises has equally effective in improving SPL (left) muscle activity and joint position sense in flexion and left rotation direction. Hence the study suggested that incorporation of proprioception training along with conventional therapy may be considered when designing a rehabilitation program for motor cycle riders.

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ANNEXURE I

CONSENT FORM

TITLE OF THE STUDY:

“EFFECTS OF PROPRIOCEPTION TRAINING ON NECK JOINT POSITION SENSE AND MUSCLE ACTIVITY AMONG MOTOR CYCLE RIDERS”

Investigator: **PRAJNA PARAMITA ROUT**, Physiotherapist.

I, Mr. / Mrs., freely and voluntarily agree to participate in the research project.

PURPOSE OF STUDY

I have been informed that this study is going to find out the effectiveness of proprioception training on neck joint position sense and muscle activity among motor cycle riders. The result of this study might assist therapist to prevent future injury related to neck proprioception among motorcycle riders.

PROCEDURE

I understand that I will be assessed by **PRAJNA PARAMITA ROUT** and intervention will be performed on me. The intervention is explained to me in detail and it will take approximately 20-30 mins to complete the procedure. After the completion of intervention, on 4th week final measurements will be recorded.

RISK AND DISCOMFORTS

Prajna Paramita Rout will be monitoring me during the intervention session and will assist me in case I have any difficulty during therapy.

CONFIDENTIALITY

I understand that data collected during this study will be subjected to the confidentiality and privacy regulations of rehabilitation centre. If the data are used for publication in the medical literature or for teaching purpose, no names will be used, and other identifiers, such as photographs and audio or videotapes, will be used only with my special written permission.

REFUSAL OR WITHDRAWAL OF PARTICIPATION

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving my reason.

.....
Name of patient

.....
Date

.....
Signature

I have explained to Mr./Mrs.....in detail the purpose of the research procedure and the possible risks and benefits to the best of my abilities to which the subject has consented to participate.

.....
Researcher

.....
Date

.....
Signature

ANNEXURE II

DATA COLLECTION SHEET

Subject no. :

Age:

Gender:

Height:

Weight:

Hand dominance:

Driving experience:

NPRS:

Contact details:

Date of assessment:

Sl. No.	Outcome Measures		Pre intervention	Post intervention
1	JPE test	Cervical flexion		
		Cervical extension		
		Cervical rotation (Rt)		
		Cervical rotation (Lt)		
2	EMG	SCM (Rt)		
		SCM (Lt)		
		SPL (Rt)		
		SPL (LT)		
		SSC (Rt)		
		SSC (Lt)		

Signature of the investigator

Prajna Paramita Rout

ANNEXURE III

ETHICAL CLEARANCE CERTIFICATE



ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

ABSMARI/IEC/2023/061

Ref. No. _____

APPROVAL LETTER
APPENDIX- VIII

Date: 02/09/2023

To,

Prajna Paramita Rout
ABSMARI
273, PAHAL, BHUBANEWAR-752101

Protocol Title: Effects of Proprioception Training on Neck Joint Position Sense and Muscle Activity Among Male Motor Cycle Riders – A Randomised Controlled Trials

Protocol ID.: ABS-IEC-2023-PHY-024

Subject: Approval for the conduct of the above referenced study

Dear Mr./Ms./Dr **Prajna Paramita Rout**

With reference to your Submission letter dated 12/08/2023 the ABSMARI IEC has of the Ethics reviewed and discussed your application for conduct of clinical trial on dated 02/09/2023 (Sat Day).

The following documents were reviewed and discussed

S.N.	Documents	Document (Version/Date)
1	IEC Application Form	08-08-2023
2	Informed Consent Form	08-08-2023
3	Undertaking form PI	08-08-2023
4	CRF	08-08-2023
5	COI from the Investigators	08-08-2023

The following members were present at meeting held on 02-09-2023

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
1	Prof. Dr. E. Venkata Rao	Professor (MBBS, MD, Dept. of Community Med.) IMS & Sum Hospital, BBSR	Chair Person	M	N
2	Dr. Satyajit Mohanty	Director-Medcare Hospital, BBSR	Basic Medical Scientist	M	N
3	Dr. Ashok Singh Chouhan	PhD, Pharmacology, Assoc. Prof. Dept. of Pharmacology, Hi-Tech Medical College & Hospital, BBSR	Basic Medical Scientist	M	N

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ABSMARI ETHICS COMMITTEE

ABHINAV BINDRA SPORTS MEDICINE AND RESEARCH INSTITUTE,
BHUBANESWAR, ODISHA

Prof. (Dr.) E. Venkata Rao
Chairperson

Mr. Chinmaya Kumar Patra
Member Secretary

Ref. No. ABSMARI/IEC/2023/061

Date: 02/09/2023

MEMBERS

Dr. Smaraki Mohanty,
Clinician

Dr. Satyajit Mohanty,
Basic Medical Scientist

Dr. Ashok Singh Chouhan
Basic Medical Scientist

Mr. Shib Shankar Mohanty
Legal Expert

Ms. Annie Hans,
Social Scientist

Ms. Subhashree Samal,
Lay Person

Mr. Deepak Ku. Pradhan,
Scientific Member

IEC-SECRETARIAT

Mr. Gouranga Ku. Padhy
Mr. Susant Ku. Raychudamani

S.N.	Name of the Member	Designation & Qualification	Representation as per NDCT 2019	Gender (M/F)	Affiliation with the Institution (Y/N)
4	Dr. Smaraki Mohanty	Asst. Prof-IMS & Sum Hospital/MBBS, MD (Community Med)	Clinician	F	N
5	Mr. Chinmaya Kumar Patra	Principal-ABSMARI, MPT	Member Secretary	M	Y
6	Mr. Shiba Sankar Mohanty	Junior Counsel-Lt. Ramachandra Sarangi's Chamber / BA LLB	Legal Expert	M	N
7	Ms. Annie Hans	Disability Inclusive Development Co-Ordinator in Humanity and Inclusion (India/Nepal/Sri Lanka). /MA in Social Work	Social Scientist	F	N
8	Ms. Subhashree Samal	Ret. Reader-Pol Sc.	Lay Person	F	N
9	Mr. Deepak Kumar Pradhan	Asst. Prof-ABSMARI, MPT	Scientific Member	M	Y

This is to confirm that only members who are independent of the Investigator and the Sponsor of the trial have voted/ provided opinion on the trial.

This Committee approves the documents and the conduct for the trial in the presented form with necessary recommendation.

The ABSMARI IEC must be informed about the progress of the study, any SAE occurring in the course of the study, any changes in the protocol and patient information/informed consent and requests to be provided a copy of the final report.

The ABSMARI IEC follows procedures that are in compliance with the requirements of ICH (International Conference on Harmonization) guidance related to GCP (Good Clinical Practice) and applicable Indian regulations.

Yours sincerely

Mr. Chinmaya Kumar Patra
Member Secretary

ABSMARI Ethics Committee
Pahal, Bhubaneswar

Member Secretary

ABSMARI ETHICS COMMITTEE



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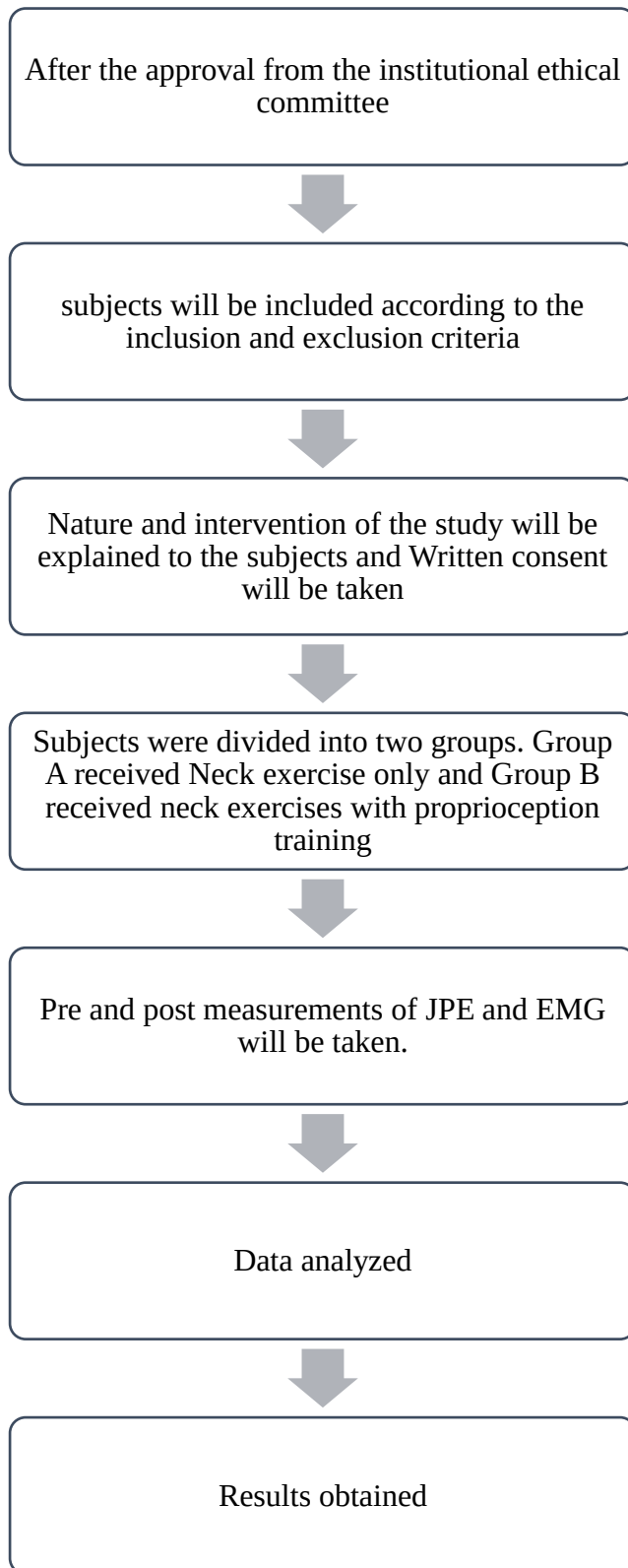
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ANNEXURE IV

PERFORMA PROTOTYPE



ANNEXURE V

MASTER CHART

Sl. No	Age	G	Ht	HD	Wt	BMI	NPRS	DE	PRE-TEST										POST-TEST									
									CF	CE	CR		SCM		SPL		SSC		CF	CE	CR		SCM		SPL		SSC	
											R	L	R	L	R	L	R	L			R	L	R	L	R	L	R	L
1.	25	M	165	1	85	31.2	4	4	7	6.4	5.6	5.5	170	164	154	145	148	146	6.8	5.8	5.4	5.5	235	189	194	215	198	196
2.	21	M	174	2	92	30.4	3	6	5.8	7.3	5.9	7.1	174	149	145	152	143	162	5.3	6.2	5.2	6.9	224	259	225	242	258	246
3.	21	M	166	1	68	24.7	3	5	5.5	6.7	7.2	6.7	154	165	152	135	178	168	5.5	5.9	7	6.5	244	265	192	225	178	186
4.	22	M	172	1	67	22.6	2	6	6	5.4	5.9	5.8	134	139	162	159	142	142	5.6	5.4	5.3	5.4	234	189	235	232	248	242
5.	21	M	170	1	62	21.5	2	7	6.8	9.2	6.4	5.2	164	155	164	156	158	149	5.8	8.7	6.4	5.2	264	255	164	256	258	196
6.	24	M	169	1	62	21.7	3	6	5.9	6	5.5	5.3	174	149	158	147	138	132	5.5	5.8	5.5	5.3	264	249	258	259	238	222
7.	23	M	187	1	97	27.7	4	9	7.5	11	10.5	11.4	139	134	141	129	147	139	7.2	10.6	9.2	10.3	274	245	254	235	268	296
8.	23	M	182	2	76	22.9	3	8	6.7	7.3	5.9	6.8	134	137	139	132	148	132	6.2	7.1	5.5	6.2	234	189	235	232	248	232
9.	21	M	167	1	73	26.2	2	3	6.8	6.9	6.8	5.7	174	165	194	185	157	146	5.9	6.5	7.3	6.4	274	265	294	205	158	176
10.	24	M	165	1	65	23.9	3	5	5.6	6.6	6.3	5.9	184	178	185	172	148	142	5.3	5.8	5.6	5.2	284	189	235	232	248	242
11.	21	M	173	1	92	30.8	3	7	5.9	6.4	6.5	6.7	154	148	184	175	169	166	5.4	5.8	5.5	6.2	224	218	184	225	198	296
12.	23	M	169	2	58	20.3	4	5	7.2	6.3	6.1	6.4	183	179	135	137	128	121	6.4	5.5	5.3	6.3	234	199	235	232	248	272
13.	25	M	169	1	68	23.8	3	7	7.8	7.5	7.9	6.9	176	134	154	132	148	146	6.6	6.9	6.8	6.1	285	215	194	232	198	196
14.	22	M	168	2	68	24.1	3	6	7.3	7.1	6.5	6.2	124	129	135	121	139	135	7	6.7	6.2	5.8	254	189	235	152	298	242
15.	24	M	174	1	72	23.8	4	8	8.7	7.4	6.7	7.5	138	125	164	152	158	146	7.5	7.1	6.6	6.4	238	275	194	272	188	176
16.	26	M	176	2	80	25.8	4	8	7.9	6.6	8.2	6.8	137	124	135	131	148	139	7.4	5.9	7.8	5.8	237	189	235	262	248	252

