

# Correlation Between Work Related Neck Pain and Hand Grip Strength Among Auto Rickshaw Drivers in Kolhapur City

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**Abstract—Background:** Work related musculoskeletal problems associated with the workplace typically arises from an imbalance between an individual physical capabilities and occupational demands. It depends on the physical attributes of the task, the environment, and the mechanical design of the work. Neck pain is one of the most common musculoskeletal problems that impairs quality of life. Mechanical attachment between neck and upper limb via skeletal, muscular, and neurological components as repetitive upper limb movement increases the mechanical stress on the neck, causing neck pain and neck muscle spasms. Hands are utilized for a range of tasks, including heavy lifting and fine motor skills. Excessive motion causes strain and overuse injuries. The intrinsic hand musculature becomes significantly weaker due to the involvement of cervical nerve roots and the hand grip muscles supplied by the cervical nerves, which causes the interosseous muscles atrophy. **Objective:** To find out correlation between work related neck pain and hand grip strength among auto-rickshaw drivers in Kolhapur city. **Methodology:** A cross-sectional study was carried out among 151 auto-rickshaw drivers of Kolhapur city age ranged from 25-35 years with no congenital musculoskeletal morbidities, previous neck surgery after fulfillment of inclusion and exclusion criteria. Neck Disability Index (NDI) was used to assess neck pain, numerical pain rating scale (NPRS) for pain intensity and hand grip strength was measured using Jamar hand dynamometer in kilogram (Kg) unit. **Results:** On data analysis result showed statistically significant very strong negative correlation between neck pain and hand grip strength with p value ( $p < 0.0001$ ). The Pearson co-efficient correlation between NDI and hand grip strength was 0.7768. **Conclusion:** This study concluded that neck pain and hand grip strength are

inversely correlated.

**Index Terms—**NDI, NPRS, Auto-rickshaw drivers, work related neck pain

## I. INTRODUCTION

The neck is a complex structure that connects the head to the torso. It consists of various muscles, bones, nerves, blood vessels, and other tissues. Key components include: **Vertebrae:** The cervical vertebrae (C1-C7) form the spine in the neck, providing support and protection for the spinal cord. **Muscles:** Several muscles control movement and support of the neck, including the sternocleidomastoid, trapezius, scalene, and platysma muscles. **Nerves:** Important nerves in the neck include the cervical nerves, which branch out from the spinal cord and innervate different regions of the neck and upper body. **Blood Vessels:** Major blood vessels in the neck include the carotid arteries, which supply blood to the brain, and the jugular veins, which drain blood from the head and neck [1]. The neck is the area between the clavicle and base of the skull. Despite its small size, this area possesses certain important anatomical characteristics [1]. One of the neck's many functions is to act as a nerve and circulatory conduit between the head and trunk. To assist the carotid and vertebral arteries carry significant amounts of blood throughout the brain due to its high metabolic needs. This blood returns to the trunk through large jugular veins. From a clinical perspective, the lymphatic

system in the region is important because it may reveal signs of head and neck infections <sup>[1]</sup>. Four muscles together referred to as the infrahyoid muscles are situated in the neck inferiorly to the hyoid bone <sup>[1]</sup>. Any pain around the occiput, third thoracic vertebrae, and laterally between the middle edge of the scapula are anatomical areas of concern known as neck pain <sup>[2]</sup>. If a patient experiences neck pain for longer than three months, it is deemed chronic. Spondylosis, spinal stenosis, disc herniation, stress, bad posture, and prolonged position are some of the conditions that can cause neck pain. Numerous symptoms, including headaches and neck soreness, pain between the shoulder blades, and arm issues like numbness or weakness, are linked to neck pain <sup>[5]</sup>. Neck pain is one of the most frequent musculoskeletal Problem. In the general population prevalence of neck pain ranges from 16.7% to 75.1% <sup>[3,4]</sup>. The research has reported that a high prevalence of work-related musculoskeletal disorders affects individuals in a variety of professions especially those with physically demanding occupations <sup>[4]</sup>. Handgrip is the term used to describe the static force that a hand may exert around a dynamometer. Hand grip strength is used to evaluate functional activity. Hand grip strength is measured in order to identify the entire upper arm strength <sup>[5]</sup>. Repetitive movements of wrist flexion and extension causing pain and fatigue <sup>[6,7]</sup>. Muscles of hand grip supplied by the cervical nerves and involvement of cervical nerve roots produces significant weakness of the intrinsic musculature of the hand and leads to atrophy of the interosseous muscles. Prolonged repetitive movements of flexion and extension of wrist leads to pain and results in reduction in the hand grip strength, overuse and strain injuries <sup>[8,9]</sup>. Previous research has shown that a number of factors such as age, gender and occupation, have an impact on hand grip strength. Some studies have shown that workers who exposed to more physically demanding repetitive activities tends to have lower hand grip strength subsequently causing strength deficit <sup>[10]</sup>. Auto-rickshaw drivers are susceptible to musculoskeletal disorders related to their jobs because of factors like vibration exposure, improper posture, and prolonged work hours. The driving includes sitting for longer hours in a fixed posture which applies ample amount of forces on spine <sup>[11]</sup>. Auto-rickshaws are common form of public transportation. However, drivers spend 8-10 hours

daily in traffic they work for longer duration and frequently sit with one to two passengers in front of them while adopting an awkward position that can put static strain on the spine and supporting tissues <sup>[11]</sup>. Driving is a task that requires extended periods of sitting in a fixed posture which can cause neck problems. Sitting for prolonged position exerts considerable forces on the cervical spine, body is subjected to different forces: acceleration and deceleration leads swaying of the body side to side, whole body up and down vibrations which causes pain, stress and reduced work capacity <sup>[12]</sup>.

## II. METHODOLOGY

The study protocol was presented for approval in front of institutional ethical committee and protocol committee of D. Y. Patil Education Society, deemed to be University, Kolhapur and D.Y. Patil college of Physiotherapy, Kolhapur and Ethical was granted by the committee. An Observational study was conducted in Kolhapur city among 151 auto-rickshaw drivers after that, consulting participants were approached the nature and purpose of the study were explained. A written as well as informed consent were taken for all the participants. A data collection sheet was prepared and distributed to each of them. A brief demographic data including name, age was collected using data collection sheet. The study excluded participants with congenital musculoskeletal morbidities, previous neck surgery and any medical condition affecting cervical spine. Participants were selected according to the inclusion criteria and underwent assessments using Neck Disability Index Questionnaire, NPRS and hand grip strength.

Inclusion criteria: Male Auto-rickshaw Drivers, Age group from 25-35 years, participants with neck pain, driving experience (more than 3 years), auto-rickshaw drivers who are driving for more than 7 hours day, participants willing to participate in the study. Exclusion criteria: Participants with congenital musculoskeletal morbidities, any previous neck surgery that can cause neck pain, all other participants who are not fulfilling the above-mentioned criteria. The study focused on auto-rickshaw drivers, age range between 25 and 35 years, who have been driving for a minimum of 3 years. Neck disability index

questionnaire it consists of total 10 items; it gives information about how neck pain affects our ability to manage in everyday life. Each section was scored on a 0 to 5 rating scale, points summed to a total score out of 50 the score was calculated and recorded in data sheet, reliability and validity have been checked. Pain intensity was measured using Numerical pain rating scale it consists of total 10 points in which 0 means no pain, 5 means moderate pain and 10 means worst possible pain. The reliability and validity have been checked, the score was calculated and recorded in data sheet. Grip strength was measured in the same position for all auto-rickshaw drivers: seated on a chair in an upright position with back support and armrest, shoulder abducted slightly, elbow 90 degree flexed, forearm and wrist in neutral position, and holding the dynamometer by the dominant hand. Participants were instructed to squeeze the dynamometer handle as much as you can three times, rest between each squeeze was given to overcome fatigue. Then value was noted and mean of three measurements in Kg unit was recorded. The Neck disability index, Numeric pain rating scale and hand grip strength scores were recorded for all 151 participants on data collection sheet. Master chart was prepared, containing participant number, age, hand dominance, years of working, work duration in hours, days of working per week, break time, NDI, NPRS and grip strength in kg. The statistical analysis was carried out by utilizing the relevant biostatistical tool and master chart. The statistical variables including mean and SD of age, years of working, work duration, days of working, NDI, NPRS, and hand grip strength were calculated. Correlation between neck pain and hand grip strength were calculated. Finally, the study was concluded by a statistical analysis, discussion and conclusion.

### III. MATERIALS AND METHODS

Neck Disability Index Questionnaire, pain Rating Scale, jamar Hand dynamometer, chair, data collection sheet, dontsent form. Study Type: Observational study Study design: Cross sectional study, Study place: Kolhapur city Study Population: Auto-rickshaw Drivers Sampling design: Convenient sampling Study Duration :6 months Sample Size – The sample size was calculated by using prevalence: Margin of error is 8% For the unknown prevalence. We can take it is

50%.

Outcome measures: Neck disability index: This questionnaire has been designed to give information about how your neck pain has impacted your day-to-day functioning. Participant have to answer every section and mark in every section only the one box that applies to you. Participants have to check the items that most accurately depicts your issue, even if you may feel that two or more of the statements in any given section apply to you. It consists of total 10 items including pain, personal care, lifting, reading, headaches, concentration, work, driving, sleeping, and recreation. Each section is scored on a 0 to 5 rating scale, in which zero means 'No pain' and means 'Worst imaginable pain'. The test can be interpreted as a raw score, with a maximum score of 50, or as a percentage. 0 points means: no activity limitations, 50 points means complete activity limitation. A higher score indicates more patient-rated disability. A score of 0-4 is interpreted as no neck disability, 5-14 as mild, 15-24 as moderate, 25-34 as severe and over 35-50 as complete neck disability. Points summed to a total score. Reliability The NDI has a fair to moderate test-retest reliability in patients with mechanical neck pain but also for patients with cervical radiculopathy. although intra class correlations can change between 0,50 and 0,98. These differences may occur because some studies do not separate chronic or acute neck pain or due to the fact that the study only used patients with acute neck pain and the retestinterval was 72 hours. Validity Validity is tested in different trails by comparing NDI with different instruments: eg VAS, Patient-specific Functional Scale, The Disability Rating Index. They all had strong correlation coefficients suggesting their content is highly comparable: The NDI has a good construct validity. The NDI is seen as a valid tool to measure neck pain and disabilities in patients with neck pain due to acute or chronic conditions as well as in patients suffering from musculoskeletal dysfunctions, whiplash - associated disorders and cervical radiculopathy. Numeric Pain Rating Scale: The Numeric Rating Scale (NRS) is a widely utilized pain screening tool employed to evaluate the severity of pain at a specific moment, typically on a scale from 0 to 10. In this scale, zero denotes the absence of pain, while 10 signifies the most severe pain imaginable. The Numeric Pain Rating Scale (NPRS) serves as a segmented version of the visual analog scale (VAS) and is utilized to gauge

the intensity of pain experienced by an individual. In this scale, respondents select a whole number from 0 to 10 integers that most accurately represents the severity of their pain. Typically presented in a horizontal bar or line format, the NPRS can be administered verbally, making it suitable for telephone interviews, or graphically for self-completion. Respondents are instructed to indicate the numeric value on the segmented scale that aligns with their perception of pain intensity, allowing for a quantifiable assessment of discomfort levels.

**Reliability** High test–retest reliability has been observed in both literate and illiterate patients with rheumatoid arthritis ( $r = 0.96$  and  $0.95$ , respectively) before and after medical consultation. **Validity** for construct validity, the NPRS was shown to be highly correlated with the VAS in patients with rheumatic and other chronic pain conditions (pain>6 months): correlations range from  $0.86$  to  $0.95$ . **Jamar Hand Dynamometer:** The Jamar dynamometer is recommended by the American Society for Surgery of the Hand and the American Society of Hand Therapists. Jamar dynamometer has been modified to accommodate each participant’s hand size by changing handle grip to enable finger placement at the

proximal and distal IP joints, around 90 degrees of flexion. It was requested to the participants to use their dominant hand to complete the test. Each participant was seated upright, elbows flexed at a 90degree angle, shoulders are slightly abducted, wrist in neutral position. Participants were instructed to squeeze dynamometer handle as much as possible three times, rest period was given between each squeeze. Then mean of three trials in kg unit was recorded. **Reliability:** Reliability ranges from  $0.88$  to  $0.93$

**IV. RESULTS**

A total of 151 participants, ages 25 to 35, with a mean age  $32.13 \pm 2.68$  years, who drove rickshaw and complained of neck pain were chosen for the study from Kolhapur city. Participants having prior neck surgery or congenital musculoskeletal morbidities were excluded.

Table no 1 shows the hand dominance of participants out of 151 participants ,141 subjects have right hand dominance and 10 have left hand dominance, so statistical analysis showed that 93% of the subjects have right hand dominance and only 7% have left hand dominance.

Hand dominance	No. of Participants	Percentage
Right	141	93%
Left	10	7%
Total	151	100%

GRAPH -1 The pie chart shows that the vast majority of the participants in the study were right hand (93%). only (7%) were left handed.

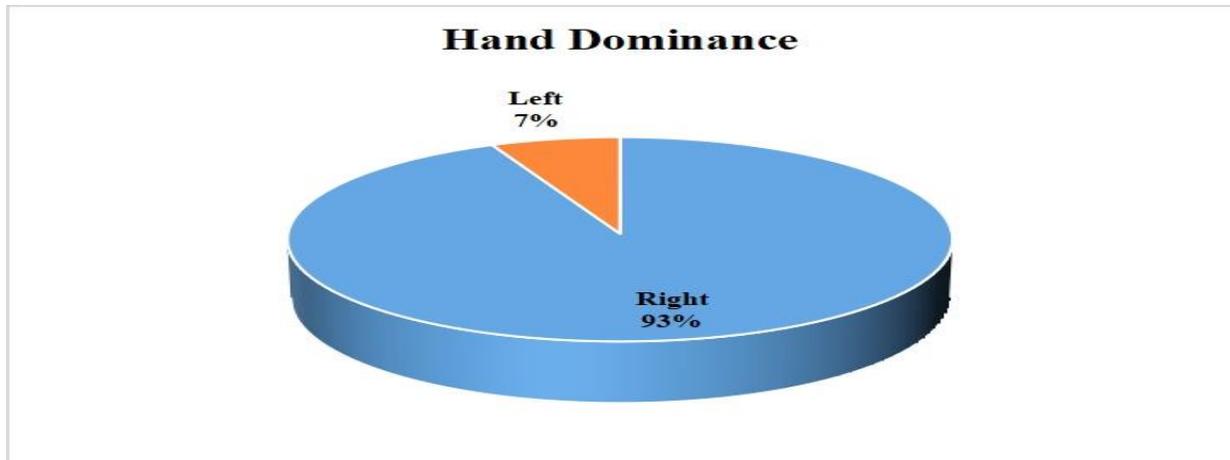


Table-2 shows A descriptive statistical variable including mean ± SD of age 32.13±2.68, years of working 9.49±3.44, work duration in hours 9.26±1.24, days of working per week 6.60±0.49.

The Neck Disability Index (NDI) score, a measurement of neck pain intensity was 15.91±4.88 and the Numerical Pain Rating Scale (NPRS) score, another pain intensity measurement was 5.26±1.23.

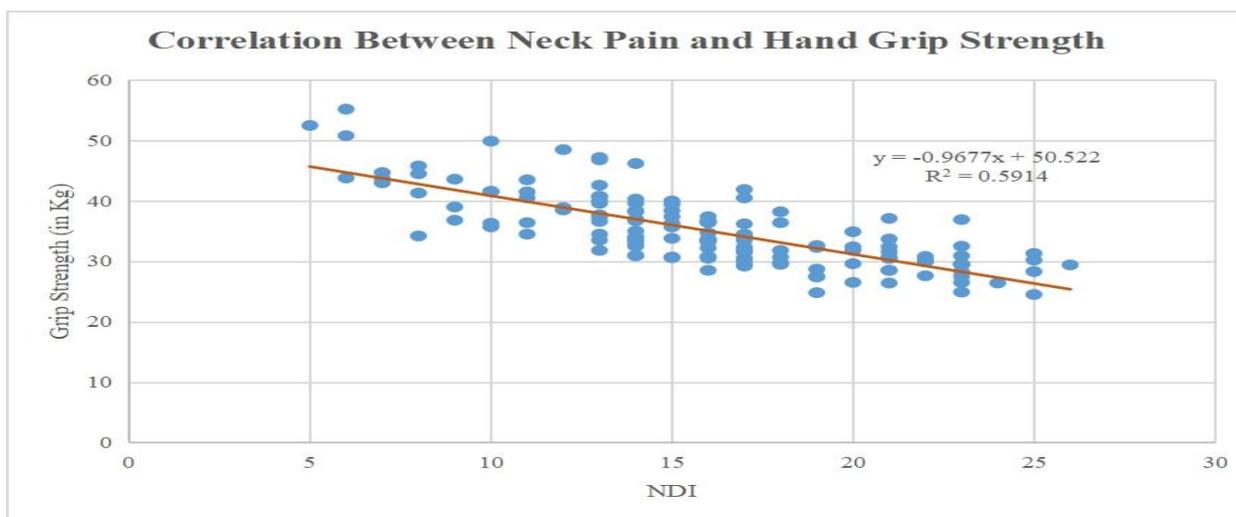
Hand Grip strength was measured by using Jamar Hand Dynamometer for all subjects in same position with dominated hand mean of three measurements was taken in kg unit. The average hand grip strength was 35.06±6.17

Work duration in hours	9.26	1.24
Days of working/ week	6.60	0.49
NDI/50	15.91	4.88
NPRS /10	5.26	1.22
Grip strength in Kg	35.06	6.17

Table-3 shows the analysis found a statistically significant strong negative correlation between neck pain and hand grip strength. The correlation coefficient (r) was -0.7768, and the p-value was 9.95E-32. A negative correlation means that there is an inverse relationship between the two variables. In this case, it means that as the neck pain score increases, the hand grip strength decreases. This study shows that there is correlation between neck pain and hand grip strength in auto rickshaw drivers.

Variables	Mean	SD
Age	32.13	2.68
Years of working	9.49	3.44

Correlation between		Correlation Coefficient ( r )	P Value
Neck Pain	Hand grip Strength	-0.7768	9.95E-32



GRAPH -2 The scatter plot shows a significant strong negative correlation between neck pain and hand grip strength. From left All the participants shows inclining tendency from right bottom to left top, also all the participants are scattered in narrow strip. This means that as the reported neck pain scores increase, the hand grip strength scores tend to decrease. The correlation coefficient (r) is -0.7768, with a p-value (p<0.0001). which indicates a very strong negative correlation. In simpler terms, people who reported higher levels of neck pain also tended to have lower hand grip strength.

### V. DISCUSSION

The study of work is the simplest definition of ergonomics. Rather than forcing an employee to suit a job, it is beneficial to fit the job to the person. Numerous earlier studies focus on the examination of individuals in the workplace with regard to workplace design, equipment layout, safety, productivity, and training. This consequently has an impact on anthropometry, kinesiology, psychology, biomechanics, and physiology. Ergonomics aids in risk assessment and the implementation of control measures for musculoskeletal disorders related to the

workplace. WRMSDs happen when a worker's physical capabilities and the physical demands of their profession are out of balance. Extended exposure to ergonomic risk factors can cause physical harm to an employee that results in multiple sclerosis. One of the common risk factors for drivers is movement repetition; uncomfortable, unsupported, motionless, or sustained for extended periods of time postures, motion that occurs from bending and twisting, such as a rise in speed or acceleration; Compression from holding onto pointed objects, such as tool handles, can focus force on certain body parts. Inadequate recovery time as a result of working overtime without taking breaks or switching up jobs; excessive vibration, often caused by vibrating objects. The arms, particularly the wrist, fingers are among the most commonly impacted locations<sup>5</sup>. Work-related neck pain and hand grip strength are significant concerns among auto rickshaw drivers due to the nature of their job, which involves prolonged periods of sitting and gripping the steering wheel.

Auto rickshaw drivers often experience neck pain due to the nature of their work, which involves long hours of sitting in a fixed position, constant turning of the head to check for passengers or traffic. This sedentary posture, combined with constant vibrations from the vehicle, can lead to muscle stiffness, tension, and eventually, neck pain. Factors such as poor ergonomics, including inadequate seat support and improper positioning of the steering wheel, can exacerbate the problem. Additionally, repetitive head movements while navigating through traffic can strain the neck muscles further.

Grip strength is crucial for autorickshaw drivers as they need to continuously hold the steering wheel for extended periods. The repetitive gripping motion, coupled with the vibrations from the road, can lead to fatigue and reduced hand grip strength over time. This can not only affect their driving performance but also increase the risk of musculoskeletal disorders such as carpal tunnel syndrome and tendonitis.

In our study we examined the correlation between work related neck pain and hand grip strength among 151 auto-rickshaw drivers in Kolhapur city. Our purpose was to find out work related neck pain affects hand grip strength auto-rickshaw drivers, considering inclusion and exclusion criteria.

**Demographic profile**

**Age** The age of the participants in this study ranged

from 25-35years, with an average  $32.13 \pm 2.68$ . Hand dominance in our study Out of 151 auto-rickshaw drivers the right hand was more dominant than left leg. the right hand was 93% dominant and left hand was 3% dominant. Years of working in our study we included the participants driving auto-rickshaw rickshaw for more than 3 years. The minimum number of years participants driving auto-rickshaw in our study was 3 years and maximum 15 years. work duration in our study we included the participants working hours for more than 7 hours with an average  $9.26 \pm 1.24$ . Drivers works for longer hours which further leads strain and overuse injuries. Days of working per week in our study the minimum number of working was 6 days and maximum was 7 days per week with an average  $6.60 \pm 0.49$ .

Outcome measures- Neck disability index the outcome measure was Neck disability index, the minimum score of NDI was 5 and maximum score was 25 out of 50, with an average  $15.91 \pm 4.88$ . Most of the previous articles have used NDI for correlation and prevalence of neck pain. NDI score  $\leq 4$  indicates no neck disability and  $\geq 35$  indicates complete neck disability. Numeric pain rating scale in our study the minimum numeric pain rating score was 3 and maximum numeric pain rating score was 8. The mean of NPRS was  $5.26 \pm 1.22$ . Jamar hand dynamometer in our study hand grip strength was measured using Jamar hand dynamometer in kg unit. The mean of hand grip strength was  $35.06 \pm 6.17$ . The minimum hand grip strength reported by participants was 24.8 kg and maximum were 55.2.

## VI. CONCLUSION

This study was conducted among auto-rickshaw drivers ageing from 25-35 years in Kolhapur city The goal of our study was to find out correlation between work related neck pain and hand grip strength among auto-rickshaw drivers in Kolhapur city. Based on the statistical analysis the present study concluded that, significant strong negative correlation between neck pain and hand grip strength with  $p < 0.0001$ .

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