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Original article:

Association of cervical range of motion, cervical core strength and pectoralis minor tightness in car drivers

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ABSTRACT:

Background : Prolonged driving can lead to asymmetric postures and musculoskeletal disorders resulting in physiological illness and can affect cervical range of motion, cervical core strength and pectoralis minor muscle length.

Objective : The purpose and objective of this study was to associate cervical range of motion, cervical core strength and pectoralis minor muscle length among drivers.

Method : In this study 35 drivers were taken according to convenient sampling and inclusion and exclusion criteria of age group between 20-35 years were assessed.

For the assessment cervical range of motion was measured by goniometer, cervical core strength was measured by pressure biofeedback and pectoralis minor tightness was measured by vernier caliper.

Result : The result established from the research exposed that when minimum driving experience was associated with cervical flexion (R= -0.30403), cervical extension (R= -0.14948), left side cervical lateral flexion (R= -0.21621), left cervical rotation (R= -0.0.43602), right side cervical rotation (R= -0.36896), cervical core strength (R= -0.19354) respectively showed negative correlation and with right side cervical lateral flexion (R= 0.01072), left side pectoralis minor muscle tightness (R= 0.38065) and right side pectoralis minor muscle tightness (R= 0.35135) respectively showed positive correlation.

Conclusion: This study concluded that as the driving experience increases; cervical flexion, cervical extension, left side cervical lateral flexion, left and right side cervical rotation, cervical core strength respectively decreases or vice versa but with the increase in driving experience right side cervical lateral flexion, left and right side pectoralis minor muscle tightness also increases.

Keywords : Cervical Range of Motion, Cervical Core Strength, Pectoralis Minor Muscle Tightness, Car Drivers.

INTRODUCTION

Driving is regulated and controlled movement of motor vehicles. Driving skills along with maintaining correct posture makes its convenient and easy to drive minimizing physical, mental and social obstacles (Haley,2008). For the controlled operation and movement of vehicle the term used is 'driving'. Drivers who work for long hours mainly complain of pain in shoulder, neck and lower back. Driver's sitting position while driving is non neutral which can increase or decrease flexion of neck (Jeyaraj, 2018). Prolonged sitting while driving leads to directly impact on the spine (Noda, Malhotra, DeSilva, Sapukotana & DeSilva,2015).

The drivers who work for long hours they are more liable to poor posture. Poor posture such as forward head posture and protracted shoulder result in neck pain. Head upright position and weight of head is held by spine; while the head is in forward flexion the spinal vertebrae unable to support and hold the weight of the head (Massaccesi, Pagnotta, Soccetti, Masali Masiero & Greco, 2003). For compensating the role of spine; for maintaining the posture and holding head upright; the ligaments, muscles and tendons have to work more (Gillespie,2005).

Changes in the curvature of the neck bone due to an imbalance in muscular pattern leads to rounded shoulder causing stooped posture (Kim et al.,2018).

Measurement of cervical ROM are majorly required to evaluate the severity of impairment or disability in patients with work- related disorders (Hagen et al.,1997). Due to prolonged sitting and driving there occurs an imbalance between the curvature of the spine and muscles that are attached to the neck bone leading to forward head posture which causes rounded shoulder and neck pain that are correlated with problems of limited cervical range of motion and affects the kinematics of the cervical spine (Singla et al.,2017).

Limited cervical range of motion is the obstacle for the effective functioning of daily activities. The normal range of motion of cervical spine is 50° of flexion, 60° of extension, 45° of lateral flexion, and 90° of rotation to both sides (Department of social and health services, 2014).

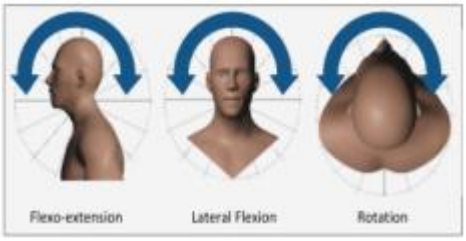

FIGURE1.1 CERVIVAL MOVEMENTS

Pectoralis minor one of the most important and sometimes neglected muscle of the shoulder girdle originates from anterior surface of third, fourth and fifth ribs near costal cartilage and inserts at the medial and upper aspect of the coracoid process of the scapula (Oliver Jones, 2017). When this muscle becomes tight due to its overuse leads to lifting of the shoulder blades, and causes rounding of the shoulders and may collapse of the chest (Dayana et al., 2016).

The pectoralis minor length test is the method that is used to determine if this muscle is of normal length or is short and the 2.6 cm distance has been proposed as the length that separates a muscle of normal length to one that is short and may be associated with symptoms (Lewis & Valentine, 2007).

FIGURE 1.2 LOCATION OF PECTORALIS MINOR MUSCLE

Core strength is mainly linked with the maintenance of the body in ideal posture and less about the power. The overuse injuries can often be preventable by having the stable and strong core (Elson, 2018).

In today's era though driving is a necessity for people but it is observed that prolonged driving if done in incorrect posture will aggravate pain in neck and shoulders thereby causing discomfort and postural deformity in the drivers (Kashif, Zafar, Asif, Munawar, 2015).

This study is done to throw light on the relation between cervical range of motion, cervical core strength and pectoralis minor tightness in car drivers.

AIM AND OBJECTIVE

The aim of study is to associate and determine cervical range of motion, cervical core strength and pectoralis minor tightness in car drivers.

OPERATIONAL DEFINITION

Car Drivers- An individual who has a minimum driving experience of 2 years and who drives at least 2 hours in a day regularly whether at a stretch or at intervals.

Cervical Range of Motion- Range of motion is defined as the complete movements around a particular joint. The cervical range of motion is measured using goniometer. At the cervical region there are four major movements essential for activity of daily life [flexion, extension, lateral flexion, side rotation].

Cervical Core Strength- The cervical core strength measured using pressure biofeedback. It is the strength of the muscles attached to the cervical spine that helps in providing support to spine, maintaining posture and help preventing posture.

Pectoralis Minor Tightness-The tightness of the pectoralis minor fibres measured using vernier calliper. The primary function of this muscle is to stabilize scapula. It even includes depression, abduction or protraction, internal rotation and downward rotation of the scapula. The tightness of pectoralis minor muscle is commonly identified as a part of imbalance. It is a tonic muscle that tends to be overactive and prone to tightness.

METHOD AND METHODOLOGY

The material used during the study were goniometer to check cervical range of motion, pressure biofeedback to measure cervical core strength, vernier caliper to check pectoralis minor tightness.

35 subjects [males; age 20 to 35 years; only males included in the study; working hours should be 2 or more than 2 hours; experience of 2 years or above] were used in the study. The participants were asked to sign the informed consent form after explaining to them the purpose of collecting the data. Following this the, cervical range of motion, pectoralis minor tightness and cervical core strength were assessed.

Cervical range of motion (flexion, extension, lateral flexion, rotation) assessment was done using a goniometer .

- Cervical Flexion-

Position: The subject was asked to sit with head and neck in anatomical position, hand placed on the lap and back supported and at rest.

Fulcrum - on the external auditory meatus.

Stationary arm- perpendicular to the floor in line with head.

Moving arm- placed parallel to the nose.

The Subject was asked to bend the neck forward and the degree of cervical flexion was measured.

- Cervical Extension-

Position: The subject was asked to sit with head and neck in anatomical position, hand placed on the lap and back supported and at rest.

Fulcrum - on the external auditory meatus.

Stationary arm- perpendicular to the floor in line with head.

Moving arm- placed parallel to the nose.

The Subject was asked to bend the neck Backward and the degree of cervical extension was measured.

- Cervical Lateral flexion-

Position: The subject was asked to sit with head and neck in anatomical position, hand placed on the lap and back supported and at rest.

Fulcrum- Placed over the spinous process of seventh cervical vertebra.

Stationary arm- perpendicular to the floor and placed on the thoracic spinous process.

Moving arm- placed in line with occipital protuberance of the occipital bone.

The Subject was asked to bend the neck on side (first right and then left) and the degree of cervical lateral flexion was measured for both sides respectively.

- Cervical Rotation-

Position: The subject was asked to sit with head and neck in anatomical position, hand placed on the lap and back supported and at rest.

Fulcrum- placed at the centre of the cranial aspect of the head.

Stationary arm- placed in line with the imaginary line between the two acromial processes.

Moving arm- placed in the line with the tip of nose.

The Subject was asked to perform neck rotation first to right and then left and the degree of cervical rotation was measured.

Pectoralis minor muscle tightness was measured using a vernier caliper. In this the subject was asked to lie on treatment couch in relaxed supine position. The subject's hands were rested gently on the abdomen. The investigator measured the distance in millimetres using vernier calliper. In this the examiner measured the distance between the couch and acromion.

Without exerting any downward pressure into table, the digital part displaying the measurements of the instrument was placed on the table and the other was placed to the lateral aspect of posterior acromion for measuring the distance for pectoralis minor length (2.6 cm or 1inch distance has been proposed as the length that separates a pectoralis minor muscle normal length to one that is short). Readings were recorded and noted for both the left and right side in inches.

Cervical core strength was measured using a pressure biofeedback. In this the subject was in supine position. The folded stabilizer pressure biofeedback unit [folded into thirds] was placed under upper cervical spine and occipital area and was inflated up to 20mmHg. The subject was asked to press and hold the pressure up to 10seconds. The readings were taken three times and noted and 20mmHg was subtracted from every reading.

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FIGURE 3.4 CERVICAL LATERAL FLEXION.

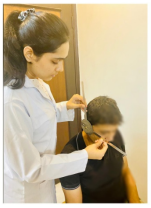


FIGURE 3.5 CERVICAL FLEXION AND EXTENSION.

FIGURE 3.6 CERVICAL ROTATIONS.

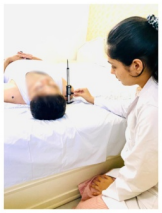


FIGURE 3.7 PECTORALIS MINOR MUSCLE LENGTH.

FIGURE 3.8 CERVICAL CORE STRENGTH.

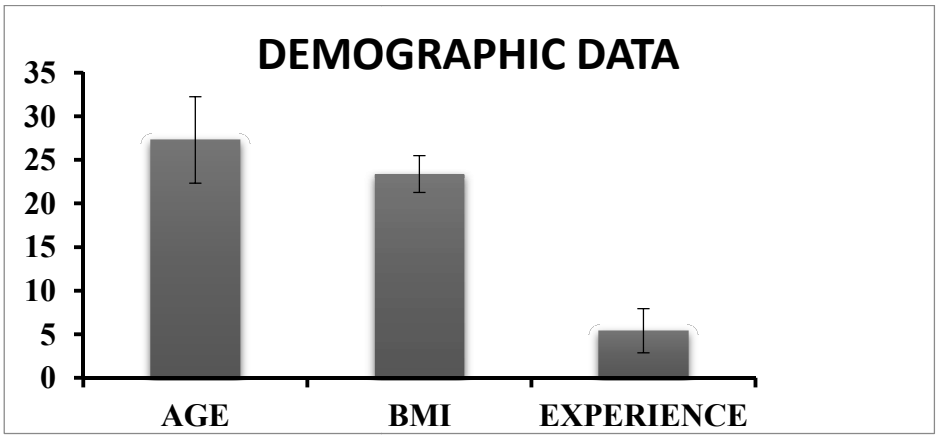
RESULT

DEMOGRAPHIC DATA

The demographic details of the subjects included in the study are depicted in the following table 5.1. The mean age group of the 35 subjects was 27.31± 4.96 years. 35 males participated in the study with mean BMI 23.3± 2.10 Kg/m^2 and the mean minimum driving experience was 5.41± 2.53.

TABLE 5.1 Demographic characteristics of the subjects

DRIVERS	AGE	BODY MASS INDEX	MINIMUM DRIVING EXPERIENCE
MEAN±SD	27. 31±4.96	23. 39±2.1	5.41±2.53



GRAPH 5.1 MEAN±SD OF DEMOGRAPHIC DATA OF DRIVERS

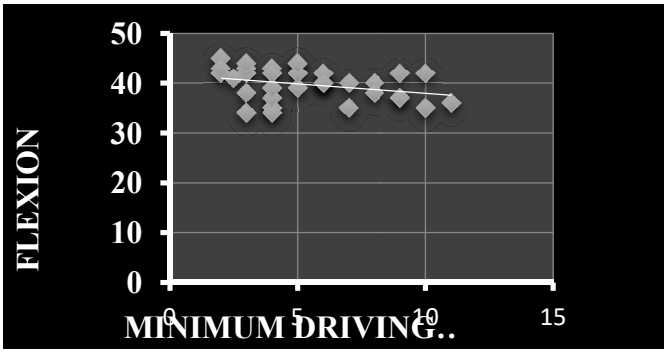
Table 5.2 Correlation coefficient value for the correlated variables

CORRELATION GROUP	CORRELATION COEFFICIENT
MINIMUM DRIVING EXPERIENCE AND CERVICAL FLEXION	-0.30403
MINIMUM DRIVING EXPERIENCE AND CERVICAL EXTENSION	-0.14948
MINIMUM DRIVING EXPERIENCE AND LEFT CERVICAL LATERAL FLEXION	-0.21621
MINIMUM DRIVING EXPERIENCE AND RIGHT CERVICAL LATERAL FLEXION	0.01072
MINIMUM DRIVING EXPERIENCE AND LEFT CERVICAL ROTATION	-0.43602
MINIMUM DRIVING EXPERIENCE AND RIGHT CERVICAL ROTATION	-0.36896
MINIMUM DRIVING EXPERIENCE AND CERVICAL CORE STRENGTH	-0.19354

MINIMUM DRIVING EXPERIENCE AND LEFT PECTORALIS MINOR TIGHTNESS	0.38065
MINIMUM DRIVING EXPERIENCE AND RIGHT PECTORALIS MINOR TIGHTNESS	0.35135

Association between minimum experience of driving and cervical flexion is shown below through its values and the correlation found to be is -0. 304030.

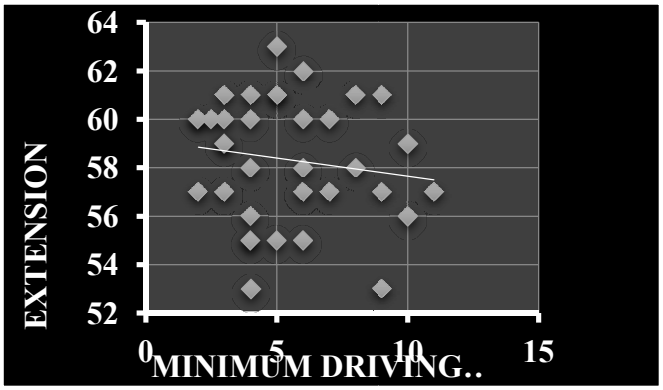
It shows that the relation between minimum experience of driving and cervical flexion is mild negative correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.2).



GRAPH 5.2 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND CERVICAL FLEXION.

Association between minimum experience of driving and cervical extension is shown below through its values and the correlation found to be is -0.149489.

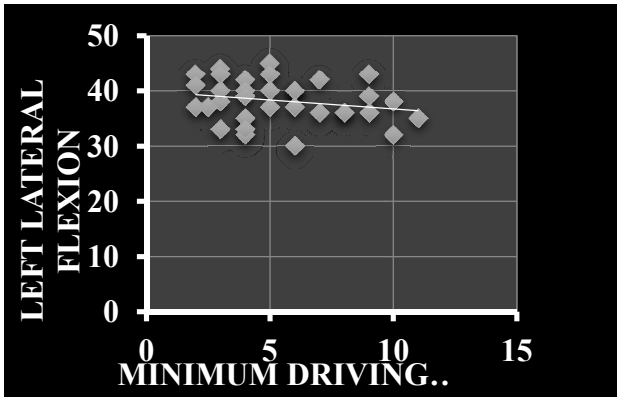
It shows that the relation between minimum experience of driving and cervical extension is mild negative correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.3).



GRAPH 5.3 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND CERVICAL EXTENSION.

Association between minimum experience of driving and left side cervical flexion is shown below through its values and the correlation found to be is -0.21621.

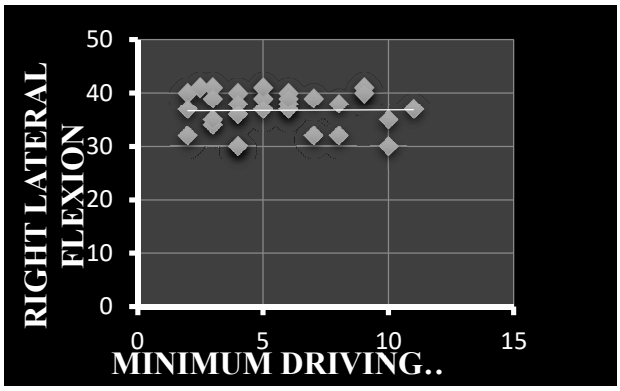
It shows that the relation between minimum experience of driving and left side cervical flexion is mild negative correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.4).



GRAPH 5.4 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND LEFT SIDE CERVICAL LATERAL FLEXION.

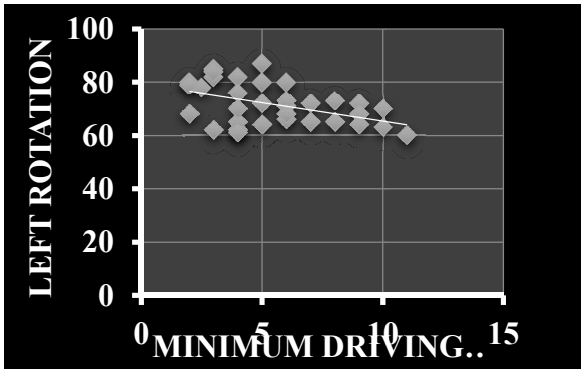
Association between minimum experience of driving and right side cervical lateral flexion is shown below through its values and the correlation found is 0.01072.

It shows that the relation between minimum experience of driving and right side cervical flexion is mild positive correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.5).



GRAPH 5.5 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND RIGHT SIDE CERVICAL LATERAL FLEXION.

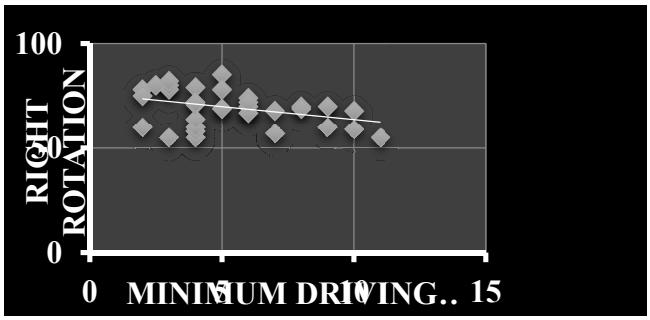
Association between minimum experience of driving and left side cervical rotation is shown below through its values and the correlation is -0.43602. It shows that the relation between minimum experience of driving and left side cervical flexion is mild negative correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.6).



GRAPH 5.6 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND LEFT SIDE CERVICAL ROTATION.

Association between minimum experience of driving and right side cervical rotation is shown below through its values and the correlation found is -0.36896.

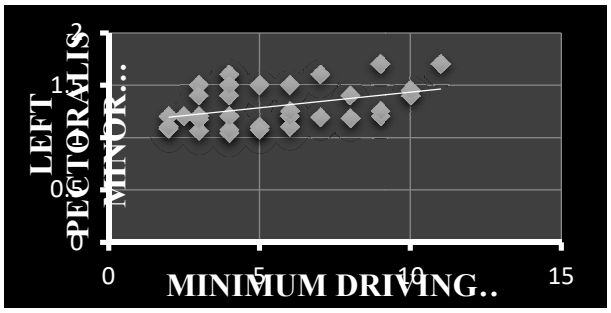
It shows that the relation between minimum experience of driving and right side cervical rotation is mild negative correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.7).



GRAPH5.7 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND RIGHT SIDE CERVICAL ROTATION.

Association between minimum experience of driving and left side pectoralis minor tightness is shown below through its values and the correlation found to be is 0.38065.

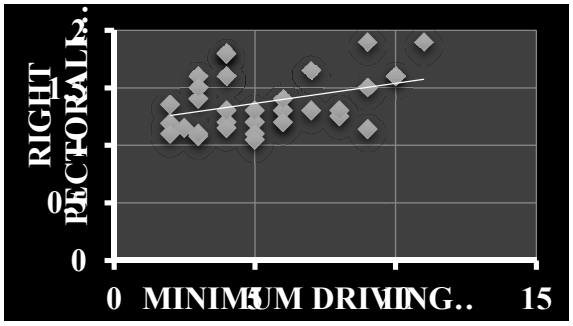
It shows that the relation between minimum experience of driving and left side pectoralis minor tightness is positive correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.9).



GRAPH 5.9 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND LEFT SIDE PECTORALIS TIGHTNESS.

Association between minimum experience of driving and right side pectoralis minor tightness is shown below through its values and the correlation found to be is 0.35135.

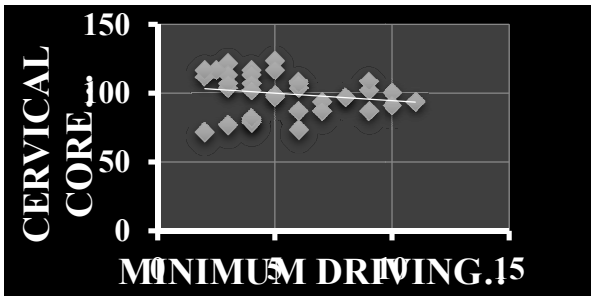
It shows that the relation between minimum experience of driving and right side pectoralis minor tightness is positive correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.10).



GRAPH 5.10 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND RIGHT SIDE PECTORALIS TIGHTNESS.

Association between minimum experience of driving and cervical core strength is shown below through its values and the correlation found to be is -0.19354.

It shows that the relation between minimum experience of driving and cervical core strength is mild negative correlation and the linear correlation between the same is shown in the graph below (FIGURE 5.8).



GRAPH 5.8 CORRELATION BETWEEN MINIMUM DRIVING EXPERIENCE AND CERVICAL CORE STRENGTH.

DISCUSSION

In the present study, it was intended to associate the cervical range of motion, cervical core strength and pectoralis minor muscle tightness in car drivers. The mean age group of the 35 subjects was 27.31± 4.96 years. 35 males participated in the study with mean BMI 23.3± 2.10 kilogram per meter square.

Correlation between minimum driving experience and cervical flexion, cervical extension, left side cervical lateral flexion, left and right side cervical rotation, cervical core strength respectively was found to be negative mildly which means that as the driving experience increases; range of motion of cervical flexion, cervical extension, left side cervical lateral flexion, left and right side cervical rotation, cervical core strength decreases or vice versa when correlated with minimum driving experience individually. Correlation between minimum driving experience and right side cervical lateral flexion, left and right side pectoralis minor muscle tightness respectively was found to be positive which means that as the driving experience increases; right side cervical lateral flexion, left and right side pectoralis minor muscle tightness also increases when correlated with minimum driving experience individually.

According to Mohokar et.al,(2018) risk of developing musculoskeletal symptoms and disorders increases with the increase in driving years. This research was done among the auto drivers. And the results are even similar in the present study though the population taken was of car drivers and it is observed that the musculoskeletal

symptoms are correlated with driving experience due to faulty postures adopted majorly. According to Kwon et.al,2018 sitting in an awkward posture for a prolonged time leads to spinal or musculoskeletal disease. Attaining such postures for longer duration even overloaded and overstressed the work of muscles of spine i.e. agonist and antagonist and surrounding ligaments (Winter & Sons,2005). Workers who maintained the identical sitting posture throughout their working hours without changing it were reported to be more vulnerable to LBP than those who change postures. The prolonged sitting postures causes decrease in the movement at the cervical spine (Marras,2007).

The right side rotation was affected majorly due to overtaking action and right side mirror viewer. According to Indian rules of driving overtaking was done from the right side. The cervical flexion and extension movements were affected because of the faulty forward head posture attained during prolonged driving. Forward Head Posture when maintained for a long period of time it flexed the cervical vertebrae in forward position and increased stress and load on cervical extensors causing decrease in cervical flexion and extension motion (Edmondston et.al,2011). The cervical lateral flexion and rotation movements were not affected by forward head posture as it influenced the movements in sagittal plane and not the movements that occured in horizontal plane (Meisingset et.al,2016).

One muscle that is frequently compromised in shoulder and upper quadrant pathology was the pectoralis minor and a shortening of this muscle had been associated with a forward head posture (Donatelli,1992).Lewis et.al,(2007) had stated in his research that normal pectoralis minor muscle length measured between the treatment table and posterior aspect of the acromion (patient supine, arms by side, elbows flexed) is 2.6cm or 1inch. He also described that if this distance was greater than this than it showed the pectoralis minor muscle tightness and shortness. In the present study same concept for measuring pectoralis minor muscle tightness for prolonged sitting while driving was used with the help of vernier calliper and it was consistent with the results of the other studies (Bostard,2008).

In the present study the result between experience of driving and pectoralis minor muscle tightness came positive which means as driving increases the tightness of pectoralis minor muscle increases which could lead to permanent habitual faulty postures and may also lead to injuries such as subacromial impingement, winging of scapula etc.

It was even seen that decrease in core strength makes cervical flexors weak and unable to provide better support to the spine and even degrades the spine gradually (Harvard Medical School,2015)

FIGURE 6.1 DRIVING POSTURE.

In the present study it has been found that the weak cervical core creates musculoskeletal problems, faulty posture alignment and affects the functionality and quality of life. It even increases neck pain.

Strengthening of the cervical core is very important to reduce bad posture and to decrease pain. Performance related to musculoskeletal problems are frequent among car drivers and other prolonged sitting job groups that carry repetitive movements with loading the muscles involved.

LIMITATIONS

- Only males were taken.
- Thoracic and lumbar range of motion were not assessed.
- The age group taken was 18-35 deliberately to avoid osteoarthritis conditions and degenerative changes.
- Car drivers were selected only from Delhi-NCR. Small sample size was taken.
- Car ergonomics has not been taken as the variable which can also give an effective correlation with minimum driving experience and musculoskeletal symptoms.

CONCLUSION

In the present study it is seen that there is reduced cervical range of motion except right side cervical lateral flexion when correlated with minimum experience of driving. There is also the negative correlation between driving experience and cervical core strength which means that with increase in experience of driving there occurs weakness of cervical core. The pectoralis minor muscle tightness is found to be increased because of faulty altered postures while prolonged sitting. The conclusion for the above variables is due to awkward posture, weakness, repetitive movements or overuse while driving for long hours.

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