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PREVALENCE OF UPPER CROSS SYNDROME IN SCHOOL GOING CHILDREN BY MEASURING CRANIOVERTEBRAL ANGLE USING KINOVEA SOFTWARE AND TIGHTNESS TEST

An observational study

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Abstract: Upper crossed syndrome is caused by weak lower and middle trapezius, tight upper trapezius and levator scapulae, weak deep-neck flexors, tight suboccipital muscles and sternocleidomastoid, weak serratus anterior, and tight pectoralis major and minor. Poor posture is the main driver of UCS. Postural deviations are a common problem among children caused by long term effects of poor posture induced by different factors of modern lifestyle. Sitting is the most common body position of every school child during classroom activities. The daily physical stresses associated with carrying bagpack causes significant forward lean of head and trunk. The simultaneous occurrence of forward head posture and rounded shoulders is a typical manifestation of upper crossed syndrome.

Method - Observational study was conducted on 200 Subjects. According to the inclusion and exclusion criteria. Subjects were selected and explained about the procedure and informed consent was taken from all the included subjects and their teacher/parents before starting the procedure. Pectoralis major contracture test, Pectoralis minor contracture test, Upper trapezius muscle length test, Lower and Middle trapezius weakness test was done. Lateral view photo was taken then cranio-vertebral angle measured using kinovea software .Data was recorded and analysed. The results were analyzed and documents.

Result - : According to the tests performed as mentioned above 1% population was tested positive for pectoralis major contracture test, 72 % population was tested positive for pectoralis minor tightness test, 89.5 % and 90 % tested positive for middle and lower trapezius weakness test respectively , 73% tested positive for upper trapezius tightness test and 76.5 % population showed decreased cranio-vertebral angle values which suggests forward head posture. The above mentioned results collectively suggest that 24% of the population exhibited upper cross syndrome.

Conclusion – The study concludes that there is 24% of the population showing prevalence of the upper cross syndrome in school going children's. Hence it is necessary to create postural awareness and ergonomics advice among school going children

Index Terms - Upper cross syndrome, poor posture, Upper trapezius muscle length test, Lower and Middle trapezius weakness,

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I. INTRODUCTION

Children are backbone of the nation, on their health and prosperity depends the health of the nation. Musculoskeletal health in school children is a global health problem (1).

There is strong association of poor posture with imbalance created in musculoskeletal system and is common condition to be reported as UCS.

In Upper Cross Syndrome (UCS) there is tightness of the upper trapezius and levator scapula on the dorsal side crosses with tightness of the pectoralis major and minor. Weakness of the deep cervical flexors, ventrally, crosses with weakness of the middle and lower trapezius. UCS is often seen in individuals who sit for prolonged periods with static posture [2].

The development of UCS is primarily attributed to imbalances between tonic and weak muscles [2]. Our body consists of two types of muscles: postural muscles, such as the pectoralis major, upper trapezius, and sternocleidomastoid, and phasic muscles, such as the deep-neck flexors and lower trapezius. Postural muscles tend to tighten as they are frequently activated in various movements, while phasic muscles, responsible for dynamic functions, tend to weaken [3]. This imbalance between opposing muscle groups in UCS leads to postural disturbances [4].

Individuals with upper crossed syndrome often exhibit forward head posture (FHP), thoracic spine hunching (rounded upper back), raised and protracted shoulders, scapular winging, and limited mobility in the thoracic spine [5]. In some cases, musculoskeletal disorders can be caused by manual material handling activities, particularly when performed in inappropriate positions and involving repetitive reactions in poor posture throughout the workday [3][4].

Postural deviations are a common problem among children caused by long term effects of poor posture induced by different factors of modern lifestyle. Sitting is the most common body position of every school child during classroom activities. The problem related to prolonged sitting develop when children start going to school, mostly because today children have to sit in classroom for about 5 to 10 hours. Classroom furniture (bench) which might contribute in hunching of thoracic spine (rounded upper back)[5] . The daily physical stresses associated with carrying bagpack causes significant forward lean of head and trunk [6]

Fig1: School sitting posture

Fig2: Carrying bagpack

It has been reported that FHP is associated with the weakening of the isometric strength and endurance of the neck flexors [6] The simultaneous occurrence of forward head posture and rounded shoulders is a typical manifestation of upper crossed syndrome [8]. Musculoskeletal injuries often affect the neck and upper limbs, particularly in professions involving repetitive tasks which involve muscles of neck and upper back, prolonged static postures, and heavy lifting [9]. Prolonged maintenance of abnormal or inappropriate postures is a common cause of forward head posture [10].

School going children often spend prolonged periods in a seated position, which can lead to poor posture and muscle imbalances. UCS, characterized by weakened and tight muscles in the neck, shoulders, and upper back, can have detrimental effects on musculoskeletal health. Understanding the prevalence of UCS in this school going children population will helps identify the extent of the issue and raises awareness about the importance of maintaining proper posture and ergonomics during school time.

UCS is not limited to the student phase; if left unaddressed, it can persist into adulthood and impact individuals' professional and personal lives. Early detection and intervention during the children years can prevent the progression of UCS and its associated health consequences. By studying the prevalence of UCS in students studying for competitive exams, healthcare professionals and policymakers can devise strategies for early identification, treatment, and long-term management of UCS.

Assessing Upper Cross Syndrome (UCS) involves conducting specific tests to evaluate muscle tightness and weakness. The tests include the Upper Trapezius Muscle Length Test to assess tightness in the upper trapezius, the Lower and Middle Trapezius Weakness Test to evaluate weakness in the lower and middle trapezius, the Pectoralis Major Tightness Test to examine tightness in the pectoralis major, and the craniovertebral angle measure by using kinovea software to assess forward head posure. These tests provide valuable information about muscle imbalances and dysfunction associated with UCS, helping healthcare professionals develop targeted treatment and intervention strategies to restore musculoskeletal balance.

II. METHODOLOGY

This observational study is conducted on 200 subjects that are school going children age 10-16 years old. Ethical committee clearance was obtained and permission was taken from the department. Written consent was taken from the teachers/ parents of the subjects who fulfil the inclusion and exclusion criteria. The subjects were informed about the procedure. Pectoralis major contracture test, pectoralis minor contracture test, upper trapezius tightness test, lower and middle trapezius weakness test were done. Craniovertebral angle measured using kinovea software. Outcome measure values were noted and statistical analysis and interpretation was done.

III.A INCLUSION CRITERIA

- School going children
- Both genders will be included in study
- Age 10-16 years old

III.B EXCLUSION CRITERIA

- Participants with any spinal deformity.
- Participants who have undergone recent surgery.
- Participants with fracture in vertebrae
- Participants with a malignancy condition
- Congenital shoulder deformities.
- Recent fractures to related joints

IV. OUTCOME MEASURES

1. **Pectoralis Major Contracture Test [9]**

   Purpose: To check the pectoral muscle tightness

   Patient Position: The patient lies supine and clasps the hands together behind the head.

   Procedure: The arms are then lowered until the elbows touch the examining table.

   Positive Result: A positive test occurs if the elbows do not reach the table and indicates a tight pectoralis major muscle

Fig3: Pectoralis Major Contracture Test

2. **Pectoralis Minor Test[10]**

   Purpose: To check pectoralis minor tightness.

   Subject position: The patient position is Supine lying and adopt their natural relaxed posture.

   Procedure: Distance of the acromion process from the examining table was measured using measuring tape on both left and right side as shown in fig.

   Positive result: Distance >2.54cm [1inch] suggesting pectoralis minor tightness

Fig4: Pectoralis Minor Contracture Test

3. **Trapezius Weakness Test[20]**

   1. Middle Trapezius Muscle:

   Patient Position: The patient position is prone lying with the arms abducted to 90 degree and laterally rotated.

   Therapist Position: The test involves the examiner testing horizontal extension of the arm watching for retraction of the scapula, which should normally occur.

Positive Result: If scapular protraction occurs, the middle fibres of trapezius are weak (Fig 4).

Fig5: Middle Trapezius strength test

2. **Lower Trapezius Muscle**:

Patient Position: The patient position is prone lying with the arm abducted to 120 degree and shoulder laterally rotated.Therapist Position: The examiner applies resistance to diagonal extension and watches for scapular retraction that should normally occur. Positive Result: If scapular protraction occurs, the lower trapezius is weak

Fig6: Lower Trapezius Strength Test

4. **Upper Trapezius Muscle Length Test [20]**

Procedure –

The patient lies supine. Practitioner stands at the head of the table facing the patient. Flex the patient's neck fully and laterally flex away from the tested side (Fig. 6).

The patient's head and neck are supported by the practitioner's hand and forearm on the non-tested side and may also be gently stabilized on your abdomen.

Using your hand on the tested side, depress the patient's shoulder girdle on the tested side by applying pressure caudally over the distal clavicle and acromioclavicular joint. To selectively increase tension on the upper fibres, ipsilateral neck rotation may be added.

Length is assessed by the quality of the end-feel, which should be a smooth and gradual increase in resistance to shoulder depression, as well as by comparing the right and left sides.

Fig7: Upper Trapezius Muscle Length Test

Craniovertebral angle [12]

For measurement of Cranio-vertebral angle by using kinovea software

Participant in sitting on a stool with an erect posture, hand by the side, they asked to focus on a particular point with the neck in a neutral position, hip and knee in 90 degrees of flexion and foot rest on the floor. Marker placed on C7 to tragus and a horizontal line extending from C7 to Marker and angle measured.

The normal Cranio-vertebral angle ranges between 48-50 degrees. Anything less the 48 degrees is defined as Forward head

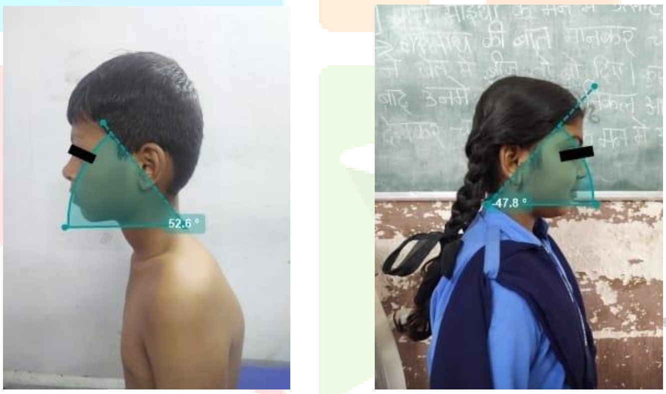


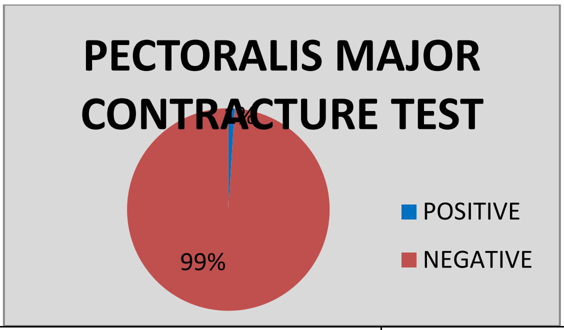
Fig8: Craniovertebral angle

V. STATISTICAL ANALYSIS

Data was collected and analysed.

VI. RESULTS

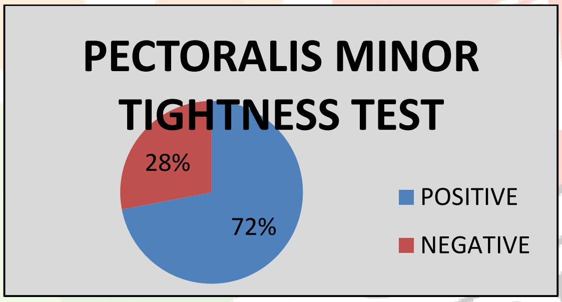
CHART: 1



TEST	POSITIVE	NEGATIVE
PECTORALIS MAJOR CONTRACTURE TEST	2	198

Chart 1 Interpretation: The above pie chart shows the results of the pectoralis major contracture test. This graph shows that among 200 participants 1% (i.e. 2 participants) tested positive for this test and 99% (i.e. 198 participants) tested negative for this test.

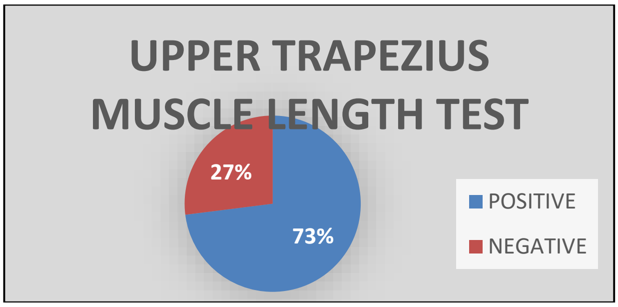
CHART: 2



TEST	POSITIVE	NEGATIVE
PECTORALIS MINOR CONTRACTURE TEST	145	56

Chart 2 Interpretation: The above pie chart shows the results of the pectoralis major contracture test. This graph shows that among 200 participants 72% (i.e. 145 participants) tested positive for this test and 28% (i.e. 56 participants) tested negative for this test.

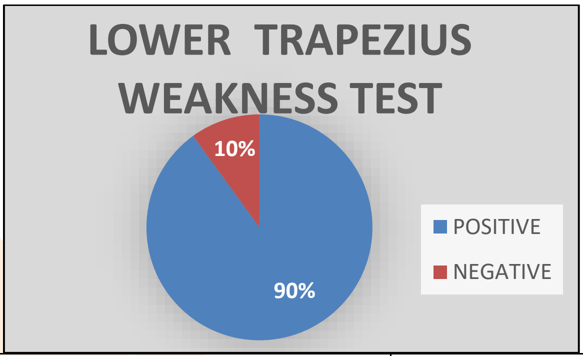
CHART: 3



TEST	POSITIVE	NEGATIVE
UPPER TRAPEZIUS MUSCLE LENGTH TEST	73%	27%

Chart 3 Interpretation: The above pie chart shows the results of the Upper trapezius muscle length test. This graph shows that among 200 participants 73% (i.e. 146 participants) tested positive for this test and 27% (i.e. 54 participants) tested negative for this test.

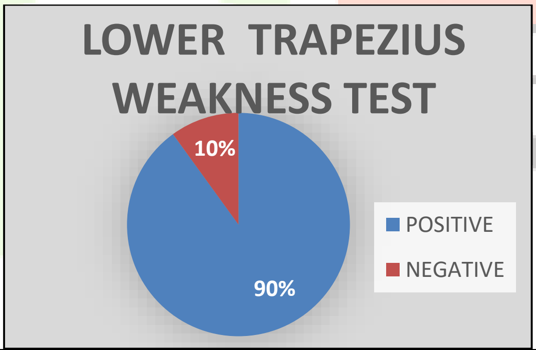
CHART:4



TEST	POSITIVE	NEGATIVE
UPPER TRAPEZIUS MUSCLE LENGTH TEST	90%	10%

Chart 4 Interpretation: The above pie chart shows the results of the lower and trapezius weakness test. This graph shows that among 200 participants 90 % (i.e.179 participants) tested positive for this test and 10 % (i.e.21 participants) tested negative for this test.

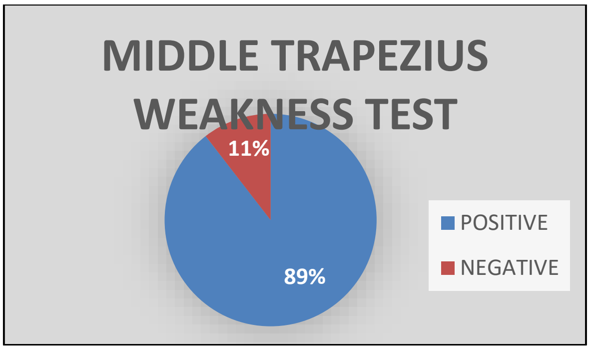
CHART: 5



TEST	POSITIVE	NEGATIVE
UPPER TRAPEZIUS MUSCLE LENGTH TEST	90%	10%

Chart 5 Interpretation: The above pie chart shows the results of the lower and trapezius weakness test. This graph shows that among 200 participants 90 % (i.e.179 participants) tested positive for this test and 10 % (i.e.21 participants) tested negative for this test .

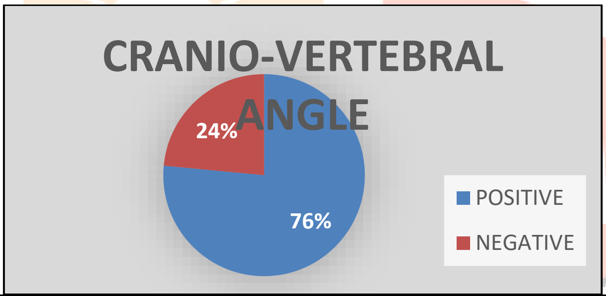
CHART:6



TEST	POSITIVE	NEGATIVE
MIDDLE TRAPEZIUS WEAKNESS TEST	89%	11%

Chart 6 Interpretation: The above pie chart shows the results of the Upper trapezius muscle length test. This graph shows that among 200 participants 89 % (i.e.180 participants) tested positive for this test and 11 % (i.e. 20 participants) tested negative for this test.

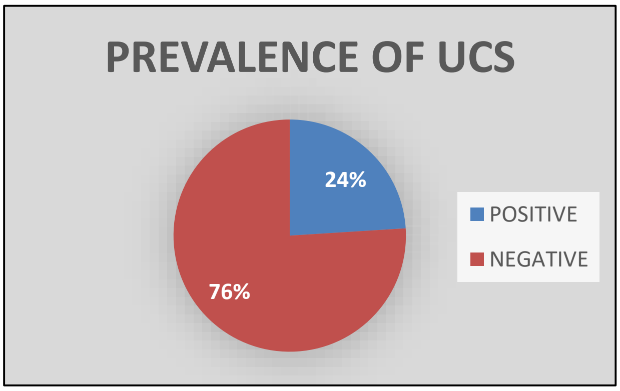
CHART:7



TEST	POSITIVE	NEGATIVE
CRANIOVERTEBRAL ANGLE	76%	24%

Chart 7 Interpretation: The above pie chart shows the results of the Cranio-vertebral angle. This graph shows that among 200 participants 76 % (i.e 147 participants) tested positive for forward head posture.

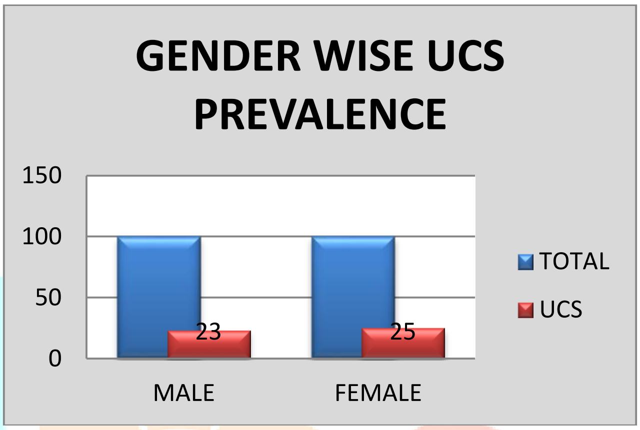
CHART: 8



TEST	PRESENT	ABSENT
PREVALENCE OF UPPER CROSS SYNDROME	24%	76%

Chart 8 Interpretation: The above pie chart shows the prevalence of Upper cross syndrome. This graph shows that among 200 participants 24% (i.e.48participants) have Upper cross syndrome.

CHART:9



	MALE	FEMALE
PREVALENCE OF UPPER CROSS SYNDROME	23%	25%

Chart 9 Interpretation: The above pie chart shows the prevalence of Upper cross syndrome in individual male and female. This graph shows that among 100 male participants 23% (i.e.23 participants) have Upper cross syndrome and among 100 female participants 25% (i.e.25 participants) have upper cross syndrome.

VII. DISCUSSION

The study is aimed to investigate the prevalence of upper cross syndrome (UCS) in school going children. The findings of this study contribute to the existing literature by shedding light on the prevalence rates of UCS in this specific population i.e. School going children.

In this study, a total of 200 subjects were selected based on specific inclusion and exclusion criteria. The procedure and purpose of the study were explained to the subjects, teacher and informed consent was obtained from all participants before the start of the procedure.

Several tests were conducted to assess the musculoskeletal condition of the subjects. These tests included the pectoralis major contracture test, pectoralis minor tightness test, upper trapezius muscle length test, lower and middle trapezius weakness test, and measured CVA. These tests aimed to evaluate the flexibility, strength, and function of various muscles and joints in the neck, shoulders, and upper back.

The results showed that 24% of the population exhibited upper cross syndrome.

According to the tests performed as mentioned above 1% population was tested positive for pectoralis major contracture test , 89.5 % and 90% tested positive for middle and lower trapezius weakness test respectively , 73 % tested positive for upper trapezius tightness test and 77% population showed values of cranioverebral angle lower than average which suggests forward head posture.

In a study conducted by pratik chandarana; sheshna rathod; dinesh sorani aimed to find the prevalence of upper cross syndrome in college going students in which he took 140 students with age group between 17 to 23 yrs. They assessed pectoralis major and minor tightness, neck extensor tightness and strength of scapular retractors and neck flexor. They found that there was highest prevalence of neck extensor tightness followed by scapular retractor weakness.[4]

M Rampraasad, Jeba Alias and AK Raghuveer conducted a study to find effect of backpack weigth on postural angles in preadolescent children. 200 healthy male school going children were taken of age group 12 to 13 yrs. Craniovertebral angle was measured using digitizing software. Study concluded that the CV angle changed significantly after 15% of bagpackload [6]

Forward head posture increases the workload for many of the muscles attached to the cervical spine, which has the job of holding up the head. Over time, forward head posture can lead to muscle imbalances as the body tries to adapt and find efficient ways to hold the head up for straight-ahead vision. Some muscles become elongated and weakened, whereas other muscles become shorter and tighter. The muscles that weaken are deep cervical flexors and lower and middle trapezius.

During poor posture the muscle like lower and middle trapezius and the deep cervical flexors are in elongated position .If a muscle in this position for a prolonged period of time the physical stresses placed on the muscle are substantially diminished. This results in decay of contractile protein in the muscle, a decrease in muscle fiber diameter, a decrease in the number of myofibrils, and a decrease in intramuscular capillary density, the outcome of which is muscle weakness (decreased muscle force).[24,25,26]

The repetitive action of maintaining a hunched or slouched position significant stress on the muscles and structures of the upper body. In this scenario, the children's incorrect posture, such as slouching or hunching over a bench, carrying heavy bagpacks can lead to muscle imbalances and postural abnormalities. The sustained static position places excessive strain on the muscles of the neck, upper back, and shoulders. The forward head posture, rounded shoulders, and tightened chest muscles contribute to the development of upper crossed syndrome.

Static posture for extended periods can lead to tightness in the upper trapezius muscle. This can occur due to muscle imbalances, a forward head position, weak upper back muscles, and stress. Poor posture strains the upper trapezius, causing it to become overactive and tight.Therefore, there is a greater rate of upper trapezius tightness due to the prolonged stresses on the muscle due to the poor posture and long study hours. [2]

In UCS, the muscles in the front of the body, such as the pectoralis major and upper trapezius, become tight and shortened. This tightness is primarily caused by prolonged periods of forward head posture, rounded shoulders, and elevated shoulder blades. At the sarcomere level, there is a decrease in the length of these muscles, leading to a state of chronic contraction. Conversely, the muscles in the back of the body, such as the deep cervical flexors and lower trapezius, become weak and lengthened in UCS. These muscles are responsible for maintaining proper posture and stabilizing the spine. Due to poor posture and excessive tightness in the anterior muscles, the posterior muscles become lengthened and weakened at the sarcomere level. As UCS progresses, there is a shift in the recruitment patterns of muscles. The tight and shortened muscles in the front of the body become dominant, while the weak and lengthened muscles in the back become inhibited. This altered muscle recruitment further perpetuates the muscle imbalances seen in UCS. The muscle imbalances and altered recruitment patterns in UCS result in an uneven distribution of forces across the joints and tissues. This can lead to excessive stress on certain structures, such as the cervical spine, shoulder joints, and surrounding soft tissues. Over time, this can contribute to pain, discomfort, and the development of postural abnormalities.[12]

In conclusion, this study on the prevalence of upper cross syndrome in school going children's by measuring craniovertebral angle by using kinovea soft ware and tightness test highlights the importance of addressing musculoskeletal imbalances in early age group. The findings contribute to our understanding of UCS and underscore the need for interventions aimed at promoting proper posture, ergonomic practices, and targeted exercises to mitigate the consequences associated with UCS and enhance the well-being and performance of school going children.

VIII. CONCLUSION

The study concludes that there is 24% of the population showing prevalence of the upper cross syndrome in school going children's.

Hence it is necessary to create postural awareness and ergonomics advice among school going children's

IX. CLINICAL IMPLICATION

Early Detection and Intervention: The study helps in identifying and early detection of the prevalence of upper cross syndrome enabling healthcare professionals to intervene promptly and prevent the progression of musculoskeletal imbalances.

The study finds the prevalence of upper cross syndrome. This knowledge can guide the development of preventive measures, such as ergonomic interventions, postural awareness programs, and exercises, to reduce the incidence and impact of upper cross syndrome in this population

X. LIMITATION OF STUDY

The strength of deep cervical flexor muscle couldn't be assessed .

The subjects were not controlled from doing any sort of exercises which may have altered the results.

XI. RECOMENDATION AND FUTURE SCOPE OF STUDY

The article will raise awareness among students, parents, teachers and healthcare professionals about the consequences of UCS in children's.

Understanding the prevalence of upper cross syndrome in school going children's enables healthcare professionals to develop targeted treatment approaches.

More objective outcome measures may be designed to diagnose upper crossed syndrome in school going children.

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