



## **Effectiveness of Deep Flexor Muscle Strengthening Exercise for Neck Pain Disability among Adolescents**

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## ABSTRACT

Neck pain from poor posture can be explained as in an upright position the head is supported by the spinal vertebrae. Once the head is flexed forward, for example while using a laptop, the vertebrae do not support the weight of the head as much. Muscles, tendons, and ligaments work harder to hold up the head, which is roughly the weight of a bowling ball. Over time, the muscles and other soft tissues tighten up due to the excessive workload required to hold the head in position. The anterior neck muscles become weak from being stretched, and neural structures are kept in less than optimal positions. A quasi experimental study design was used to assess the effectiveness of deep flexor muscle strengthening exercise for neck pain disability among adolescents. 60 students were selected from two schools for the study, 30 from each school for experimental and control group. Neck disability was assessed from students using neck disability scale. Experimental group received demonstration on deep flexor muscle strengthening exercise for 30 mins. The results of the study shows that 45(37.5%) of the adolescents in study group and 37(32.5%) in the control group had mild disability respectively. Most of the adolescents in the both the group had mild disability due to carrying heavy schoolbags, reading and writing with head down posture for long period of time. There was a significant difference in the mean difference score of overall neck pain disability score between the study and control group at the level of  $p < .001$ . There was also significant difference in the mean score of study and control group in the factors like reading, headache, concentration and lifting at the level of  $p < .01$  and  $p < .05$  respectively. The study concluded that the adolescent students were experiencing mild neck pain disability. Regular practice of deep flexor muscle strengthening exercise is an effective way to reduce the level of neck pain disability among adolescents.

## KEYWORDS

*Neck pain disability, Adolescent students*

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## INTRODUCTION

Adolescence is the period in human growth and development that occurs after childhood and before adulthood, from ages 11 to 19. It represents one of the critical transitions in the lifespan and is characterized by a tremendous pace in growth and change. The process of adolescence is a period of preparation for adulthood during which several key developmental experiences occur. Besides physical and sexual maturation, the experiences like movement

toward social and economic independence, and development of identity, the acquisition of skills needed to carry out adult relationships and roles, and the capacity for abstract reasoning occurs (WHO, 2015)<sup>1</sup>.

Posture of adolescents can be affected by both internal and external influences, which may make adolescents more susceptible to injury. Lifting, carrying and handling a heavy backpack on the back causes forward leaning and bad posture, this can lead to excess load on the spine,



and pain and discomfort in the neck, shoulders and back. Students do not attend school can be influenced by a number of factors ranging from a lack of community support and an unsupportive school environment or family to poor health<sup>2</sup>.

Neck pain from poor posture can be explained as, in an upright position the head is supported by the spinal vertebrae. Once the head is flexed forward, for example while using a laptop, the vertebrae do not support the weight of the head as much. Muscles, tendons, and ligaments work harder to hold up the head, which is roughly the weight of a bowling ball. Over time, the muscles and other soft tissues tighten up due to the excessive workload required to hold the head in position. The anterior neck muscles become weak from being stretched, and neural structures are kept in less than optimal positions. This chronic overload and tightening of soft tissues may eventually result in decreased blood flow and oxygen to the soft tissues, ultimately causing pain<sup>3</sup>.

The neck joints may be kept in abnormal positions which may eventually cause joint pain and muscle weakness. The manifestation frequently occurs is tension headaches and painful “knotty” spots in the neck and upper trapezius muscles (muscles that run from the neck to the shoulder blade). The common causes of neck pain in

adolescents are carrying heavy unbalanced loads, reading and writing with head down for long period of time, sitting on the desk with inappropriate posture for longer period of time, poor sleeping posture, and long term computer use<sup>4</sup>.

Over the past decade, numerous studies have shown an association between reduction in the strength and endurance capacity of the cervical muscles that relating to neck pain. It has been found that certain muscles in the cervical spine tend to get weakened in neck pain, the most common of these are the deep and anterior cervical flexors. Thus, in order to gain muscle strength, flexibility and endurance, to restore injured tissues, and to contribute to ability to sustain normal life activities, exercise is one of the most frequently used modalities in the rehabilitation of subjects with neck pain<sup>5</sup>.

The deep neck flexors are a group of muscles that are responsible for forward bending and side-bending of the neck. These muscles are also very important for supporting the weight of the head against gravity and stabilizing the neck during various body movements. For these reasons, it is very important to maintain the correct length and strength of the deep neck flexor muscle group. And researchers have demonstrated that individuals with weak deep neck flexors are more prone to



experience neck pain and having strong deep neck flexors can actually prevent future occurrences of neck pain<sup>6</sup>.

**Myoung-Hyo Lee (2013)** tested the effects of deep flexor muscle-strengthening exercise on the neck–shoulder posture, and the strength and endurance of the deep flexor muscles of highschool students. 30 seventeen-year-old female high-school students, who complained about bad posture and chronic neck–shoulder pain, were randomly divided into an experimental group of 15 subjects, who performed a deep flexor muscle-strengthening exercise and a control group of 15 subjects, who performed a basic stretching exercise. The experimental group showed statistically significant changes in head tilt angle, neck flexion angle, forward shoulder angle, after the training. In contrast, the control group showed no statistically significant changes in these measures following the training. So the study concludes that strengthening cranio-cervical flexor muscles is important for the <sup>adjustment</sup> of neck posture, and maintaining their stability and it is also required to improve neck-shoulder posture<sup>7</sup>.

**Weber Hellstenius (2009)** conducted a study among 131 students aged between 10-13 years old. The students divided into no pain group or neck pain/headache

group. Along with questionnaire, physical examination was performed by a doctor of chiropractic to establish head posture, active cervical rotation, passive cervical joint functioning, and muscle impairment. The study found that forty percent of the children (n = 52) reported neck pain and/or recurrent headache. Neck pain and/or headache was not associated with forward head posture and joint dysfunction in the upper and middle cervical spine. However, joint dysfunction in the lower cervical spine was significantly associated with neck pain and/or headache in these preadolescents. Most of the students had nonsymptomatic biomechanical dysfunction of the upper cervical spine<sup>8</sup>.

**Rick Kaselj (2013)** conducted a study to assess the effect of deep flexor muscle strengthening exercises on neck-shoulder posture among 30 seventeen year old female high school students who sit for 10 hours behind a desk a day, who had bad posture and chronic neck-shoulder pain. The researchers divided the 30 females into two groups, one group performed deep flexor muscle-strengthening exercises which focused on low-load training of the cranio-cervical muscles and the other group just did stretching. Each group got 30 minutes of training, and then they performed the exercises 5 times a week for 8 weeks. Then on the posttest experiment



group had an improvement in head tilt angle, neck flexion angle, and forward shoulder angle on cranio-cervical flexion test while the control group had no improvement. The researcher concluded that deep flexor muscle strengthening exercises on neck-shoulder posture is an excellent effective exercise and require no equipment that can be applied for the people with neck pain. Exercise is one of the most frequently used modalities in the rehabilitation of subjects with neck pain to gain muscle strength, flexibility and endurance, restore injured tissues, and to contribute ability to sustain normal life activities<sup>9</sup>.

## STATEMENT PROBLEM

A study to assess the effectiveness of deep flexor muscle strengthening exercise on neck pain disability among adolescents in selected high schools at Arakkonam, Vellore District, Tamilnadu.

## OBJECTIVES OF THE STUDY

- Assess the level of neck pain disability among adolescents in the study and the control group.
- Assess the effectiveness of deep flexor muscle strengthening exercises on neck pain disability among adolescents.
- Associate the neck pain disability with selected background variables.

## HYPOTHESIS:

There will be a significant decrease in the level of neck pain disability among adolescents who practice deep flexor muscle strengthening exercise than those who do not.

## MATERIALS AND METHODS

### Research Design

A quasi experimental non randomized pretest posttest control group design was used in the study.

Study group -- O1 \*X O2

Control group -- O1 \* O2

- O1 - A pretest assessment of neck pain using Neck pain disability index scale was used to collect the responses.
- \*- Regular activities were carried out among the control group students.
- \*X - Practice of deep flexor muscle strengthening exercise for 20 minutes, from Monday to Friday, five days per week for two weeks.
- O2 - A posttest assessment of neck pain disability were done using Neck pain Disability Index Scale on the next day of two week intervention period in the study and the control group.

### Variables in the study

Independent variables: Deep flexor muscle strengthening exercise

Dependent variable: Neck pain disability.

### Manipulation



The intervention provided was deep flexor muscle strengthening exercise to the 11<sup>th</sup> standard students with neck pain disability score of 5-14 (mild disability) for two weeks in the study group. On the first day of demonstration an introduction regarding structure and functions of neck muscle was given by lecture cum discussion using power point presentation for 20 minutes. Then on the same day 30 students were divided in to 3 groups, each group consisted of 10 students. Each group received lecture cum demonstration class regarding deep flexor muscle strengthening exercises around 30 minutes separately, doubts were clarified. From next day, the students practiced the deep flexor muscle strengthening exercise training under the direct supervision of investigator constituting 2 levels and each level had 4 steps and was provided for 20 minutes for five days per week from Monday to Friday for two weeks. The students were encouraged to practice by their own on Saturday and Sunday. The time duration to perform each level of exercise was 10 minutes. The intervention was provided in the recreational hall of the school from 11.00 a.m to 11.30 a.m.

### **Control**

The students with neck disability score of 5 – 14 (mild disability), carried out their

regular activity. No intervention was provided to the control group.

### **Setting**

The study was conducted in two private co-education schools namely Dr.V.Genguswamy Naidu Matriculation Higher Secondary school and S.M.S Vimal Matriculation Higher Secondary School, Arakkonam town, Vellore district. The schools were selected based on feasibility and convenient of the investigator. The schools are situated around 60 kilometers away from Sri Ramachandra University. The medium of institution in both schools is English and have classes from Pre.K.G to 12th standard. Description regarding 11th standard students is given below.

### **Population**

The target population of this study was adolescents studying in Dr.V.Genguswamy Naidu

Matriculation Higher Secondary school and S.M.S Vimal Matriculation Higher Secondary School, Arakkonam town, Vellore district. The accessible population was 11th standard students with neck pain disability index score of 5 – 14 (mild disability) studying in both the schools.

### **Sample Size**

The sample consisted of 60 students of which 30 were in the study group and the 30 were



in the control group selected from two different schools.

### **Sampling Technique**

#### **Step I:**

A convenient sampling technique was used to select the two schools for conducting the study in Arakkonam town, Vellore district, and also to assign a school to study and control group. Dr.V.Genguswamy Naidu Matriculation Higher Secondary school for study group and S.M.S Vimal Matriculation Higher Secondary School for the control group were assigned conveniently.

#### **Step II:**

A screening was done to get the list of students with mild disability score (5-14) using Neck Pain Disability Index scale among the students studying in Dr.V.Genguswamy Naidu Matriculation Higher Secondary school and S.M.S Vimal Matriculation Higher Secondary School. There were 45 and 37 students with mild disability in Dr.V.Genguswamy Naidu Matriculation Higher Secondary school and S.M.S Vimal Matriculation Higher Secondary School respectively. Out of which 40 and 34 students fulfilled inclusion and exclusion criteria. Using simple random technique (lottery method) 30 students in study group and 30 students in control group were selected.

#### **Inclusion criteria**

1. Available at the time of study period
2. Both male and female students studying 11th standard were included
3. Having neck disability index score of 5 – 14 (mild disability)

#### **Exclusion criteria:**

1. Attending yoga training programme.
2. On treatment for neck pain.
3. Not willing to participate.

#### **Description of Tool**

The instrument consisted of two parts – Section A and Section B

##### **Section A**

It includes background variables like, gender, family income, occupation of the father, area of residence, previous academic year's percentage, attending computer class, recreational activities, mode of travelling and distance from home to school.

##### **Section B**

It refers to neck pain disability index (NDI) scale (Howard Vernon, 1991) 6 point rating scale. The perceived neck pain disability scale consists of 10 sections, which includes pain intensity, personal care, lifting, reading, headache, concentration, work, driving, sleeping, and recreation each section has six questions with a score from 0 to 5.

#### **Scoring and Interpretation**

The neck disability index scale score was interpreted as follows. (Total score is 50).



- Score 0 – 4 = No disability
- Score 5 – 14 = Mild disability
- Score 15 – 24 = Moderate disability
- Score 25 – 34 = Severe disability
- Score 35-50= Complete disability

### **Validity and Reliability**

The content validity was obtained from experts in Pediatric Nursing speciality. The reliability was done by test-retest method and the reliability obtained was  $r = .80$ .

### **Intervention**

The intervention provided was deep flexor muscle strengthening exercise to the 11<sup>th</sup> standard students with neck pain disability score of 5-14 (mild disability) for two weeks. The students were asked to assemble in the school recreational hall. On the first day of demonstration the investigator gave a brief description regarding structure and functions of neck muscle by lecture cum discussion using power point presentation for 20 minutes. Following that on the same day 30 students were divided in to 3 groups, each group consisted of 10 students. Each group received lecture cum demonstration class regarding deep flexor muscle strengthening exercises around 30 minutes separately, doubts were clarified (20 minutes demonstration and 10 minutes clarification).

From next day, the students practiced the deep flexor muscle strengthening exercise

training under the direct supervision of investigator constituting 2 levels and each level had 4 steps and was provided for 20 minutes for five days per week from Monday to Friday for two weeks. The students were encouraged to practise by their own on Saturday and Sunday. The time duration to perform each level of exercise was 10 minutes.

### **Level I:**

**Step 1:** The students of the study group were made to sit on their respective benches in a comfortable position looking straight ahead with their feet flat on the floor.

**Step 2:** The students were instructed to bend their head forward slightly and tuck the chin towards the neck.

**Step 3:** The students were instructed to maintain their chin tuck and position the head so the eyes were in level with the horizon.

**Step 4:** This position was maintained for 1-2 minutes. The level I exercise steps were performed for 10 times. (Students relaxed themselves from the exercise posture after first 5 times).

### **Level II:**

Following the level I exercise, level II exercise steps were practiced by the students of the study group. In level II, exercise **STEP1** and **STEP 2** were repeated as in level I exercise.





**Step 3:** Maintain the chin tuck and position the head so the eyes were in level with the horizon. Keep the head and spine straight and lean forward.

**Step 4:** Students were instructed to put their elbows on the thighs and hold on in this position for 1-2 minutes and then rest. The level II exercise with 4 steps was

performed for 10 times (students relaxed themselves from the exercise posture after first 5 times). The above mentioned exercises under the deep flexor muscle strengthening exercises were practiced by the study group for 20 minutes 5 days per week for two weeks between 10 and 11 am under the supervision of the investigator.

## RESULTS AND DISCUSSION

**Table 1** Level of neck pain disability among adolescents in the study and control group

Level of Neck Pain disability	Study group (n=120)		Control group (114)	
	f	%	f	%
1. No disability	75	62.5	77	67.5
2. Mild disability	45	37.5	37	32.5
3. Moderate Disability	0	0.0	0	0.0
4. Severe disability	0	0.0	0	0.0
5. complete disability	0	0.0	0	0.0

Table 1 shows that 37.5% of the adolescents in study group and 32.5% in the control group had mild neck pain disability. From which 60 mild neck pain

disability students were selected for the study. (30 from study group and 30 from control group).

**Table 2** Frequency and percentage distribution of background variables of the adolescent and their parents in the study group and control group (N = 60)

BACKGROUND VARIABLES		Study group (n=30)		Control group (n=30)		Chi square & p-value
		f	%	f	%	
Gender	Male	9	30.0	6	20.0	0.80 .371
	Female	21	70.0	24	80.0	
Family income	< 10,000	5	16.7	6	20.0	2.32 .509
	10,001 to 20,000	5	16.7	9	30.0	
	20,001 to 30,000	6	20.0	6	20.0	
	above 30000	14	46.7	9	30.0	
Occupation of father	Private sector	6	20.0	12	40.0	3.76 .152
	Government sector	6	20.0	7	23.3	
	Other	18	60.0	11	36.7	
Area of residence	Urban	17	56.7	22	73.3	1.83 .176
	Rural	13	43.3	8	26.7	



Previous academic year's percentage	55 to 65	2	6.7	4	13.3	0.75 .686
	65 to 75	4	13.3	4	13.3	
	75 and above	24	80.0	22	73.3	
Attending computer class	Yes	10	33.3	13	43.3	0.63 .426
	No	20	66.7	17	56.7	
Recreational activities	No	-	-	2	6.7	4.88 .181
	Dance and music	15	50.0	8	26.7	
	Television	8	26.7	10	33.3	
	Hanging out with friends	7	23.3	10	33.3	
Mode of travelling	Walking	3	10.0	2	6.7	39.74*** 0.000
	Cycle	5	16.7	17	56.7	
	Spare bus	-	-	11	36.7	
	School Bus	22	73.3	-	-	
Distance from home to school	0 - 5 km	14	46.7	21	70.0	11.27** .010
	6 – 10 km	8	26.7	3	10.0	
	11 – 15 km	-	-	4	13.3	
	16- 20 km	8	26.7	2	6.7	

\*\*p<.01

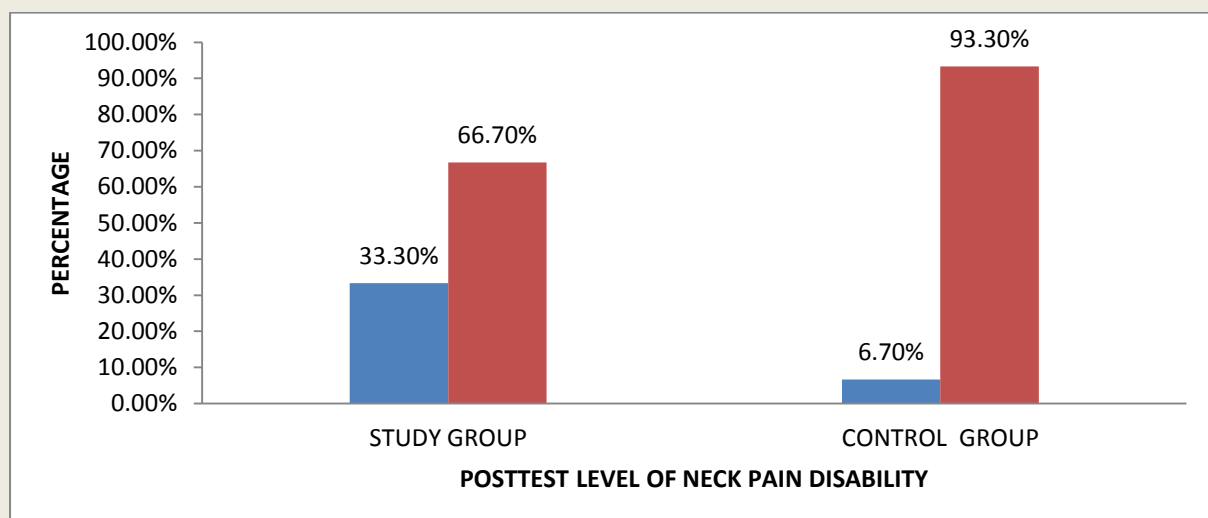
\*\*\*p<.001

**Table 3** Comparison of level of neck pain disability between study and control group during posttest (N=60)

Level of Neck Pain Post test	Study group (n=30)		Control group (n=30)		df	Chisquare & p-value
	f	%	f	%		
(0-4) No disability	10	33.3	2	6.7	1	6.67
(5-14) Mild disability	20	66.7	28	93.3		.010

Table 3 shows that the level of neck pain disability among adolescents reveals significant difference in the distribution between the study group and control group during posttest. 66.7% and 93.3% of the

adolescents had mild disability in the study and control group respectively. 33.3% of adolescents had no disability in the study group, whereas 6.7% had no disability in the control group.



**Figure 1** Comparison of level of neck pain disability between study and control group during posttest



**Table 4** Comparison of mean difference score of neck pain disability in study and control group (n=60)

VARIABLES (Total Score)	Study group (n=30)		Control group (n=30)		Independent 't' value & p-value
	Mean Difference	SD	Mean Difference	SD	
Pain intensity (5)	0.10	0.48	0.13	0.57	1.71 .092
Personal care (5)	0.00	0.45	0.10	0.60	0.72 .474
Lifting (5)	0.47	0.50	0.03	0.32	3.95*** .000
Reading (5)	0.40	0.67	0.07	0.45	3.15** .003
Head ache (5)	0.40	0.72	0.17	0.79	2.89** .005
Concentration (5)	0.47	0.57	0.03	0.66	3.11** .003
Work (5)	0.27	0.58	1.03	0.55	1.56 .118
Driving (5)	0.27	0.45	0.00	0.64	1.86 .068
Sleeping (5)	0.03	0.55	0.16	0.59	0.89 .372
Recreation (5)	0.130	0.50	0.10	0.40	1.97 .054
Overall neckpain Disability score	2.47	1.07	0.70	1.36	9.97*** .000

\*\*\* p <.001,      \*\* p< .01      \*p< .05

Table 4 shows that there was significant difference in the mean difference score of overall neck disability score between the study and the control group. There was

also significant difference in the mean score of factors like reading, lifting, headache and concentration.

**Table 5** Comparison of mean score of neck pain disability in control group in pretest and posttest (n=30)

VARIABLES (Total Score)	Pretest		Posttest		Mean Difference	Paired 't' value & p- value
	Mean	SD	Mean	SD		
Pain intensity (5)	0.30	0.46	0.43	0.50	0.13	1.27 .211
Personal care (5)	0.33	0.47	0.43	0.56	0.10	0.90 .375
Lifting (5)	1.07	0.36	1.03	0.41	0.03	0.57 .573
Reading (5)	1.13	0.34	1.20	0.40	0.06	0.81 .423
Head ache (5)	0.87	0.62	1.03	0.66	0.16	1.15 .258
Concentration (5)	0.93	0.58	0.97	0.55	0.03	0.27 .787
Work (5)	0.70	0.46	0.67	0.47	0.03	0.32 .745
Driving	0.30	0.46	0.30	0.46	0.00	0.00



(5)						1.000
Sleeping	0.70	0.53	0.87	0.43	0.16	1.54
(5)						.134
Recreation	0.30	0.46	0.40	0.49	0.10	1.36
(5)						.184
<b>Overall neckpain Disability score</b>	6.63	2.34	7.33	2.44	0.70	2.80**
						.009

\*\*p< .01

Table 5 shows the Comparison of mean score of neck pain disability in control group in pretest and posttest reveals that

overall neck pain disability score was significantly increased during posttest.

**Table 6** Comparison of mean score of neck pain disability between pretest and posttest in the study group (n=30)

VARIABLES (Total Score)	Pretest		Posttest		Mean Difference	Paired 't' value & p-value
	Mean	SD	Mean	SD		
Pain intensity (5)	0.43	0.56	0.33	0.47	0.10	1.14 .264
Personal care (5)	0.37	0.49	0.37	0.49	0.00	0.00 1.000
Lifting (5)	1.17	0.37	0.70	0.46	0.46	5.03*** .000
Reading (5)	1.20	0.48	0.80	0.55	0.40	3.24** .003
Head ache (5)	0.97	0.55	0.57	0.50	0.40	3.02** .005
Concentration (5)	1.10	0.40	0.63	0.55	0.46	4.47*** .000
Work (5)	0.83	0.37	0.57	0.50	0.26	2.50 .180
Driving (5)	0.37	0.49	0.10	0.30	0.26	3.24** .003
Sleeping (5)	0.53	0.57	0.57	0.50	0.16	0.32 .745
Recreation (5)	0.53	0.50	0.40	0.49	0.30	1.43 .161
<b>Overall neckpain Disability score</b>	7.50	1.81	5.03	1.45	2.46	12.57*** .000

\*\*\* p < .001,

\*\* p < .01

Table 6 shows that in the study group, there was significant difference in the overall neck disability mean score between the pretest and posttest. There was also significant difference in the mean score between pretest and posttest in the five aspects of neck disability, lifting, reading, headache, concentration and driving.

## CONCLUSION

The assessment of level of neck pain disability among adolescents studying 11th standard revealed that they were going through mild neck pain disability. Practicing deep flexor muscle strengthening exercise is an effective way to reduce the level of neck pain disability among adolescents by regular practice of exercises. Finally neck pain disability is



influenced by background variable like total family income in the control group. The study cannot be generalized due to study design, sample size and sampling technique to other parts of India.



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