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Effectiveness of Muscle Strengthening Exercises on Neck Pain Among Adolescents: A Quasi-Experimental Study

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ABSTRACT

Background: Poor posture during adolescence—especially forward head posture resulting from prolonged use of digital devices and heavy academic loads—contributes significantly to mus-culoskeletal disorders, including neck pain. Muscle strengthening exercises have emerged as a potential non-pharmacological intervention to reduce neck pain and improve posture.

Objectives: This study was undertaken to: (1) assess the level of neck pain among adolescents before and after the implementation of a muscle strengthening exercise program, (2) evaluate the effectiveness of these exercises in alleviating neck pain, and (3) examine the association between post-intervention neck pain levels and selected demographic and clinical variables.

Methods: A quasi-experimental study was conducted among 60 adolescent students selected through non-probability purposive sampling from Government Girls Senior Secondary School, Safidon (JIND). Data were collected using a structured demographic and clinical questionnaire (Part A) and the Modified Wong-Baker FACES Pain Rating Scale (Part B). A pre-test was followed by a Planned Teaching Program (PTP) that covered the introduction, procedure, indications, and contraindications of muscle strengthening exercises. A post-test was administered 15 days after the intervention. Data were analyzed using descriptive and inferential statistics.

Results: The mean pre-test pain score was 55.67%, which significantly reduced to 27.67% in the post-test, indicating an improvement in neck pain levels among adolescents following the interven-tion. Chi-square analysis revealed a significant association between post-intervention pain levels and selected demographic (age, gender, education, area of residence, etc.) and clinical variables (type and duration of neck pain, daily screen usage, posture habits, etc.) at the 0.05 significance level. However, no significant association was found for other variables.

Conclusion: The findings indicate that muscle strengthening exercises are effective in reducing neck pain among adolescents. Educating students on proper posture and incorporating regular exercise can play a critical role in managing musculoskeletal health in the school-age population.

INTRODUCTION

Poor posture is increasingly common among adolescents, often due to prolonged computer use, inappropriate school furniture, heavy backpacks, and lack of physical activity. One prevalent is-sue is forward head posture, which contributes to neck–shoulder pain and weakens deep cervical flexor (DCF) muscles such as the longus colli and longus capitis—key muscles for maintaining neck stability and posture[5].

Neck pain (NP) affects up to 70% of people globally and is particularly common among high-school students and teachers due to static postures and high workloads. Teaching, in particular, involves prolonged head-down positions and computer use, increasing the risk of musculoskeletal strain. Despite its prevalence, there is limited evidence on effective interventions targeting NP in these populations.

Strengthening DCF muscles through targeted exercises like craniocervical flexion (CCF) has shown promise in improving posture and reducing NP. This study aims to evaluate the effectiveness of deep flexor muscle-strengthening exercises on posture, pain, and muscle endurance among adolescents with chronic neck–shoulder discomfort[6].

The current study was undertaken with three main objectives:

- To assess the level of neck pain among adolescents before and after intervention.
- To evaluate the effectiveness of muscle-strengthening exercises on neck pain.
- To determine the association between post-intervention pain levels and various demographic and clinical variables.

By focusing on adolescent students in a school setting, this research aims to provide empirical evidence on the utility of DCF exercises as a non-invasive, cost-effective intervention to combat the growing problem of neck pain in youth[1].

Hypothesis:

H_1: There will be significant difference in pre and post intervetional level of neck pain score among adolescents.

H_2: There will be significant association between level of neck pain and demographical or clinical variables.

Material And Methods

This study was designed to assess the effectiveness of muscle-strengthening exercises in reducing neck pain among adolescents studying in selected schools in Jind. The theoretical foundation of the research was based on Ernestine Weidenbach's *Helping Art of Clinical Nursing* theory, which was adapted slightly to fit the needs of this study[2].

An experimental research approach was adopted to evaluate the outcomes of the intervention. Before the main study, the research tool was tested for reliability using the Test–Retest method on a small group of six adolescent students from Budhakhera, Jind, ensuring it could consistently measure knowledge related to neck muscle strengthening exercises.

A pilot study was conducted from March 14 to March 19, 2022, at Budhakhera, Jind. This trial run helped assess the feasibility of the study, availability of participants, and effectiveness of the research methods before the actual data collection phase.

Ethical approval was secured from the institution's ethical committee, and permission to conduct the study was granted by the school principal. Informed written consent was obtained from all participating adolescents, affirming their voluntary involvement in the research.

The main study was carried out in March 2019, where data was collected to measure students' knowledge and experience regarding muscle-strengthening exercises for neck pain. Both descriptive and inferential statistical methods were employed to analyze the data and determine the effectiveness of the exercise intervention.

Results:

SECTION-A: Description of demographical variables and clinical variables.

The study included adolescents from various age groups, with most (43%) aged between 10–20 years. A majority (53%) were female. Regarding marital status, 38% were married, followed by 35% widowed, and smaller groups were divorced or single (13% each). In terms of religion, most participants were Christian (38%), followed by Muslim (32%), Hindu (20%), and others (10%).

Educationally, 47% had secondary education, while the rest had primary, senior secondary, or postgraduate qualifications. Household income varied, with 38% earning ₹21,000–₹25,000 annually. Participants were evenly split between urban and rural areas. Dietary habits showed 53% followed a vegetarian diet.

Family structure showed a slight majority (52%) living in joint families. Regarding habits, 45% reported smoking, 30% consumed alcohol, and 25% had no such habits.

In terms of health, 45% of adolescents reported having neck pain, most of which lasted 1–3 months (43%). The most common pain sensations were tightness (33%) and burning (30%).

Daily routines showed that 42% worked on computers for 8–10 hours a day, and 45% used cell phones for 4–6 hours. Common commuting methods included two-wheelers (32%) and cars (28%), with 38% traveling 2–3 hours daily (Table 1).

Work postures varied, with 33% sitting, while others used semi-Fowler, supine, or prone positions. Half of the students took rest breaks during work, and 55% reported using self-care methods to manage neck pain.

LIMITATIONS:
1. Adolescence students, age group between12-18 year.
2. Adolescence students, who can read, write or understand either Hindi or English.
3. Adolescence students in selected Govt. Sen. Secondary School, Budhakhera (JIND).

Table 1.Frequency distribution of demographical variables and clinical variables

Variables	Opts	Percentage	Frequency
Age in years	0 -10 year	16.70%	10
	10 - 20 year	41.70%	25
	20 - 30 year	31.70%	19
	30 - 40 year	10.00%	6
Gender	Male	46.70%	28
	Female	53.30%	32
Marital status	Single	13.30%	8
	Married	38.30%	23
	Widow/Widower	35.00%	21
	Divorced/Separated	13.30%	8
Religion	Hindu	20.00%	12
	Christian	38.30%	23
	Muslim	31.70%	19
	Others	10.00%	6
Educational status	Primary	23.30%	14
	Secondary	46.70%	28
	Post graduate	20.00%	12
	Senior secondary	10.00%	6
Annual household income	Rs 10,000-15,000	5.00%	3
	Rs16,000 - 20,000	28.30%	17
	Rs21,000-25,000	38.30%	23
	Rs 25,000 and Above	28.30%	17
Area of living	Urban	50.00%	30
	Rural	50.00%	30
Dietary habit	Vegetarian	53.30%	32
	Non-Vegetarian	46.70%	28
Type of family	Nuclear family	48.30%	29
	Joint family 10 Habits	51.70%	31
	Alcoholism	0.00%	0
	Smoking	0.00%	0
	None	0.00%	0
Habits	Alcoholism	30.00%	18
	Smoking	45.00%	27
	None	25.00%	15
Do you have neck pain?	Yes	45.00%	27
	No	55.00%	33

How long have you been suffering with neck pain?	Less than a month	26.70%	16
	1-< 3 months	43.30%	26
	3-< 6 months	30.00%	18
What type of neck pain do you experience?	Tingling, Pricking	21.70%	13
	Pain of tight touch	33.30%	20
	Hot or burning	30.00%	18
	Electrical shock	15.00%	9
How long do you work with computer per day?	8 hours	30.00%	18
	8-10 hours	41.70%	25
	> 10 hours	28.30%	17
How do you commute to school?	By bus	21.70%	13
	By two-wheeler	31.70%	19
	By car	28.30%	17
	By train	18.30%	11
How many hours do you travel per day?	1- 2 hours	30.00%	18
	2- 3 hours	38.30%	23
	> 3 hours	31.70%	19
What is the duration of cell phone use per day?	2- 4 hours	25.00%	15
	4- 6 hours	45.00%	27
	6- 8 hours	30.00%	18
Which of the following position do you adapt regularly while working with computer?	Supine	18.30%	11
	Sitting	33.30%	20
	Semi fowler	30.00%	18
	Prone	18.30%	11
Do you utilize rest hours in between work?	Yes	50.00%	30
	No	50.00%	30
Do you take any self-care measures for neck pain?	Yes	55.00%	33
	No	45.00%	27

Table 2.Effectiveness of muscle strengthening exercise during neck pain among adolescents

Diagram Showing Individual Score Gain (Effectiveness)						
Mean%	**Pretest Pain**	**Posttest Pain**	**Difference**	**Pretest Pain Score %**	**Posttest Pain Score %**	**Difference%**
Average	5.57	2.77	2.8	55.67	27.67	28

SECTION-B: Effectiveness of muscle strengthening exercise during neck pain among adolescents.

The pre-test results showed a pain score of 55.67%, while the post-test score decreased to 27.67%. This significant reduction indicates that the pain levels among adolescents with neck pain improved after the intervention. The findings suggest that muscle strengthening exercises were effective in reducing neck pain among adolescents (Table 2).

To meet the study objectives, the Chi-square test was applied to examine the association between the level of neck pain and selected demographic and clinical variables. The results indicated that there was no statistically significant association between pain levels and any of the demographic variables (such as age, gender, marital status, religion, education, income, area of residence, diet, family type, and personal habits) or clinical variables (such as presence of neck pain, duration and type of neck pain, computer use, mode of commute, travel time, phone usage, working posture, break time during work, and self-care practices)[3].

The calculated Chi-square values were less than the critical value at the 0.05 significance level, confirming that none of the variables

Table 3.Shows that the association of pretest pain score and socio demographic or clinical variables

Association of pretest pain scores with selected socio-demographic and clinical data variables.										
Variables	**Opts**	**SEVERE PAIN**	**MODERATE PAIN**	**MILD PAIN**	**NO PAIN**	**Chi Test**	**P Value**	**df**	**Table Value**	**Result**
Age in years	0 -10 year	2	5	3	0	9.521	0.391	9	16.919	Not Significant
	10 - 20 year	7	12	6	0					
	20 - 30 year	6	11	1	1					
	30 - 40 year	2	3	0	1					
Gender	Male	9	16	2	1	3.44	0.329	3	7.815	Not Significant
	Female	8	15	8	1					
Marital status	Single	3	3	2	0	6.392	0.7	9	16.919	Not Significant
	Married	8	12	2	1					
	Widow/Widower	4	13	3	1					
	Divorced/Separated	2	3	3	0					
Religion	Hindu	2	7	2	1	13.103	0.158	9	16.919	Not Significant
	Christian	12	7	4	0					
	Muslim	2	13	3	1					
	Others	1	4	1	0					
Educational status	Primary	3	7	4	0	6.54	0.685	9	16.919	Not Significant
	Secondary	8	16	3	1					
	Post graduate	5	5	1	1					
	Senior secondary	1	3	2	0					
Annual household income	Rs 10,000-15,000	0	2	1	0	5.078	0.827	9	16.919	Not Significant
	16,000 - 20,000	5	11	1	0					
	Rs 21,000-25,000	7	10	5	1					
	Rs 25,000 and above	5	8	3	1					
Area of living	Urban	11	12	6	1	3.451	0.327	3	7.815	Not Significant
	Rural	6	19	4	1					
Dietary habit	Vegetarian	8	18	4	2	3.012	0.39	3	7.815	Not Significant
	Non-Vegetarian	9	13	6	0					

Type of family	Nuclear family	8	16	4	1	0.425	0.935	3	7.815	Not Significant
	Joint family 10 Habits	9	15	6	1					
	Alcoholism	0	0	0	0					
	Smoking	0	0	0	0					
	None	0	0	0	0					
Habits	Alcoholism	3	11	3	1	3.872	0.694	6	12.592	Not Significant
	Smoking	10	13	4	0					
	None	4	7	3	1					
Do you have neck pain?	Yes	9	11	6	1	2.497	0.476	3	7.815	Not Significant
	No	8	20	4	1					
How long have you been suffering with neck pain?	Less than a month	6	6	4	0	3.749	0.711	6	12.592	Not Significant
	1-< 3 months	6	16	3	1					
	3-< 6 months	5	9	3	1					
What type of neck pain do you experience?	Tingling, Pricking	3	7	3	0	6.847	0.653	9	16.919	Not Significant
	Pain of tight touch	6	9	4	1					
	Hot or burning	7	10	1	0					
	Electrical shock	1	5	2	1					
How long do you work with computer per day?	8 hours	6	7	5	0	7.217	0.301	6	12.592	Not Significant
	8-10 hours	5	14	4	2					
	> 10 hours	6	10	1	0					
How do you commute to school?	By bus	3	6	4	0	6.851	0.653	9	16.919	Not Significant
	By two-wheeler	4	11	3	1					
	By car	7	9	1	0					
	By train	3	5	2	1					
How many hours do you travel per day?	1- 2 hours	7	8	3	0	2.278	0.892	6	12.592	Not Significant
	2- 3 hours	5	13	4	1					
	> 3 hours	5	10	3	1					
What is the duration of cell phone use per day?	2- 4 hours	4	10	1	0	5.553	0.475	6	12.592	Not Significant
	4- 6 hours	9	11	5	2					
	6- 8 hours	4	10	4	0					
Which of the following position do you adapt regularly while working with computer?	Supine	3	6	2	0	6.507	0.688	9	16.919	Not Significant
	Sitting	7	9	3	1					
	Semi fowler	4	9	5	0					
	Prone	3	7	0	1					

Do you utilize rest hours in between work?	Yes	8	16	6	0	2.491	0.477	3	7.815	Not Significant
	No	9	15	4	2					
Do you take any self-care measures for neck pain?	Yes	12	14	6	1	3.003	0.391	3	7.815	Not Significant
	No	5	17	4	1					

showed a meaningful association with the level of pain among the adolescents (Table 3).

POST TEST SCORE:

As per the study objectives, a Chi-square test was conducted to examine the relationship between pain levels and various demographic and clinical factors. The analysis showed that some variables had a statistically significant association with the pain scores. These included demographic factors such as age, gender, marital status, religion, education level, household income, area of residence, dietary habits, type of family, and personal habits. Similarly, clinical variables like presence of neck pain, its duration and type, hours spent on the computer, mode of travel to school, daily travel time, cell phone usage, working posture, taking rest breaks, and use of self-care measures also showed a significant link to pain levels.

The Chi-square values for these associations were greater than the critical value at the 0.05 level of significance, indicating a meaningful relationship.

However, for other variables, the Chi-square values were less than the critical value, suggesting that there was no significant association between those factors and the pain levels of adolescents (Table 4).

Table 4.Shows that the association of post-test pain score and socio demographic or clinical variable

Association of posttest pain scores with selected socio-demographic and clinical data variables										
Variables	**Opts**	**SEVERE PAIN**	**MODERATE PAIN**	**MILD PAIN**	**NO PAIN**	**Chi Test**	**P Value**	**df**	**Table Value**	**Result**
Age in years	0 -10 year	0	4	4	2	4.837	0.565	6	12.592	Not Significant
	10 - 20 year	0	12	9	4					
	20 - 30 year	0	8	4	7					
	30 - 40 year	0	1	3	2					
Gender	Male	0	11	10	7	0.161	0.923	2	5.991	Not Significant
	Female	0	14	10	8					

Marital status	Single	0	3	3	2	6.852	0.335	6	12.592	Not Significant
	Married	0	12	9	2					
	Widow/Widower	0	8	6	7					
	Divorced/Separated	0	2	2	4					
Religion	Hindu	0	5	3	4	1.6	0.953	6	12.592	Not Significant
	Christian	0	10	7	6					
	Muslim	0	7	8	4					
	Others	0	3	2	1					
Educational status	Primary	0	7	4	3	7.788	0.254	6	12.592	Not Significant
	Secondary	0	11	12	5					
	Post graduate	0	5	1	6					
	Senior secondary	0	2	3	1					
Annual household income	Rs 10,000-15,000	0	0	2	1	5.82	0.444	6	12.592	Not Significant
	Rs 16,000 - 20,000	0	9	3	5					
	Rs 21,000-25,000	0	10	7	6					
	Rs 25,000 and above	0	6	8	3					
Area of living	Urban	0	12	12	6	1.44	0.487	2	5.991	Not Significant
	Rural	0	13	8	9					
Dietary habit	Vegetarian	0	13	9	10	1.647	0.439	2	5.991	Not Significant
	Non-Vegetarian	0	12	11	5					
Type of family	Nuclear family	0	13	10	6	0.574	0.751	2	5.991	Not Significant
	Joint family 10 Habits	0	12	10	9					
	Alcoholism	0	0	0	0					
	Smoking	0	0	0	0					
	None	0	0	0	0					
Habits	Alcoholism	0	9	5	4	1.389	0.846	4	9.488	Not Significant
	Smoking	0	11	10	6					
	None	0	5	5	5					
Do you have neck pain?	Yes	0	11	10	6	0.364	0.834	2	5.991	Not Significant
	No	0	14	10	9					
How long have you been suffering with neck pain?	Less than a month	0	7	5	4	4.43	0.351	4	9.488	Not Significant
	1-< 3 months	0	14	7	5					
	3-< 6 months	0	4	8	6					

What type of neck pain do you experience?	Tingling, Pricking	0	3	7	3	8.686	0.192	6	12.592	Not Significant
	Pain of tight touch	0	11	5	4					
	Hot or burning	0	9	3	6					
	Electrical shock	0	2	5	2					
How long do you work with computer per day?	8 hours	0	7	7	4	0.627	0.96	4	9.488	Not Significant
	8-10 hours	0	11	7	7					
	> 10 hours	0	7	6	4					
How do you commute to school?	By bus	0	6	5	2	5.307	0.505	6	12.592	Not Significant
	By two-wheeler	0	6	6	7					
	By car	0	10	4	3					
	By train	0	3	5	3					
How many hours do you travel per day?	1- 2 hours	0	10	3	5	6.828	0.145	4	9.488	Not Significant
	2- 3 hours	0	11	7	5					
	> 3 hours	0	4	10	5					
What is the duration of cell phone use per day?	2- 4 hours	0	9	4	2	3.119	0.538	4	9.488	Not Significant
	4- 6 hours	0	10	9	8					
	6- 8 hours	0	6	7	5					
Which of the following position do you adapt regularly while working with computer?	Supine	0	5	3	3	1.631	0.95	6	12.592	Not Significant
	Sitting	0	7	7	6					
	Semi fowler	0	7	7	4					
	Prone	0	6	3	2					
Do you utilize rest hours in between work?	Yes	0	14	7	9	2.76	0.252	2	5.991	Not Significant
	No	0	11	13	6					
Do you take any self-care measures for neck pain?	Yes	0	13	12	8	0.31	0.857	2	5.991	Not Significant
	No	0	12	8	7					

DISCUSSION

The findings of this study clearly highlight the positive impact of muscle strengthening exercises in reducing neck pain among adolescents. Before the intervention, the average pain score (pre-test) was 5.57, indicating a moderate level of discomfort. After the exercise program, the average pain score (post-test) reduced significantly to 2.77. This shows a notable decrease of 2.80 points in the pain levels.

The consistent improvement in pain scores from pre-test to post-test, along with similar standard deviations, suggests that the exercises were not only effective for a few individuals but beneficial across the group. This supports the conclusion that a structured muscle strengthening exercise routine can play an important role in managing neck pain in adolescents.

These results align with previous evidence that physical activity, especially targeted strengthening exercises, helps relieve musculoskeletal pain and improves posture and flexibility, which are key contributors to neck discomfort in this age group—especially with increasing screen time and sedentary habits.

Therefore, incorporating such exercise programs into school routines or daily adolescent activity can be a practical, low-cost solution to manage and even prevent neck pain.

CONCLUSION

This study was carried out to evaluate the effectiveness of muscle strengthening exercises in reducing neck pain among adolescent students. The findings suggest that such exercises can significantly help in managing neck discomfort, thereby improving students' well-being and daily functioning[4].

Through this research, adolescent students gained valuable knowledge about how specific exercises can reduce and prevent neck pain, which may help avoid further complications in the future. By promoting awareness and encouraging healthy physical habits, the study contributes positively to the overall health education of young individuals.

An experimental research design was used, with a sample size of 60 adolescents selected through non-probability purposive sampling. Data was collected using structured questionnaires to gather demographic and clinical details, along with the Modified Wong-Baker FACES Pain Rating Scale (Wong, B., 1981) to assess pain levels. The tool's reliability and validity were confirmed by the research committee of the College of Nursing.

Although the study had limitations and delimitations in terms of design and scope, it provides meaningful insights for the nursing field. The results support integrating muscle strengthening exercises into school or community health programs for adolescents. Future research with larger sample sizes and varied settings is recommended to further validate and expand these findings.

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Declaration of Interest: The author declares no personal or financial relationships with individuals or organizations that have influenced or could be perceived to have influenced the study's content and conclusions.

Ethics approval: Ethical clearance was obtained from the Institutional Ethics Committee. Prior permissions were secured from the heads of the local institutions, and informed consent was obtained from all participants. The confidentiality and anonymity of the subjects were maintained throughout the study.

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