



ISSN: 0975-833X

Available online at <http://www.journalcra.com>

International Journal of Current Research
Vol. 15, Issue, 07, pp.25221-25225, July, 2023
DOI: <https://doi.org/10.24941/ijcr.45484.07.2023>

**INTERNATIONAL JOURNAL
OF CURRENT RESEARCH**

RESEARCH ARTICLE

A QUASI EXPERIMENTAL STUDY TO EVALUATE THE EFFECTIVENESS OF DEEP NECK FLEXOR MUSCLE STRENGTHENING EXERCISE VERSUS NECK STRETCHING EXERCISE ON NECK PAIN AMONG ADOLESCENTS

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ARTICLE INFO

Article History:

Received 24th April, 2023
Received in revised form
19th May, 2023
Accepted 29th June, 2023
Published online 20th July, 2023

Key words:

Deep neck flexor muscle strengthening exercise, Neck stretching exercise, Neck pain, adolescents.

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ABSTRACT

A quasi experimental study to evaluate the effectiveness of deep neck flexor muscle strengthening exercise versus neck stretching exercise on neck pain among adolescents. The study adopted a quasi-experimental research design, preintervention and post-intervention assessments were carried out using the revised Oswestry neck pain questionnaire. The participants for study group I and study group II were selected using a simple random technique, with 30 participants in each group. An unpaired "t" test was performed, and the obtained value was 3.52, which was significant at $p \leq 0.01$. The mean value for study group I was 24.60, while for the Study group II, it was 30.90. These results indicated that deep neck flexor muscle strengthening exercises were more effective in relieving neck pain.

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Citation: Shyji, K. and Dr. Reena Evency A. 2023. "A quasi experimental study to evaluate the effectiveness of deep neck flexor muscle strengthening exercise versus neck stretching exercise on neck pain among adolescents". *International Journal of Current Research*, 15, (07), 25221-25225.

INTRODUCTION

Adolescence was the phase of life between childhood and adulthood, encompassing ages between 12 to 19 years. It was a unique stage of human development and an important time for laying the foundation of good health. It was a period of rapid growth, which was reflected in the posture as well. (Davidson, D. 2022). Posture plays an essential role in maintaining normal balance. Good posture was more than just standing up straight; it reflects the proper state of the body and mind. Various factors triggered spasms in the shoulders and neck muscles, reducing the effectiveness of biomechanical functions and weakening the soft tissues, making adolescents more susceptible to injury. These factors included forward head posture resulting from the use of mobile phones and computers, prolonged sitting at desks for attending classes or using computers, the use of desks and chairs not suitable for their physique, heavy school bags, beds that did not promote good posture, lack of exercise, and excessive learning activities. Neck pain was a common problem for adolescents due to improper posture. (Smythe, & Jivanjee M 2021). Neck pain is one of the musculoskeletal conditions that have become a major cause of concern especially in the young population. It is also known as cervical pain which refers to pain that occurs between the cervical region 1 and 7.

Usually neck pain occurs in adolescents because of improper posture, especially long-time static posture due to a lot of time spent while doing homework, improper height of the desk and seat, which affect muscles as well as bones of the neck. This causes a heavier muscular load, which leads to muscle weakness and loss of mobility which in turn causes pain and discomfort in the neck later on. Therefore, early management and intervention are important to prevent the complications that may occur due to neck pain. (Sterling, M 2018) Deep cervical flexor exercise was a low-load exercise that targeted the deep cervical flexor muscles. This exercise focused on the deep flexor muscles of the cervical region rather than the superficial flexor muscles. The exercise helps to maintain mobility in the deep neck flexor muscles, strengthened the deep muscles around the neck, and improved their functions. (Vernon, H. 2018). Neck stretching exercises helped to relieve neck pain and improve neck muscle function. These exercises decreased muscle stiffness and improved muscle flexibility. The exercises focused on both the deep and superficial muscles around the neck, including the upper trapezius, sternocleidomastoid, suboccipitalis, scalenus, levator and scapula. (Hovin, Tunwattana & Kuptniratsaikul, V 2016). Lee and Park (2013) conducted a study to evaluate the effectiveness of deep neck flexor muscle strengthening exercises and neck stretching exercises on neck and shoulder pain among high school students. They evaluated 30, 17

years old female high school students. The researchers used the Wilcoxon signed-rank test to determine changes in neck-shoulder posture, as well as the strength and endurance of the muscles. After analyzing the findings, they found that strengthening the neck flexor muscles was important for adjusting neck posture and reducing neck-shoulder pain. Almaz, Aziem, Draz, (2018) conducted a study to evaluate the effectiveness of deep neck flexor exercises in managing neck pain among patients with neck pain. A randomized controlled research design was used in the study. The sample consisted of sixty patients with non-specific neck pain of at least six-week duration, who were randomly assigned to one of three groups. Group 1 received physical therapy agents including transcutaneous electrical nerve stimulation, continuous ultrasound, and infrared irradiation. Group 2 received physical therapy agents, isometric, stretching, and scapula thoracic exercises. Group 3 received physical therapy agents and deep neck flexor exercises. The patients' pain levels were evaluated using a visual analog scale, a neck disability index, and the range of motion in three planes at baseline and after one month of treatment. After the intervention, the results showed that only group 3 demonstrated a significant difference among the groups ($p < 0.05$). Throughout the study, significant improvements in disability were observed in group 3, as assessed by the neck disability index and range of motion. The 't' value was 16.0, indicating statistical significance ($p < 0.05$). Therefore, the study concluded that deep neck flexor exercise was superior to isometric, stretching, and scapula thoracic exercises in managing neck pain.

During the community field practice in Advanced Nursing Practice, many parents stated that their adolescent children suffered from neck pain that disrupted their normal daily activities as well as educational activities. It was also noted that the students restrained themselves from involvement in curricular and co-curricular activities. As a result, the researcher developed an interest in implementing deep neck flexor muscle strengthening and neck stretching exercises to reduce neck pain among adolescents.

Statement of the problem: A quasi experimental study to evaluate the effectiveness of deep neck flexor muscle strengthening exercise versus neck stretching exercise on neck pain among adolescents in selected schools at Kanyakumari district.

Objectives of the study

- To assess and compare preintervention and postintervention score on neck pain among adolescents in study group I and II.
- To evaluate the effectiveness of deep neck flexor muscle strengthening exercise and neck stretching exercise on neck pain among adolescents in study group I and II.
- To associate the selected demographic variables among adolescents with their preintervention score on neck pain in study group I and II.
- To associate the selected clinical variables among adolescents with their preintervention score on neck pain in study group I and II.

Hypotheses

H₁: There was a significant difference between preintervention and postintervention score on neck pain among adolescents in study group I and II.

H₂: There was a significant difference between postintervention score on neck pain among adolescents in study group I and II.

METHODOLOGY

A quantitative research approach was adopted for the study. The independent variables were deep neck flexor muscle strengthening exercise and neck stretching exercise, while the dependent variable was neck pain among adolescents. The study was conducted for study

group I at St. Lawrence Higher Secondary School, Madathattuvilai and for study group II at St. Aloysius Higher Secondary School, Vetturimadam. Formal permission was obtained from the ethical committee of the institution and the principals of the selected schools, and informed written consent was obtained from the adolescents and their parents. Screening was performed using the neck motion rating scale in both schools. During the screening process, 77 adolescents were identified from St. Lawrence Higher Secondary School, Madathattuvilai and 74 adolescents were identified from St. Aloysius Higher Secondary School, Vetturimadam. After the screening, 30 participants were selected from each school. The sample size was determined using Slovin's formula and the participants were selected using a simple random sampling technique (lottery method). Once rapport was established with the adolescents, neck pain was assessed using the Oswestry Revised Questionnaire. This tool consisted of Section I, which included demographic, clinical variables and Section II, which comprised of Oswestry Revised Questionnaire. The intervention was explained to the adolescents and their parents, and a convenient environment was provided for the adolescents to perform the exercises. The investigator taught and guided the adolescents in performing the deep neck flexor muscle strengthening exercise for study group I and the neck stretching exercise for study group II. The total length of the intervention was approximately 20 minutes, and it took place over a period of 15 days. On the 15th day after the intervention, the postintervention assessment was conducted.

RESULTS AND DISCUSSION

The results were discussed based on the objectives of the study

Demographic variables among adolescents: In study group I, the frequency and percentage distribution of demographic variables among adolescents revealed that, according to age, the majority of 17 (56.6%) adolescents belonged to the age group of 14 years. Regarding gender, the majority of 16 (53.3%) were females. In terms of the mother's educational status, the majority of 18 (60%) had undergone school education. In relation to the mother's occupational status, the majority of 10 (33.3%) were unemployed, and 10 (33.3%) were private employees. According to the father's educational status, the majority of 20 (66.7%) had undergone school education. Regarding the father's occupational status, the majority of 20 (66.6%) were daily laborers. With regard to the type of diet, the majority of 26 (86.6%) took a mixed diet. According to the usage of mobile phones, the majority of 10 (33.3%) used them for 3-4 hours, and 10 (33.3%) did not use mobile phones. Assessing extracurricular activities, the majority of 11 (36.6%) were involved in sports. Considering the usage of pillows while sleeping, the majority of 18 (60%) used one pillow. With regard to the hours of doing homework, the majority of 21 (70%) used to do homework in less than two hours. Analyzing seating arrangements while studying, the majority of 11 (36.6%) used to sit on the floor. Assessing the usage of computers, the majority of 22 (73.3%) were not using computers.

In study group II, the frequency and percentage distribution of demographic variables among adolescents revealed that, according to age, the majority of 15 (50.0%) adolescents belonged to the age group of 13 years, and 15 (50.0%) belonged to the age group of 14 years. Regarding gender, in study group II, the majority of 15 (50.0%) were females and 15 (50.0%) were males. With regard to the mother's educational status, the majority of 16 (53.3%) had undergone school education. In relation to the mother's occupational status, the majority of 11 (36.6%) were unemployed. According to the father's educational status, the majority of 19 (63.3%) had undergone school education. Regarding the father's occupational status, the majority of 18 (60%) were daily laborers. With regard to the type of diet, the majority of 27 (90%) took a mixed diet. According to the usage of mobile phones, the majority of 15 (50%) used mobile phones for 1 to 2 hours. Assessing extracurricular activities, the majority of 9 (30%) were not involved in any extracurricular activities. Considering the usage of pillows while sleeping, the majority of 23 (76.6%) used one pillow. With regard to the hours of doing homework, the majority of 20

(66.6%) used to do homework for less than two hours. Analyzing seating arrangements while studying, the majority of 13 (43.3%) used the floor to sit and study. Assessing the usage of computers, the majority of 24 (80%) were not using computers.

Clinical variables among adolescents: In study group I, the frequency and percentage distribution of clinical variables among adolescents revealed that, according to age, the majority 27 (90%) had no history of neck pain. Assessing the history of any other illness, the majority 26 (86.6%) did not have any other illness. Regarding the history of treatment for other illnesses, the majority 26 (86.6%) were not taking any treatment. In study group II, the frequency and percentage distribution of clinical variables among adolescents revealed that, according to age, the majority 26 (86.6%) had no history of neck pain. Assessing the history of any other illness, the majority 27 (90%) did not have any other illness. Regarding the history of treatment for other illnesses, the majority 27 (90%) were not taking any treatment.

The first objective was to assess and compare preintervention and postintervention score on neck pain among adolescents in study group I and II: In the preintervention phase, among study group I, 16 (53.3%) adolescents and 15 (50%) from study group II had severe neck pain, while 14 (46.6%) adolescents from study group I and 15 (50%) from study group II had crippled neck pain. In both study groups, none of the adolescents had minimal, moderate, or exaggerated pain. In the post-intervention phase, among study group I, 9 (30%) adolescents had minimal neck pain, while none of the adolescents in study group II had minimal neck pain. Additionally, 20 (66.7%) adolescents from study group I and 29 (96.67%) from study group II had moderate neck pain. Furthermore, 1 (3.3%) adolescent from study group I and 1 (3.3%) from study group II had severe neck pain. In both study groups, none of the adolescents had crippled or exaggerated pain. The first objective was supported by the study conducted by Gheysvandi et al. (2019) who conducted a cross-sectional study on the prevalence and risk factors of neck pain among elementary school students. They adopted the Strength and Difficulties Questionnaire for this study. To assess each student's posture, an observational checklist called the Rapid Upper Limbs Assessment was used. In this study, 693 elementary school students aged 12 to 16 years were selected. The reported prevalence of neck pain over a month was 35.8%, and for shoulder pain, it was 30.9%. The study concluded that elementary school students had a high prevalence of neck pain. The study found that improper sitting positions, as well as physical factors such as school furniture, excessive homework, and difficulty in viewing the classroom board, were associated with pain. The second objective was to evaluate the effectiveness of deep neck flexor muscle strengthening exercise and neck stretching exercise on neck pain among adolescents in study groups I and II.

The second objective was to evaluate the effectiveness of deep neck flexor muscle strengthening exercise and neck stretching exercise on neck pain among adolescents in study groups I and II: The mean score of neck pain among adolescents in study group I was 58.80 in preintervention and 24.60 in postintervention. The paired 't' test value for neck pain was 20.69*** and the p-value was 3.66, which was significant at $p \leq 0.05$ and highly significant at $p \leq 0.01$ and $p \leq 0.001$. The findings showed that deep neck flexor muscle strengthening exercise was effective in reducing neck pain among adolescents. In study group II, the mean score on neck pain among adolescents was 58.93 in preintervention and 30.90 in postintervention. The estimated paired 't' test value for neck pain among adolescents was 25.93*** and the p-value was 3.66, which was significant at $p \leq 0.05$ and highly significant at $p \leq 0.01$ and $p \leq 0.001$. It shows that neck stretching exercise was effective in reducing neck pain among adolescents. In study group I, the mean score in the post-intervention phase was 24.60. In study group II, the mean score in the post-intervention phase was 30.90. The estimated unpaired 't' value was 3.52***, and the p-value was 2.76, which was significant at $p \leq 0.05$ and highly significant at $p \leq 0.01$.

Therefore, deep neck flexor muscle strengthening exercise was found to be more effective in relieving neck pain among adolescents. The second objective was supported by the study conducted by Aswer et al. (2021) on the effects of deep neck flexor muscle strengthening exercise on neck-shoulder posture among high-school students. The participants were randomly divided into an experimental group of 15 and a control group of 15. The experimental group performed deep flexor muscle strengthening exercises, while the control group performed basic stretching exercises. The results showed that the mean value for the experimental group was 27.52 and for the control group, it was 34.62, with a 't' value of 18.0, which was significant at $p < 0.05$. The study concluded that developing correct posture habits and providing posture training are necessary for high-school students who lead sedentary lives for more than 10 hours a day in order to prevent postural pain syndrome and functional disorders.

The third objective was to associate the selected demographic variables with their preintervention score on neck pain among adolescents in study group I and II: In study group I, the calculated values of demographic variables such as age ($\chi^2=4.692$), gender ($\chi^2=6.466$), use of mobile phones ($\chi^2=4.28$), and hours of doing homework ($\chi^2=5.0$) were greater than the table values, indicating a significant association with their preintervention score on neck pain among adolescents at $p \leq 0.05$. On the other hand, the calculated values of demographic variables such as mothers' education ($\chi^2=1.428$), mothers' occupation ($\chi^2=2.1$), fathers' education ($\chi^2=2.578$), fathers' occupation ($\chi^2=3.080$), type of diet ($\chi^2=0.020$), extracurricular activities ($\chi^2=2.06$), use of pillows ($\chi^2=0$), seating arrangement while studying ($\chi^2=2.40$), and use of computers ($\chi^2=3.51$) were less than the table values, indicating no association with their preintervention score on neck pain among adolescents at $p \leq 0.05$. In study group II, the calculated values of demographic variables such as age ($\chi^2=4.692$), gender ($\chi^2=6.533$), use of mobile phones ($\chi^2=3.96$), and hours of doing homework ($\chi^2=5.4$) were greater than the table values, indicating a significant association with their preintervention score on neck pain among adolescents at $p \leq 0.05$. Conversely, the calculated values of demographic variables such as mothers' education ($\chi^2=4.85$), mothers' occupation ($\chi^2=3.85$), fathers' education ($\chi^2=4.31$), fathers' occupation ($\chi^2=5.61$), type of diet ($\chi^2=0.370$), extracurricular activities ($\chi^2=1.42$), use of pillows ($\chi^2=0$), seating arrangement while studying ($\chi^2=1.978$), and use of computers ($\chi^2=0.833$) were less than the table values, indicating no association with their preintervention score on neck pain among adolescents at $p \leq 0.05$. The third objective was congruent with the study conducted by Hande, D & Agrawal, Y (2017) on the effect of activation of deep neck flexor muscle exercise on neck pain among smart phone users. In this study, 30 participants were selected. The neck pain disability index tool was used to assess the participants' neck pain. The participants performed deep neck flexor activation exercises for 3 weeks, every alternate day, three times a day, for 15 repetitions. After 3 weeks, the participants were evaluated again. Data was collected using a smart phone addiction questionnaire and the neck disability index. The results showed that the mean score of the neck disability index before treatment was 58.6%, which decreased to 4.87% after treatment. The 't' value was 29.3, indicating statistical significance at $p < 0.05$. The study concluded that the experimental group demonstrated an increase in functional status and a decrease in disability. The chi-square value of the selected demographic variable, such as the hours of using a mobile phone, was associated with neck pain among smart phone users.

The fourth objective to the selected clinical variables with their pre intervention score on neck pain among adolescents: In study group I and II: In study group I, the calculated value of the clinical variable, such as the history of neck pain ($\chi^2=3.88$), was greater than the table value, indicating a significant association with their preintervention score on neck pain among adolescents at $p \leq 0.05$. Conversely, the calculated values of clinical variables, such as the history of any other illness ($\chi^2=.488$) and history of taking treatment ($\chi^2=1.488$) for any other illness, were less than the table value,

Table 1. Comparison of mean, standard deviation and paired 't' test on preintervention and post intervention score on neck pain among adolescents in study group I and II.

N = 60						
Sl. No.	Group	Assessment	Mean	SD	df	Paired 't' test
1	Study Group I (n=30)	Pre intervention	58.80	6.06	29	20.69*** p = 3.66
		Post intervention	24.60	8.02		
2	Study Group II (n=30)	Pre intervention	58.93	6.34	29	25.93*** p = 3.66
		Post intervention	30.90	6.44		

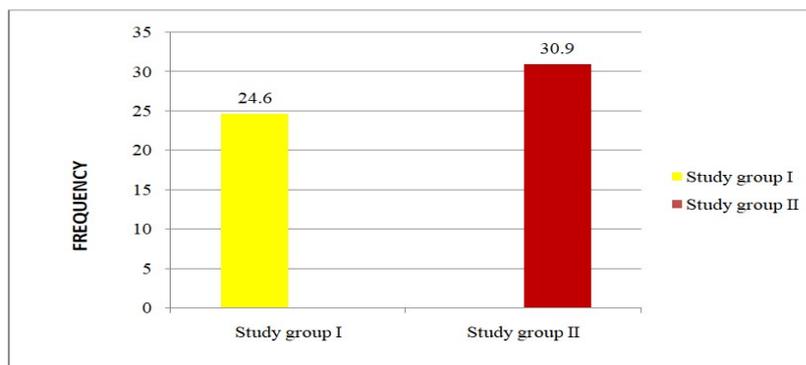
Significant at < 0.05*, p<0.01**, p<0.001 ***

Table 2. Comparison of mean, standard deviation and unpaired 't' test on post intervention score on neck pain among adolescents in study group I and II

Variable	Study group I		Study group II		Unpaired 't' Value
	Mean	SD	Mean	SD	
Neck pain	24.60	8.02	30.90	6.44	3.52** p=2.76

Significant at <0.05*, p<0.01**

N = 60

**Fig. 1. Post intervention mean score on neck pain among adolescents**

indicating no association with their preintervention score on neck pain among adolescents at $p \leq 0.05$. In study group II, the calculated value of the clinical variable, such as the history of neck pain ($\chi^2 = 4.61$), was greater than the table value, indicating a significant association with their preintervention score on neck pain among adolescents at $p \leq 0.05$. Conversely, the calculated values of clinical variables, such as the history of any other illness ($\chi^2 = 3.33$) and history of taking treatment for any other illness ($\chi^2 = 3.33$) were lesser than the table value, indicating no association at $p \leq 0.05$ with their preintervention score on neck pain among adolescents. The fourth objective was supported by the study conducted by Haile, T. et al. (2020).

They conducted a cross-sectional study to examine the prevalence and factors associated with neck pain among medical students. The study included 422 participants, and data was collected using a structured questionnaire adapted from the Nordic Musculoskeletal Questionnaire. The study found that 49.2% of the participants self-reported experiencing neck pain in the previous 12 months. The study concluded that neck pain is not uncommon among medical students and identified a significant association between a history of previous neck pain, physical exercise, duration of reading, and awkward neck posture with neck pain among medical students.

Implications

- Nurses working in hospitals and community areas implemented deep neck flexor muscle strengthening exercise as a significant means of reducing neck pain among adolescents.
- Workshops or conferences for nursing students were conducted on the impact of deep neck flexor muscle strengthening exercise in day-to-day nursing practice, and nurse educators provided the students with adequate exposure to deep neck flexor muscle strengthening exercise for neck pain.

Limitations

- Since there was less chance to conduct this study in school settings, especially with 9th standard adolescents, the

investigator faced a lot of difficulty in obtaining permission to conduct the study.

CONCLUSION

The study was conducted to determine the effectiveness of deep neck flexor muscle strengthening exercise versus neck stretching exercise in reducing neck pain among adolescents. Based on the results, the investigator concluded that the practice of deep neck flexor muscle strengthening exercise was beneficial in reducing neck pain among adolescents. Nurses could have utilized this exercise as a nursing intervention in their practice.

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