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Original Article

Effect of Mckenzie Neck Exercises on Neck Pain and Disability in Smart Phone Users' Adolescents

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ABSTRACT

The use of smartphones has grown significantly in our digital culture. Parallel with the growing use of smartphones, musculoskeletal problems and neck pain associated with intensive smartphone use have also increased. **Aim:** Evaluate the effect of McKenzie neck exercises on neck pain and disability in smart phone user's adolescents**. Design**: A quasi experimental research design was utilized. **Subjects:** A stratified simple random sample of 60 students were recruited. **Setting:** The study was conducted at three schools in Tanta city at Gharbeya Governorate. **Tools:** Three tools were used: **Tool I**: structured interview schedule. **Tool II**: Smart phone addiction short version scale. **Tool III**: The Neck Pain and Disability scale**. Results:** The majority of the studied adolescents had medical history of neck pain. There was gender differences in smart phone addiction as the majority of the male adolescents were smart phone addicted compared to female adolescents. There was statistically significant differences in the mean score of total neck pain and disability in the studied adolescents before and after the application of Mckenzie neck exercises program. **Conclusion:** Mckenzie neck exercises were effective in decreasing neck pain and related disability in smart phone user's adolescents. **Recommendation:** Continues educational programs to adolescents about the importance of neck strengthen exercises and ergonomic posture positions during smart phone uses.

Key words: Adolescents, McKenzie Neck exercises, Neck pain, Smart phone.

Introduction

Smartphone use is a fundamental and vital demand for today's generation. In addition to being able to make and receive calls, cellphones are frequently used to browse social media sites, videos and music. Smartphones are now considered to be a daily need as well as an illustration of contemporary high-technological equipment. Teens are more likely than adults to become smartphone addicts because they use

smartphones more frequently and for longer periods of time (**Yana et al., 2021; Kong et al., 2017).** Smartphones, usually available, present a great chance for ongoing data collection and recording. It is accessible for everyone, inexpensive, time-efficient, and strengthens autonomy. Smartphone ownership was estimated at 3.8 billion users globally in 2021. Generally speaking, users may be able to control their physical and mental health and assist efforts to modify their behavior through digital apps. Addiction rates are higher and teens are more prone to become engrossed in digital media. Furthermore, a number of national surveys found that teenagers are twice as likely as adults to become addicted to smartphones. Every year, there is a growth in the number of smartphone users (**Gokmen et al., 2020 ; Jinal & Deepak, 2018).**

Pain is a common feature of adolescents that originates from the musculoskeletal system. Musculoskeletal pain can affect muscles, ligaments, bones, and joints. The percentage of children and adolescents experiencing musculoskeletal pain at least once a week is around 8–32%, while this percentage increases up to 40% in monthly evaluations. However, a number of variables have been shown to have a relationship with musculoskeletal pain development and progression, such as, high levels of physical activity, female sex, psychosocial symptoms, obesity and sitting for extended periods of time on smartphone (**Yana et al., 2021; Jinal& Deepak, 2018).**

Back and neck discomfort are among the most prevalent non-specific symptoms worldwide, which is increasingly being observed and reported amongst teenagers (**Alhakami et al., 2019; Somaye et al., 2022).** Occurrence of neck pain amongst students was illustrated to be significantly high as demonstrated by the annualized worldwide burden, which is between 34.5% and 71.5% (**Dieleman et al., 2020; Xu et al., 2020).** Thirty percent of all cases of neck and back pain recorded worldwide are students, with adolescents accounting for 15.8% to 22.1% of these cases (**Agrawal & Hande, 2017).** However, the load of these musculoskeletal aches also causes physiological and psychological stress, which impairs their capacity for creativity. A lower quality of life and an increased risk of associated secondary impairments result from the general public's lack of information regarding the manifestations of neck and back pain (**Shahkolai et al., 2022; Karasel et al., 2022).**

For regular care, a specialized intervention and management tool are required. Clinically, evidence-based therapeutic techniques for neck pain have been presented by a number of earlier studies (**Yamato et al., 2018)** the McKenzie method is a well-known spinal and neck pain treatment and also a diagnostic tool (**Saeterbakken et al., 2020; Suvarnnato et al., 2019; Shoukat et al., 2020).** The McKenzie method's ability to classify the type of neck discomfort through self-tests without the need for specific equipment is one of its main advantages. The McKenzie technique classifies neck pain into

three syndromes: posture, dysfunction, and derangement, based on repeated movement in a certain direction. Based on the mechanical reaction to repeated motion in the desired direction. Also, it offers a customized exercise regimen for self-care that is based on clinical presentations **(Boumosleh & Jaalouk, 2017)**.

The deep neck flexor muscles can be retrained to improve activation level and lessen symptoms of neck pain while maintaining cervical vertical alignment. The deep neck flexor musculature is a dense region with muscle spindles that is immediately worked on by the deep neck flexor exercises. These exercises also increase neck stability by enhancing the cervical spine's awareness of position and motion. Additionally, it is effective in treating persistent neck pain, which may have a long-term influence on preventing recurrent occurrences of the condition (**Kamel et al., 2023; Kumar et al., 2021).**

Significance of the study:

Smartphones had improved our lives and are now necessary for daily tasks, however excessive and uncontrolled use of them may lead to smartphone addiction. Smart phone addiction is a growing global public health concern, especially for youth (**Ratan et al., 2022)**. According to Statista, around 6.92 billion people, over 85.74% of the world's population, used smartphones in 2023 (**Turner, 2023).** In Egypt, the overall prevalence of smartphone addiction was 53.6% Eldesokey et al., 2021. Potential dangers of musculoskeletal pain have increased as a result of the rise in smartphone usage. Fourty-three percent of smartphone users report having neck pain (**Ahmed et al., 2022)**. Recent research has revealed that smartphone users, especially those who are addicted to their devices, have a higher probability of experiencing musculoskeletal pain in the upper back, neck, and wrists/hands **(Mustafaoglu et al., 2021)**.

Students between the ages of 12 and 18, who were more prone to experience neck and back discomfort, reported that McKenzie exercises significantly reduced their pain. The McKenzie method is a well-liked method for diagnosing and treating neck pain in adolescents. It is defined as a series of daily exercises in directed preference. Changes in mechanical, cognitive, and sensory pain perception may result from this strategy, offering more opportunity to modify pain expectancies, fear beliefs, and functional limits. Repeatedly performing neck retraction exercises helps to reestablish the cervical lordosis curve and considerably lessen pain (**Lee et al., 2020)**. So, the current study aimed to evaluate the effect of Mckenzie neck exercises on neck pain and disability in smart phone user’s adolescents.

Aim of the study:

The aim of the current study was to evaluate the effect of Mckenzie Neck Exercises on neck pain and disability in smart phone user’s adolescents.

Research Hypothesis:

Mckenzie Neck Exercises expected to be effective in reducing neck pain and disability in smart phone user's adolescents.

Subjects and Method

Research design:

Quasi experimental research design was utilized.

Setting:

The study was carried out at three schools: Nawag mixed secondary school, Tanta Secondary school for girls and Ali Mohamed Ahmed preparatory school affiliated to Tanta city at Gharbeya Governorate

Subjects:

The students were stratified into two educational zone; east and west educational administration zone at three schools and the students were randomly selected to reach the estimated sample size to be 60 students by using Epi info software utilizing a power analysis with a 5% error margin, based on the level of significance (95%) and research power (80%)

Inclusion Criteria:

- Adolescents aged between 12 to 18 years
- Both sex
- Adolescents usage of smart phone more than 4 hr /day

Exclusion Criteria:

- Adolescents with disc lesion
- Adolescents with spondylolysis or spondylolisthesis
- Adolescents with neck deformities
- Adolescents with trauma or fracture around the cervical region.

Tools of the study:

Three tools were used in this study:

Tool I: Structured Interview Schedule:

It was developed by the researcher after reviewing the recent literature (**Na et al., 2018; Gumuscu et al., 2023).** to collect the socio-demographic characteristics of the studied adolescents and contained information about: age, sex, residence, medical history and attendance to related exercise program.

Tool II Smart phone addiction short version scale for adolescent

It was developed by **Kwon et al. (2013) and Sfendla et al. (2018)** and adapted by the researcher. It was a self-reporting scale used to measure smartphone addiction before exercise. The Arabic version of this scale was utilized. It consists of 10 items. The students were asked to write down their answers on a 6-point Likert scale ranging from (1=strongly disagree) to (6 =strongly agree).

Scoring system: a different range for male and female were used:

Male were addicted to scores more than 31

Male high risk of addiction with scores between 22-31

Female were addicted to scores more than 33

Female were high risk of addiction with scores between 22-33

Tool III: The Neck Pain and Disability scale (NPAD)

It was developed by **Wheeler et al. (1999)** and adapted by the researcher to gauge the neck pain and related disability. It consisted of 20-item scale measures problems with neck movements, neck pain intensity, effect of neck pain on emotion and cognition, and the level of interference with daily life activities. Its interference with vocational, recreational, social, and functional aspects of living; and the presence and extent of associated emotional factors.

Students mark their answer to each item on a 10cm visual analog scale (VAS). Item scores range from 0 to 5, and the total score is a total of the item scores (possible range 0 (no pain) – 100 (maximal pain)). The levels of neck disability were scored as the following:

- Non neck disability was scored: 0-8 (0-8%)
- Mild neck disability was scored: 9-29 (9-29%)
- Moderate neck disability was scored: 29-48 (29-48%)
- Sever neck disability was scored: 49-64 (49-64%)
- Complete neck disability was scored: 65-100 (65-100%)

Methods

- **Administrative process;** the study was granted official permission by the relevant authorities.
- Ethical committee approval gained from Faculty of Nursing at Tanta University with code number of approval 86-9-22

1. **Ethical and legal considerations: -**
   a- Before beginning the study, the committee member provided ethical permission.
   b- The student provided informed consent before taking part in the study.
   c- Privacy and anonymity for the students were assured.
2. Having a meeting with study participants to go over the goals of the research and to let them know they can leave the study at any moment.
3. **Developing Tools:** tools of the study were created and adapted by the researchers depending on the review of recent literatures.
4. **Validity and reliability;** A panel of five professors with competence in pediatric nursing and physiotherapy medicine examined the study's tools for face and content validity prior to implementation. The results between 90% to 100%, and adjustments were made. Utilizing the Cronbach alpha test and the findings of the pilot study, the reliability of all study tools was assessed. Every tool's reliability was 0.902.
5. **A Pilot study** was conducted on 10% of students to verify the tools' viability and clarity, and the appropriate modifications were made. The study sample did not include the pilot study.
6. The study was conducted into four phases

A-Assessment phase

- During this stage, all of the study's participants were informed of its goal in an effort to attain

their cooperation. The students are given study materials by the researchers, who also provide instructions on how to complete them.

- The researchers were available 5 days per week in the aforementioned setting to assess the actual needs for the students, applying exercise and measure neck pain for 6 weeks from the beginning of the exercise program. Smart phone addiction students were assessed before the Mckenzie neck exercises program.

B- Planning phase included the following steps:

- Setting objectives
- Preparation of the videos and images illustrated the McKenzie neck exercises.
- The students were divided into 6 groups and each group included 10 students.

C-Implementation phase

- All the researchers collaborated in collecting the data and postural advising for students during performing the McKenzie neck exercises for 2 sets of 10 repetition, with 10 seconds hold. Exercises were given 5 times a week. A Total of 30 exercises in 6 weeks
- The materials used in this research were videos and images that explained the technique of McKenzie neck exercises
- Duration of data collection was within 6 months from 1 April to 30 September 2023.

Technique of McKenzie neck exercises.

Stage 1

The student was instructed to take seated position with head gently and progressively tilted forward while retracting or tucking in chin. After holding this posture for ten seconds, the student went back to initial position.

Stage 2

The student was instructed to take seated position with the chin tucked in and to tilt head back slowly and softly, as though staring up at the sky, while maintaining this posture. The student held this posture for ten seconds them return back into initial position.

Stage 3

Student was instructed to take seated position and to retractor tuck the chin and hold this position while slowly bending head sideways. The student kept this position for ten seconds and returned to the initial position.

Stage 4

Student was instructed to take seated position and asked to retract or tuck the chin and hold this position while slowly turning the head as far as possible. The student kept this position for ten seconds and returned back to the initial position.

C- Evaluation phase:

The students was evaluated first to assess their addiction to smart phone and then neck pain and disability will be evaluated before the McKenzie neck exercises and after 6 weeks of application of 30 McKenzie neck exercises sessions to the student.

Statistical analysis:

The gathered data was processed, tabulated, and statistically assessed using the statistical computer program SPSS version 23. For numerical values, there was a range, mean, and standard deviation. Analysis of variance (ANOVA) and differences within groups repeated measures ANOVA were used to compare the mean values of more than two categories. To evaluate the correlation between variables, Pearson and Spearman's correlation coefficient (r) were employed. At $p<0.05$, the significant level was chosen. **White.,2019.**

Results:

Table (1) illustrates that, more than half (53.3%) of the studied adolescence their age ranged from 16 years to less than 18 years with a mean ± SD =16.616 ± 1.151. The majority (85.0%) of the studied adolescents were female and more than half of them (51.7%) from rural areas. In addition, the majority (85%) of the studied adolescent had medical history of neck pain and more than two-thirds (66.7) of them didn't attend any training exercise program related to neck pain

Figure (1) clarifies that, 11.1% of male were at high risk for smart phone addiction while one-third (33.3%) of females were at high risk of smart phone addiction. Furthermore, the majority of the males (88.9 %) were smart phone addicted while 64.8% of females were addicted.

Figure (2) reveals that, the studied males were more addicted to smart phone use than females as the mean of smart phone addiction in males was 38.66 while in females was 37.23.

Table (2) indicates that, McKenzie neck exercises were more effective in decreasing neck pain and disability including mild, moderate,

sever, and complete neck disability with statistically significant difference in all levels of neck pain before and after the McKenzie neck exercises (p<0.0001). Furthermore, there was statistically significant difference in mean scores of total neck pain and disability before and after McKenzie neck exercises (p<0.0001) as the mean± SD score of total neck pain was 28.70 ±20.23 before McKenzie neck exercises while it decreased to 10.91 ± 11.03 after McKenzie neck exercises.

Table (3) illustrates that, there was statistically negative correlation between medical history of neck pain with r= -0.262 and neck pain and disability (p= 0.043). Also, there was statistically positive correlation with r= 0.417 between attendance to related neck pain exercise program and smart phone addiction with p=0.001.

As shown from **Table (4)** there are no significant relations between the studied adolescents age, sex, residence, smart phone addiction and the total neck pain and disability before and after the McKenzie neck exercises. There was a statistically significant positive relation between smart phone addiction and the studied adolescent's attendance to related neck pain exercise program with p= **0.0001.**

Table (1): Percentage distribution of socio demographic characteristics of the studied adolescents (n=60)

	studied adolescents (n=60)	
	No.	**%**
Age (years)		
14 - < 16	12	20.0
16 - < 18	32	53.3
≥ 18	16	26.7
Range **Mean ± SD**	**14 – 18** **16.616 ± 1.151**	
Sex		
Male	9	15.0
Female	51	85.0
Residence		
Rural	31	51.7
Urban	29	48.3
Medical history		
Yes	51	85.0
No	9	15.0
Attendance to related exercise program		
Yes	20	33.3
No	40	66.7

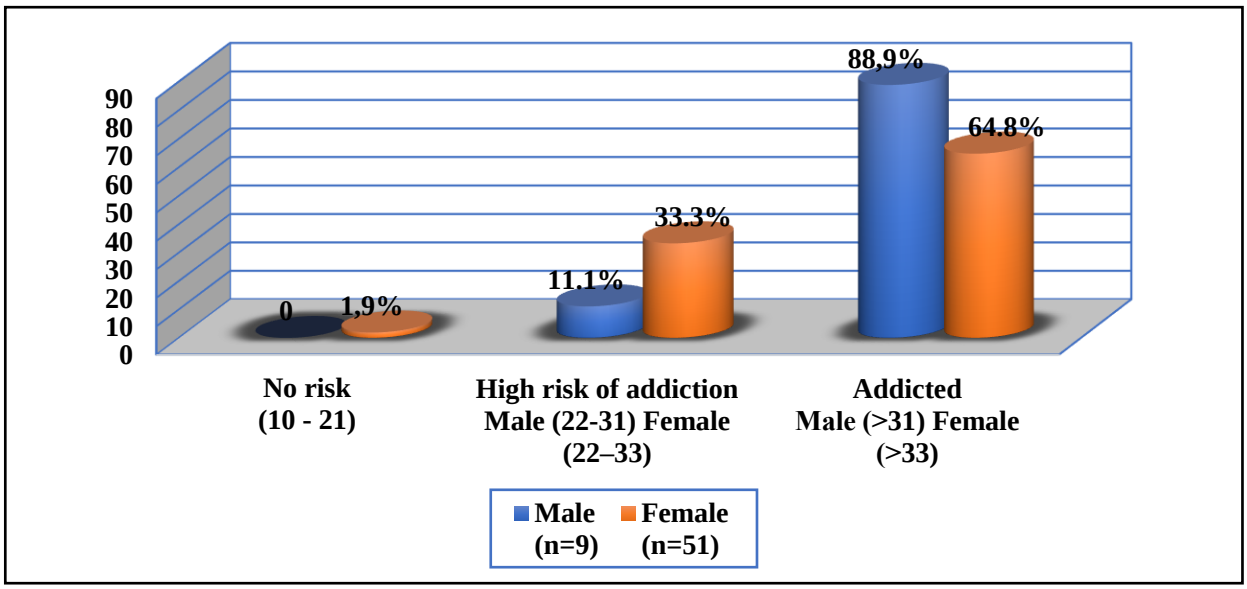

Figure (1): Levels of smart phone addiction in the studied adolescents (n=60)

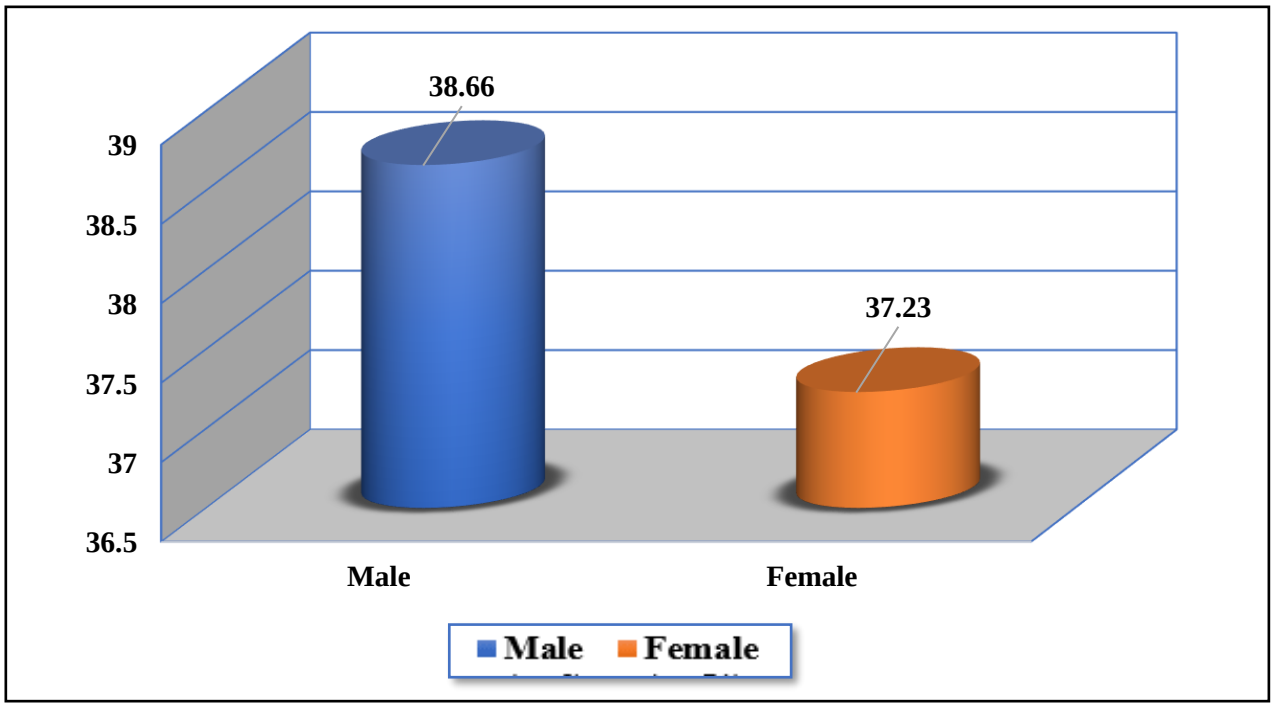

Figure (2): Mean scores of smart phone addiction for studied adolescents (n=60)

Table (2): Percentage distribution of the studied adolescents regarding levels and mean scores of total neck pain and disability before and after the Mckenzie neck exercises (n=60)

Neck pain disability	Studied adolescents (n=60).				χ^2	P
	Before (n=60)		After (n=60)			
	No.	%	No.	%		
Levels of total neck pain and disability						
Non neck disability	6	10.0	29	48.3	**28.387**	**0.0001****
Mild neck disability	36	60.0	28	46.7		
Moderate neck disability	8	13.3	3	5.0		
Sever neck disability	7	11.7	0	0.0		
Complete neck disability	3	5.0	0	0.0		
Range	**0 - 93**		**0 - 73**			
Mean ± SD	**28.70 ±20.23**		**10.91 ± 11.03**			
t- test #	**6.772**					
P	**0.0001****					

**** Highly Statistically Significant difference at (P<0.01)**
 # t- test: Paired Samples t-test

Table (3): Correlation between sociodemographic data of studied adolescent, smart phone addiction and total neck pain and disability before and after the McKenzie neck exercises.

Socio–demographic characteristics	The studied adolescents (n=60)					
	Neck Pain and Disability				Smart phone addiction	
	Before		After			
	R	P	R	P	r	P
Age (years)	-0.169	0.565	-0.099	0.195	0.004	0.974
Sex	-0.175	0.229	-0.170	0.195	-0.063	0.630
Residence	-0.123	0.347	-0.047	0.719	-0.137	0.297
Medical history	**-0.262**	**0.043***	-0.092	0.483	0.037	0.779
Attendance to related exercise program	-0.095	0.470	-0.083	0.529	**0.417**	**0.001****

*** Statistically Significant difference at (P<0.05)**
**** Highly Statistically Significant difference at (P<0.01)**

Table (4): Relation between sociodemographic data of the studied adolescent, smart phone addiction and total neck pain and disability before and after the McKenzie neck exercises.

Socio–demographic characteristics	The studied adolescents (n=60)		
	Mean ± SD		
	Neck Pain and Disability Scale		Smart phone addiction
	Before	After	
Age (in years)			
14 - > 16	29.25±17.46	10.58±13.36	37.50±11.52
16 - > 18	32.09±22.09	11.96±11.11	36.93±6.98
≤ 18	21.50±17.24	9.06±9.02	38.43±7.71
F value, P	1.492, 0.234	0.368, 0.693	0.177, 0.838
Sex			
Male	36.22±28.05	15.33±17.34	38.66±8.44
Female	27.37±18.58	10.13±9.56	37.23±8.13
t- test, P #	1.215, 0.229	1.310, 0.195	0.484, 0.472
Residence			
Rural	31.09±18.71	11.41±11.66	38.51±7.33
Urban	26.13±21.77	10.37±10.50	38.31±8.887
t- test, P #	0.948, 0.347	0.362, 0.719	1.052, 0.297
Medical history			
Yes	37.80±18.37	12.66±8.86	37.62±8.67
No	25.66±20.09	10.33±11.70	36.93±6.38
t- test, P #	**2.066, 0.043***	0.706, 0483	0.282, 0.779
Attendance to related exercise program			
Yes	31.40±18.05	12.20±10.55	42.20±6.37
No	27.35±21.33	10.27±11.34	35.07±7.911
t- test, P #	0.728, 0.470	0.634, 0.529	**3.495, 0.0001****

**** Statistically significant difference at level P < 0.01**
 # t- test: Independent samples, t-test

Discussion

Besides making life easier with the useful software apps, smartphones provide social and leisure options including social media browsing, online gaming, and web browsing (**Ratan et al., 2022).** Recent years have seen an increase in the prevalence of cervical pain, which is often associated with the general population especially the youth using cell phones in an addictive manner that may be harmful to their health (**Wash et al., 2022; Benini et al., 2022**).The purpose of this study was to evaluate the effect of Mckenzie neck exercises on neck pain and disability in smart phone user's adolescents.

The results of this study clarified that more than half of the smart phone addicted adolescents in the age group of 16 to less than 18 years and the majority of the studied adolescents were females. Similarly, **Bhanderi et al. (2021)** found a high smart phone addiction rate in adolescents with the age between 16 to 19 years. From the researchers' point of view the possible explanation for the high prevalence of smart phone addiction among the adolescents that they usually use smart phones for

calling the family and friends, using the Internet, especially for social networking, watching movies or listening to music, and for schoolwork. Another probable reason is that the adolescents were born and raised during the internet era and they prefer online communication to face-to-face communication.

Regarding history of neck pain among smart phone adolescents, the study demonstrated that the majority of the studied adolescents had medical history of neck pain and more than two thirds of them didn't attend any training exercise program concerning neck pain. This result was in line with **Minghelli (2021**) who studied the relation between the use of mobile telephone and adolescents neck pain, he stated that more than half of adolescents who used their phones for long periods of time and in incorrect posture were more likely to experience neck pain. They also reported that neck pain affected 7.8% of them at the time of evaluation, 36.4% of them during a 6-month period, and that neck pain affected them at some point in their lives (lifetime prevalence). Also, **Benini et al. (2022)** stated that a statistically significant correlation existed between smartphone addiction and cervical pain. From the researcher point of view, smart phones typically have small screens, which make them more likely to result in a hunched posture and a view that is mainly below eye level. This can result in improper posture when used for an extended length of time, such as forward head posture, which can cause neck pain.

The finding of this study showed that there were gender differences regarding to the smart phone addiction as the majority of the studied males were smart phone addicted. In addition, the mean score of smart phone addiction was higher in males than females. This result was in the same line with **Ratan et al. (2022)** who found that male participants had higher levels of smartphone addiction than female participants, with a 61.4% total incidence of addiction. On the other hand, the current finding contradicted with **Taywade & Khubalkar (2019)** who reported that females and males have significantly different pattern of smartphone usage as females spend more amount of time on smartphones than males.

Regarding the effect of McKenzie exercises on neck pain, this study showed that McKenzie neck exercises were more effective in decreasing level of neck pain and disability including mild, moderate, sever, and complete neck pain and disability with statistically significant difference before and after the Mckenzie neck exercises. Furthermore, the study also illustrated that there was statistically significant reduction in the mean scores of total neck pain and disability in studied adolescents after application of Mckenzie neck exercises program. It is evident from a researcher's perspective that these exercises can assist increase neck strength and flexibility, which can enhance posture, decrease neck pain, and increase physical fitness generally. These finding was consistent with **Sufizadeh & Anbarian (2023)** who reported that The McKenzie exercise is a more effective way to reduce neck and shoulder pain and disability after using a smartphone. Also, **Kong et al. (2017)** stated that

deep cervical flexor muscle training on a regular basis combined with adherence to smartphone usage guidelines constitutes an efficient therapy approach for reducing neck discomfort and disability in smartphone addicts.

Similarly, **Suhara et al. (2023)** studied the effect of neck stabilization vs McKenzie exercise for mechanical neck pain among young adults, he stated that McKenzie exercise was more effective than the neck stabilization exercise in decreasing the neck pain and improving the functional performance among mechanical neck pain patients. Also, **Avaghade et al. (2023)** discovered that both the McKenzie protocol and segmental spinal stabilization exercises were helpful in treating neck discomfort in patients with cervical postural syndrome, the McKenzie protocol proved to be more advantageous in this regard. Furthermore**, EL-Kablawy et al. (2023)** revealed that Kendell and Mackenzie exercise on a regular basis was more effective therapy for decreasing neck discomfort and disability in patients with chronic non-specific neck pain.

In addition, these results revealed that there was statistically negative correlation between medical history of neck pain, neck pain and disability. Also, there was statistically positive correlation between smart phone addiction and attendance of the studied adolescent to related neck pain exercise program. Depending on the study results, it was clear that Mackenzie neck exercises were effective for reducing neck discomfort and disability in smart phone adolescents' users.

Conclusion

The study concluded that McKenzie neck exercises were effective in decreasing neck pain and related disability in smart phone users' adolescents as there were statistically significant difference in adolescent's neck pain before and after McKenzie neck exercises.

Recommendation

Based on the findings of this study, the following recommendations are derived:

- Regular teaching program are recommended to identify adolescents and emphasize the significance of neck strengthening exercises and ergonomic postures when using smartphones.
- Adolescent students should be aware of acceptable hours for smart phone use and the negative impact of excessive use of smart phones on general health and quality of life.
- Additional researches are required to increase awareness of neck pain related to screen time and usage, as well as preventative strategies.

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