

# **Mechanical Neck Pain and its Impact on Ventilatory Functions in Smartphone Addicted Population**

**Hany Ezzat Obeya<sup>1</sup>, Kareem Ezz Eldeen Ali Ghaly<sup>2</sup>, Ramy Salama Draz<sup>1</sup>,**

1 Department of Physical Therapy for Cardiovascular/Respiratory Disorder and Geriatrics, Faculty of Physical Therapy, Cairo University, Egypt

2 Demonstrator at cardiovascular and Respiratory disorders and Geriatrics

Delta university

**Corresponding author:** Kareem Ezz Eldeen Ali Ghaly, master degree student

**Official email of the corresponding author:** mr.kareem1994@gmail.com

## **ABSTRACT**

**Background:** Smartphones have become an integral part of our everyday lives, and the number of individuals who use smartphones is growing every day with plenty of those individuals suffered from mechanical neck pain especially after long-term smartphone use which in turn can affect the ventilatory functions. **Objectives:** This study aimed to evaluate two parameters from the ventilatory functions, including (FVC) forced vital capacity and (FEV1) Forced expiratory volume in first second. **Methods:** A total of 100 of smartphone addicts of both genders with mechanical neck pain were enrolled in this study; they were recruited from students of Delta university. Age ranges from (18 to 25). **Results:** The study results revealed statistical significant difference between mean value of FVC and FEV1 within study group compared to the predicted normal value **Conclusions:** It was concluded that mechanical neck pain has a significant negative effect on the ventilatory functions in smartphone addicted population.

**Keywords:** Smartphone Addiction, Ventilatory functions, Mechanical neck pain.

## INTRODUCTION

Smartphones have become an integral part of our everyday lives, and the number of individuals who use them is growing every day. Smartphones have a significant advantage over traditional mobile phones in terms of internet connection, hence they are regarded as portable computer alternatives [1]

People were urged to work from home when educational institutions and businesses were shut down. Students were given access to online learning activities Following the World Health Organization's (WHO) proclamation of COVID-19 as a Public Health Emergency of International Concern governments placed social mobility and travel restrictions. [2]

Long-term smartphone use may cause changes in cervical spine posture and proprioception [3]. Excessive smartphone usage might put a lot of pressure on the cervical spine, causing the curve to change[4]. When using a smartphone, most people maintain a head flexion of (33°-45°) from vertical [5].

The percentage of smartphone users who suffer from musculoskeletal symptoms ranges from 1% to 67.8%. With a frequency of 17.3 percent to 67.8% [6], neck discomfort is the most frequent musculoskeletal complaint among smartphone users. Neck pain was shown to be more common in people who used their phones frequently[7].

Neck discomfort is linked to the amount of time spent on a smartphone, particularly the length of time spent on it and multitasking activities [8]

Mechanical neck pain (MNP) is a general term for a vague discomfort that intensifies with neck movement [9]. Neck pain was classified as "non-specific" or mechanical when it was induced or aggravated by neck motions or chronic neck postures, and no specific underlying condition could be found [10]

Mechanical neck pain is characterized by localized and/or referred pain, as well as point soreness and limited cervical range of motion (CROM). Reduced upper cervical spine movement can lead to excessive lower cervical spine movement. increased fatigue in the sternocleidomastoid, anterior scalenus, and upper trapezius muscles changes the neck postures and breathing patterns, and causes a reduction in range of motion (ROM). [11]

Functional deficits in patients with chronic neck pain include weakening of deep bending neck muscles owing to activation of neck surface muscles, increased forward head posture deformity, proprioception impairment, and poor balance. Furthermore, restricted cervical spine mobility limits the spine's range of motion and impairs respiratory function. [12]

The following factors are thought to contribute to respiratory dysfunction in chronic neck pain patients: weakening of the deep neck flexor and extensor muscles, decreased cervical and thoracic spine stability, and alterations in chest wall mechanics. Due to muscular hyperactivity and limited range of motion of the cervical spine, these mechanical changes cause modifications in the force length curves of the sternocleidomastoid muscles. Despite the fact that neck pain is commonly thought of and treated as a neuromusculoskeletal phenomenon in clinical practice, some researchers believe that the close anatomical relation of the cervical region with the thoracic spine, as well as their musculoskeletal and neural interconnection, may lead to accompanying alterations in the thoracic spine and chest wall, as well as changes in pulmonary function [13] Additionally, forward head posture (smaller cranio-vertebral angle), cervical mobility (reduced flexion and rotation), and the occurrence of neck discomfort were all linked to sagittal thoracic spine posture (higher upper thoracic angle) [14]

**Materials and methods:**

**Study design: Randomized controlled study**

This study was designed to identify if there any relation between mechanical neck pain & ventilatory function in smartphone addicted population, it was carried out at from students of Delta university. The study was enrolled from March 2021 till November 2021. Number of ethical committee approval: P.T.REC/012/003476.

**Participants,**

A number of (100) volunteers of smartphone addicts with mechanical neck pain were enrolled in this study from both sexes with age ranged from 18-25 with inclusion criteria of:

- smartphone addicts with mechanical neck pain (men and women).
- Not participated in any kind of pulmonary rehabilitation program.

- BMI Ranging from 18.5-24.9 kg/m<sup>2</sup>. (Normal BMI) [15]
- A score ranging from 10% to 48% in Neck disability index in both male & female participants. **Figure 1**
- Smartphone addiction scale-short version (Arabic version) scores of ≥ 31 and ≥ 33 for male and female participants respectively. **Figure 2**

**Neck Disability Index**

This questionnaire has been designed to give us information as to how your neck pain has affected your ability to manage in everyday life. Please answer every section and mark in each section only the one box that applies to you. We realise you may consider that two or more statements in any one section relate to you, but please just mark the box that most closely describes your problem.

**Section 1: Pain Intensity**

I have no pain at the moment

The pain is very mild at the moment

The pain is moderate at the moment

The pain is fairly severe at the moment

The pain is very severe at the moment

The pain is the worst imaginable at the moment

**Section 2: Personal Care (Washing, Dressing, etc.)**

I can look after myself normally without causing extra pain

I can look after myself normally but it causes extra pain

It is painful to look after myself and I am slow and careful

I need some help but can manage most of my personal care

I need help every day in most aspects of self care

I do not get dressed, I wash with difficulty and stay in bed

**Section 3: Lifting**

I can lift heavy weights without extra pain

I can lift heavy weights but it gives extra pain

Pain prevents me lifting heavy weights off the floor, but I can manage if they are conveniently placed, for example on a table

Pain prevents me from lifting heavy weights but I can manage light to medium weights if they are conveniently positioned

I can only lift very light weights

**Office Use Only**

Name \_\_\_\_\_

Date \_\_\_\_\_

I cannot lift or carry anything

**Section 4: Reading**

I can read as much as I want to with no pain in my neck

I can read as much as I want to with slight pain in my neck

I can read as much as I want with moderate pain in my neck

I can't read as much as I want because of moderate pain in my neck

I can hardly read at all because of severe pain in my neck

I cannot read at all

**Section 5: Headaches**

I have no headaches at all

I have slight headaches, which come infrequently

I have moderate headaches, which come infrequently

I have moderate headaches, which come frequently

I have severe headaches, which come frequently

I have headaches almost all the time

**Section 6: Concentration**

I can concentrate fully when I want to with no difficulty

I can concentrate fully when I want to with slight difficulty

I have a fair degree of difficulty in concentrating when I want to

I have a lot of difficulty in concentrating when I want to

I have a great deal of difficulty in concentrating when I want to

I cannot concentrate at all

**Figure (1) Neck pain & disability index [16]**

موافق بشدة	موافق	موافق نسبيا	معارض نسبيا	معارض	معارض بشدة	الأسئلة	
6	5	4	3	2	1	عدم انجاز عمل مخطط له بسبب الانشغال بالهواتف الذكية	1
6	5	4	3	2	1	ايجاد صعوبة في التركيز في القسم ، اثناء القيام بمهمة ، او اثناء القيام بعمل ما بسبب استعمال الهواتف الذكية	2
6	5	4	3	2	1	الشعور بالآلم في المعصمين و الجزء الخلفي للرقبة اثناء استعمال الهواتف الذكية	3
6	5	4	3	2	1	عدم القدرة على الاستغناء عن الهواتف الذكية	4
6	5	4	3	2	1	عدم الصبر و الانفعال بدون الهواتف الذكية	5
6	5	4	3	2	1	التفكير في الهاتف في الوقت الذي لا احمله	6
6	5	4	3	2	1	عدم الاستغناء عن الهواتف الذكية رغم معرفة ان تأثيراتها سلبية على حياتي اليومية	7
6	5	4	3	2	1	تفقد الهاتف الذكي باستمرار لعدم تقويت التحديث مع الاشخاص في تويتر او فايسبوك	8
6	5	4	3	2	1	استعمل هاتفي الذكي اكثر مما توقعه	9
6	5	4	3	2	1	اجماع الأشخاص المحاطين بي على استعمال هاتفي الذكي اكثر من اللازم	10

Figure (2) Smartphone addiction scale- short version (Arabic version) [17]

### Study procedures,

#### Before starting the study:

- The purpose of the study was explained for each patient with a patient consent form to be signed as an agreement to be included in the study.
- Each patient answered both questionnaires of neck disability index and smartphone addiction scale in order to calculate his/her score to find out if the patient was eligible to be included in the study
- Each subject was examined medically by physician in order to exclude any medical problems.
- Each subject's history was taken carefully to collect information about general condition and physical activity.

- The patient's height and weight were measured and BMI was calculated.
- Each patient will take an adequate explanation about ventilatory function tests procedures and different maneuvers for each task.
- The patient will be advised to avoid eating a heavy meal before the test

#### Testing procedures:

**Apparatus used:** Spirometry (FVC,FEV1,FEV1/FVC and PEF) Medisoft ergocart professional, power 230V AC 50Hz, Serial number: 161121-05-0018, Belgium.

Testing procedure according to **Obaya et al.,2021 [18]:**

1. Patient preparation should consist of explanation the purpose of the test and how it was done. with keeping the explanation brief and in simple terms.
2. The patient was seated in comfortable sitting position with loosening any tight clothes like neckties or belts.
3. The patient was showed the proper chin neck position, chin should be slightly elevated and neck slightly extended, this position should be maintained throughout the forced expiratory procedures, the patient was not allowed to bend the chin to the chest.
4. A clean mouth piece was placed on the valve at the end of spirometer tubing for each patient.
5. The patient was taught how to relax and regularly breathe through the mouth piece before the test was started.
6. A nose clip was placed on the patient's nose.
7. The device was switched on, the personal patient's data including age, sex, race, weight and height were entered.
8. Mouthpiece was into patient's mouth, the patient was told not to bite down on mouthpiece, lips should be sealed tightly and the tongue should not stick out into mouthpiece.
9. The patient was asked to breath 3 tidal breaths then fully expire, then take a deep inspiration to expire forcefully and rapidly as much as possible through the mouthpiece, the procedure was repeated 3 times and the best record was taken.
10. Assessment of ventilatory function is based on comparing a subject test result against the reference or predicted value in order to do this correctly, the patient's height (without shoes) age (on day of test), sex and sometimes, weight are needed.

**Data analysis:**

The statistical analysis was conducted by using statistical SPSS Package program version 20 for Windows (SPSS, Inc., Chicago, IL). The following statistical procedures were conducted:

- Descriptive statistics including the mean and standard deviation for FVC, FEV1.
- Statistical level all statistical analyses were significant at level of probability less than an equal 0.05 ( $P \leq 0.05$ ).

( $P=0.0001$ ;  $P<0.05$ ) decreased in mean value of FVC within study group compared to the predicted normal value with change 1.22 between predicted and study group. **table 1**

**Results;**

. The statistical analysis by independent t-test revealed that there was significantly

**Table (1):** Comparison of mean values FVC between predicted normal values and study group

Items	FVC (Mean $\pm$ SD)
<b>Predicted group (n=100)</b>	4.63 $\pm$ 0.90
<b>Study group (n=100)</b>	3.41 $\pm$ 0.87
<b>Mean difference (change)</b>	1.22
<b>t-value</b>	8.704

<b>P-value (P&lt;0.05)</b>	0.0001*
<b>Significance</b>	S

Data are expressed as mean ±standard deviation  
 P-value: probability value                      S: significant                      \* Significant (P<0.05)

The statistical analysis by independent t-test revealed that there was significantly (P=0.0001; P<0.05) decreased in mean value of FEV1 within study group compared to the predicted normal values with change 1.26 between predicted and study. **Table (2)**

**Table (2):** Comparison of mean values FEV1 between predicted normal values and study group

<b>Items</b>	<b>FEV1 (Mean ±SD)</b>
<b>Predicted group (n=100)</b>	3.95 ±0.69
<b>Study group (n=100)</b>	2.69 ±0.72
<b>Mean difference (change)</b>	1.26
<b>t-value</b>	11.20
<b>P-value (P&lt;0.05)</b>	0.0001*
<b>Significance</b>	S

Data are expressed as mean ±standard deviation  
 P-value: probability value                      S: significant                      \* Significant (P<0.05)

## Discussion

The current study was designed to detect the effect of mechanical neck pain on the ventilatory functions of the smartphone addicted population.

The values of ventilatory functions that were measured: forced vital capacity (FVC) and forced expiratory flow (FEV1).

The result of our study agreed with **Mohamed et al.,2019** who investigated the ventilatory function response to training of cervical muscles in mechanical neck pain patients and reported that mechanical neck pain causes forward head posture and this was due to weakness of deep cervical flexors.

Weaknesses of the neck muscles resulted in a forward head posture in addition to decline in thoracic mobility, which means increased kyphosis in the upper thoracic region and a reduction in the volume of the thoracic cage. This creates a resistance to exhalation and therefore lowers the FVC. [19]

Also, the results of this study coincided with **Moawd et al.,2015** who investigated the Effect of over-usage of smart phone in a non-neutral neck position on respiratory function in female adults. And found that there was a significant effect on FEV1 values. [20]

In addition, our result agrees with **Mohamed et al.,2019** who investigated the ventilatory function response to training of cervical muscles in mechanical neck pain patients and reported that mechanical neck

pain causes forward head posture and this was due to weakness of deep cervical flexors. Weaknesses of the neck muscles resulted in a FHP in addition to decline in thoracic mobility, which means increased kyphosis in the upper thoracic region and a reduction in the volume of the thoracic cage. This creates a resistance to exhalation and therefore lowers the FEV1. [19]

On the other hand, our study disagreed with **Wirth et al.,2014** who studied the respiratory dysfunction in patients with chronic neck pain and the influence of thoracic spine and chest mobility and found that there was no significant effect of chronic neck pain on FVC. [21]

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