

Correlation of Reduced Endurance Capacity of Neck Flexor and Extensor in Cigarette Smokers of College Going Students

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ABSTRACT

Background: Muscle endurance is the ability of muscle to contract repeatedly against a load (resistance), generated and sustain tension and resist fatigue over an extended period of time. Smoking causes variety of health diseases and it also affects skeletal muscle dysfunction as well. Cigarette smoke constituents and systemic inflammatory mediators enhance proteolysis and inhibit protein synthesis, leading to loss of muscle mass.

Objectives: To find out the correlation between the neck flexor endurance capacity and neck extensor endurance capacity with 1-5 years of smoking history.

Methods: Data collection was done from college of physiotherapy and college of nursing using convenient sampling. 60 Male subjects were included in study between the age group of 20-30 years with 1-5 years of smoking history. The score of neck flexor endurance capacity and neck extensor endurance capacity using neck flexor endurance test and neck extensor endurance test, and the data were analyzed.

Result: The result of study showed a statistical significance in the neck flexor and extensor endurance capacity ($p < 0.001$) ($r = -0.59$ for NFEC, -0.54 for NEEC) using neck flexor endurance capacity test and neck extensor endurance capacity test in subjects with 1-5 years of smoking history.

Conclusion: The study concludes that there is reduced endurance capacity of neck flexor and neck extensor muscles in smokers with 1-5 years of smoking history.

Keywords: Cigarette smoking, muscle strength, neck flexor and extensor endurance test, 1-5 years smoking history.

INTRODUCTION

Muscle endurance is the ability of muscle to contract repeatedly against a load [resistance], generated and sustain tension and resist fatigue over an extended period of time.⁽¹⁾

Smoking is four times more in men than in women globally and the constituents present in tobacco products causes variety of health diseases and it also affects skeletal muscle dysfunction as well.⁽²⁾ In fact, reduction in exercise capacity even occur after just one session of smoking and non-

symptomatic smokers more often complain of fatigue than non-smoker.⁽³⁾ A recent longitudinal study in a large cohort of young healthy subjects showed that smoking 100g tobacco per week was associated with a 2.9% in men and 5% in women reduction of muscle force in 15 years, independent of physical activity.⁽⁸⁾

In comparison of smoking and non-smoking athlete, cigarette smoking athlete have significant decrease in strength and flexibility of muscle when evaluate by the Kraus-Webber test.⁽⁹⁾ Cigarette smoking

also affects the grip muscle strength.⁽¹⁰⁾ According to Kruger et al, protein degradation in the skeletal muscle pathways of mice were found when they were exposed to smoke, in addition there is also decrease in muscle mass, muscle weight, changes in muscle fiber type and muscle cross sectional area and oxidative fibers. Here a time dependent decrease of oxidative type-I fiber in rectus femoris muscle, soleus muscle and gastrocnemius muscle were found.⁽¹¹⁾

Cigarette smoke constituents and systemic inflammatory mediators enhance proteolysis and inhibit protein synthesis, leading to loss of muscle mass.⁽³⁾ Cigarette smoke is a complex aerosol consisting of thousands of various constituents including reactive oxygen and nitrogen free radicals, toxic aldehydes and more which potentially stimulate protein breakdown and impair protein synthesis. Among these constituents, aldehyde is capable of entering the circulation and directly affecting skeletal muscle tissue.⁽⁶⁾ Reduced skeletal muscle contractile endurance in smokers may result from impaired oxygen delivery to the mitochondria and ability of the mitochondria to generate ATP due to interaction of carbon monoxide with hemoglobin, myoglobin and components of respiratory chain.⁽³⁾

Incidence and Prevalence

According to S. K. Jindal et al, Prevalence, Quits-rates, and respiratory morbidity of tobacco smoking in India

28.5% Males

2.1% Females

The few reports of tobacco smoking in different population groups report its prevalence from about 15% to over 50% among men.⁽⁵⁾

Tobacco smoking in most parts of India except Punjab, Maharashtra and Sikkim is reported in about one fourth to half of adult men of over 15 years of age.

Women, smoking was more common in the North Eastern States, Jammu and Kashmir and Bihar, while most other

parts of India had prevalence rates of about 4% or less.⁽⁵⁾

The aimed to find out the correlation of reduced endurance capacity of neck flexors and extensors in cigarette smokers. The objective of the study was to find out the endurance capacity of neck flexor in cigarette smokers, to find out the endurance capacity of neck extensor in cigarette smokers, to find out the correlation between neck flexors and extensors with 1-5 years of smoking history.

MATERIAL AND METHODS

60 males from college of physiotherapy and college of nursing Miraj, Maharashtra, India participated voluntarily in this study. The participants were selected based on the inclusion criteria that are age group of 20-30 years, 1-5 years of smoking history, and 5-6 cigarettes per day. The exclusion criteria were participants who had a history of cervical region injury in last six months, participants who had underlined musculoskeletal cardiac and neurological disorders. Ethical clearance was obtained from Institutional Ethical Committee of College of Physiotherapy, Wanless Hospital, Miraj Medical Centre, Miraj. The participants were briefed about the study and written informed consent and demographic data in the form of age, gender, BMI, smoking history were taken from the participants.

PROCEDURE

Neck flexor endurance test and Neck extensor endurance test were performed.

Instruction for performing neck flexor endurance test-

Position of patient- Supine; was asked participant to tuck his chin maximally and preserved the isometric contraction; with this contraction he was asked to lift his head and neck by roughly 2.5cm over the plinth and maintained this head and neck position. During the test, oral command was given like "tuck your chin" or hold your head up" till the participant no longer hold

it. The test was discontinued as participant move his head or as skin folds open up due to loss of chin tuck or when he indicated fatigue or pain.



Figure 1 Neck Flexor Endurance Test

Instructions for performing neck extensor endurance test-



Figure 2 Neck Extensor Endurance Test

Position of participant was in prone position and arms by his side. Then he was made to protrude his head off the plinth and was given support to the head by using stool, which we kept at the end of the plinth. The therapy belt or strap was used to stabilize the upper thoracic spine as this belt which was fastened and tighten over T6

vertebral level. A 2kg weight was suspended from the headband which was fix around the participants head and which was hanged to just short of floor. The test was started when the participant was instructed to retract his chin and hold the head firm in the level position while stool support was gradually removed. The test was discontinued as participant failed to maintain his head in stable horizontal position or as the suspended weight touch the floor.

Statistical Analysis:

All statistical analysis was done by using SPSS 20 for windows. The level of significance was set $p < 0.001$. Descriptive analysis was used to calculate mean. Pearson correlation coefficient test was performed to find out correlation.

RESULT

Table 1: Distribution of cigarette smokers according to different parameters

Parameters	Mean	Std. Deviation
Age	23.78	2.59
BMI	23.95	2.8
Cigarettes per day	5.35	0.48

Mean age of cigarette smokers was 23.78 years.

Mean BMI of cigarette smokers was 23.95

Mean Cigarettes per day of cigarette smokers was 5.35.

Table 2: Distribution of smoking years of cigarette smokers

Smoking years	Frequency	Percent
1	7	11.67
2	10	16.67
3	12	20.00
4	13	21.67
5	18	30.00
Total	60	100.00

18 (30%) cigarette smokers were smoking from last 5 years, 13 (21.67%) were smoking from last 4 years, 12 (20%) cigarette smokers were smoking from last 3 years, 10 (16.67%) were smoking from last 2 years and 7 (11.67%) were smoking from last year.

Table 3: Distribution of Cigarettes per day of cigarette smokers

Cigarettes per day	Frequency	Percent
5 per day	39	65
6 per day	21	35
Total	60	100

39 (65%) cigarette smokers were smoking 5 cigarettes per day and 21 (35%) cigarette smokers were smoking 4 cigarettes per day.

Table No. 4 Year wise correlation of endurance capacity of neck flexor and extensor muscle

NFEC	N	Mean	Std. Deviation
1 year	7	28.29	1.38
2years	10	24.40	2.84
3years	12	25.50	2.02
4years	13	23.92	2.69
5years	18	21.44	3.01
NEEC	N	Mean	Std. Deviation
1 year	7	135.14	2.91
2years	10	118.40	10.12
3years	12	125.00	3.72
4years	13	122.23	9.93
5years	18	108.28	13.98

Mean neck flexor endurance capacity for 1 year was found to be 28.9, for 2 years 24.40, for 3 years 25.50, for 4 years 23.92, for 5 years 21.44

Mean neck extensor endurance capacity for 1 year was found to be 135.14, for 2 years 118.40, for 3 years 125.00, for 4 years 122.23, for 5 years 108.28

Table 5: Correlation between neck flexors and extensors with 1-5 years of smoking history

Correlation of	Smoking per years	p value
NFEC (sec)	-0.59	<0.001
NEEC (sec)	-0.54	<0.001

Correlation analyses revealed a negative relationship between neck flexors and extensors with 1-5 years of smoking history ($p < 0.001$) ($r = -0.59$ for NFEC, -0.54 for NEEC)

So, it indicates that as smoking history increases, endurance capacity of neck flexors and extensors decreases. Also, it showed significant correlation between 1-5 years of smoking history with reduced endurance capacity of neck flexors and extensors.

Thus, alternative hypothesis (H^1), significant correlation between reduced endurance capacity of neck flexor and extensor in cigarette smokers is accepted.

DISCUSSION

The purpose of this study was to find out the correlation between reduced endurance capacity of the neck flexor and extensor in cigarette smokers with 1-5 years of smoking history. A total of 60 male subjects were recruited in the study. Subjects were recruited according to smoking history of 1-5 years. Neck flexor muscle endurance test and neck extensor muscle endurance test was performed on 60 male subjects to check the correlation with normal data (in seconds). The result was found to be significant within the subjects with neck flexor muscle endurance test and neck extensor muscle endurance test ($p < 0.001$) ($r = -0.59$, -0.54) respectively. The study was over a short course of time considering one-time data collection.

In my present study it showed that as the years of smoking increases there was reduction of neck endurance capacity for flexor and extensor muscle. Even with the 1 year of smoking history there was reduction of neck flexor endurance capacity by mean of 28.29, for 2 years 24.40, for 3 years 25.50, for 4 years 23.90, and for 5 years 21.44; there was reduction of neck extensor endurance capacity by mean for 1 year 135.14, for 2 years 118.40, for 3 years 125.00, for 4 years 122.23, and for 5 years 108.28; this concluded that there is correlation of reduced endurance of neck flexor and extensor muscle with 1-5 years of smoking history with 5-6 cigarettes per day.

Smoking causes skeletal muscle dysfunction even before overt pulmonary pathology.⁽³⁾ There is evidence of smoking affecting anti-gravity muscles thereby reducing physical endurance in healthy smokers.⁽¹⁵⁾ In this present study it showed that even smaller muscles: neck flexors like rectus capitis lateralis, rectus capitis anterior, scalene muscle, longus colli and longus capitis; neck extensor like rectus capitis posterior major, rectus capitis posterior minor, obliques major and obliques minor which helps to maintain posture are commonly affected with smoking history of 1-5 years. There is study

which showed that neck muscles like longus colli, longus capitis and scalene muscles have higher proportion of type I fibers (i.e. slow oxidative fibers)⁽¹⁴⁾ which have ability to function for longer periods without fatiguing makes them useful in maintaining posture, producing isometric contractions, and stabilizing bones and joints; even with this property of slow oxidative fibers smoking hampered the neck muscle and causes reduction of muscle mass and muscle endurance capacity even with the smoking history of 1-5 years.

Cigarette smoke constituents and systemic inflammatory mediators enhance proteolysis and inhibit protein synthesis, leading to loss of muscle mass.⁽³⁾ Cigarette smoke is a complex aerosol consisting of thousands of various constituents including reactive oxygen and nitrogen free radicals, toxic aldehydes and more which potentially stimulate protein breakdown and impair protein synthesis. Among these constituents, aldehydes are capable of entering the circulation and directly affecting skeletal muscle tissue.⁽⁶⁾ Reduced skeletal muscle contractile endurance in smokers may result from impaired oxygen delivery to mitochondria and ability of the mitochondria to generate ATP due to interaction of carbon monoxide with hemoglobin, myoglobin and components of respiratory chain.

The previous study showed the adverse effect of smoking on muscle structure and function maybe the explanation behind the hampered neck flexor and extensor endurance capacity in this study. This review condenses the proof that, neck muscle endurance is significantly reduced in smokers with 1-5 years of smoking history.⁽²⁾

A recent longitudinal study in a large cohort of young healthy subjects showed that smoking 100g tobacco per week was associated with a 2.9% in men and 5% in women reduction of muscle force in 15 years, independent of physical activity.⁽⁸⁾ Some of the studies have correlated the unpropitious effect of cigarette smoking on

the muscle strength. Kumar and Kumar reported that, in comparison to the non-smoking athletes, cigarette smoking athletes between the age range of 19-30 years have significant decrease in strength and flexibility of muscles when evaluated by the Kraus-Webber fitness test.⁽⁹⁾

According to Kruger et al, protein degradation in the skeletal muscle pathways were found on exposure to smoke, in addition a time-dependent reduction in muscle mass, muscle cross-sectional area, and oxidative fibers were reported.⁽¹¹⁾ As per Degens H, et al, the constituents of cigarette smoke alongside systemic inflammatory mediators' cause shrink in muscle mass due to enhancement in proteolysis and inhibition of protein synthesis.⁽³⁾ In addition, diminished skeletal muscle contractile endurance in smokers may result from impeded oxygen distribution to mitochondria to produce ATP because of interaction of carbon monoxide with myoglobin, hemoglobin and other elements of the respiratory chain.

CONCLUSION & LIMITATIONS

The present study concludes that there is reduced endurance capacity of neck flexor and neck extensor muscles in smokers with 1-5 years of smoking history which indicates that alternative hypothesis is proved that there is significant correlation between the neck flexor and extensor muscle with 1-5 years of smoking history. $P=0.001$ for both NFEC and NEEC respectively & $r=-0.59$ for NFEC, 0.54 for NEEC

The limitations of study were 1-5 years of smoking history and participants recruited limited to male. For further research purpose female participants can be included and can be done on smokers with varied age groups.

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