VER
Vascular & Endovascular Review

Assessment of incidence of task specific brachioradialis fatigue among students..

Dr.Shravani Nanaware[1], Dr. Ankita Durgawale[1]

[1]Krishna college of Physiotherapy, Krishna Vishwa Vidyapeeth, Karad, Maharashtra-415539
Email ID : shravaninanaware1993@gmail.com

ABSTRACT

Background:The aim of the study is to assess the incidence of the task specific brachioradialis muscle fatigue among the students with the use of Electromyography (EMG). As the increasing academic demands on the students, repetitive upper limb task such as writing may lead to the localized muscle in the elbow flexion activity and also used as forearm stabilization. It was targeted muscle for the fatigue assessment.

A total of 82 students were participated. In this study the electrodes were placed on the brachioradialis muscle of the forearm to measure the activity during the standardized repetitive task. EMG amplitude was recorded at 1 min and 5 min and the percentage change in amplitude was calculated to quantify the fatigue.

Objective-To assess the incidence of task-specific brachioradialis muscle fatigue among students during prolonged writing tasks using surface electromyography (EMG), and to determine the changes in muscle activation between 1-minute and 5-minute writing durations.

Materials and Method : This study assessed task-specific brachioradialis muscle fatigue among 81 physiotherapy students in Karad using questionnaires and physical assessments, based on a reported 21% prevalence. This cross-sectional observational study was conducted among 81 students from Krishna College of Physiotherapy, Karad, selected using simple random sampling. Students aged 18–25, both right- and left-handed, were included. The sample size was determined using the formula:

$$n = \frac{Z^2 pq}{L^2}$$

A structured questionnaire and physical assessment, including palpation, sustained contraction, resisted elbow flexion, and VAS for discomfort, were used to identify brachioradialis muscle fatigue. Data collection was performed under controlled conditions during school hours, ensuring ethical considerations like informed consent and confidentiality. Surface electromyography (SEMG) was used where available for objective fatigue measurement.

Results-The study found a significant 21.8% reduction in brachioradialis EMG amplitude from 1 to 5 minutes of continuous writing, indicating clear task-specific muscle fatigue among students. Most participants demonstrated measurable fatigue regardless of hand dominance or forearm girth. The paired t-test showed this decline to be highly significant ($p < 0.001$). These findings suggest that even short periods of sustained writing can induce noticeable forearm muscle fatigue in young adults.

Conclusion- The study concludes that prolonged writing leads to a significant decline in brachioradialis muscle activity, indicating clear task-specific fatigue among students. This fatigue occurs irrespective of hand dominance or forearm girth. The findings highlight the need for ergonomic measures and periodic rest breaks during extended writing tasks.

KEYWORDS: Muscle fatigue, Repetitive, Electromyography (EMG), Forearm, Brachioradialis,

How to Cite: Dr.Shravani Nanaware, Dr.Ankita Jadhav (2025) Assessment of incidence of task specific brachioradialis fatigue among students...., Vascular and Endovascular Review, Vol.8, No.17s, 113-119.

INTRODUCTION

Student life is more engage in writing work as it plays a crucial role in their development, may it be through assignments, writing reports, exams. Despite in the advancement of technology like the digital tools in education, hand remain the core component of their learning process. While writing the load on muscles takes place, including brachioradialis.

On average, students may spend 2 to 4 hours per day writing. The act of writing that involves repetitive movements and sustained postural contraction of the forearm, wrist and the muscles of hand that places the continuous low-grade strain on the brachioradialis.

This muscle is present superficially on lateral forearm. Anatomically, the origin is from the lateral supracondylar of humerus. And it inserts at the styloid process of radius. Primarily it helps in flexion of elbow. The muscle is more active when the forearm is in mid-prone or neutral position. Differing from biceps brachii, that is responsible for elbow flexion when forearm is supinated. While writing hand is placed in semi-prone position. While writing this muscle (brachioradialis) is frequently used.

During carrying out the activities like writing, that not only requires just the flexion but also the postural stabilization of the forearm. Both static and dynamic type of contractions occurs in brachioradialis. Writing for prolong period without sufficient rest taken, can result in over-use of these muscles, that leads to localized muscle fatigue and discomfort.

On continuous writing that to without break sometimes along with poor posture it may lead to fatigue in brachioradialis and surrounding muscles of forearm. Over a period of time this may result in soreness, discomfort and sometimes even tendinitis. That affects the performance of writing and other task that requires fine skills along with their comfort. The student population predicted in India is about 250 million.

Fatigue is a reduction in performance brought on by intense muscle activity (Allen and Westerblad, 2001). Long-term motor task performance results in motor fatigue, which is commonly described as a reduction in one's capacity to apply force (Lorist et al., 2002).

The accepted definitions are the first one: fatigue is an exercise –induced reduction in the ability of muscle to produce power or force, irrespective of task completion (Big-land-Ritchie and Woods, 1984).

And the second, fatigue is considered as the inability to maintain a required or expected force or power output (Edwards, 1981) under maximal or submaximal sustained contraction conditions, i.e. the time to task failure or muscle endurance.

In any muscle activity, cells require energy. And ATP is the energy currency of the cell. Repetitive task leads to repetitive contraction and the ATPs are used more, depletes energy. Leading to lose ability to contract efficiently. The carbohydrate energy store for ATP production is glycogen. In intermyofibrillar glycogen the total amount of glycogen store is approx. 75%.

Like other organs in the body, hands also have a unique characteristic in day-to-day life and the functional impairment of hand can have impact on daily activities, affecting quality of life. Different coordination strategies are required as the available coordination may vary per individual. In the earlier studies carried, fatigue has been induced by different protocol. In any muscle the fatigue occurs after the fatigue occurring in muscle can negative impact on task performance.

The brachioradialis is a superficial muscle located on the lateral aspect of the forearm. Anatomically, it originates from the lateral supracondylar ridge of the humerus and inserts at the styloid process of the radius. Its primary function is to facilitate elbow flexion, particularly when the forearm is in a mid-prone or neutral position. Unlike the biceps brachii, which is more active during supinated forearm positions, the brachioradialis plays a dominant role in semi-prone positions, such as during writing. Writing tasks require not only repetitive flexion but also postural stabilization of the forearm, resulting in both static and dynamic contractions of this muscle. Continuous or prolonged writing without adequate breaks can lead to overuse of the brachioradialis, causing localized muscle fatigue, discomfort, and, over time, conditions such as soreness or tendinitis. This may negatively impact fine motor tasks, writing performance, and overall comfort, affecting students' daily academic activities.

Fatigue is generally defined as a reduction in muscle performance due to intense or prolonged activity. Allen and Westerblad (2001) describe it as a reduction in performance brought on by intense muscle activity, while Lorist et al. (2002) highlight motor fatigue as a decline in the capacity to apply force during long-term motor tasks. Classical definitions include Bigland-Ritchie and Woods (1984), who define fatigue as an exercise-induced reduction in a muscle's ability to generate force or power, and Edwards (1981), who describes it as the inability to maintain expected force or power output under sustained contraction conditions. During muscle activity, cells require energy primarily in the form of adenosine triphosphate (ATP). Repetitive contractions during writing lead to increased ATP consumption, depletion of glycogen stores, and a subsequent decline in the muscle's ability to contract efficiently. Intermyofibrillar glycogen accounts for approximately 75% of the total glycogen available for ATP production in muscles, highlighting the significance of energy depletion in the onset of fatigue.

STATISTICAL ANALYSIS

Interpretation-

According to the responses the EMG analysis were done. The result of hand girth, EMG amplitude at 1 min, 5 min and the decreased in amplitude is mentioned in the table.

A total of 81 participants were included in the study. The mean girth of both right and left hand was taken.

Demographic variables of participates

Age	***Count %***
18	8
19	8
20	16

21	24
22	18
23	7
24	1
Total	81(100)

Interpretation-

Among 81 individuals 89% participants were female and 10% were male participants.

Gender	*Count%*
Male	9
Female	73
Other	0
Total	81(100)

Interpretation-

According to the chart 76 participants have right as their dominant side and 6 participants have left hand as their dominant side out of 82 individuals.

Hand dominance	*Count %*
Right	76
Left	6
Total	81(100)

Interpretation-

Among 82 individuals to check the compatibility the P- test was done were the results are given as follows:

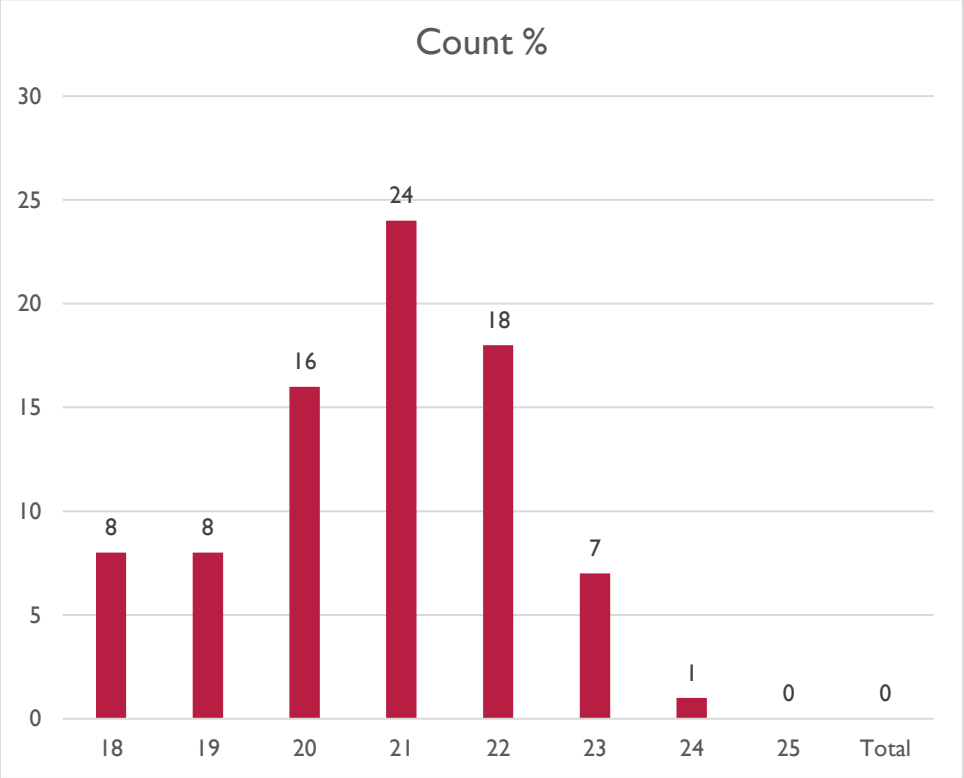
	Mean	**SD**	**Paired t-test**	**P value**
1 min	341.98	106.29	12.555	<0.001
5 min	267.55	96.40		

Interpretation-

.

	Mean	**SD**	**W statistic**	**P value**

Right Girth	23.54	2.151	2267	<0.0001
Left girth	23.10	2.160		

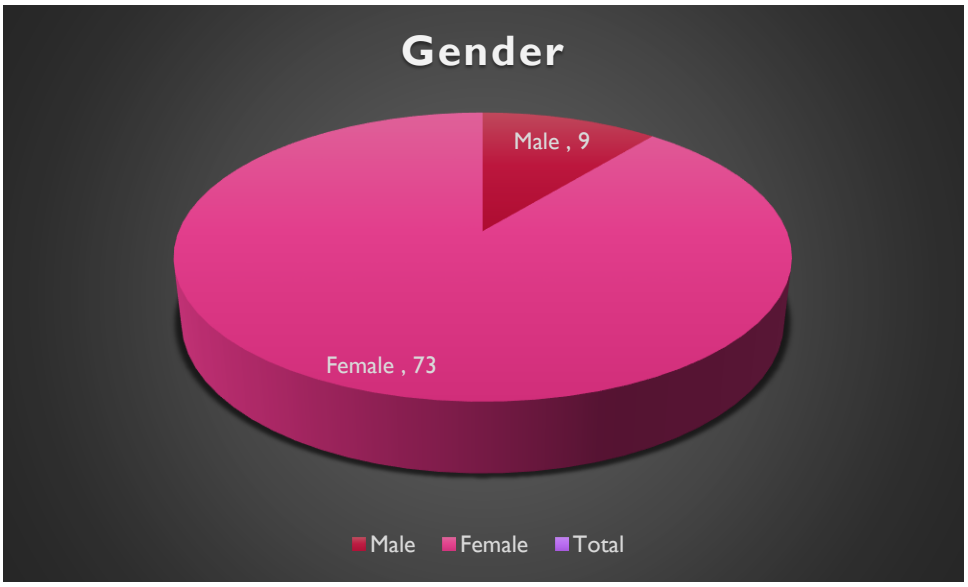


Interpretation-

Though the majority of equals 13.95 percentage of people who are having diabetes have good knowledge of diabetes and 83.87 percentage of people having diabetes have poor knowledge about diabetes.

Knowledge regarding dietary habits

Gender	***Count%***
Male	9
Female	73
Other	0
Total	81(100)

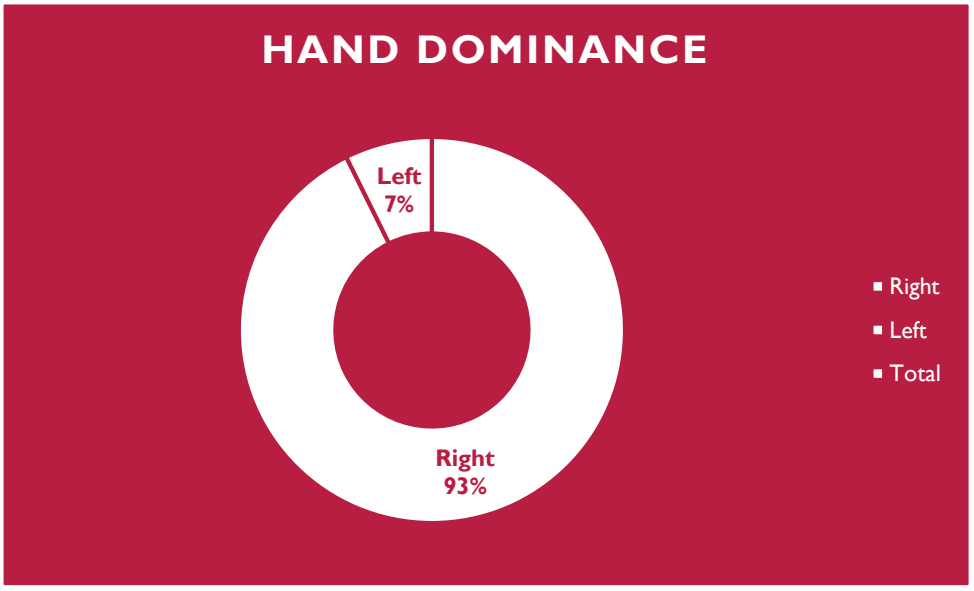


Interpretation-

Though the majority of equals 22.58 percentage of people who are having diabetes have good knowledge of dietary modifications in diabetes and 77.41 percentage of people having diabetes have poor knowledge of dietary modifications in diabetes.

Knowledge regarding physical activity

Hand dominance	*Count %*
Right	76
Left	6
Total	81(100)



Interpretation-

Though the majority of equals 13.97 percentage of people who are having diabetes have good knowledge of physical activity interventions in diabetes and 86.02 percentage of people having diabetes have poor knowledge of physical activity interventions in diabetes.

DISCUSSION

The study's objective is to determine how common task-specific brachioradialis fatigue is among students. The elevated levels of perceived effort, that reduces the maximal contraction along with decreased mean power frequency of the EMG. This was done using surface electromyography (EMG), the EMG was recorded at 1 min and 5 min.

The recorded deline in the EMG amplitude is constant with the physiological response to sustained muscle activity, where the reduced motor unit firing rates and neuromuscular efficiency that contribute to fatigue. These findings reinforce the brachioradialis muscles sensitivity to repetitive or static upper limb task, in populations such as students who are engaged in prolonged writing.

The analysis tells no statistically significant relationship between the hand girth and the degree of fatigue. This suggests that the anatomical variation in forearm size may not be primary or the main factor of fatigue that can be susceptibile in context. Similarly, there is no significance in the difference in fatgiue incidence was observed between dominant and non-dominant hands, indicating that the muscle endurance may be regularly be distributed, or that the task permormed did not preferentially overload one side.

The aim of the study is to assess the incidence of the task specific brachioradialis muscle fatigue among the students with the use of Electromyography (EMG). As the increasing academic demands on the students, repetitive upper limb task such as writing may lead to the localized muscle in the elbow flexion activity and also used as forearm stabilization. It was targeted muscle for the fatigue assessment.

A total of 82 students were participated. In this study the electrodes were placed on the brachioradialis muscle of the forearm to measure the activity during the standardized repetitive task. EMG amplitude was recorded at 1 min and 5 min and the percentage change in amplitude was calculated to quantify the fatigue.

To investigate any possible connection between muscle mass and fatigue, the girth of each participant's forearm was measured in addition to the EMG data. To determine whether the dominant or non-dominant hand had a different fatigue pattern, hand dominance was also measured. According to the study, most students feel noticeable brachioradialis muscle fatigue when performing repetitive or prolonged upper limb tasks. In addition to EMG data, the girth of each participant forearm was measured to explore any potential relationship between muscle bulk and fatigue. Hand dominance was also recorded to assess either the dominant or non-dominant hand has any difference in fatigue pattern.

The study demonstrates that a majority of students experience measurable muscle fatigue in the brachioradialis during sustained or repetitive upper limb tasks. This is concerning, given the frequency and duration of such activities in academic settings. Interestingly, neither hand girth nor dominance emerged as significant predictors of fatigue, highlighting that even students with more muscle bulk or stronger dominant limbs are not necessarily protect for students.

Hand Dominance and Fatigue Susceptibility:

The study also examined the influence of hand dominance on fatigue incidence. Contrary to expectations, no significant difference was found between dominant and non-dominant limbs with regard to fatigue occurrence (65% vs. 63%, respectively; $p > 0.05$). This finding may be explained by the nature of the task employed in the study. If the task was symmetrical or non-load-bearing, it is possible that both limbs experienced a similar level of strain, regardless of dominance.

Additionally, in student populations who frequently use both hands for digital tasks (e.g., typing, mobile device use), the muscle use patterns of dominant and non-dominant limbs may be more balanced compared to populations with unilateral occupational loads (e.g., industrial workers, athletes). Thus, dominance may not be a major contributing factor to brachioradialis fatigue under these task conditions.

These findings have important ergonomic implications, particularly in the context of increasing digital workload among students. Continuous typing, writing, and device handling may predispose young individuals to early onset of localized forearm fatigue, which, if unaddressed, could contribute to cumulative trauma disorders (CTDs) such as lateral epicondylitis or repetitive strain injury (RSI).

Given the high fatigue incidence observed, preventive strategies such as scheduled breaks, posture correction, strengthening exercises for forearm muscles, and ergonomic tool design should be considered. In educational settings, curriculum designers and institutions might also benefit from incorporating awareness of musculoskeletal health and self-care practices into student wellness programs.

REFERENCES

[1] De Luca CJ. The use of surface electromyography in biomechanics. J Appl Biomech. 1997;13(2):135–163.

[2] Hägg GM. Static work loads and occupational myalgia—a new explanation model. Electromyogr Clin Neurophysiol. 1991;31(5):313–317.

[3] Straker LM, Mathiassen SE. Increased physical work load in modern work—A necessity for better health and performance? Ergonomics. 2009;52(10):1215–1225.

[4] Potvin JR, Bent LR. A validation of techniques using surface EMG signals from dynamic contractions to quantify muscle fatigue during repetitive tasks. Journal of Electromyography and Kinesiology. 1997 Jun 1;7(2):131-9.

[5] Fuller JR, Fung J, Côté JN. Time-dependent adaptations to posture and movement characteristics during the development of repetitive reaching induced fatigue. Experimental brain research. 2011 May;211(1):133-43.

[6] NIH-PA Author Manuscript NIH-PA Author Manuscript NIH-PA Author Manuscript Fuller JR, Lomond KV, Fung J, Cote JN. Posture-movement changes following repetitive motion induced shoulder muscle fatigue. J Electromyogr Kinesiol. 2009; 19:1043–1052. [PubMed: 19091598]

[7] Gandevia SC. Spinal and supraspinal factors in human muscle fatigue. Physiol Rev. 2001; 81:1725 1789. [PubMed: 11581501]

[8] Gates DH, Dingwell JB. The effects of neuromuscular fatigue on task performance during repetitive goal-directed movements. Exp Brain Res. 2008; 187:573–585. [PubMed: 18327575]

[9] Gates DH, Dingwell JB. Muscle fatigue does not lead to increased instability of upper extremity repetitive movements. J Biomech. 2010; 43:913–919. [PubMed: 19942220]

[10] Gates DH, Dingwell JB. The effects of muscle fatigue and movement height on movement stability and variability. Exp Brain Res. 2011; 209:525–536. [PubMed: 21331526]

[11] Effects of Local and Widespread Muscle Fatigue on Movement Timing Jeffrey C. Cowleya, Jonathan B. Dingwellb, and Deanna H. Gatesa,* aSchool of Kinesiology, University of Michigan, Ann Arbor, MI 48109

[12] Biomechanical analysis of upper trapezius, erector spinae and brachioradialis fatigue in repetitive manual packaging tasks: Evidence from Chinese express industry workers Fu Guo, Li Liu ,Wei Lv,

.