

Prevalence of Repetitive Strain Injuries in Upper Extremities Among Egyptian School Teachers: A Cross Sectional Study

MOHAMMED H. EL GENDY, Ph.D.; NABIL M. ABDEL-AAL, Ph.D. and MARIAM YACOUP ATTIA, M.Sc.

The Department of Physical Therapy for Basic Sciences, Faculty of Physical Therapy, Cairo University

Abstract

Background: The prevalence of Repetitive strain injuries (RSIs) in upper extremities is reported in many countries, but its occurrence among teachers in Egypt has not been reported.

Aim of Study: To investigate the prevalence of RSIs in teachers at Giza Schools and to assess the effect of RSIs on the hand and pinch grip strengths.

Material and Methods: A sample of 515 teachers has been recruited from secondary schools in Giza. Subjects had 5 or more years of work experience and their age ranged from 35 to 60 years old. Participants were asked to answer the self-structured questionnaire. Hand and pinch grip strengths were measured by hand grip and pinch grip dynamometers.

Results: The prevalence of RSIs in Giza school teachers was 89.51%. There was an impact of RSIs on the hand and pinch grip strength. Hand grip strength or pinch grip strength was the highest affected component (86.55%). There was a significant increase in the prevalence of RSIs in the right upper limb 86.6% compared with that the left upper limb 13.4%. The prevalence of RSIs was greater with exceeding many hours per week, elongated manners during schooling, ageing, and among females.

Conclusion: There was a highly significant prevalence of RSIs in upper extremities among teachers in Giza schools ($p=0.0001$). Also, there was a negative impact of RSIs on the hand and pinch grip strengths.

Key Words: Repetitive strain injuries – Prevalence – Teachers.

Introduction

MUSCULOSKELETAL disorders (MSDs) are frequent, with eighty percent of people experiencing neck pain at some point of their lives. The risk factors reported to MSDs comprise uneasy stance, extended posture, weighty lifting, and work atmosphere [1]. Repetitive strain injury (RSI) is one sort of MSD that affects the upper extremity and neck [2]. Repetitive strain injury was characterized as

injury induced or exacerbated by repeated or prolonged maximal exertion of the soft tissue constructions of the body, that include ligaments, tendons, muscles, and nerves. The prevalence of RSI is increased in the workplace which associated with substantial indirect costs to society [3].

Appreciation of teachers and their health is very important because their work is quite indispensable in any country. The future development of any nation is in the hands of teachers [4], but their work tasks often involve a significant use of a 'head down' posture and prolonged stressed position which cause a high prevalence of RSIs, with prevalence rates of 40% to 95%, during the course of their work [5]. Several studies show that teachers have a higher incidence of RSIs than those in other occupations especially in the upper extremities that reach up to 95% [1,5,6]. The neck muscle spasm may produce a significant weakness of the intrinsic musculature of the hand [7], and the hand function especially hand pinch grip that has an impotent role for school teachers [8].

The prevalence of RSIs among teachers has been published in different countries; however, it has not been investigated among Egyptian teachers. Hence the aim of this study was to examine the prevalence of RSIs in upper extremities among

Abbreviations:

RSI : Repetitive strain injury.
MSDs : Musculoskeletal disorders.
 χ^2 : Chi squared value.
 p -value : Probability value.
 \bar{x} : Mean.
SD : Standard deviation.
MD : Mean difference.
 t -value : Unpaired t -value.
 p -value : Probability value.
CI : Confidence interval.

Correspondence to: Dr. Mariam Yacoub Attia,
E-Mail: mariam.yacoub93@gmail.com

teachers in Giza schools, and to measure the impact of repetitive strain injuries on the hand and pinch grip strengths among teachers in Giza Schools.

Material and Methods

Design and setting:

This cross-sectional analytic research was carried out at different schools in Giza between November 2019 and December 2020. The current study was approved by the Faculty of Physical Therapy, Cairo University's ethical committee (P.T.REC/012/002528). All the participants had been knowledgeable about the aim and advantages of the study and signed the written consent form before participation.

Subjects:

A sample of 515 teachers from both genders participated in the study.

The inclusion criteria included:

- Age between 35 to 60 years old.
- Five years or more of work experience.
- Pain experienced for more than three months prior to the study.
- The participant's conditions were confirmed by a positive structural questionnaire.
- Whereas healthy teachers have experienced no neck pain for three months prior to the study.

The exclusion criteria included:

- Osteoarthritis on hand.
- Other orthopedic conditions.
- Neurological conditions.
- Shoulder surgery.
- Upper limb fracture.

Sample size and sampling methodology:

The sample size of this research was estimated using a single population ratio formula calculator at <http://sampsizemethod.sourceforge.net/iface/#prev> by considering 50% prevalence of RSIs, 95% confidence period and 5% margin of error (precision). So, the estimated sample size was 385 school teachers. Eventually, the sample size of 515 was obtained by adding 33% non-response rate.

As of November 2019, there were 121 governmental secondary schools in Giza governorate. Multi-stage sampling methodology was considered to select the research participants. Firstly, governmental secondary schools in Giza governorate were selected based on the area of location. Subsequently, twenty one schools were proportionally chosen

using simple casual sampling from each stratify. From the selected schools the samples were proportionally recruited according to the total number of teachers in the chosen school using an alphabetical list.

Questionnaires and measurements:

• *The self-structural questionnaire:* The structural Questionnaire focused on the following three parts: Part one, Demographic characteristics include age, gender, education, marital status, number of children, part time jobs, number of working hours per week, and years of teaching experience. Part two, Health condition includes health attitude (drinking coffee, doing regular exercise, wearing high heel shoe), history of trauma, inherited and chronic diseases, osteoarthritis on hand, shoulder surgeries, upper extremity fractures, site of RSIs, right or left side of RSIs and the duration of pain. Part three, work characteristics includes teaching posture, and stretching to write on board [1].

• *Hand grip dynamometer:* JAMAR hand dynamometer (Lafayette Instrument Company, USA) was used to test the handgrip strength. It is the most commonly cited in the literature and accepted as the gold standard by which other dynamometers are assessed. It has the most widespread normative data [9]. The JAMAR is small and portable. The dial reads strength in kilograms and pounds, with marks at increases of 2kg or 5 lb [10].

• *Pinch grip dynamometer:* Is an instrument for measuring the maximum isometric strength of the thumb to index finger, pulp to pulp pinch grip. It is highly reliable and valid instrument for testing pinch grip strength. It is an ideal tool for measuring isometric tip, key and palmar pinch strength [9]. The innovative configuration of the JAMAR Hydraulic Pinch Gauge frees the client to execute a correct pinch pattern since the therapist, not the client, supports the load of the gauge. The result is a very precise pinch-force calculation, clear of artifact. The Red Indicator needle remains at full reading time until reset [11].

Statistical analysis:

Descriptive figures of mean, standard deviation, frequencies, percentages and confidence interval (CI) were utilized in presenting the subjects' demographic and clinical data. Quantitative variables were recapitulated using mean and standard deviation, while categorical variables were recapitulated using frequencies and percentage. The relationship between risk factors and RSIs was examined by chi-square test and logistic regression. Right and left hand and pinch grip strength were compared

in subjects with right and left RSIs using paired *t*-test. The level of significance for all statistical tests was set at $p < 0.05$. All statistical measures were carried out using the statistical package for social studies (SPSS) version 25 for windows.

Results

I- Demographic characteristics:

The age of the participants was 42.21 ± 6.47 years (min. 31, max. 60), and 50.3% of subjects were less than 40 years old, while 49.7% were more than 40 years old. The teaching experience of the participants was 16.07 ± 6.54 years (min. 5, max. 38), and 258 (50.1%) subjects had less than 16 years of teaching experience, while 257 (49.9%) subjects had more than 16 years of teaching experience. One hundred seventy-seven teachers (34.4%) were males, while 338 (65.6%) were females. Two hundred eighty-eight (56%) subjects worked more than 40 hr./week, and 227 (44%) worked less than 40 hr./week.

II- Health status:

Twenty three (4.5%) subjects had a chronic disease, twelve (2.3%) subjects had a shoulder surgery, thirty one (6%) subjects had previous upper limb fracture, two (0.4%) subjects had hand osteoarthritis, twelve (2.3%) subjects had history of prolonged pain through the last decade, and 265 (51%) subjects had a member of the family with RSIs. Only 83 (16%) subjects participated in regular exercises, two hundred eighty-eight (56%) subjects drink coffee and 21 (4%) subjects wear high heel shoe. Three hundred sixteen (61.4%) subjects had to stretch to write on board, and 97 (18.8%) subjects work with computer. Regarding teaching posture, four hundred fifteen (80.6%) subjects had prolonged teaching posture, while 100 (9.4%) had alternated teaching posture (Table 1, Fig. 1).

III- Prevalence of RSIs in Giza secondary schools:

The prevalence of RSIs in Giza secondary schools was 89.51% with 95% CI of 86.56-91.87%. Fifty four (11.49%) subjects had no RSIs and 461 (89.51%) subjects had RSIs pain. There was a significant increase in the prevalence of RSIs 89.51% compared with non RSIs 11.49% ($p = 0.0001$).

In subjects with RSIs, 399 (86.6%) subjects had the right upper limb affected and 62 (13.4%) subjects had the left upper limb affected. There was a significant increase in the prevalence of RSIs in the right upper limb 86.6% compared with that the left upper limb 13.4% ($p = 0.0001$) (Table 2, Fig. 2). The shoulder was the commonest site

of RSIs pain reported by 35.14% followed by the neck 31.89%, the wrist by 21.26%, and the elbow by 11.71%.

Table (1): The health status and work characteristics of the study group.

Health status	Yes	No
Chronic disease	23 (4.5%)	492 (95.5%)
History of trauma (accident during last 10 years)	12 (2.3%)	503 (97.7%)
Member of family had RSIs	265 (51%)	250 (48.5%)
Participation in regular exercise	83 (16%)	432 (84%)
Drinking coffee	288 (56%)	227 (44%)
Wearing high heel shoe	21 (4%)	494 (96%)
Work characteristics	Yes	No
Stretching to write on board	316 (61.4%)	199 (38.6%)
Working with Computer	97 (18.8%)	418 (81.2%)
Teaching posture	Prolonged	Alternated
	415 (80.6%)	100 (19.4%)

Table (2): Difference between RSIs in right and left sides.

	Right side	Left side	z-value	p-value	Sig.
RSIs	399 (86.6%)	62 (13.4%)	22.2	0.0001	S

p-value: Probability value. S: Significant.

There was a significant association between age and RSIs ($p = 0.02$). There was a significant increase in the prevalence of RSIs in subjects who are older than 40 years (92.6%) compared with subjects who are younger than 40 years (86.5%). There was a significant increase in the prevalence of RSIs in females 94.7% compared with that in males 79.7% ($p = 0.0001$). There was no significant association between the teaching experience and RSIs ($p = 0.76$).

There was a significant association between RSIs and working hours per week ($p = 0.0001$). Additionally, there was a significant increase in the prevalence of RSIs in subjects who work more than 40 hr/week (95.5%) compared with that in subjects who work less than 40 hr/week (81.9%). There was no significant association between RSIs and stretching to write on board ($p = 0.79$) or family history of RSIs ($p = 0.09$) or coffee intake ($p = 0.81$). However, there was a significant association between RSIs and working with computer ($p = 0.01$). Furthermore, there was a significant increase in the prevalence of RSIs in working with computer user (91.1%) compared with that none computer user (82.5%). There was a significant association between RSIs and teaching posture ($p = 0.006$). There was a significant increase in the prevalence of RSIs in subjects with prolonged posture (97%) compared with that alternated posture (87.7%), (Table 3).

In right side RSIs, the mean \pm SD of right-hand grip strength (affected side) was 28.15 ± 12.37 kg and that of the left side was 30.39 ± 13.17 kg with the mean difference of -2.24 kg. There was a significant decrease in right hand grip strength compared with that of the left side ($p=0.0001$) in right-side RSIs. In left-side RSIs, the mean \pm SD of the right-hand grip strength was 37.63 ± 12.96 kg and that of the left side (affected side) was 31.29 ± 11.45 kg with the mean difference of 6.34 kg. There was a significant decrease in left hand grip strength compared with that of the right side ($p=0.0001$) in left side RSIs. (Table 4, Fig. 3).

In right-side RSIs, the mean \pm SD of right pinch grip strength (affected side) was 11.44 ± 5.55 kg and that of the left side was 11.86 ± 5.33 kg with the mean difference of -0.42 kg. There was a significant decrease in right-side pinch grip compared with that of the left side ($p=0.0004$) in right side RSIs. In left-side RSIs, the mean \pm SD of the right pinch grip strength was 13.13 ± 5.8 kg and that of the left-side (affected side) was 10.85 ± 5.59 kg with the mean difference of 2.27 kg. There was a significant decrease in left pinch grip strength compared with that of the right side ($p=0.0001$) in left side RSIs. (Table 5, Fig. 4).

Table (3): The prevalence of RSIs with selected factors.

Factors	Prevalence of RSIs		χ^2 -value	<i>p</i> -value	Sig.
	Yes	No			
<i>Age classes:</i>					
<40 years	224 (86.5%)	35 (13.5%)	5.09	0.02	S
>40 years	237 (92.6%)	19 (7.4%)			
<i>Gender:</i>					
Females	320 (94.7%)	18 (5.3%)	27.89	0.0001	S
Males	141 (79.7%)	36 (20.3%)			
<i>Teaching experience:</i>					
<16 years	232 (89.9%)	26 (10.1%)	0.09	0.76	NS
>16 years	229 (89.1%)	28 (10.9%)			
<i>working hours per week:</i>					
>40 h/week	275 (95.5%)	13 (4.5%)	24.82	0.0001	S
<40 h/week	186 (81.9%)	41 (18.1%)			
<i>Stretching to write on board</i>					
No stretch	282 (89.2%)	34 (10.8%)	0.06	0.79	NS
	179 (89.9%)	20 (10.8%)			
<i>Family history of RSIs:</i>					
Positive	243 (91.7%)	22 (8.3%)	2.77	0.09	NS
Negative	218 (87.2%)	32 (12.8%)			
<i>Drinking coffee</i>					
No coffee intake	257 (89.2%)	23 (10.1%)	0.05	0.81	NS
	204 (89.9%)				
<i>Work with computer:</i>					
Computer user	381 (91.1%)	37 (8.9%)	6.31	0.01	S
None computer user	80 (82.5%)	17 (17.5%)			
<i>Teaching posture:</i>					
Prolonged	97 (97%)	3 (3%)	7.4	0.006	S
Alternated	364 (87.7%)	51 (12.3%)			

χ^2 : Chi squared value. *p*-value: Probability value. S: Significant. NS: Non significant.

Table (4): *t*-test for difference between the right and left Handgrip strength in the side of RSIs.

Side of RSIs	Rt. Handgrip (kg)	Lt. Handgrip (kg)	MD (95%CI)	<i>t</i> -value	<i>p</i> -value	Sig.
Rt side (n=399)	28.15 \pm 12.37	30.39 \pm 13.17	-2.24 (-2.95, -1.52)	-6.13	0.0001	S
Lt side (n=62)	37.63 \pm 12.96	31.29 \pm 11.45	6.34 (4.65, 8.02)	7.52	0.0001	S

t-value: Unpaired *t*-value. *p*-value: Probability value. MD: Mean difference. S: Significant.

Table (5): *t*-test for difference between the right and left pinch grip strength in the side of RSIs.

Side of RSIs	Rt Pinch grip (kg)	Lt Pinch grip (kg)	MD (95%CI)	<i>t</i> -value	<i>p</i> -value	Sig.
Rt side (n=399)	11.44±5.55	11.86±5.33	-0.42 (-0.66, -0.19)	-3.54	0.0004	S
Lt side (n=62)	13.13±5.8	10.85±5.59	2.27 (1.55, 3.0)	6.29	0.0001	S

t-value: Unpaired *t*-value. *p*-value: Probability value. MD: Mean difference. S: Significant.

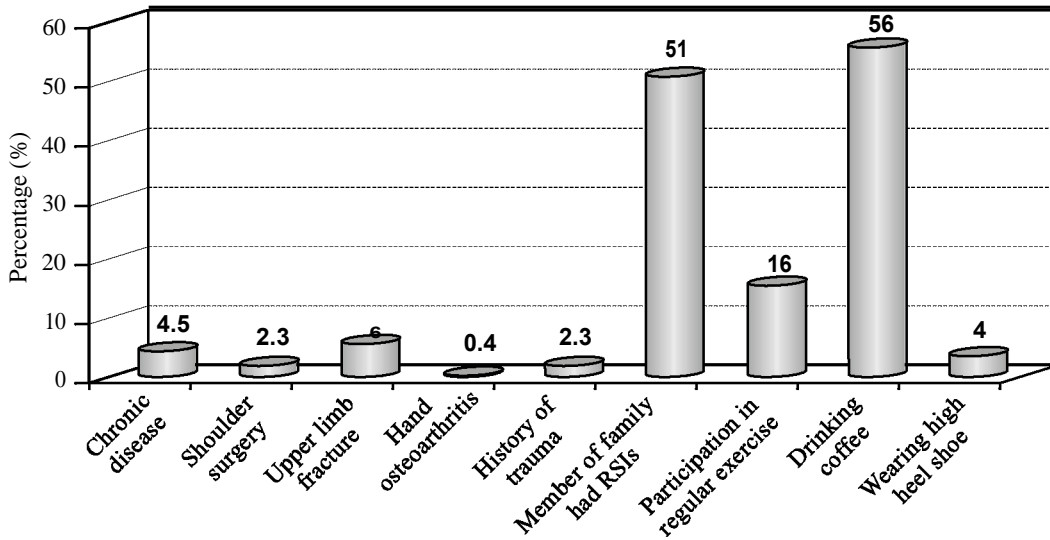


Fig. (1): Health Status of the study group.

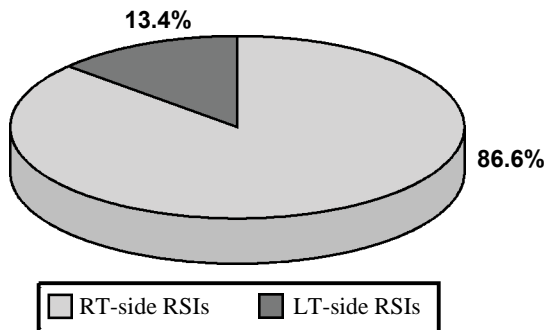


Fig. (2): Prevalence of RSIs of right and left sides.

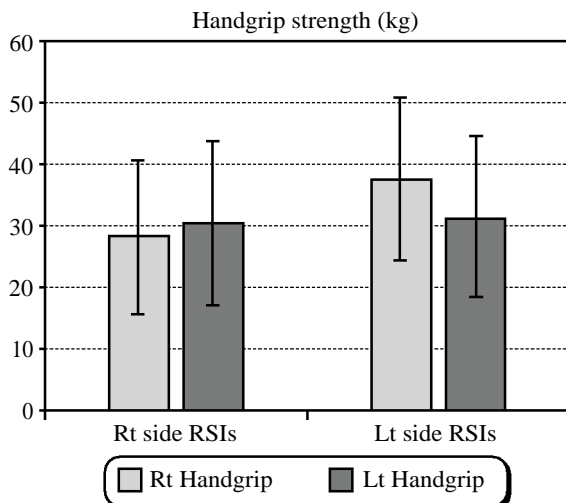


Fig. (3): Effect of RSIs side on right and left hand grip strength.

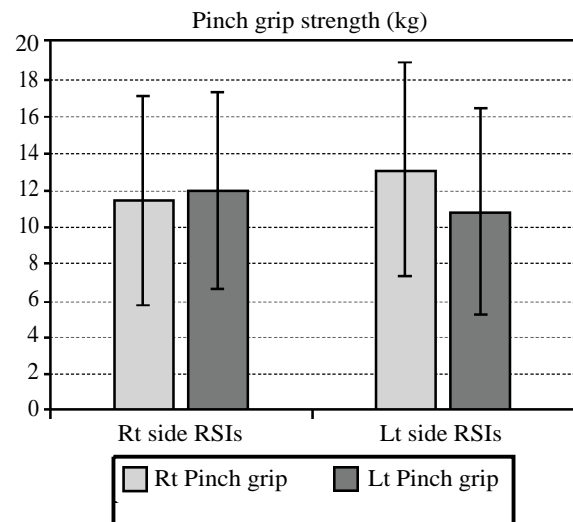


Fig. (4): Effect of RSIs side on right and left hand grip strength.

Discussion

School teachers represent an occupational group, in which the prevalence of RSIs, in various body sites, seems to be elevated [6]. The result of the current study revealed that there is high prevalence of RSIs found among teachers in Giza schools (89.51%), supported from some previous reports regarding RSIs among teachers in Ethiopia, Thailand, Hong Kong, India, Kuala Lumpur, Nigeria and in Malaysia [1,6,12-16]. Nevertheless, the

prevalence of this research is higher than the studies carried out in China, Saudi Arabia, Japan and Brazil, where the prevalence ranged from 31.6% to 60% [17-20]. This difference that was recorded in prevalence rate of RSIs could be as a result of the difference in the educational systems, study design, the facilities available for the teachers at their schools or social, cultural, and economic differences between Egypt and other nations.

The highest prevalence of RSIs was at the area of the shoulder (35.14%) which was in line with that in Hong Kong, with prevalence (69.3%) [12], China (73.4%) [21], India (33.12%) [13], and in Nigeria (62.3%) [15]. There was a significant increase in the prevalence of RSIs in teachers of more than 40 years old compared with subjects of less than 40 years. The reasons might be the consequence of aging, age-related degenerative changes, turning down of tissue healing, lessening of cartilage, and increasing suffering to neck and shoulder structures due to workload. This result is in line with the studies conducted in Botswana, Ethiopia and in Malaysia [6,16].

There was a significant increase in the prevalence of RSIs in subjects with more than forty working hours per week compared with that in subjects with less than forty working hours per week which were supported by some previous studies in Thailand, Hong Kong and in Malaysia [1,12,16]. There was a significant increase in the prevalence of RSIs in females contrasted with that in males, this is matched with the studies of university academic staff in Hong Kong, China, India, Kuala Lumpur, and in Nigeria [13-15,21,22]. The elevated hazard of developing RSIs after teaching in females could be explained by many factors as they were more likely suffering emotional exhaustion compared with males among teachers [23]. Also, females have a lower pain threshold than males, where the pressure pain threshold increases with muscle strength [24], and the muscle strength in the upper limb for males is 1.2-1.7 times those in females. Consequently, females could have a lower pain threshold than males [22].

There was no association between a teaching experience and RSIs in the current study. However, in Hong Kong, teachers with teaching experience of less than 5 years got the highest life-long prevalence of RSIs [12]. This could be due to the sample size; in Hong Kong the sample size was one hundred teachers from secondary schools collected by simple one stage cluster sampling method [12], but in our study; Sample size were five hundred and fifteen randomly selection.

There was no significant association between RSIs and stretching to write on board which was similar to that in Hong Kong [12]. In the current study, there was no significant association between RSIs and family history of RSIs, however, in that of Thailand, family members had two times higher risk developing RSIs compared to the healthy family [1]. This could be due to the sampling selection method; in Thailand were collected by simple one stage cluster sampling method [1], but in our study; Samples were randomly selected.

Also there was no significant association between RSIs and coffee intake. There was a significant increase in the prevalence of RSIs in working with computer users compared to that of non-computer users which was confirmed with the results of previous studies in Hong Kong and Nigeria [15,22]. Working with a poking chin position during computer processing would induce a significant load on the subsequent neck muscle leading to muscle weakness. This would boost loading on non-contractile composition and posterior cervical structures causing RSIs [4].

In our study, there was a significant increase in the prevalence of RSIs in teachers with prolonged posture compared with that with alternated posture. This was matched with the studies in Thailand [1], Ethiopia [6], and in Hong Kong [4] because the awkward position by persistent muscle stretching, mainly the overhead position, induced neck and upper limb disorders in teachers. Repetitive strain injuries had a negative impact on hand and pinch grip strengths of governmental secondary school teachers in Giza. Hand and pinch grip strength decrease in the side of RSIs compared with the side of non RSIs. These findings were matched with the studies in USA [25], Japan [26], and in Turkey [27].

Conclusion:

This study showed that there is a high significant prevalence of RSIs in the upper extremities among teachers in government secondary schools in Giza. Also, there is a high significant prevalence of RSIs in right side compared with that of the left side. Furthermore, repetitive strain injuries had a negative impact on hand and pinch grip strengths of governmental secondary school teachers in Giza.

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Conflict of interest:

The authors declare no conflicts of interest.

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مدى انتشار إصابات الاجهاد المتكررة فى الأطراف العليا بين معلمى المدارس المصرية

لقد تم حصر انتشار إصابات الإجهاد المتكررة فى الأطراف العلوية بين معلمى المدارس فى العديد من البلدان، ولكن لم يتم حصر حدوثها بين المعلمين فى مصر. وبالتالي كان هدف البحث معرفة مدى انتشار إصابات الإجهاد المتكررة لدى المعلمين فى مدارس الحكومية الثانوية بالجيزة. ولإختبار تأثير إصابات الإجهاد المتكررة على قوة قبضة اليد بين المعلمين، وكذلك لإختبار تأثير إصابات الإجهاد المتكررة على قوة قبضة القرصة بين المعلمين.

تم اختيار ٥١٥ معلماً من المدارس الثانوية بمحافظة الجيزة. ولدى هؤلاء الأشخاص سنوات أو أكثر من الخبرة العملية وتراوح أعمارهم من ٣٥ إلى ٦٠ عاماً. وطلب من المشاركين الإجابة على الاستبيان الذاتى. وتم قياس قوة قبضة اليد والقرصة بواسطة مقاييس دينامومتر قبضة اليد والقرصة.

أظهرت الدراسة أن هناك انتشار كبير لإصابات الإجهاد المتكررة فى الأطراف العلوية بين معلمى المدارس الثانوية الحكومية فى الجيزة. وأن هناك تأثير كبير لإصابات الإجهاد المتكررة على قوة قبضة اليد وكذلك قوة القرصة بين المعلمين فى مدارس الجيزة. بالإضافة إلى ذلك قد أوضحت النتائج أن الجانب الأيمن هو الجانب الأكثر شيوعاً لإصابات الإجهاد المتكررة، الكتف هو المنطقة الأكثر انتشاراً لإصابات الإجهاد المتكررة. والعمر والعمل على أجهزة الكمبيوتر وثبات الوضع لفترات طويلة وساعات العمل فى الأسبوع من عوامل الخطر الهامة التى أدت إلى تطور إصابات الإجهاد المتكررة فى الطرف العلوى بعد التدريس وأيضاً تزداد أكثر بين الإناث. يُنصح المعلمون بالتعرف على العوامل الخطر المهنية وتقليلها، إن أمكن، لتقليل فرصة الإصابة بألم الرقبة وألم الأطراف العلوية.