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EFFECTIVENESS OF PREVENTION EXERCISES PROTOCOL AMONG OFFICE WORKERS WITH SYMPTOMS OF CARPAL TUNNEL SYNDROME

PATRYCJA ŁACH[1] and ANNA KATARZYNA CYGAŃSKA[2]

[1] Central Institute for Labor Protection – National Research Institute, Warsaw, Poland
Department of Ergonomics
[2] Józef Piłsudski University of Physical Education in Warsaw, Warsaw, Poland
Faculty of Rehabilitation

Abstract
Objectives: Carpal tunnel syndrome (CTS) is common among office workers and limits functional hand ability and the ability to work. Carpal tunnel syndrome prevention programs implementation are still insufficient among office workers. In view of the fact that physical activity is the best method of preventing musculoskeletal complaints the aim of the study was to evaluate the effectiveness of prevention exercises protocol for hand and wrist pain among office workers. **Material and Methods:** Study group consists form 62 office workers, reporting complaints of hand and wrist pain. Exercise group it was 49 subjects who performed the exercise protocol and the non-exercise group consisted of 13 subjects. An exercises program, consisting of 7 exercises. The program was planned for daily routine during 8 weeks. The effectiveness of the exercise program was assessed by physical parameters (hand grip and pinch grip strength, force of forearm muscles) and questionnaires (*Visual Analog Scale* pain scale, *Carpal Tunnel Syndrome Symptom Severity Scale*, and *Carpal Tunnel Syndrome Functional Status Scale* functional hand assessment questionnaires) were performed. Assessment was performed before and after the intervention. **Results:** Statistical analysis of the data showed significant changes in the value of measured hand grip of the right hand ($Z = -2.85$, $p < 0.01$). For pinch grip, changes were significant for both the right ($Z = -2.12$, $p < 0.05$) and the left hands ($Z = -2.35$, $p < 0.05$). Functional performance improved significantly in bought groups. There was no statistically significant change in the intensity of experienced pain. **Conclusions:** The results of the study indicate that performing a preventive exercise program regularly has an effect on increasing forearm muscle strength in a group of office workers. Office workers with symptoms of CTS who exercised regularly had higher results in hand grip and pincer grip strength. Exercises do not affect the level of pain complaints, which may indicate a more complex etiology of pain perception in this study group. Int J Occup Med Environ Health. 2024;37(1):45–57

Key words:
pain, physical activity, office workers, functional ability, hand grip, carpal tunnel syndrome

INTRODUCTION

Carpal tunnel syndrome (CTS) is the most common upper limb compression neuropathy nowadays [1–3]. Thiese et al. [4] report that the prevalence of carpal tunnel ranges 6.3–11.7%, and its occurrence is already considered an epidemic. According to Pourmemari et al. [5] its incidence ranges 2.2–5.4% per 1000 people. Researchers on the topic of CTS also agree that the highest incidence of the condition is observed among occupational groups performing repetitive hands flexion and extension movements [6,7]. Among people who perform repetitive manual work, especially during activities that require

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Corresponding author: Anna Katarzyna Cygańska, Józef Piłsudski University of Physical Education in Warsaw, Faculty of Rehabilitation, Marymoncka 34, 00-968 Warsaw, Poland (e-mail: anna.cyganska@awf.edu.pl).

repeated flexion and extension of the hands, the incidence of CTS increases up to 10% [8]. Office workers are one of the occupational groups at risk of wrist/hand symptoms especially if they are women [9] and if they are >30 years of age [10], although according to the Polish certification CTS is not defined as an occupational disease among office workers (using computers).

Carpal tunnel syndrome occurs as a result of an increase in pressure in the carpal canal, which occurs through the interaction of internal and external mechanical factors leading to a decrease in the volume of the carpal canal or an increase in the volume of the elements within it. Compression of the nerve causes paresthesia's of the palmar-radial part of the hand, pain in the area of the wrist joint and hand, and sometimes in the forearm or shoulder. As a consequence, sensory loss may occur in the first 3 fingers on the palmar side or weakness and atrophy of the muscles involved in thumb inversion and oppositions [7]. Among the various forms of therapeutic improvement for patients with mild to moderate CTS, physiotherapy is the most commonly used method. Among the treatments used are ultrasound, electrotherapy, laser therapy and magnetotherapy, as well as kinesitherapy, which involves treatment with movement [11]. According to Wilk [12], the most effective exercises are those aimed at stretching and neuromobilization of the median nerve. Few reports are available on the effectiveness of conducting therapy using exercise alone. Most of the interventions presented in the publications are aimed at people diagnosed with CTS and not prevention of people who are at risk and experiencing the first symptoms that may indicate the appearance of neuropathy in the future.

The purpose of this study was to evaluate the effectiveness of prevention exercises protocol for hand and wrist pain among office workers.

MATERIAL AND METHODS

The study enrolled 65 subjects, all of whom were office workers. The exercise group consisted of 49 subjects who

Table 1. Biometric data of office workers reporting complaints of hand and wrist pain, tested at the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland, 2021

Variable	Participants (N = 62)		p
	exercise group (N = 49)	non-exercise group (N = 13)	
Age [years] (M±SD)	47.25±9.55	46.07±8.19	0.686
Body mass [kg] (M±SD)	74.34±14.87	67.27±15.93	0.138
Body high [cm] (M±SD)	169.02±7.80	168.67±6.29	0.882

performed the exercise protocol min. 3 times/week, and non-exercise group consisted of 13 subjects who performed hand exercises <3 times/week. The respondents performed all their work duties normally during these 8 weeks, and there were no changes in the timing or number of duties at work. The exercise program was completed by 62 subjects (3 subjects dropped out). Table 1 presents the biometric data of the study population.

The following inclusion criteria were used in the study: office work, the presence of CTS in the early stage of the disease diagnosed by a physician on the basis of presenting symptoms (positive at least 1 of the 4 provocative tests performed: Tinel's test, Phalen's test, reverse Phalen's test, Durkan's test), duration of symptoms (pain, numbness and tingling of the fingers of the hand, weakness of grip strength) persisting for >3 months, no contraindications to physical exercise. Exclusion criteria included: the presence of other pathological conditions in the wrists, a history of fractures of the forearm or hand, a history of an accident in the last 6 months, a diagnosis of malignant neoplasm ever in life, a diagnosis of autoimmune or other systemic disease ever in life, a diagnosis of other diseases causing symptoms characteristic of CTS (differential diagnosis).

Developed based on the available literature and the researchers' clinical experience, the set of exercises consisted of 7 exercises. Table 2 show detailed descrip-

Table 2. Descriptions of the exercises for preventing musculoskeletal complaints, the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland, 2021

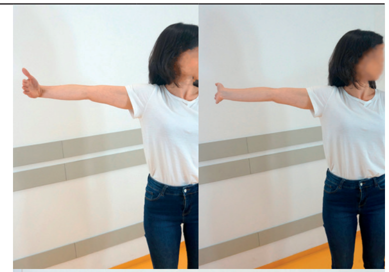
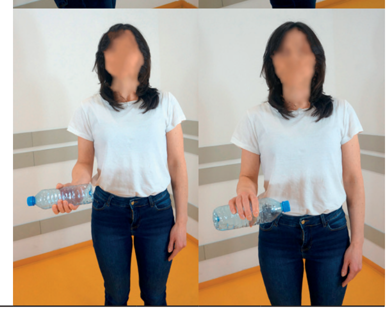
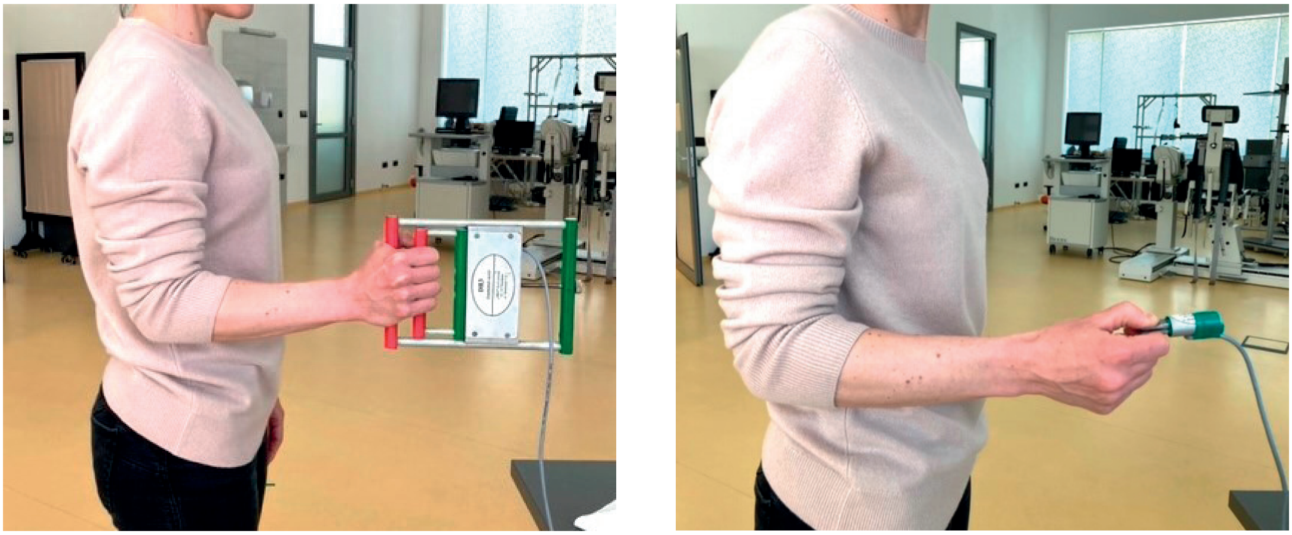
Exercise	Starting position	End position/motion	Comments	Picture
Mobilization of the median nerve	standing position, feet set at hip width, one upper limb hangs freely along the torso, the other is visited at the shoulder joint to 90°, rotation of the head and neck in the direction opposite to the exercised upper limb, gaze directed forward (ahead)	perform alternating flexion and extension movements of the wrist	– avoid lifting the shoulder and bending the forearm during the stretching of the nerve when extending the arm – mild discomfort is possible (expected) – a tingling/ numbness/tension sensation in various parts of the limb	
Stretching the median nerve	standing position, feet positioned at hip width, upper limbs abducted at the shoulder joints to 90°, and the palmar side of the hands is facing the ground, gaze facing forward (in front)	make a movement of straightening your hands and lengthening your arms by spreading them out to the sides (a movement as if you want to push the walls apart)	– avoid lifting shoulders and bending forearms as well as bending fingers – during the stretching of the nerve when extending the arm, mild discomfort is possible (expected), a sensation of tingling/numbness/ tension in different parts of the limb	
Chest stretching	standing position (sideways to the wall), feet set at hip width, one upper limb hangs freely along the torso, the other is visited at the shoulder joint to a right angle and the hand rests on the wall (arm in external rotation that is, fingers pointing backwards), gaze directed forward (in front of you)	take a small step, turning your torso away from the wall while keeping your hand position unchanged	– keep the forearm straight and avoid lifting the shoulder up during the exercise – when stretching, do not do pumping/springing, after stretching, maintain the position until the tissues relax – gentle discomfort, tingling/ numbness/tension sensation in different parts of the limb ora chest is possible (expected) – perform the exercise on the right and left side	

Table 2. Descriptions of the exercises for preventing musculoskeletal complaints, the Biomechanics Laboratory of CIOP-PIB, Warsaw, 2021 – cont.

Exercise	Starting position	End position/motion	Comments	Picture
Stretching the flexor muscles of the hand and fingers	kneel supported, fingers abducted at the metacarpophalangeal joints, thumb and fingers flat against the floor	shift your weight forward so that your arms are as straight as possible	– avoid bending your fingers (pulling your fingers away from the ground) – during the exercise you will feel tension/discomfort, stretching of the forearm – if you feel pain in the wrist reduce the intensity of stretching – after the exercise, relax your wrists by doing a few circles or "shake" them	
Hand extension with resistance	standing position, feet set hip-width apart, one upper limb hanging freely along the torso, the other limb bent at the elbow joint to 90°, forearm pronated, weight held in the hand	perform alternating flexion and extension movements of the hand with resistance	– control the flexion movement of the hand so that the hand slowly lowers instead of falling under the influence of gravity and the dead weight of the weight being held – avoid over-squeezing the weight – keep the forearm in the same position during hand movements	
Hand flexion with resistance	standing position, feet set hip-width apart, one upper limb hanging freely along the torso, the other limb bent at the elbow joint to 90°, forearm supinated, weight held in the hand	perform alternating flexion and extension movements of the hand with resistance	– control the flexion movement of the hand so that the hand slowly lowers instead of falling under the force of gravity and the dead weight of the weight being held – avoid over-squeezing the weight, keep the forearm in the same position during hand movements	
Pronation and supination of the forearm with resistance	standing position, feet set hip-width apart, one upper limb hanging freely along the torso, the other limb bent at the elbow joint to 90°, forearm pronated, weight held in the hand	perform alternating forearm supination and pronation movements with resistance	– control the movement – avoid over-squeezing the weight, keep the forearm in the same position during the hand movements	

Photos: Patrycja Łach.

a) b)



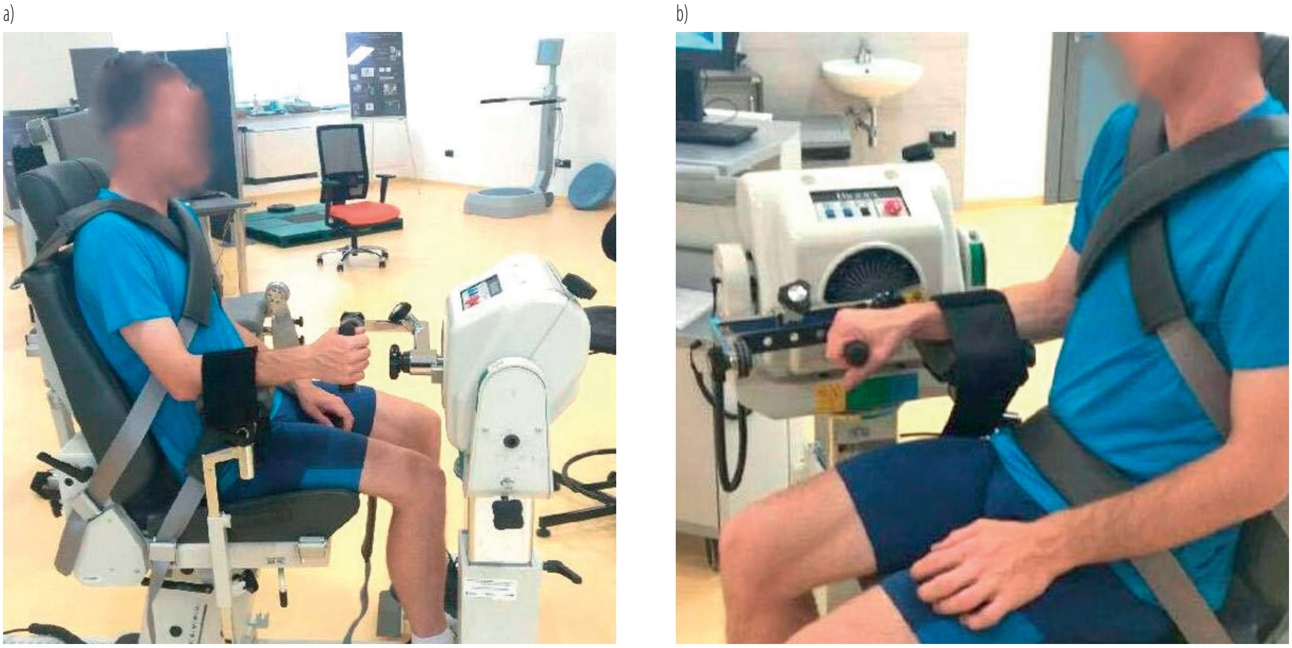
Photos: Patrycja Łach.

Figure 1. Measurement position of a) hand grip strength, b) pincer grip strength, the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland, 2021

tions of the exercises. Participants took part in detailed, individual instruction in the exercises by a specialist (a physiotherapist) before beginning to perform the exercise program on their own, and were given a specially prepared script describing how to perform each exercise. The exercises were performed independently by the subjects. If the participant was unable to perform the recommended exercise, an individual modification was proposed, with the same effect and no difficulty in performance. They were advised to perform the exercises regularly, a minimum of 3 times a week. Participants were provided with contact with the researcher (physiotherapist) throughout the project, and were able to ask questions and voice their concerns.

Evaluation of effectiveness the exercises protocol based on objective measurements and results of survey questionnaires, performed before and after the program. Measurement of hand grip strength and pincer grip strength (separately for the right and left sides), under static conditions, was carried out using the DR3 hand dynamometer and the DMP2 phalangeal dynamometer (JBA Zb. Staniak, Warsaw, Poland). Both measurements were performed in a standing position with the subject's arm held close to the body, the forearm was positioned parallel to the ground (angle at the elbow joint 90°), the radial-carpal joint in a neutral position (Figure 1a). When measuring pincer grip strength, the subject pressed the sensor, located on the joint between the distal and middle phalanges, of the index finger with the thumb (Figure 1b). Force measurements were always started with the healthy hand (without complaints), and the test subject generated the maximum force, twice with a pause of a few seconds between measurements, then the procedure was repeated for the other limb. The pincer grip force was then measured. The test subject was asked to hold the tension for about 3 s.

Measurements of maximum force moments in the distal joints of the upper extremities were carried out using the Biodex Multi-Joint System (Biodex Medical Systems, Inc., Shirley, NY, USA). The force tests were performed in the sitting position, the backrest angle was 85° to the seat. The torso was stabilized with 2-point belts running from



Photos: Patrycja Łach.

Figure 2. Measuring position during the measurement of muscular moments of a) supination and pronation of the forearm, and b) flexion and extension of the hand, the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland, 2021

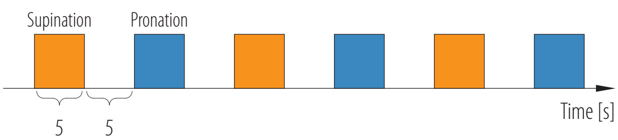


Figure 3. Schematic of the measurement procedure during the test of the strength of the muscles of the supination and pronation of the forearm on the Biodex Multi-Joint System, the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, 2021

the shoulder joint, to the opposite hip plate, and a pelvic belt to stabilize the upper body and avoid additional torso movements. Torque values were measured during forearm rotation and inversion (Figure 2a) and during arm flexion and extension (Figure 2b). The subject performed isometric tension 3 times, performing the reversal and inversion of the forearm and the extension and flexion of the arm as showed Figure 3.

Validated survey questionnaires were also used to evaluate the effectiveness of the exercise set: *Carpal Tunnel Syndrome Symptom Severity Scale* (CTS SSS), *Carpal Tunnel Syndrome Functional Status Scale* (CTS FSS), *Visual Analog Scale* (VAS) pain level. The CTS SSS and CTS FSS questionnaires by Levine [13] were translated and adapted among Polish patients with CTS. In both questionnaires there are a total of 19 questions assessing the level of pain during activities of daily living, in which answers are rated on a scale of 1 ("no pain") to 5 ("unbearable pain"). The questionnaires were completed 3 times (before, during and after the program).

Ethics

The Ethics Committee for Scientific Research Involving Human Subjects at the Institute of Human Nutrition Sciences at the Warsaw University of Life Sciences , Warsaw, Poland has approved the study (No. 34/2021, August 23, 2021).

Statistics

Statistical analysis of the collected data was conducted with the SPSS program. The normality of the distributions of the analyzed variables was checked using the Kolmogorov-Smirnov test. If the normality of the distribution was confirmed, statistical analysis of the variables was carried out using parametric tests, otherwise non-parametric tests were used. Non-parametric test for dependent variables, Wilcoxon test for pairs of observations and parametric test, Student's t-test were used. When comparing 3 dependent variables, the nonparametric Friedmann test or parametric test, ANOVA analysis of variance was performed. Statistical significance was set at $p < 0.05$.

RESULTS

Statistical analysis showed, significant differences in the value of measured grip strength of the right hand before and after the intervention in the experimental group. The mean value of force increased from 324.63 N to 338.75 N. For the left hand, the changes were not statistically significant. For pincer grip strength, the changes were significant for both the right hand and the left hand. There were no statistically significant differences in hand grip strength and pincer grip strength in the non-exercise group. Table 3 compares the initial and final measurements in the 2 study groups. There were no statistically significant difference in the value of measured grips strength before and after the intervention between both experimental groups (Table 4).

In the experimental group, the values of maximum muscle force moments showed statistically significant differences during right and left forearm pronation and right and left hand straightening and flexion. In the non-exercise group, the values of maximum moments of forces in the forearm and radial-carpal joints on the right and left sides showed no statistically significant differences. Table 5 presents the detailed results of the performed measurements of the maximum moments of muscle forces.

The average pain score marked on the VAS, decreased from 53 pts to 39 pts, the change was not statistically sig-

Table 3. Hand grip strength and pincer grip strength before and after intervention in between the study groups of office workers reporting complaints of hand and wrist pain, the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland, 2021

Variable	Measurement before the exercises					Measurement after the exercises				
	exercises group		non-exercises group		p	exercises group		non-exercises group		p
	M±SD	95% CI	M±SD	95% CI		M±SD	95% CI	M±SD	95% CI	
Grip strength [N]										
right hand	324.63±111.48	292.61–356.66	370.95±102.98	308.72–433.19	0.128	338.75±100.86	309.78–367.72	367.75±103.51	305.20–430.30	0.426
left hand	303.04±96.94	275.19–330.88	338.94±106.63	274.50–403.37	0.316	311.85±94.05	284.84–338.86	342.65±125.87	266.58–418.71	0.622
Pincer grip strength [N]										
right hand	76.47±22.89	69.90–83.05	81.96±19.99	69.88–94.04	0.402	80.59±26.62	72.94–88.23	82.62±22.93	68.76–96.48	0.628
left hand	71.86±22.89	65.29–78.43	77.04±16.38	67.14–86.94	0.299	76.60±23.20	69.94–83.27	76.68±23.40	62.55–90.82	0.842

Table 4. Hand grip strength and pincer grip strength before and after intervention in the study groups of office workers reporting complaints of hand and wrist pain, divided into right and left sides, the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland 2021

Parameter	Measurement		Z	p
	before the exercises	after the exercises		
Grip strength [N] (M±SD)				
right hand				
exercises group	324.63±111.48	338.75±100.86	–2.85	0.004*
non-exercises group	370.95±102.98	367.75±103.51	–0.18	0.861
left hand				
exercises group	303.04±96.94	311.85±94.05	–1.47	0.142
non-exercises group	338.94±106.63	342.65±125.87	–0.25	0.807
Pincer grip strength [N] (M±SD)				
right hand				
exercises group	76.47±22.89	80.59±26.62	–2.12	0.034*
non-exercises group	81.96±19.99	82.62±22.93	–0.38	0.701
left hand				
exercises group	71.86±22.89	76.60±23.20	–2.38	0.017*
non-exercises group	77.04±16.38	76.68±23.40	–0.31	0.753

* $p < 0.05$.

nificant. The results of pain levels in both study groups over the past 7 days are shown in Table 6.

Subjects in the experimental group rated the functional status of their hand better than those in the non-exercise group, a statistically significant difference. In contrast, lower symptom severity in the second and third measurements than before the exercise program was declared by subjects in both groups, with the change being higher in the experimental group. Table 7 shows the results of measurements of the functional status of the hand and the severity of symptoms in both study groups.

DISCUSSION

Results of the study confirmed that developed program of exercises is effective in prevention for hand and wrist pain among office workers with symptoms of CTS. Improvements were shown in both muscle strength and grip tests, as well as in the subjects' functional status. To evaluate the effectiveness of the exercise program, tools commonly used in the diagnosis of median nerve compression neuropathy were used [14]. An analysis of pain levels was included, using subjective assessment on VAS [15]. Respondents assessed the level of pain they experienced in the 7 days preceding the survey. In addition, the *Boston Carpal Tunnel Questionnaire* was completed as a basis for assessing functional capacity, when evaluating changes due to therapy or progression of ailments [16]. Functional assessment using the above questionnaire, was performed 3 times before, during and after the 2-month exercise program. Hand grip strength and pincer grip strength measurements were used as an objective tool [17]. In addition, measurements of the maximum force moments in the upper limb joints and the range of motion of the hand joints were carried out using the Biodex Multi-Joint System. Muscle force moments were measured under isometric conditions.

Table 5. Maximum moments of muscle forces in the distal joints of the upper limbs among the office workers reporting complaints of hand and wrist pain, tested at the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland, 2021

Parameter	Measurement		Z	p
	before the exercises	after the exercises		
Supination [Nm] (M±SD)				
right forearm				
exercises group	3.78±2.32	4.03±2.56	–1.23	0.220
non-exercises group	4.18±2.27	4.60±2.36	–0.52	0.600
left forearm				
exercises group	3.06±2.13	3.33±2.41	–0.98	0.327
non-exercises group	3.34±2.43	3.06±2.85	–0.67	0.505
Pronation [Nm] (M±SD)				
right forearm				
exercises group	5.26±2.37	6.13±2.70	–3.48	0.001*
non-exercises group	6.11±2.65	6.38±2.28	–1.01	0.311
left forearm				
exercises group	5.11±2.18	6.26±2.57	–4.42	0.001*
non-exercises group	5.61±1.79	5.97±2.01	–0.94	0.345
Extension [Nm] (M±SD)				
right hand				
exercises group	6.09±2.90	7.09±2.94	–3.14	0.002*
non-exercises group	8.02±3.69	8.03±2.59	–0.59	0.552
left hand				
exercises group	5.86±2.65	6.49±2.59	–2.31	0.021*
non-exercises group	6.99±3.17	7.02±3.33	0.00	1.00
Flexion [Nm] (M±SD)				
right hand				
exercises group	10.84±4.44	12.92±4.92	–4.07	0.001*
non-exercises group	13.60±4.97	13.40±4.97	–0.35	0.727
left hand				
exercises group	11.04±4.77	12.83±5.05	–3.93	0.001*
non-exercises group	14.95±5.99	13.71±6.06	–1.64	0.101

* $p < 0.05$.

The study reports that grip strength decreases in patients diagnosed with CTS compared to those without neuropathy. The median nerve innervates the flexor muscles of the fingers and wrist, passing through the carpal tunnel. It is responsible for the motor innervation of the muscles and the sensation of the first 3 fingers, which is what makes it possible to perform a proper hand grip and pincer grasp with the fingers [18–21].

All of the subjects had office jobs, in which they perform manual activities in a sitting position. Occupational

Table 6. The level of pain experienced in the last 7 days by the office workers reporting complaints of hand and wrist pain, tested at the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland, 2021

Study group	Pain level (M±SD)		t	p
	measurement before the exercises	measurement after the exercises		
Exercises group (N = 49)	49.36±19.73	48.48±17.33	0.22	0.830
Non-exercises group (N = 13)	53.00±8.87	38.75±25.62	1.70	0.188

Table 7. Results of functional status assessment of the hand and severity of carpal tunnel syndrome (CTS) complaints among the office workers reporting complaints of hand and wrist pain, tested at the Biomechanics Laboratory of Central Institute for Labor Protection – National Research Institute, Warsaw, Poland, 2021

Variable	Measurement			χ^2	p
	first	second	third		
Hand functional status (M±SD)					
exercises group	1.84±0.74	1.65±0.80	1.64±0.80	9.68	0.008*
non-exercises group	1.74±0.96	1.57±0.51	1.42±0.58	5.10	0.078
Severity of CTS complaints (M±SD)					
exercises group	2.13±0.69	1.85±0.80	1.79±0.75	26.68	0.001*
non-exercises group	1.73±0.55	1.73±0.54	1.48±0.47	13.15	0.001*

* $p < 0.05$.

risk factors influence the occurrence of upper extremity complaints, according to the study. Problems with compression neuropathy are more common in occupational groups exposed to repetitive flexion and extension movements of the hand [6,18], which occurs with inadequate, or prolonged use of computer equipment. In the study group, 79% of people spend >6 h at work in a sitting position. When using a keyboard and mouse, as many as 48.4% of respondents keep their hands in a position where the hands are below or above the forearms, resulting in excessive palmar or dorsal flexion. Prolonged mouse handling may be a factor in increasing the risk of upper extremity musculoskeletal disorders [9,22,23]. Studies show that physical activity has a preventive effect and reduces the risk of musculoskeletal complaints [24]. Studies show that regular exercise has a measurable effect in terms of improving muscle strength and improving the functional ability of the hands, despite the lack of significant differences in pain levels. This indicates that physical activity should be one of the main methods of counteracting pain associated with office work. On the other hand, physical exercise alone for advanced conditions and worsening complaints in diagnosed carpal tunnel may not be sufficient.

The topic of prevention of hand and wrist pain is often addressed due to the fact that CTS is the most common compression neuropathy of the upper limb [1,5]. Meta-analyses of the effectiveness of using different therapeutic strategies are inconclusive. Most studies tend to conclude that the most promising results are obtained when interventions are mixed and implemented at different levels [25,26]. A multifactorial intervention including exercise, massage, education and ergonomic guidelines appears to be the best workplace strategy of preventing musculoskeletal disorders [27]. In addition, the important impact of working with a therapist is often emphasized by researchers. Stand-alone exercises may not be as effective as working with a therapist. For a condition as specific as compression neuropathy, exercise alone may not be effective. Despite the fact that mobilization and stretching exercises have been proven to help improve the mobility of the median nerve, thus improving the transmission of nerve impulses, and the use of so-called gliding exercises leads to the stretching of soft tissue adhesions in the carpal tunnel, their effectiveness compared to working with a physiotherapist combined with manual therapy has less significant effects [28]. In contrast, for those with mild to moderate symptoms of CTS, it appears that the use of stretching exercises to mobilize upper limb structures may be a simple and effective method used as a preventive measure for those at risk of developing compression neuropathy [29,30].

Value and limitations of the study

One of the strengths of the study was develop the effective home and easy to do program of exercises for prevention CTS in early stage symptoms. Moreover the gained improvement in symptoms was a long-term effects what was assessed in follow up by functional status assessment of the hand and severity of CTS complaints. It is also worthy to highlight that prior to the start of the exercise program, exercise instruction by a professional (physiotherapist) was provided to ensure that the exercises were performed correctly. However, some limitations should be considered; First, the study groups was not equal. Second, there were no a priori sample size calculation perform before the study because lack of input data for estimation. Third, there weren't control variables for control the dependent variable, there were only, apart from recommending to keep a current lifestyle in both cases. However, the mentioned limitations do not detract from the value of the presented publication.

CONCLUSIONS

– The results of the study indicate that performing a preventive exercise program regularly, min. 3 times/week, has an effect on increasing forearm muscle strength in a group of office workers.
– Office workers with symptoms of CTS who exercised regularly had higher results in squeeze strength and pincer grip strength.
– Exercises performed for 2 months improve functional status, while they do not affect the level of pain complaints, which may indicate a more complex etiology of pain perception in this study group.

Author contributions

Research concept: Patrycja Łach, Anna Katarzyna Cygańska
Research methodology: Patrycja Łach, Anna Katarzyna Cygańska
Collecting material: Patrycja Łach, Anna Katarzyna Cygańska
Statistical analysis: Patrycja Łach, Anna Katarzyna Cygańska
Interpretation of results: Patrycja Łach, Anna Katarzyna Cygańska
References: Patrycja Łach, Anna Katarzyna Cygańska

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