The effect of different physiotherapy programs on the head and neck region's functional state and quality of life in women working sedentary job

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Received 16 May 2026; accepted 30 June 2026; published online 30 June 2026
DOI https://doi.org/10.21595/chs.2026.26757

Abstract. The purpose of this research was to evaluate the effect of different physiotherapy programs on the head and neck region's functional state and quality of life in women working sedentary jobs, using both – patient-reported and objective measurements. Participants. The study involved 41 women working sedentary jobs, with mean age of 53,6 (±9,1) years. Participants were randomly divided into two groups, with each group receiving a different physiotherapy program. Methodology. The following patient-reported measurements were administered in the study: Numeric Rating Scale, Neck Disability Index, Tampa Scale of Kinesiophobia and SF-36 questionnaire for quality of life. Head and neck posture in the sagittal plane was assessed by measuring the craniovertebral angle using the "Apecs" mobile app. A pressure-measuring device with feedback was used to evaluate deep neck flexor strength. Cervical spine range of motion was measured with an inclinometer, movement control was assessed through performance tests. Both physiotherapy programs were performed 10 weeks. The main part of each physiotherapy program included soft tissue mobilization, mobility, stability, strengthening exercises. Participants of the first group additionally performed post isometric relaxation-based exercises, participants of the second group - stretching exercises for head and neck region. Conclusions. Both physiotherapy programs produced beneficial effects. Improvements were observed across multiple outcome measures, including pain intensity, neck disability, quality of life, cervical spine range of motion, deep cervical flexor muscle strength, and motor control of the head and neck region. Physiotherapy program with post-isometric relaxation demonstrated some advantages for pain reduction and cervical spine range of motion.

Keywords: sedentary work, women, posture, head and neck region, functional state, quality of life, physiotherapy.

1. Introduction

More and more workplaces are computerized these days and even the free time is spent doing sedentary activities. Long working hours, poor workplace ergonomics, prolonged static position and lack of breaks affects workers musculoskeletal system [1]. Therefore, sedentary jobs lead to musculoskeletal disorders, especially affecting head and neck region. This often occurs because of small repetitive movements and prolonged static position, when muscles have to hold body in the upright position without possibility to relax. Up to 42 percent office workers experience non-specific pain in the head and neck region [1]. Non-specific neck pain is defined as non-specific mechanical pain or pain related to soft tissues (after excluding pathologies, neurological disorders, tumors, infections, fractures, etc.). It is more common in women working sedentary jobs than in men [2].

When evaluating the head and neck region in sedentary job workers, posture impairments, reduced range of motion, and changes in muscle activation are often observed. The superficial neck muscles become increasingly active while the deep neck flexor muscles become weaker. Delayed activation, increased muscle fatigue, and co-contraction is observed [3]. Structural and

 ISSN PRINT 2538-7995, ISSN ONLINE 2538-8002

functional changes in both the deep and superficial neck muscles can alter muscle spindle activity, leading to changes in afferent input and resulting proprioceptive impairment. Pain in the cervical region affects the nervous system, which may further modify muscle spindle sensitivity and the neural response to afferent information. It leads to lack of movement control [4]. Those changes in sedentary workers head and neck region increase perceived discomfort and pain, by contributing to the occurrence of kinesiophobia, and can negatively affect quality of life [5, 6].

Objective measures helps to evaluate how patient's condition is changing through the treatment process, also to observe and evaluate change of clinical tests results. But additionally, it is also important to pay attention to patient-reported symptoms intensity and life quality while experiencing some discomfort or pain. Understanding patient-reported outcome measures helps in setting realistic goals, influences clinical decision-making, and provides information about treatment responsiveness [7].

It is known that physiotherapy can help reduce discomfort and pain. These symptoms in the neck and head region usually recur, so exercise therapy can reduce the pain and the risk of symptom recurrence by up to 52 percent [8]. Physiotherapy programs designed for the treatment of biomechanical pain include posture correction, mobility exercises, muscle strength and endurance training, movement control exercises, and soft-tissue rolling. The exercises are performed not only in the head and neck region but are applied using a comprehensive approach, taking into account movements of the entire spine and the function of surrounding regions [3, 9]. Due to the previously mentioned changes in muscle activation and length, the range of motion in the head and neck region decreases, which in turn limits functional movements, so stretching exercises are usually included into physiotherapy programs. Post-isometric relaxation is another effective method used to restore range of motion and reduce symptoms. In this technique, a muscle with increased tone is contracted isometrically, followed by gentle stretching to promote relaxation. The isometric contraction stimulates muscle and tendon mechanoreceptors and involves both peripheral and central modulation mechanisms, including activation of gray matter in the midbrain, as well as central nervous system mechanisms that inhibit pain signal transmission in the spinal cord. This reduces the sensation of pain and makes muscle stretching more tolerable. The application of post-isometric relaxation helps release shortened and hypertonic muscles through a neurophysiological mechanism by activating the Golgi tendon reflex, which stimulates alpha motor neurons and leads to reflex muscle relaxation. This muscle energy technique also increases hypoalgesia and improves fluid drainage. Post-isometric relaxation desensitizes peripheral nociceptors and reduces the release of pro-inflammatory cytokines [10, 11].

The purpose of this research was to evaluate the effect of different physiotherapy programs on the functional state of the head and neck region and quality of life in women working sedentary jobs, using both – patient-reported and objective measurements.

2. Participants

The study involved 41 women working sedentary jobs, with mean age of 53,6 (±9,1) years. Prior to the enrollment, all subjects were informed about the objectives of the study and provided written informed consent. The study was performed in accordance with the 1964 Helsinki declaration, its later amendments and adhered to all applicable laws and ethics standards.

Participants' inclusion criteria: young and middle-aged women (25-65 years), engaged in sedentary work for at least four hours a day, five days a week, for at least four years; not engaged in professional sports; not pregnant; not experiencing dizziness or acute pain; without history of cervical spine injuries or surgeries, inflammatory processes in the cervical spine or upper extremities, cervical intervertebral disc herniation.

Participants were randomly assigned to two groups, each group receiving a different physiotherapy program. The content of physiotherapy programs is described in 2.3 section. To minimize potential confounding effects, participants were asked to refrain from engaging in any additional therapeutic interventions during the research period. Data of participants who missed

three physiotherapy sessions in a row or four sessions in total were withdrawn from the further analysis.

3. Methods

3.1. Patient-reported measurements

Pain and discomfort were evaluated with Numeric Pain Rating Scale. The participants were asked to indicate their perceived pain level by describing its intensity expressed in numbers: from 0 (no pain at all) to 10 (unbearable pain).

For determination of neck disability participants were asked to complete Neck Disability Index (NDI) questionnaire. NDI has good to excellent internal consistency and moderate to excellent test-retest reliability [12]. NDI is a self-reported questionnaire used to assess the impact of neck pain on daily functioning, including personal care, lifting, reading, work, driving, sleeping, recreation, and concentration. Each of ten items was scored on a scale from 0 to 5, where higher scores indicate greater disability [13].

Kinesiophobia was evaluated with Tampa Scale of Kinesiophobia (TSK). The scale comprising 17 items, assigns a grade on a scale of 1-4 points, where 1 point represents strong disagreement; 2 point - disagreement; 3 points - agreement; and 4 points - strong agreement. The TSK score ranges from 17 to 68 points, with a TSK score of ≥ 37 points indicating kinesiophobia [14]. The TSK is established to be valid, reliable, and responsive [15, 16].

Participants quality of life was measured using Short Form Quality of Life Questionnaire (SF-36). This questionnaire consists of 36 items and 8 scales, including physical function, physical role, body pain, general health, vitality, social behavior, emotional role, and mental health [17]. The total score ranges from 0 to 100, with increasing score corresponding to more favorable health status.

3.2. Objective measurements

Peculiarities of sagittal plane head and neck posture was assessed interpreting the results of craniovertebral angle (CVA). Since measuring this angle while standing is more accurate than measuring it while sitting, the participant was asked to stand against the wall, facing sideways toward the examiner. Marker points were placed on the participant's body at the level of the seventh cervical vertebra (C7) and the tragus of the ear. The mobile phone was positioned 1.5 m away from the subject, at the level of the participant's acromion. The participant was asked to stand barefoot in relaxed position, and look forward. A photograph was taken using the "Apecs" mobile app, and the angle of forward head and neck tilt was calculated. CVA was measured as the angle between an imaginary line extended from C7 through the tragus, and the horizontal line [17]. A head and neck posture was considered non-optimal when the CVA was less than 53 degrees. CVA has good intra-rater reliability (ICC ≥ 0.85) [18].

The strength of the deep neck flexor muscles was evaluated using a pressure biofeedback device (Stabilizer pressure biofeedback, Chattanooga). Measurements were performed according to device manual following the standard measurement procedures.

Cervical spine ranges of movement (e.g. head and neck flexion and extension, lateral flexion to the right and left, rotation to the right and left) were measured with an inclinometer (Baseline Bubble Inclinometer, Fabrication Enterprises Inc.) according to device manual following the standard measurement procedures.

Movement control was assessed by having the participants perform movements of the head and neck region: flexion and extension of the upper cervical spine, flexion and extension of the lower cervical spine, rotation, and lateral flexion on both sides. All participants received identical verbal instructions. During the performance tests, participants were not allowed to see their own reflection. After performing a movement and taking compensations into account, it was rated as

performed correctly or incorrectly (positive/negative). The more positively were evaluated movements, the better was the movement control. The maximum possible score was 9 points. These performance tests are characterized as having good-to-high reliability [19].

3.3. Physiotherapy programs

Both physiotherapy programs lasted for ten weeks. Each program was performed twice a week and the session lasted for 55 minutes. The core components of each physiotherapy program included different type exercises with the aim to increase stability, mobility and strength and also soft tissue mobilization. Post isometric relaxation-based exercises were added to the program performed by participants of the first group (PIRE) ($n = 22$) and stretching exercises for the head and neck region were included in the program performed by participants of the second group (SE) ($n = 19$).

3.4. Data analysis

Data statistical analysis was conducted using IBM SPSS Statistics version 30.0.0. Differences between two paired groups were assessed with the nonparametric Wilcoxon signed-rank test, while comparisons between two independent groups were performed using the nonparametric Mann-Whitney U test. Results are reported as median values together with their range (minimum-maximum). For nominal data, differences between paired samples were evaluated using McNemar's test. For the analysis of qualitative characteristics, the χ^2 test was used; when the number of cases was small, Fisher's exact test was used. The difference was considered statistically significant when $p < 0.05$.

4. Results

The median age of participants in the PIRE group was 52.5 (30; 65) years, while in the SE group it was 60 (42; 65) years. The median duration of sedentary work experience was 25 (10; 40) years in the PIRE group and 30 (15; 41) years in the SE group. No significant differences between the groups were found with regard to either age ($U = 135.5$, $p = 0.053$) or duration of sedentary work experience ($U = 141$, $p = 0.075$).

During the study, a comparison between first and second evaluation was made by including objective measurement data and self-reported indicators.

After physiotherapy significant changes within the groups were observed in the following sections of the SF-36 questionnaire: energy, emotional well-being, pain, and general health. However, no significant differences were found when comparing the results between the groups (Table 1).

Following the physiotherapy intervention programs, no significant differences in kinesiophobia were observed either within the groups or between the groups.

The results of the Neck Disability Index showed significant changes between the first and second assessments in each group, although difference between the groups was insignificant.

Participants also evaluated the pain and discomfort experienced in the neck region. Analysis of the results showed that pain decreased significantly after the intervention programs in both groups. Additionally, it was observed that the improvement was greater in the PIRE group.

When evaluating the objective measurement results, it was found that the strength of the deep cervical flexor muscles improved in both groups, with no significant differences observed between the groups after physical therapy programs were applied (Table 2). Movement control also improved following the intervention programs, although difference between groups was insignificant. Assessment of the craniovertebral angle (CVA) showed no significant changes in either group after the intervention programs, also no significant differences between the groups were identified.

Table 1. Results of self-reported variables

	Group	Md (min; max), score before	Md (min; max), score after	Value of the statistical test (Z) and significance level (p)	Difference between groups before PT programs	Difference between groups after PT programs
SF-36 short form questionnaire						
Physical functioning	PIRE	87.5(70;100)	95(50;100)	$Z = –1.096$, $p = 0.291$	$U = 153.5$ $p = 0.145$	$U = 152.5$ $p = 0.134$
	SE	75(60;100)	82(60;100)	$Z = –1.196$, $p = 0.249$		
Role functioning (physical)	PIRE	100(25;100)	100(25;100)	$Z = –1.633$, $p = 0.250$	$U = 188$ $p = 0.501$	$U = 186.5$ $p = 0.445$
	SE	100(0;100)	100(0;100)	$Z = –1.89$, $p = 0.125$		
Role functioning (emotional)	PIRE	100(25;100)	100(66.7;100)	$Z = –1.841$, $p = 0.125$	$U = 196.5$ $p = 0.702$	$U = 176.5$ $p = 0.234$
	SE	100(33,3;100)	100(33.3;100)	$Z = –0.447$, $p = 1$		
Energy	PIRE	62.5(25;100)	70(40;90)	$Z = –2.885$, $p = 0.003$*	$U = 184.5$ $p = 0.528$	$U = 183.5$ $p = 0.511$
	SE	60(15;90)	70 (30;90)	$Z = –3.204$, $p < 0.001$*		
Emotional well-being	PIRE	72(52;100)	76(56;100)	$Z = –3.204$, $p <0.001$*	$U = 192.5$ $p = 0.672$	$U = 183.5$ $p = 0.511$
	SE	72(24;88)	80 (32;88)	$Z = –2.462$, $p = 0.012$*		
Social functioning	PIRE	87.5(50;100)	98.75(50;100)	$Z = –1.857$, $p = 0.125$	$U = 195$ $p = 0.703$	$U = 207$ $p = 0.965$
	SE	87.5(50;100)	100 (50;100)	$Z = –2.06$, $p = 0.063$		
Pain	PIRE	77.5(0;100)	80(0;100)	$Z = –2.579$, $p = 0.008$*	$U = 192$ $p = 0.662$	$U = 201$ $p = 0.848$
	SE	77.5(35;100)	90 (45;100)	$Z = –2.285$, $p = 0.020$*		
General health	PIRE	65(40;95)	72.5(40;85)	$Z = –2.225$, $p = 0.026$*	$U = 141$ $p = 0.075$	$U = 185.5$ $p = 0.544$
	SE	55(20;90)	70 (20;100)	$Z = –2.68$, $p = 0.005$*		
Health change	PIRE	50 (25;100)	50 (50;100)	$Z = –1.342$, $p = 0.375$	$U = 154.5$ $p = 0.126$	$U = 173$ $p = 0.324$
	SE	50 (25;100)	50 (25;100)	$Z = –0.97$, $p = 0.406$		
Tampa scale of kinesiophobia (TSK)						
Kinesio-phobia	PIRE	33.5(17; 42)	32(17;39)	$Z = –0.994$, $p = 0.328$	$U = 172.5$ $p = 0.345$	$U = 187$ $p = 0.572$
	SE	35(20;42)	33(17;41)	$Z = –1.018$, $p = 0.329$		
Neck disability index (NDI)						
Neck disability	PIRE	4(0;13)	2 (0; 12)	$Z = –2.717$, $p = 0.004$*	$U = 145$ $p = 0.094$	$U = 157.5$ $p = 0.179$
	SE	6(1; 25)	4 (0; 15)	$Z = –2.963$, $p = 0.001$*		
Numeric rating scale						
Pain and discomfort	PIRE	6 (2;9)	2 (0;5)	$Z = –3.855$, $p < 0.001$*	$U = 124.5$ $p = 0.367$	$U = 90$ $p = 0.037$*
	SE	5.5 (2;8)	4.5 (0;7)	$Z = –3.165$, $p < 0.001$*		

Table 2. Results of craniovertebral angle, deep flexors strength and movement control

	Group	Md (min; max), before	Md (min; max), after	Value of the statistical test (Z) and significance level (p)	Difference between groups before PT programs	Difference between groups after PT programs
CVA, degrees	PIRE	55(43;65)	55(42; 65)	$Z = –1.698$, $p = 0.119$	$U = 162$ $p = 0.222$	$U = 164$ $p = 0.242$
	SE	53(45;60)	53(44;60)	$Z = –0.914$, $p = 0.441$		
Deep neck flexors strength, mmHg	PIRE	26(22;30)	28(24;30)	$Z = –2.859$, $p = 0.002$*	$U = 188$ $p = 0.589$	$U = 178,5$ $p = 0.403$
	SE	28(22;30)	30(24;30)	$Z = –3.217$, $p < 0.001$*		
Movement control, score	PIRE	6(4;9)	8(5;9)	$Z = –3.8$, $p < 0.001$*	$U = 185$ $p = 0 .527$	$U = 197$ $p = 0.750$
	SE	6(3;9)	8(5;9)	$Z = –3.359$, $p < 0.001$*		

The range of motion of the head and neck region was assessed comparing the number of cases meeting the normal range for head and neck movement recorded during the first and second

assessment. Following the physiotherapy program, the number of cases meeting the normal range of neck flexion and lateral flexion increased significantly in the PIRE group, whereas the change in the SE group was not statistically significant. Results of head and neck range of movement are provided in Table 3.

Table 3. Results of head and neck range of movement

	Group	Before PT program, percent	After PT program, percent	Value significance level (p)	Difference between groups before PT programs	Difference between groups after PT programs
Flexion	PIRE	18.4	40.9	$p < 0.001$*	$p = 1$	$p = 0.746$
	SE	21.1	31.6	$p = 0.5$		
Extension	PIRE	22.7	31.8	$p = 0.727$	$p = 0.703$	$p = 0.744$
	SE	15.8	26.3	$p = 0.5$		
Lateral flexion (right)	PIRE	36.4	63.4	$p = 0.031$*	$p = 0.075$	$p = 0.028$*
	SE	10.5	26.3	$p = 0.125$		
Lateral flexion (left)	PIRE	50	77.3	$p = 0.031$*	$p = 0.342$	$p = 0.029$*
	SE	31.6	42.1	$p = 0.5$		
Rotation (right)	PIRE	22.7	36.4	$p = 0.25$	$p = 1$	$p = 0.325$
	SE	21.1	21.1	$p = 1$		
Rotation (left)	PIRE	31.8	45.4	$p = 0.125$	$p = 1$	$p = 1$
	SE	31.6	42.1	$p = 0.5$		

5. Discussion

In this study we evaluated patients self-reported and objective measurements changes after applying two different physiotherapy programs. We found that most participants had only mild functional limitations according to Neck Disability Index results, but the median in pain and discomfort score was 6, with intensity ranging from 2 to 9 points. This confirms that in clinical practice it is important not only to use questionnaires but also to assess subjective symptom intensity. Sancheti and colleagues conducted a study investigating changes in neck pain following static stretching exercises and post-isometric relaxation. Analysis of the results revealed that although pain decreased with both interventions, post-isometric relaxation was more effective. The same study also evaluated changes in neck disability and found that improvement also was greater in the post-isometric relaxation group [11]. Dudonienė and colleagues conducted a study assessing the effects of different intervention programs on neck pain, functional limitations, and range of motion. One group received post-isometric relaxation, while the other underwent stretching exercises combined with electrical stimulation. Following the interventions, post-isometric relaxation was found to reduce both pain and functional limitations more significantly [20]. Similar results were obtained in our study. A decrease in discomfort and pain in the head and neck region was observed after both intervention programs; however, as in the studies mentioned above, better outcomes were achieved in the group performing exercises based on post-isometric relaxation. When evaluating changes in neck disability, although results improved in both groups, unlike the findings of the mentioned studies, no significant difference between groups was observed following the intervention programs.

The change in kinesiophobia was not statistically significant in either group, whether comparing the number of cases or the total questionnaire scores. Bordeleau and colleagues conducted a review study stating that fear of movement is not determined solely by pain - its causes are multifactorial and include physical, social, and psychological factors. The review reported that although exercise programs are the most commonly used intervention for reducing kinesiophobia, additional measures such as pain education, relaxation training, stress management, and, when necessary, pharmacological treatment are recommended [21]. Since only an exercise program was applied in our study, the absence of these additional components may

explain why no significant changes were detected.

An analysis of health-related quality of life outcomes showed improvements in the vitality, emotional well-being, pain, and general health domains in both groups. Performing exercises promotes the development of social connections, which also contributes to improvements in emotional well-being. Similar outcomes were reported in a study conducted by Salo and colleagues, which found that after completing an exercise program, individuals experiencing chronic neck pain demonstrated improvements in physical and emotional well-being, social functioning, pain outcomes, and assessments of general health [22].

Lee and colleagues investigated the effects of exercises designed to improve head and neck posture on forward head posture [23]. Similar to our findings, no change in the forward head angle was observed following the exercise program. Different results were reported by Mylonas and colleagues, where one group received soft tissue mobilization and the other performed exercises targeting the head and neck region. A reduction in forward head posture angle was observed in both groups, but the outcomes were better among participants who performed the exercises [24]. Analysis of the literature suggests that the effects of intervention programs on posture vary, and posture improvement is not always achieved. Head and neck posture may be influenced not only by muscle length changes or muscular imbalance but also by factors such as congenital posture, degenerative changes, and the posture of other body regions [25].

Similar to our findings, Boucaut and colleagues reported improvements in deep cervical flexor muscle strength following physical exercise interventions [26]. Unlike the programs used in our study, their intervention involved exercises performed with a pressure biofeedback device; nevertheless, the results were consistent, as deep cervical flexor muscle strength improved. In our study, improvement in deep cervical flexor muscle strength was also observed in both groups. This suggests that, when exercises are performed correctly, it is possible to increase strength without the use of additional equipment.

Kim and colleagues conducted a study in which one group performed exercises aimed at improving shoulder and scapular stability, while the other group performed cervical and thoracic strengthening exercises. Improvements in cervical flexion, extension, and rotation ranges of motion were observed in both groups [27]. In the previously mentioned study by Dudonienė and colleagues, where one group received stretching exercises and electrical stimulation and the other underwent post-isometric relaxation, significant improvements in flexion, extension, and lateral flexion ranges of motion were found in both groups [20]. In our study, changes in range of motion were evaluated based on clinical significance. The results showed that after the intervention programs, the number of participants demonstrating optimal flexion and lateral flexion ranges increased significantly in the post-isometric relaxation exercise group but not in the stretching exercise group. Furthermore, when evaluating lateral flexion, a significant difference between groups was observed after the physiotherapy program, with better outcomes in the post-isometric relaxation group. No significant increase in the number of participants reaching normative values was found for the remaining neck movement range of motion.

In a systematic review, Aman and colleagues reported that performing exercises with or without visual feedback can improve motor control [28]. The findings of our study support this statement. Based on our results, both physiotherapy programs applied in this study significantly improved movement control in the head and neck region. Throughout the study, participants were educated on how to perform the exercises correctly and were informed about the importance of maintaining movement quality both during exercise and in everyday activities

Since two physiotherapy programs were compared, the findings may be useful in clinical practice when selecting a more effective intervention approach. Based on the results, when designing physiotherapy programs for individuals with sedentary occupations, we would recommend including scapular stabilization exercises, deep cervical flexor strengthening exercises, thoracic mobility exercises, foam rolling, and stretching exercises. Exercises based on post-isometric relaxation may help reduce pain in the head and neck region more effectively. In addition, compared with conventional stretching exercises, they may produce better outcomes in

improving cervical flexion and lateral flexion range of motion.

The strength of the study was the attempt to evaluate changes in functional status and quality of life, analyzing not only changes in the measured outcomes but also their clinical relevance, while paying attention to patient-reported symptoms change. Therefore, range of motion assessments were interpreted based on clinically meaningful criteria, including the possibility of measurement error. Another strength of the study was that the intervention programs were supervised, ensuring correct exercise performance and regular attendance. The main limitations of this study are the relatively small sample size and the exclusive enrollment of female participants. In addition, it was not possible to ensure compliance with workplace ergonomic recommendations, which may have influenced the observed changes in outcomes.

6. Conclusions

Both physiotherapy programs produced beneficial effects in women working sedentary jobs. Improvements were observed across multiple outcome measures, including pain intensity, neck disability, quality of life, cervical spine range of motion, deep cervical flexor muscle strength, and motor control of the head and neck region. Physiotherapy program with post-isometric relaxation demonstrated some advantages for pain reduction and cervical spine range of motion.

Acknowledgements

The authors have not disclosed any funding.

Data availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Author contributions

Gabija Zemeliauskaitė: conceptualization, methodology, investigation, data curation, data analysis, validation, original draft preparation, review and editing. Ernesta Gurskienė: data analysis, original draft review and editing, visualization. Vilma Tamulionytė: conceptualization, methodology, original draft review and editing, supervision, project administration.

Conflict of interest

The authors declare that they have no conflict of interest.

Ethics statement

Prior to the enrollment, all subjects were informed about the objectives of the study and provided written informed consent. This study was performed in accordance with the 1964 Helsinki declaration, its later amendments and adhered to all applicable laws and ethics standards.

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