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A Comparative Study on the Effect of Kendal Exercise and McKenzie Exercise in Forward Shoulder Posture among College Students

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SUMMARY

Background. The term forward shoulder or rounded shoulder posture describes a position in which the acromion extends ahead of the line of gravity, the shoulder extends, the spine rotates downward, and the anterior tilts. Prolonged sitting is usually a problem for long-term mobile users. It results in pectoralis minor shortening. The objective is to compare the effect of Kendal exercise and McKenzie exercise on forward shoulder posture among college students.

Methods. Using the Angulus app and the craniovertebral angle, about 60 participants were chosen according to selection criteria. Before the study started, all of the subjects provided written informed consent. Before providing their informed consent, every subject was briefed about the experimental methodology and procedures. These sixty individuals were divided into two groups. There were thirty people in each of the two workout groups, Kendal and McKenzie.

Results. The Pre-test and Post-test values were analyzed results suggest that Kendal exercise and McKenzie exercise group have significant improvement.

Conclusions. This study found that the McKenzie exercise is a more effective way to help college students reduce their forward head and forward shoulder posture.

KEY WORDS

Forward shoulder posture; craniovertebral angle; Kendal exercise; McKenzie exercise.

INTRODUCTION

Forward shoulder posture, also known as kyphosis, is a postural dysfunction characterized by the shoulders rounding forward and inward. This creates an imbalance in the muscles surrounding the shoulder joint, leading to potential pain and discomfort (1). One of the most prevalent deformities, accounting for 60% of shoulder anomalies, is the forward shoulder posture. Reduced physical activity and bad postural patterns in daily life might cause the skeletal and muscular components to revert to their natural shapes (2). Numerous illnesses involving dysfunction of the cervical spine, nerve, or soft tissue can cause pain in the neck and shoulders. which has a negative impact on people's health and standard of living (3).

Multiple structures interact to allow the shoulder to move in different directions. These structures respond to mechanical stimuli and change their position accordingly, due to the mismatch between the glenoid and proximal humerus' articulating surfaces (4). The head makes up six percent of the body weight, and it is connected via a number of muscles to the cervical spine, the other joints, and the kinematic chain. A prolonged position kept with the cervical spine extended can cause changes in head posture, which can result in forward head posture, a negative posture that is regarded as deviating from neutral or good posture (5).

Forward head posture also reduces cervical spine proprioception. According to this study, 85.5% of people had forward head posture and there was a substantial correla-

tion between forward head posture. Even severe pain related to forward head posture is caused by poor posture when using a computer. While bad posture can lead to discomfort and deformity, forward head posture hasn't traditionally been linked to neck problems (7).

The forward shoulder posture is linked to variations in scapular alignment and location in the frontal and sagittal planes among other posture abnormalities. Abnormal scapular position is the result of prolonged slumped posture. The scapula offers proximal stability for the functional activity of the limbs (11). The shoulder joint has a considerable deal of movement, but stability is sacrificed in the process (9). Shoulder pain is thought to emerge as a result of changes in scapular kinematics and muscle activation brought on by a forward head and rounded shoulder position. The existence of shoulder pain obscures observed differences in the scapular kinematics and muscle activation of those who have rounded shoulders and a forward head posture (10).

A complex system made up of the head, neck, and shoulders may experience one or more abnormal conditions as a result of changes in bodily processes brought on by rounded shoulders (11). The forward shoulder angle was determined by calculating the inclination angle of the line that joins C7 to the vertical reference line and the acromion. The angle at which the line connecting C7 to the tragus and vertical reference line is incline was used to compute the forward head angle (15).

Shoulder roundedness was defined as a forward shoulder angle more than or equal to 52 degrees (1, 15). The Kendall exercise corrects unstable FHP and aids in readjusting neck alignment by strengthening the deep cervical flexor and shoulder retraction muscles and stretching the pectoral muscles (1). The McKenzie exercise emphasizes extension in shoulder, which includes manipulation, range-of-motion exercises for the neck and the shoulder joint, and patient education. This encourages self-care treatment through repetition. As a self-therapeutic exercise emphasizing extension,the McKenzie method involves repeated movements. Poor posture is the most prevalent cause of neck discomfort because it strains the soft tissues and ligaments in the cervical area excessively. This results in modifications to the cervical spine's soft tissue and structure, which lessens its functionality and produces pain. McKenzie exercise therapy consists of patient education, mobilization, manipulation, and self-therapeutic exercise (6). Therefore, the study aimed to evaluate the immediate effectiveness of Kendal and McKenzie exercises for reducing forward shoulder posture and forward head posture.

MATERIALS AND METHODS

It is a comparative study done with 60 subjects with forward shoulder posture, aged between 18-24 years of college students. Through convenient sampling technique both males and females were included with the Cranio-vertebral angle less than 50 degrees. This study excludes individuals with obesity (BMI > 30), history of surgery of the spine or thorax, clinical deformity of thoracic cage and spine, traumatic neck injury, severe obesity and acute or chronic neuromuscular discomfort unrelated to other body regions, diabetes, malignant tumor, any shoulder instability, fractures related to shoulder and any nerve lesion. There was no randomization and blinding was done in this study. Before the study started, all of the subjects provided written informed consent. Before providing their informed consent, every subject was briefed about the experimental methodology and procedures. These sixty individuals were divided into two groups. There were thirty people in each of the two workout groups, Kendal and McKenzie. The study was approved by an institutional scientific review board (ISRB) with the number-04/009/2023/ISRB/SR/SCPT. The study procedure was explained to all the participants and written informed consents were obtained.

Sample size

The sample size is estimated assuming 60 subjects with forward shoulder posture, aged between 18 - 24 years of college students. Total of 60 participants were allocated into 2 groups Kendal exercise group and McKenzie exercise group.

Participants

Participants for the study were selected through convenient sampling technique both males and females were included with the cranio-vertebral angle less than 50 degrees. This study excludes individuals with obesity (BMI > 30), history of surgery of the spine or thorax, clinical deformity of thoracic cage and spine, traumatic neck injury, severe obesity and acute or chronic neuromuscular discomfort unrelated to other body regions, diabetes, malignant tumor, any shoulder instability, fractures related to shoulder and any nerve lesion.

Procedure

This study has no randomization and blinding was done in this study. Before the study started, all of the subjects provided written informed consent. Before providing their informed consent, every subject was briefed about the experimental methodology and procedures. These sixty individuals were divided into two groups. There were thirty people in each of the two workout groups, Kendal and McKenzie. The study

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Kendal group

Cervical extensors stretching

The patient was instructed to sit or stand upright in a straight posture. Tuck their chin gently in towards the chest, as though they try to create a double chin. Hold for 10 seconds, then relax and repeat 10 times. Chin Tucks leads to cervical extensor stretch and they repeated this exercise for 10 repetitions per set, for 3 sets per day.

Shoulder retraction strengthening

Patients were made to lift their arms outside at elbows 90-degree angle with an elastic band that is resisted up to around shoulder level and requested to bring their shoulder blades closer to one another by pulling the band. Go back to the neural position. They repeated this exercise for 10 repetitions per set, for 3 sets per day.

Pectoralis muscle stretching

Patient was asked to stand in a doorway with the arms raised to shoulder height and elbows bent at 90 degrees, forearms resting on the doorframe and lean forward gently, keeping the back straight, until feeling a stretch in chest. They repeated this exercise for 10 repetitions per set, for 3 sets per day.

Deep cervical flexors strengthening

Patients were asked to be in supine position with their knees bent and feet flat on the surface. Instructed to pull their chin back and place hand on back of their head and actively flex the head towards the chest, remove the hand and hold the head for 10 seconds and slowly release their head to the neutral position. They repeated this exercise for 10 repetitions per set, for 3 sets per day.

McKenzie group

Head retraction with overpressure while sitting

The patients were told to sit in a chair with their feet firmly planted in the ground and their back straight. Patients instructed to keep their head in a neutral position and gently asked to tuck their chin in towards their neck. Once the patient achieved the chin tuck position made them to place their fingers in front of their chin and then they gently moved their head backwards to take their chin away from their fingers. They performed three sets of ten repetitions of this exercise each day.

Neck extension while sitting

The patients were told to sit in a chair with their feet firmly planted in the ground and their back straight. Patients instructed to tuck their chin in towards their chest and slowly tilt their head backward so they are looking up towards the ceiling. Hold it for 10 seconds and back to neutral position. They repeated this exercise for 10 repetitions per set, for 3 sets per day.

Head retraction with overpressure while lying

Patients were asked to lie on their back on a comfortable surface. Patients were instructed to tuck their chin in towards their chest to lengthen the back of their neck, performed head retraction. Placed hands on their forehead and applied gentle pressure, encouraged further retraction of the head. Hold it for 10 seconds, release the pressure and return to their neutral position. They repeated this exercise for 10 repetitions per set, for 3 sets per day.

Neck extension while lying

Patients were asked to be in prone position on a comfortable surface. The patient is told to extend their neck by tucking their chin towards their chest. Hold the chin tuck for a few seconds, feeling a stretch in the back of the neck. Slowly and gently lift the head off the surface, allowing the neck to extend backward. Lift the head only as far as is comfortable and pain-free. Hold it for 10 seconds and back to neutral position. They performed three sets of ten repetitions of this exercise each day.

Side bending of the neck while sitting

The patient was instructed to sit in a chair with their shoulders relaxed and their back straight. Keep their feet flat on the floor and their hands resting on their lap. Start with their head in a neutral position, facing forward. Take a moment to relax the neck and shoulders. Bring the right ear to the right shoulder as slowly tilt the head to the right. Keep the shoulders relaxed and avoid lifting the shoulder on the side they are bending towards and *vice versa*. Hold the stretch for 10 seconds or as long as it feels comfortable and back to neutral position. They performed three sets of ten repetitions of this exercise each day.

Neck rotation while sitting

The patient was told to take a seat and relax their shoulders and their back straight. Keep the feet flat on the floor and hands resting on the lap. Start with the head in a neutral position, facing forward. Bring the chin to the right shoulder as they slowly turn the head to the right. Keep the shoul-

ders relaxed and avoid lifting the shoulder on the side they are turning towards and *vice versa*. Slowly bring back to the neutral position. They repeated this exercise for 10 repetitions per set, for 3 sets per day.

Neck flexion with chin-in in the sitting position

Patients were asked to make head in a neutral position, facing forward. Take a moment to relax neck and shoulders. Gently tuck their chin towards the chest, lengthening the back of the neck. Keep the gaze straight ahead, and avoid tilting the head up or down. Hold the chin tuck position for a few seconds. While maintaining the chin tuck, slowly lower the head towards their chest. Feel a stretch along the back of their neck and upper spine. Lower the head only as far as it is comfortable. Slowly bring back to the neutral position. They repeated this exercise for 10 repetitions per set, for 3 sets per day.

The self-stretch exercise methods

The patients were instructed to push out their chest and place both hands on their shoulders, to place one hand over the shoulder, hold the twisted hand's elbow, and then slowly pull the head inside until it reached its full stretched position with the other hand over the head, to turn their head till it reached its maximum extension. The patient was told to look straight ahead, gently rotate their head horizontally, and come to a stop when they reached the highest possible value, to toss their head back and rotate it until it reached its maximum extension, to turn their head till it reached its maximum position, to sustain each action for 10 seconds, then take a 5 second break. Each subject performed 10 repetitions per set, for 3 sets per day.

Outcome measures

Craniovertebral angle

A popular technique for measuring forward head posture objectively is the craniovertebral angle. Unquestionably, the precision of the craniovertebral angle has a role in recognizing forward head position; therefore, determining the craniovertebral angle cut-off point is crucial to accurately diagnosing the condition. The forward head angle was defined as the inclination of the line that joins the tragus of the ear to the C7 spinous process and the vertical reference line.

Angulus app

The Angulus app is a smartphone application that helps users correct their posture and lower their chance of developing neck and back discomfort. The app uses a smartphone's accelerometer and gyroscope to track the user's movements and provide real-time feedback on their posture. It includes a variety of exercises and stretches to help users strengthen their core muscles, improve their spinal alignment, and reduce tension in their neck and shoulders. The app also provides educational resources on posture, ergonomics, and injury prevention, as well as gamification elements to make the exercises and stretches more engaging and fun. This study has used this application for measuring the forward shoulder posture angle to determine by calculating the inclination angle of the line that joins C7 to the vertical reference line and the acromion.

Data analysis

The gathered information was analyzed and examined. For each parameter, the mean and standard deviation were utilized. The pre-test scores of forward shoulder posture and forward neck posture sense were measured using Craniovertebral angle and Angulus app. Scores were obtained prior to the initiation of intervention and measured after 4 weeks of intervention and taken as post-test values. The data was tabulated and evaluated (**figures 1-5**).

RESULTS

The gathered information was tabulated and analyzed using descriptive and inferential statistics. For every parameter, the standard deviation (SD) and mean value were calculated. The paired t-test was used to examine any significant differences between the pre- and post-test measures for the same group. To investigate significant differences between two groups, the analysis was done using the unpaired t-test and the significance difference between the post-test values of both groups.

In both Kendal and McKenzie groups the individuals were assessed for forward shoulder posture using Angulus app and forward head posture using Craniovertebral angle. The mean value of Angulas app and Craniovertebral angle was increased after giving intervention in both Kendal and McKenzie group compared to the pre-test mean values. The results suggest that findings are considered to be statistically significant with P-value < 0.0001 (**table I**).

The post-test values of Angulus app and Craniovertebral angle shows that the forward shoulder posture and forward head posture was significantly improved after giving intervention in McKenzie group compared to the Kendal group. The results suggest that findings are considered to be statistically significant with P-value < 0.0001 (**table II**).

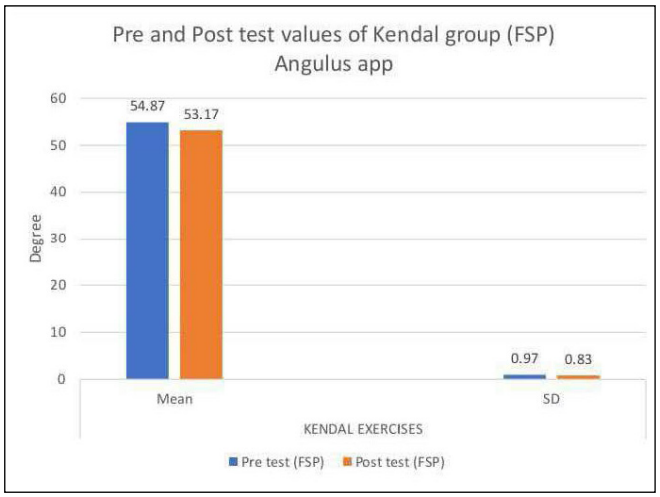


Figure 1. Comparison of Pre test and Post test values of Angulus app in Kendal group.

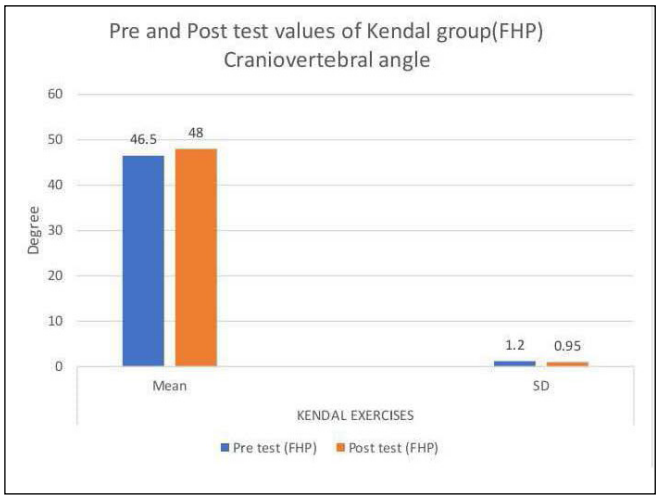


Figure 2. Comparison of Pre and Post test values of Craniovertebral angle in Kendal group.

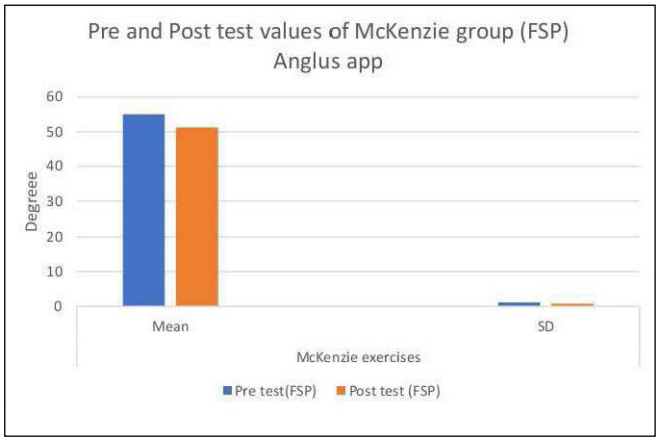


Figure 3. Comparison of Pre test and Post test values of Angulus app in McKenzie group.

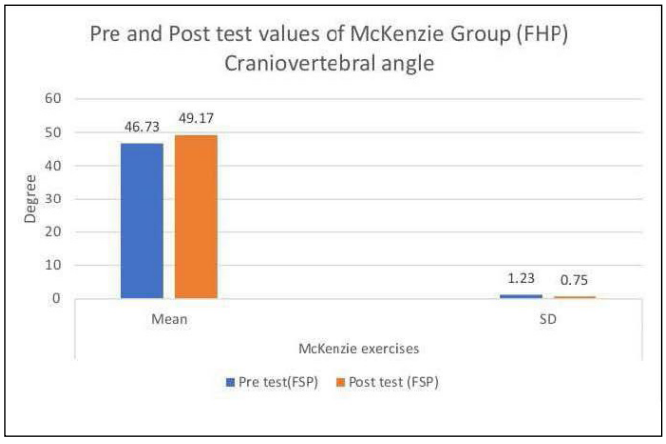


Figure 4. Comparison of Pre and Post test values of Craniovertebral angle in McKenzie group.

This demonstrates that McKenzie group received a higher score than Kendal group. Thus McKenzie group is considerably effective than Kendal Group among forward shoulder posture subjects.

DISCUSSION

According to the scapular index, despite the fact that there was a statistically significant change, there was no difference between the groups before and after the intervention across all three groups in Lee *et al.*'s study (1). A statistically significant distinction existed between self-stretch exercise group and Kendal exercise group in the post-test results. According to this outcome, Kendal exrcise group appears to be

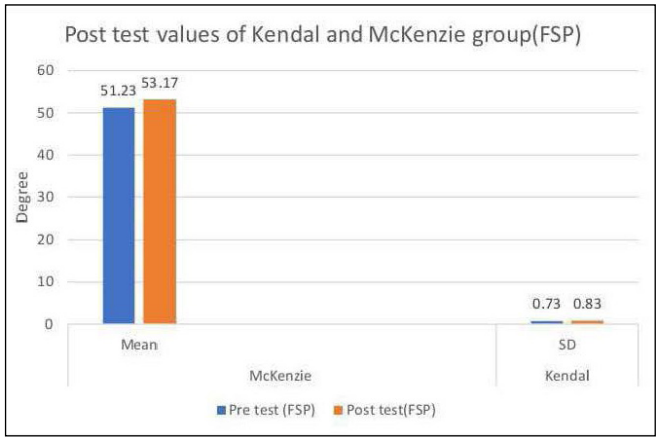


Figure 5. Comparison of Post test values of Angulus app in Kendal group and McKenzie group.

Table I. Comparison of Pre-test and Post-test values of Angulus app in Kendal group and McKenzie group.

Outcome measures	Group		Mean	SD	T-value	P-value
(FSP) Angulus app	Kendal group	Pre-test	54.87	0.97	14.2974	< 0.0001
		Post test	53.17	0.83		
	McKenzie group	Pre-test	55.03	1.10	16.7457	< 0.0001
		Post-test	51.23	0.73		
Craniovertebral angle	Kendal group	Pre-test	46.50	1.20	13.0467	< 0.0001
	McKenzie group	Post-test	48	0.95		
		Pre-test	46.73	1.23	17.2228	< 0.0001
		Post-test	49.17	0.75		

The post-test mean of Angulas app and Craniovertebral angle was increased comparing to the pre-test mean in both Kendal and McKenzie group.

Table II. Comparison of Post test values of Angulus app in Kendal Group and McKenzie Group

Outcome measures	Group		Mean	SD	T-value	P-value
(FSP) Angulus app	Kendal group	Post-test	53.17	0.83	8.8132	< 0.0001
	McKenzie group	Post-test	51.23	0.73		
Craniovertebral angle	Kendal group	Post-test	48	0.95	5.2993	< 0.0001
	McKenzie group	Post-test	49.17	0.75		

The post-test means of McKenzie using Angulus app and Craniovertebral angle was increased comparing to the post-test value of Kendal group.

more focused on shoulder retractors than self-stretch exercise group. Exercises like McKenzie and Kendall are frequently used to enhance forward head posture. Additionally, as self-stretch exercise has a comparable effect on other groups, it can recommend novel exercises for improving and rounded shoulder posture. The study by Lynch (2) used foam rollers to perform scapular protraction movements and chest muscle stretches as chin-in and chest exercises for swimming athletes, and found that these interventions had a positive impact on forward head posture and rounded shoulder posture. The Lee's study showed that, in addition to strengthening the muscles, performing stretch exercises for the chest and shoulder retraction muscles for six weeks enhanced the alignment and stability of the head, shoulder, and upper extremities. Additionally, Lee's study that used 2-week chest muscular workouts to report favorable outcomes on the craniovertebral angle and rounded shoulder posture measurements predicted that the application of stretching intervention would be crucial in the therapeutic treatment of forward head posture and rounded shoulder posture (1).

The purpose of the study of Kim *et al*. was to ascertain how the McKenzie exercise program affected pulmonary function and forward head posture. Forward head position, FVC, FVC% pred, FEV1, and FEV1%pred were all markedly improved in the McKenzie exercise group following the intervention. Although there is a limited number of participants and no extended monitoring, the results indicate that McKenzie exercise may be useful in enhancing forward head position and respiratory performance (6).

Thigpen *et al*. showed that a forward-leaning head and rounded shoulders increased scapular internal rotation during overhead reaching activities and loaded facial tasks. They also increased scapular anterior tilt and upward rotation during loaded facial tasks (10).

Stretching activities for the pectoralis muscle and resistance training exercises for the glenohumeral abductors, external rotators, scapular retractors and elevators, and three times a week for six weeks on persons in the study of Wang *et al*. who had forward head position. Yet, there were notable improvements in the patients' horizontal abductors, external rotators, and internal rotators' muscular strength (14).

The results of a 4-week shoulder stability training program included an elastic band stabilisation exercise with a pectoralis minor stretching exercise to improve balance and maximal shoulder muscle strength in individuals with rounded shoulder posture. Their equilibrium, both static and dynamic, was positively affected in the latter group. Based on exercise, the groups' maximal shoulder muscle strengths were compared, and it was shown that both the stretching and stabilizing exercise groups had significantly higher maximal shoulder muscle strengths (12).

Absence of exercise results in atrophy of the scapular muscles, weakening of the stabilizing muscles and muscles between the scapula, and abnormalities of the forward shoulder in Hajihosseini *et al.*'s study (16). As a result, this area requires adequate stretching of shortened muscles and strengthening of weaker muscles. In light of the current study's findings and the intended efficacy of improvement trainings in reducing the forward shoulder angle, we recommend that professionals and researchers implement the improvement training regimens employed in this study by adhering to the aforementioned guidelines. According to the current findings, executing the trainings in this study in particular, the combinational and comprehensive trainings is an appropriate, safe, and scientific way to correct the forward shoulder posture (2).

Aziz *et al.*'s study investigated neck and back pain in Madrassa students, a previously overlooked population. It explored the effectiveness of the McKenzie method, a self-directed approach, for managing pain in these students who may have difficulty attending traditional therapy sessions. The findings suggest that the McKenzie method can be a valuable tool for reducing pain and improving self-care awareness in this population. This could potentially help to reduce the risk of chronic musculoskeletal problems in adulthood (13).

CONCLUSIONS

According to this study, 4 weeks of Kendal group and McKenzie group had good results, but McKenzie exercises are more significantly effective in reducing forward shoulder posture, and forward head posture among college students. The Angulus app measures the forward shoulder posture and the Craniovertebral angle measures the forward head posture.

FUNDINGS

None.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

CONTRIBUTIONS

DDP: methodology, investigation, formal analysis, writing - original draft. RK: conceptualization, methodology, supervision, writing - reviewing & editing.

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CONFLICT OF INTERESTS

The authors declare that they have no conflict of interests.

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