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The Impact of smartphone addiction on forward head posture and shoulder mobility among young adults - A case control study

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Abstract
Background: Excessive smartphone use imposes physical and musculoskeletal strains, users often flex their necks and wrists for prolonged periods and repetitively use their fingers, leading to cervical spine problems, forward head posture and pain in the neck, shoulders, wrists and thumbs. Recent mechanistic evidence also suggests that near maximal head angles (>~40°) may trigger the cervical flexion-relaxation phenomenon, potentially aggravating neck issues by shifting load from active musculature to passive structures.
Aim of this study: To find the impact of smartphone addiction on forward head posture and shoulder mobility among young adults. Specifically, the study seeks to examine whether smartphone addiction is related to forward head posture and shoulder mobility.
Method: 18-25 aged 206 eligible participants who met the inclusion criteria were categorized into case and control groups of 103 each. Demographic data of participants were recorded. Outcome measures of degree of FHP, both right and left shoulder mobility with SAS scores were recorded for further data analysis. Data was analysed by student't' test and |^2 – tests Microsoft Excel for windows.
Results: Participants with high SAS scores (12.5) in case group showed significantly lower degree of FHP (15.46), right and left shoulder mobility when compared to participants in control group who have relatively lower SAS scores with p≤0.001***.
Conclusion: This study concluded that high use of smartphone (SAS) had highly statistically significant reduction
in degrees of FHP, right and left shoulder joint mobility in 18-25 years of young adults when compared to control group of young adults were using comparatively less usage of smartphones.
Keywords: Smartphone, Addiction, Forward Head Posture, Shoulder Mobility, Young Adults

INTRODUCTION:

Smartphone addiction, often described as a behavioural addiction, is increasingly recognized as a widespread issue among young adults across the globe. It manifests in the persistent and excessive use of mobile devices, often interfering with daily life activities such as studying, driving, social interactions, and even sleeps (Harwood *et al.*, 2014). Excessive smartphone use imposes physical and musculoskeletal strains, users often flex their necks and wrists for prolonged periods and repetitively use their fingers, leading to cervical spine problems, forward-head posture and pain in the neck, shoulders, wrists and thumbs (Alghadir*et al.*, 2025).

Beyond musculoskeletal issues, problematic use is associated with sleep disturbances, poorer overall health and impaired cognitive performance (Amin *et al.*, 2024). It is also linked to headaches, attention deficits and increased risk of accidents, with many users reporting reduced physical activity and neglect of responsibilities. In India, the burden of smartphone and internet use is particularly striking. According to the Internet and Mobile Association of India (IAMAI), there are currently 692 million active internet users, nearly equally distributed between rural (351 million) and urban (341 million) populations, with projections suggesting this number may rise to 900 million by 2025 (IMAI). This widespread use has both positive and negative implications. On one hand, mobile devices have been associated with benefits such as enhanced connectivity, improved family and peer relationships, and increased work efficiency (Ran *et al.*, 2006). On the other hand, research consistently highlights detrimental patterns including problematic use, dependency, and associated health issues such as anxiety, depression, sleep disturbances, and musculoskeletal discomfort (Ratan *et al.*, 2021; Elhai *et al.*, 2017; Busch *et al.*, 2021).

Sustained smartphone use drives a characteristic upper quadrant posture known as forward head posture (FHP), rounded/protracted shoulders, and prolonged cervical flexion that increases passive tissue load and active muscle demand in the neck–shoulder complex (Torkamani et al., 2023). Kinematic and EMG studies show that greater cervical flexion angles during phone viewing (often ~30–50°) elevate upper trapezius and cervical extensor fatigue and pain, with steeper flexion producing higher fatigue indices and discomfort compared with neutral head position (Babangida et al., 2025).

Longer uninterrupted bouts further amplify these effects, particularly in individuals who already present with FHP, indicating a time-dose response for trapezius/neck extensor loading and perceived pain. Field and lab observations add that lack of back or arm support (e.g., sitting without backrest, holding the phone low on the abdomen) worsens cervical alignment and increases muscular strain, whereas supported sitting yields more favourable head neck posture (Gada and Oberoi 2018).

Beyond the neck, smartphone use alters scapular and shoulder mechanics: addiction severity has been associated with scapular imbalance, lower serratus anterior activity, and higher upper/lower trapezius and anterior deltoid activity patterns consistent with increased shoulder loading during prolonged device holding; experimental work similarly reports that shoulder posture modulates neck/shoulder kinematics and muscle loading under smartphone tasks (Shinde et al., 2019). Real-world and survey data indicate that these postures are widely adopted across the day (sitting more in morning/afternoon; lying more in evening), keeping young users consistently exposed to MSD risk at high daily usage durations (Farmer J etal., 2020).

Recent mechanistic evidence also suggests that near maximal head angles (>~40°) may trigger the cervical flexion-relaxation phenomenon, potentially aggravating neck issues by shifting load from active musculature to passive structures. Collectively, reduced postural variability (static, flexed head-neck with protracted shoulders) and inadequate micro-breaks concentrate stresses on cervical discs, facet joints, and peri-scapular muscles, explaining the chronic discomfort profiles frequently reported in heavy smartphone users (Toh et al., 2017).

The main aim of the present study is to comprehensively investigate the impact of smartphone addiction on forward head posture and shoulder mobility among young adults. Specifically, the study seeks to examine whether smartphone addiction is related to forward head posture and shoulder mobility. By integrating these domains, the study aims to provide a holistic understanding of the multidimensional impact of smartphone addiction on young adults.

METHODOLOGY:

Study design: Prospective case control study.

Study setting: The study conducted at Medical Trust Institute of Medical Sciences and Research Centre, Cochin, Kerala, and at the Institute of Physiotherapy, Srinivas University, Mangalore.

Duration of study: August 2023 and January 2025

Study Population:

- Case group – Subjects with smart phone addictions
- Control group –Subjects without smart phone addictions

Sampling method: Purposive sampling

Sample size: 206, calculated by proportional method with $\alpha = 0.05$, CI = 95%, $\beta = 80\%$ (0.2) and 50% of unknown population. G-Power 3.2 version through calculator.net for windows was used for calculating the sample size.

Selection Criteria:

Inclusion criteria:

Case group

1. Participants aged 18–25 years.
2. Both male and female subjects.
3. Subjects who had been using smartphones for a minimum of 3 hours daily.
4. History of smartphone use for at least two years.
5. Participants owning a smartphone.
6. Smartphone Addiction Scale–Short Version (SAS-SV) score >31 for men and >33 for women.

Control group

1. Participants aged 18–25 years.
2. Both male and female subjects.
3. Subjects who had been using smartphones for a minimum of 3 hours daily.
4. History of smartphone use for at least two years.
5. Participants owning a smartphone.
6. Smartphone Addiction Scale–Short Version (SAS-SV) score <31 for men and <33 for women.

Exclusion criteria

Case Group

1. Subjects not willing to participate.
2. SAS-SV score <31 (men) and <33 (women).
3. Presence of any musculoskeletal or neurological disorder.
4. Presence of any other comorbidities or disabilities.
5. History of congenital heart disorders.
6. Presence of pulmonary dysfunctions (e.g., asthma, COPD).
7. History of cervical fractures, traumatic head injury, or whiplash injury.
8. Consumption of sedative drugs or alcohol within the past two days.

Control group

1. Subjects not willing to participate.
2. SAS-SV score ≥31 (men) and ≥33 (women).
3. Presence of any musculoskeletal or neurological disorder.
4. Presence of any other comorbidities or disabilities.
5. History of congenital heart disorders.
6. Presence of pulmonary dysfunctions (e.g., asthma, COPD).
7. History of cervical fractures, traumatic head injury, or whiplash injury.
8. Consumption of sedative drugs or alcohol within the past two days.

Procedure:

Undergraduate and postgraduate students from Allied Health Sciences at the Medical Trust Institute of Medical Sciences, Cochin, and the Institute of Physiotherapy, Srinivas University, Mangalore were taken as population for this study. After obtaining ethical approval from Srinivas University (Ref.No: PhD/IPT/SU/23/002), written informed consent were taken from all recruited participants. 206 eligible participants who met the inclusion criteria were categorized into case and control groups of 103 each. This study followed the Declaration of Helsinki 2013 related to human studies with ethical standards.

DATA COLLECTION & STATISTICAL ANALYSIS:

Demographic and lifestyle information, including age, gender, BMI, dominant hand, duration of smartphone use, daily hours of use, sleep duration, and smoking status, were collected using a structured data sheet.

Measured outcomes were recorded using standardized, validated protocols: Forward head posture was evaluated by photogrammetric with Kinovea software and Shoulder flexibility was tested using the shoulder reach flexibility test. All assessments were performed in a quiet, well-lit room, with the same qualified physiotherapist conducting the tests to minimize inter-rater variability. Standardized procedures for each instrument and questionnaire were followed, with prior explanation and demonstration provided to participants. Data were recorded in structured proformas and later transferred into Microsoft Excel for statistical analysis.

RESULTS:

Table 1: Age distribution of participants in case and control group:

Group	Mean	SD	Minimum	Maximum
Case	20.78	1.89	18	25
Control	20.52	1.61	18	25

Table 2: Gender distribution of participants in case and control group:

Group	Gender			
	Female		Male	
	F	%	F	%
Case	70	44.9%	33	66.0%
Control	86	55.1%	17	34.0%

Figure 1: Smart phone addiction in case and control groups

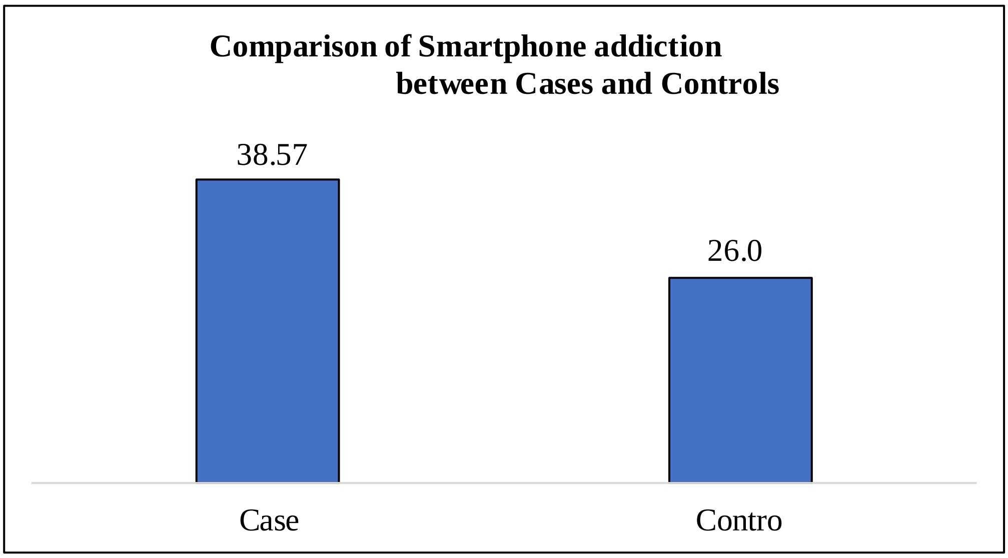

Table 3: Mean, S.D. and t-value to compare SAS between Case and Control Group. (Independent 't' test) (n=206, n=103 for each control and experimental group)

Group	Mean	S.D.	Difference in mean	*n*	*t*	*p-value*
Case	38.57	5.06	12.5	206	17.69	$p < 0.001^{***}$
Control	26.07	5.09				

Mean smart phone addiction scores in Case and Control groups respectively with mean difference of 12.5 show that the difference between mean in two groups (38.57&26.07). Since the *p-value*< 0.001***, there was a highly significant difference in SAS scores between the Case group and Control Grou

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Figure 2: Forward Head Posture using t-tests

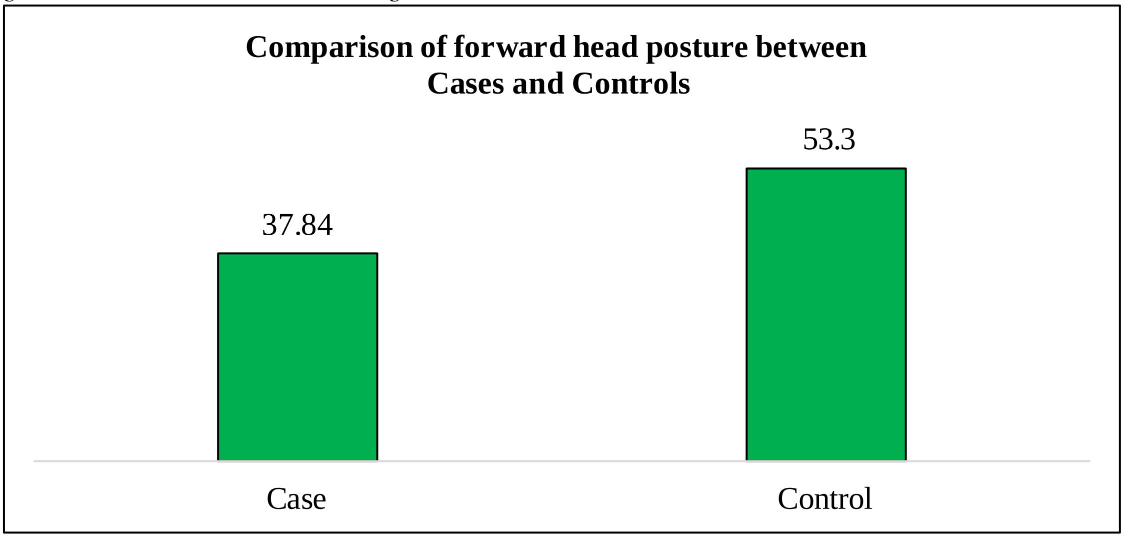

Table 4: Mean, S.D. and t-value to compare FHP between Case and Control Group (Independent 't' test) (n=206, n=103 for each control and experimental group)

Group	Mean	S.D.	Difference in mean	*n*	*t*	*p-value*
Case	37.84	7.65	15.46	206	18.67	$p < 0.001$***
Control	53.3	3.47				

Mean forward head posture scores in Case and Control show the difference of 15.46 two groups (37.84 & 53.3).Since the *p-value*< 0.001***, there is a significant difference in FHP scores between the Case group and Control Group. The mean forward head posture score in Case group was significantly low (Mean = 37.84; CVA of less than 50 is considered indicative of forward head posture) whereas in Control group is higher than 50 (Mean = 53.3). Hence we can conclude that there was significantly high number of forward head posture cases among young adults with smart phone addiction.

Figure 3: Shoulder Mobility (Right) using χ^2 – tests

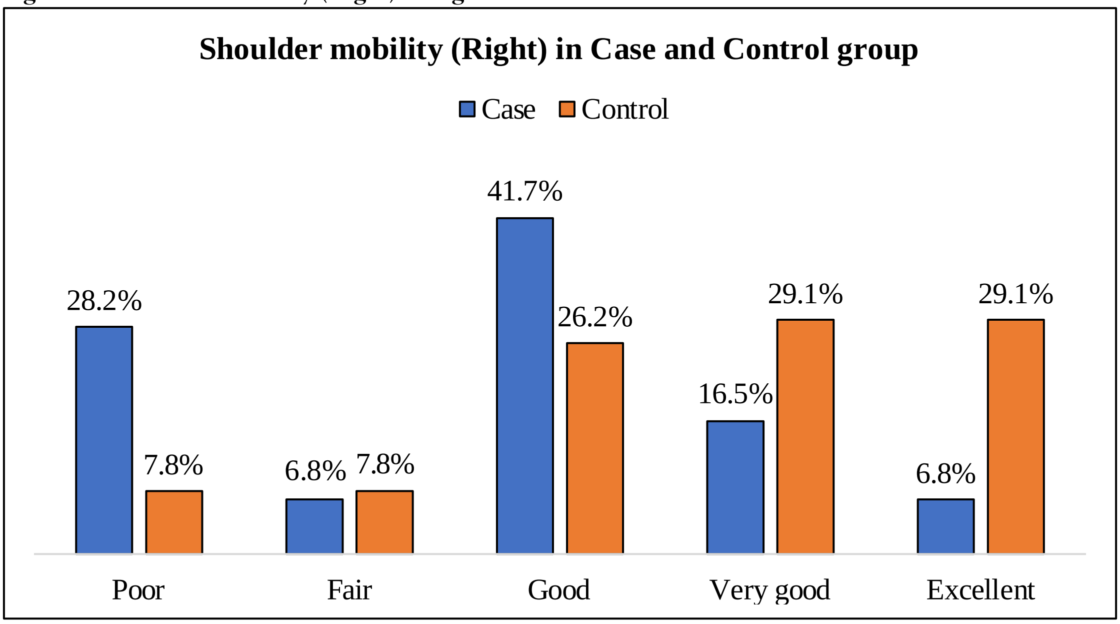

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Table 5: Shoulder Mobility (Right) using χ^2 – tests

Shoulder mobility (Right)	Case		Control		χ^2	*p-value*
	f	%	F	%		
Poor	29	28.2%	8	7.8%	33.54	< 0.001***
Fair	7	6.8%	8	7.8%		
Good	43	41.7%	27	26.2%		
Very good	17	16.5%	30	29.1%		
Excellent	7	6.8%	30	29.1%		

This table interprets that 28.2% of the young adults in case group had poor shoulder mobility (right) whereas only 7.8% had poor shoulder mobility in control group. Also 29.1% of the young adults in control group had excellent shoulder mobility whereas only 6.8% in case group. The chi-square test statistics 33.54 gives a *p-value* < 0.001***, hence there is a significant influence of smart phone addiction on shoulder mobility

Figure 4: Shoulder Mobility (Left) using χ^2 – tests

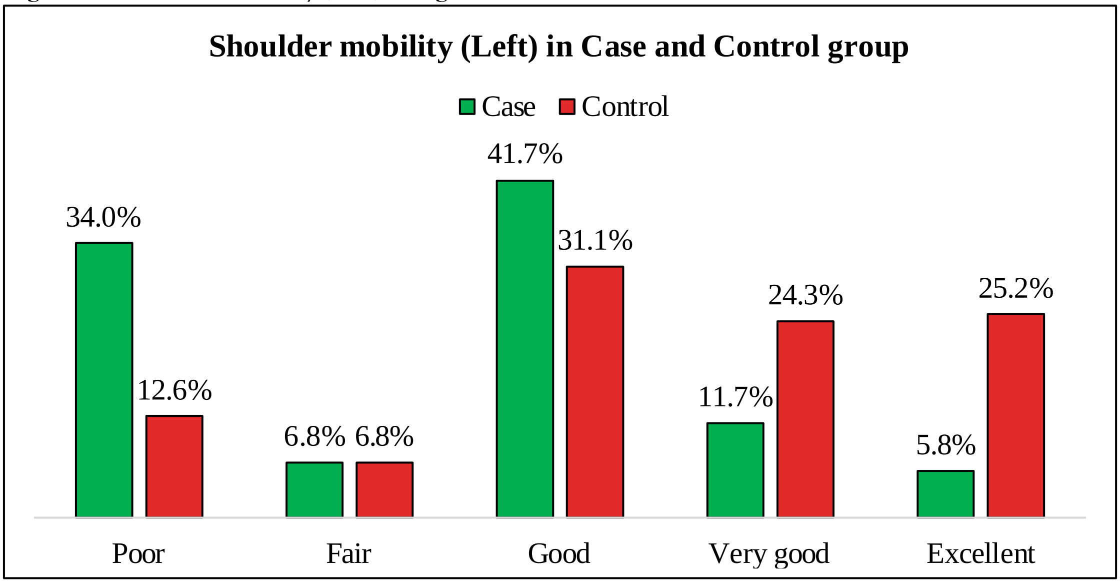

Table 5: Shoulder Mobility (Left) using χ^2 – tests

Shoulder mobility (Left)	Case		Control		χ^2	*p-value*
	f	%	F	%		
Poor	35	34.0%	13	12.6%	28.76	< 0.001***
Fair	7	6.8%	7	6.8%		
Good	43	41.7%	32	31.1%		
Very good	12	11.7%	25	24.3%		
Excellent	6	5.8%	26	25.2%		

This table interprets that 34% of the young adults in case group had poor shoulder mobility (left) whereas only 12.6% had poor shoulder mobility in control group. Also 25.2% of the young adults in control group had excellent shoulder mobility whereas only 5.8% in case group. The chi-square test statistics 28.76 gives a *p-value* < *0.001****, hence there is a significant influence of smart phone addiction on shoulder mobility.

DISCUSSION:

This study results expressed the difference between outcome variables of SAS scores, degree of FHP, both right and left shoulder mobility scores. In that results, regarding SAS scores were higher in case group when compared to control group, whereas the other outcome measures of degree of FHP, right and left shoulder mobility were lower in case group when compared to control group.

In this artificial intelligence (AI) era, excessive digital use and screen time made high human upper body strain with ill advised posture and ergonomic compromises. More than 6 hrs per day of screen use made this point more vulnerable musculoskeletal changes in upper body. Specifically upper quadrant of head, neck and upper thoracic spine area undergoes excessive stress in muscles, joints and other soft tissues in that area. This study results confirmed those changes in limited forward head movement which was reflected in reduced degrees of FHP in case group, and right and shoulder mobility in range of motion. This might happened because of physiological and functional changes in muscles and surrounding soft tissues in upper body part of head, neck and upper thoracic part. Silent and calming influences of stress in this are musculoskeletal part due to prolonged use and high SAS scores in smartphone addicted cases reflected the physiological changes in muscles with reduced strength and mobility and limited joint ROM in head, neck and upper thoracic part.

Already published results of various studies explained the reason of maximal head angles (>~40°) may trigger the cervical flexion-relaxation phenomenon, potentially aggravating neck issues by shifting load from active musculature to passive structures. Collectively, reduced postural variability (static, flexed head- neck with protracted shoulders) and inadequate micro-breaks concentrate stresses on cervical discs, facet joints, and peri-scapular muscles, explaining the chronic discomfort profiles frequently reported in heavy smartphone users (Toh et al., 2017).

And this study outcomes strengthened the scientific research evidence of Sustained smartphone use drives a characteristic upper quadrant posture known as forward head posture (FHP), rounded/protracted shoulders, and prolonged cervical flexion that increases passive tissue load and active muscle demand in the neck–shoulder complex (Torkamani et al., 2023). Kinematic and EMG studies show that greater cervical flexion angles during phone viewing (often ~30–50°) elevate upper trapezius and cervical extensor fatigue and pain, with steeper flexion producing higher fatigue indices and discomfort compared with neutral head position (Babangida et al., 2025).

Finally outcome this study affirmed that the changes in FHP, shoulder mobility of right and left side due to increased SAS scores in case group with high statistical evidence. Stress and strain related changes in upper quadrant muscles, soft tissues and shoulder joint mobility were the main reasons for those structural and functional changes in young adults with smartphone addiction.

Limitations of this study:

Particular age group between 20 to 25, less male participants in both groups, relatively small sample compared to huge population of smartphone users, observational design were the main limitations of this study.

Future recommendations:

This study can be expanded in different age groups particularly above 50 years population, equal number of male participants in both groups, sufficient larger sample more relevant to huge population of smartphone users, advanced interventional study designs like RCT might be considered.

CONCLUSION:

This study concluded that high use of smartphone (SAS) had highly statistically significant reduction in degrees of FHP, right and left shoulder joint mobility in 18-25 years of young adults when compared to control group of young adults were using comparatively less usage of smartphones.

Clinical significance:

- By understanding the impact of excessive smartphone use in 20-25 years young adults, this population can be educated about the adverse effects of smartphone addiction in altering the upper quadrant function and changes in FHP, shoulder mobility.

- Preventive measures related to ergonomics, physical activity, postural correction exercises can be made as a part of regular exercise and life style modification program on this specific population.

Credit AUTHORSHIP CONTRIBUTION STATEMENT:
Author 1: Conceptualization, Formal Analysis, Methodology, Writing – Original Draft, Project Administration.
Author 2*: Conceptualization, Investigation, Writing – Original Draft, Writing – Review and Editing, Investigation, Project Supervision.
Author 3: Formal Analysis, Data Collection, Methodology, Investigation.
Author 4: Formal Analysis, Data Collection, Methodology, Investigation.

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ETHICS STATEMENT:
The study was approved by the Institutional Ethics Committee (Ref.No: PhD/IPT/SU/23/002).

PATIENT INFORMED CONSENT STATEMENT:
All the patients involved in this study gave their informed consent

CONFLICT OF INTEREST:
The authors declare no conflicts of interest

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