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Effect of Yogic Interventions on Kinematical and Anthropometrical Parameters for Holistic Development among School Students: An NEP 2020 Perspective of India

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Abstract

Introduction: A significant part of India's cultural legacy, yog has been acknowledged for its potential advantages for both mental and physical well-being. Although its beneficial effects on body composition and flexibility are well recognized, there are still few empirical investigations that quantify such advantages, particularly for youths. Examining the effects of 8-week structured yog practice on particular kinematical (joint angle) and anthropometric (body measures) metrics in Indian youth was the goal of this study. **Methods:** Thirty male secondary school students from the Ajmer district of Rajasthan, ages 14 to 18, participated in an 8-week yogic training activities (five days a week, for 45 minutes each). The Common Yoga Protocol was followed during the intervention, which comprised asanas, pranayama, and relaxation techniques. Kinovea motion analysis software was used to evaluate kinematical parameters, such as spinal rotation, hip and shoulder joint angle. ISAK protocols were followed when performing anthropometric measurements, such as height, weight, arm span, chest circumference, BMI, leg length, and body fat percentage. **Results:** Significant increases in joint flexibility were found in post-intervention analyses: spinal rotation increased by 6° ($p < 0.001$), hip joint extended by 4° ($p < 0.001$), and shoulder joint flexed by 8° ($p < 0.001$). Positive effects were shown by anthropometric evaluations, particularly a decrease in body fat percentage with an improvement in BMI values, which were consistent with normative data for active teenagers. **Conclusion:** These results highlighted yoga's potential as a comprehensive approach to physical development in school curricula, aligning with the goals of India's National Education Policy 2020. The structured yogic intervention successfully improved joint mobility and positively impacted body composition among young participants.

Palabras Clave: NEP, Yoga, Adolescents, Joint Mobility, Anthropometry, Kinematic

Resumen

Introducción: Una parte significativa del legado cultural de la India, el yoga ha sido reconocido por sus ventajas potenciales para el bienestar mental y físico. Aunque sus efectos beneficiosos sobre la composición corporal y la flexibilidad son bien reconocidos, todavía hay pocas investigaciones empíricas que cuantifiquen tales ventajas, particularmente para los jóvenes. El examen de los efectos de la práctica estructurada de yoga de 8 semanas en métricas cinemáticas (ángulo articular) y antropométricas (medidas corporales) particulares en jóvenes indios fue el objetivo de este estudio. **Métodos:** Treinta estudiantes varones de secundaria del distrito de Ajmer de Rajastán, de 14 a 18 años, participaron en actividades de entrenamiento yóguico de 8 semanas (cinco días a la semana, durante 45 minutos cada una). El Protocolo Común de Yoga se siguió durante la intervención, que comprendía asanas, pranayama y técnicas de relajación. Se utilizó el software de análisis de movimiento Kinovea para evaluar parámetros cinemáticos, como la rotación de la columna vertebral, el ángulo de la articulación de la cadera y el hombro. Se siguieron los protocolos ISAK al realizar mediciones antropométricas, como altura, peso, envergadura, perímetro torácico, IMC, longitud de piernas y porcentaje de grasa corporal. **Resultados:** Se observaron aumentos significativos en la flexibilidad articular en los análisis posteriores a la intervención: la rotación espinal aumentó 6° ($p < 0,001$), la articulación de la cadera se extendió 4° ($p < 0,001$) y la articulación del hombro se flexionó 8° ($p < 0,001$). Las evaluaciones antropométricas mostraron efectos positivos, en particular una disminución del porcentaje de grasa corporal y una mejora en los valores del IMC, que coincidieron con los datos normativos para adolescentes activos. **Conclusión:** Estos resultados resaltan el potencial del yoga como un enfoque integral para el desarrollo físico en los currículos escolares, en consonancia con los objetivos de la Política Nacional de

Educación de la India de 2020. La intervención yóguica estructurada mejoró con éxito la movilidad articular e influyó positivamente en la composición corporal de los jóvenes participantes.

Keywords: NEP, Yoga, Adolescentes, Movilidad articular, Antropometría, Cinemática

Introduction

Ashtanga Yoga is the path to self-purification and self-realization; through the practice of Yama, Niyama, Asana, and Pranayama, the seeker transcends physical limitations and attains holistic harmony. (Yoga Sutras, II.28, Patanjali)

Originating in India, yoga is a timeless spiritual practice that represents a whole science of life and goes beyond simple physical exercise. According to Iyengar (2005), it unites movement, breath, and consciousness to integrate the body, mind, and soul. According to Swami Vivekananda (1896), the word "yoga" has its etymology from the Sanskrit root "yuj", which means to yoke or combine and represents the synthesis of the individual self with the universal awareness.

Growing recognition of yoga's value in promoting harmonious growth has come from contemporary pedagogical frameworks. In the verses of the Bhagavad Gita (6.5), it is stated that "One must elevate oneself by one's own mind and not degrade oneself." For the conditioned soul, the mind is both his ally and his foe. Yoga fosters internal discipline and awareness, which are attributes reflected in this proverb.

Empirical research has repeatedly demonstrated in recent decades that yoga helps school-aged children's physical health, emotional stability, and intellectual development in quantifiable ways (Telles et al., 2012; Ross & Thomas, 2010). In addition to improve anthropometric metrics including BMI and limb girth (Kumar & Raj, 2018), it also improves balance, postural alignment, and neuromuscular coordination (Woodyard, 2011). Within this framework, kinematical and anthropometric assessments become reliable instruments for assessing the physical growth. Joint kinematics, step length, and stability are examples of kinematical variables that shed light on the mechanical elements of bodily movement (Hall, 2014), whereas anthropometry investigates the structural and functional adaptations associated with exercise (Norton & Olds, 2001).

As per this scientific paradigm, the National Education Policy (NEP) 2020 highlights the need to move away from rote-based learning and toward integrated and experiential learning. According to the Ministry of Education (2020), it promotes the inclusion of yoga and physical literacy in the curriculum with the goal of fostering children holistically, encompassing the cognitive, affective, and psychomotor domains. In addition to promoting evidence-based evaluation of physical fitness, NEP 2020 suggests the use of diagnostic and formative assessments in health and wellbeing.

Notwithstanding the goal of the policy, not many studies have thoroughly investigated the anthropometric and biomechanical effects of structured yoga interventions in school curricula. In order to close this knowledge gap, the current study used a quantitative method to evaluate how yoga practices affect schoolchildren, offering a framework based on both Vedic knowledge and modern scientific methodology.

This study explored the transformative potential of yoga in improving kinematical efficiency and anthropometric health through the structured application of asanas, pranayama, and meditation. This will not only support physical development but also the larger objectives of holistic education as envisioned by NEP 2020, India.

Materials and Methods

Research Design

A quasi-experimental, pre-test–post-test one group design was used in this study to assess how yoga therapies affected schoolchildren's kinematical and anthropometrical parameters. The technique followed the ethical guidelines provided by the Indian Council of Medical Research (ICMR, 2017) and was organized in accordance with suggestions made by other yoga-based intervention studies (Gothe et al., 2013; Telles & Singh, 2022).

Participants

Thirty secondary school pupils, ages fourteen to eighteen, were specifically chosen from the district of Ajmer's coeducational government schools. To guarantee equal representation across age and gender subgroups,

stratified random sampling was employed. Excluded were those with long-term health issues, orthopedic restrictions, or continuous involvement in organized yoga or fitness programs.

Intervention Protocol

Upon obtaining signed informed consent from the participants' and the ethical approval from the Institutional Research Ethics Committee the students participated in an 8-week, systematic yoga training program that lasted five days a week for 45 minutes each. The training schedule (represented in table 1) had been developed in collaboration with experienced yoga instructors by following the curriculum adheres to the Common Yoga Protocol (Ministry of AYUSH, 2019).

Table 1. 8-week Yoga and Mindfulness Intervention Schedule

Week	Days	Daily Structure	Yoga Postures (Asanas)	Breathwork (Pranayama)	Meditation & Relaxation
Week 1	Mon–Fri	5 min breathing prep → 30 min asana flow → 10 min unwind	Tadasana, Vajrasana	Anulom Vilom – 3 cycles	OM chanting (5 min) + gentle relaxation
Week 2	Mon–Fri	Same flow structure as Week 1	Add Vrikshasana	Increase Anulom Vilom to 4 cycles	OM chanting (5 min) + Yoga Nidra (5 min)
Week 3	Mon–Fri	As above	Include Trikonasana	Switch to Nadi Shodhana – 3 cycles	Guided mindfulness meditation (10 min)
Week 4	Mon–Fri	Continuation of previous structure	Add Bhujangasana	Nadi Shodhana – 4 cycles	Maintain 10-minute guided mindfulness
Week 5	Mon–Fri	As in earlier weeks	Introduce Paschimottanasana	Anulom Vilom + Bhramari – 2 rounds each	OM chanting (5 min) + Yoga Nidra (5 min)
Week 6	Mon–Fri	Maintain same structure, refine movements	Focus on perfecting previous postures	Bhramari – 3 cycles	Extended Yoga Nidra (10 min)
Week 7	Mon–Fri	Asana-Pranayama-Meditation sequence continues	Practice all learned postures as a sequence	Combine Nadi Shodhana & Bhramari – 2 rounds each	Focused breath-awareness meditation
Week 8	Mon–Fri	Full routine consolidation	Integrate complete asana series smoothly	Practice all three pranayamas in a smooth sequence	Alternate daily: Yoga Nidra / OM Chanting (10 min)

Notes:

- **Warm-Up Phase (5 minutes):** Begin each session with light joint mobility movements, focusing on neck rolls, shoulder shrugs, and ankle circles, combined with breath awareness to settle the body and mind.
- **Relaxation & Mindfulness Phase (10 minutes):** End with practices to calm the nervous system and cultivate inner awareness—shifting the focus from activity to rest and observation.

With assistance from physical education instructors from the same schools, the scholar as professional yoga trainer led the sessions.

Variables and Tools

Selected parameters with the measures are represented in table 2.

Table 2. Overview of Kinematic and Anthropometric Variables Assessed

Category	Measured Attribute	Unit	Source/Protocol
Kinematic Parameters	Shoulder Flexion	Degrees (°)	Custom Observational Framework
	Hip Extension	Degrees (°)	Custom Observational Framework

	Spinal Rotation (Twisting)	Degrees (°)	Custom Observational Framework
Body Composition & Anthropometry	Height	Centimeters (cm)	ISAK
	Body Weight	Kilograms (kg)	ISAK Guidelines
	Arm Span	Centimeters (cm)	ISAK Guidelines
	Chest Girth (Inspiration)	Centimeters (cm)	ISAK Recommendations
	Body Mass Index (BMI)	kg/m²	WHO Standard Calculation
	Leg Length	Centimeters (cm)	ISAK Protocol
	Body Fat %	Percentage (%)	Jackson & Pollock (1978)

Measurements were taken by qualified personnel, and all instruments were calibrated before the evaluation.

Data Collection Procedure and Analysis

The final (post-test) data was gathered within a week of the intervention's conclusion, while the pre-test data was obtained one week before. Data confidentiality and voluntary involvement were maintained for the entire study. In order to guarantee consistency, all testing were carried out in a regulated yoga studio environment with detailed instructions and practice sessions. Kinovea motion analyzer software was used to carefully analyze the video in order to verify the practitioners' joint angles. Values for kinematical and anthropometrical measures were recorded independently by Using SPSS (Version 25.0). For every variable, descriptive statistics were calculated. Paired sample t-tests were used to examine variations within joint kinematic groups. P-values less than 0.05 were regarded as statistically significant.

Result

The current study looked at how an 8-week yoga program affected the anthropometric and biomechanical characteristics of youth. To assess baseline characteristics and post-intervention changes, both descriptive and inferential statistical methods were incorporated.

Anthropometric Indicators

The subjects' anthropometric profiles are shown in Table 3. Thirty male adolescents between the ages of 14 and 18 made up the sample (M = 15.83, SD = 1.34), indicating a developmentally homogeneous group that was probably experiencing peak height velocity (Malina et al., 2004).

In line with normative statistics for yogic groups, the mean BMI (M = 20.78, SD = 0.16) and body fat percentage (M = 10.86%, SD = 0.67) showed a lean physique typical of active teenage guys (Heyward & Wagner, 2004). Participants' physical appropriateness for biomechanical studies is further supported by the balanced values for leg length and chest circumference, as well as the proportionate congruence between height and arm span (M = 174.93 cm) (Beunen & Malina, 1988; Zatsiorsky & Kraemer, 2006).

Table 3. Summary of Anthropometric Characteristics (N = 30)

Parameter	Sample Size (N)	Minimum	Maximum	Mean	SD
Age (Years)	30	14	18	15.83	1.34
Height (cm)	30	169.00	180.00	174.27	2.94
Weight (kg)	30	59.00	68.00	63.13	2.33
Arm Span (cm)	30	170.00	182.00	174.93	3.15
Chest Circumference (cm)	30	83.00	91.00	87.27	2.15
Body Mass Index (kg/m²)	30	20.50	21.10	20.78	0.16
Leg Length (cm)	30	89.00	98.00	93.53	2.37
Body Fat Percentage (%)	30	9.80	12.20	10.86	0.67

Joint Kinematics

Joint angles before and after the interventions were examined using descriptive statistics and paired-sample t-tests.t (29) = 5.86, p <.001, indicates a substantial improvement in shoulder joint angle from the pre-test to the post-test. In contrast, the Hip Joint Angle increased significantly from the pre-test to the post-test by about 4°. At t (29) = 4.95, p <.001, the spinal twist range improved considerably from the pre-test (M = 43.43°, SD ≈ 7.0) to the post-test (M = 49.43°, SD ≈ 7.0). These results evidenced that for all tested joints, the intervention improved joint flexibility and mobility significantly.

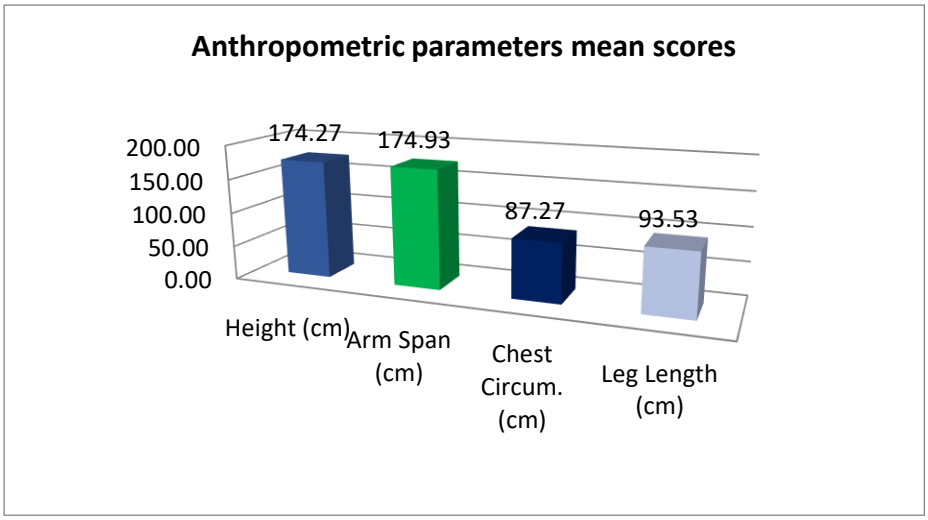

Figure 1. Graphical representations of anthropometric variables

Table 4. Summary of Joint Angle Measurements before and after Intervention (N = 30)

Measurement Phase	Joint Angle Type	N	Minimum (°)	Maximum (°)	Average (°)	SD (°)
Pre-Assessment	Shoulder Joint	30	142.00	174.00	155.40	9.12
	Hip joint	30	16.00	28.00	21.33	3.34
	Spinal Rotation (Twist)	30	36.00	53.00	43.43	4.70
Post-Assessment	Shoulder Joint	30	150.00	182.00	163.40	9.12
	Hip joint	30	20.00	32.00	25.33	3.34
	Spinal Rotation (Twist)	30	42.00	59.00	49.43	4.70

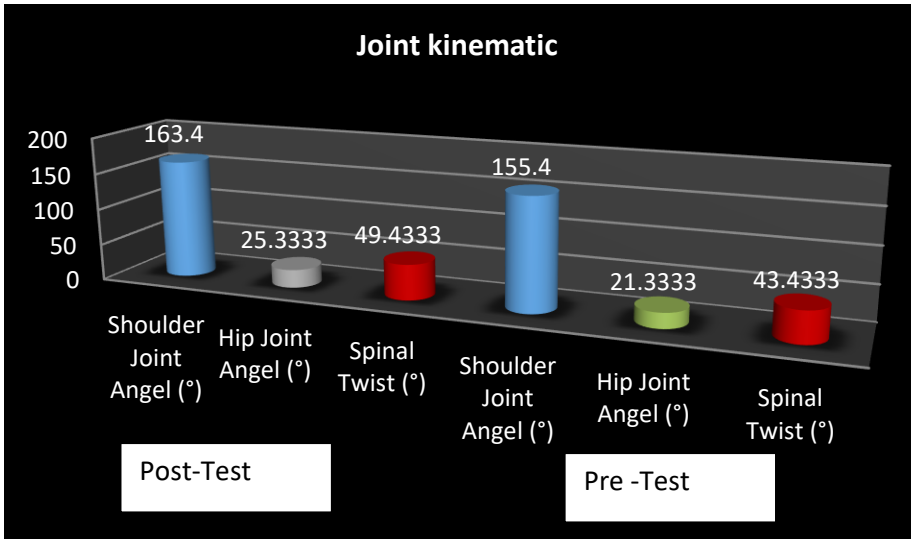

Figure 2. Graphical representations of joint kinematics (^{0})

Table 5. Comparative Analysis Using Paired t-Test on Joint Kinematics (N = 30)

Type of Joint Movement	t-Value	Degrees of Freedom (df)	Significance Level (p)	Interpretation
Shoulder Flexion	5.86	29	< 0.001	Statistically Significant
Hip Extension	4.12	29	< 0.001	Statistically Significant
Spinal Rotation	4.95	29	< 0.001	Statistically Significant

Discussion

The shoulder joint showed substantial improvements (Δ = 8.0°), indicating greater scapular mobility and glenohumeral flexibility. These results align with research conducted by Wilke et al. (2016), which showed how stretching contributes to the elongation of soft tissues and the improvement of joint mobility. Furthermore, as suggested by Behm and Chaouachi (2011), dynamic elements of yoga poses might have aided in neuromuscular regeneration. The significance of pelvic mobility and lower-body flexibility in functional movement patterns is highlighted by the observed 4° increase in hip joint angle. According to Page (2012), hip mobility interventions enhance locomotor efficiency and lessen musculoskeletal stress, two important aspects of teenage physical education and athletic development.

A significant 6° increase in spinal twist capability suggests better lumbar-pelvic rhythm and thoracic spine rotation. According to Kibler et al. (2006), who connected spinal flexibility with both performance and injury prevention, these modifications are essential for trunk mobility. The significance of spinal mobility in lowering compressive stresses and improving postural control was also mentioned by McGill (2007). NEP 2020 emphasizes the inclusion of physical education in school curricula, outlines holistic development goals that are reflected in these kinematical and physical advancements. The yoga module's ability to improve the said parameters is in line with NEP's mission to support school-age children's physical literacy, resilience, and self-awareness in addition to their academic achievement.

Conclusion

The results of this investigation indicated that youngsters' joint flexibility and mobility could be much enhanced by an organized 8-week yoga program. These enhancements were noted in the hip, shoulder, and spinal joints, confirming the effectiveness of yoga in improving adaptive kinematics and mobility. Furthermore, the anthropometric profiles show that the sample had a well-developed body, which enabled substantial responses to flexibility exercises.

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Data availability

Full access to data on request.

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There is no external funding to declare.

Conflicts of Interest

The author declare that he has no competing interests.

Informed Consent

Statement all the athletes and their parents included in the study provided written informed consent.

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