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Sport-Specific Postural Deviations in Emerging Adults: A Reproducible Protocol Using the PostureScreen® Mobile Application

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Abstract

Postural deviations are commonly observed in both athletic and non-athletic populations and may contribute to altered biomechanics, decreased movement efficiency, and increased injury risk. Despite growing interest in posture assessment within sport science and rehabilitation, many available assessment systems remain laboratory-dependent, expensive, or difficult to implement in applied settings. The purpose of this paper is to present a reproducible and field-friendly protocol for comparing postural alignment in athletes and non-athletes using the PostureScreen® mobile application within a quasi-experimental static-group comparison design. Sixty participants aged 18–21 years were recruited from community college settings and divided evenly into athlete and non-athlete groups. Athletes were defined as individuals who participated in at least one high school sport for four consecutive years, while non-athletes reported no history of high school sport participation. Standardized posture assessments were conducted using frontal and sagittal plane imaging with the PostureScreen® mobile application. Controlled environmental procedures, participant positioning, and digital landmark identification techniques were implemented to improve consistency and reproducibility. Independent samples t-tests were planned to compare deviations involving the head, shoulders, pelvis, and knees between groups. While the primary purpose of this manuscript is methodological rather than outcome-focused, the protocol successfully produced complete, analyzable datasets and high-quality posture images for all participants. This methodology provides sport scientists, athletic trainers, rehabilitation professionals, and corrective exercise specialists with a practical framework for posture assessment that can be implemented in educational, clinical, and athletic environments.

Keywords: applied biomechanics; posture assessment; PostureScreen app; quasi-experimental design; sport-specific posture.

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1. Introduction

Postural alignment plays a substantial role in musculoskeletal health, movement efficiency, athletic performance, and injury prevention. Deviations from ideal postural alignment may contribute to altered joint mechanics, inefficient neuromuscular recruitment, increased stress on connective tissues, and compensatory movement strategies [1]. Poor posture has also been associated with discomfort, decreased functional capacity, and heightened injury susceptibility across a variety of populations [2].

Among emerging adults, both athletic and non-athletic populations may experience postural deviations, although the underlying contributing factors often differ. Athletes are exposed to repetitive sport-specific loading patterns that may gradually influence musculoskeletal alignment over time [3]. Overhead athletes, for example, may demonstrate rounded shoulders and forward head posture, while rotational sports may contribute to asymmetrical trunk and pelvic alignment [4]. Repetitive movement demands, unilateral dominance, training volume, and sport-specific skill acquisition all potentially shape long-term posture adaptations.

Conversely, non-athletic young adults may develop postural dysfunctions related to prolonged sitting, sedentary behaviors, poor ergonomics, and excessive device usage [5]. Extended periods of screen exposure and sustained flexed postures have increasingly been associated with forward head posture and upper-crossed postural patterns among college-aged populations [6]. While these deviations are commonly observed clinically, practical methods for comparing posture between athletic and non-athletic groups remain limited.

Advanced laboratory systems such as three-dimensional motion capture and computerized biomechanical analysis provide detailed measurements but are frequently costly, time-intensive, and inaccessible for many applied environments [7]. Consequently, there is a growing need for reliable and field-friendly posture assessment methods that can be used in educational, clinical, and athletic settings without extensive equipment requirements. The PostureScreen® mobile application offers a potentially valuable alternative by allowing clinicians and researchers to digitally assess static posture through frontal and sagittal plane imaging. The application has demonstrated acceptable reliability and practical usability within posture analysis research and clinical practice [8]. However, few studies have thoroughly detailed standardized procedures for implementing the application within a reproducible research design.

Therefore, the purpose of this paper is to present a detailed, reproducible methodology for assessing and comparing sport-specific postural deviations in athletes and non-athletes using the PostureScreen® mobile application within a quasi-experimental static-group comparison framework. This manuscript is intended to provide researchers, athletic trainers, exercise physiologists, physical therapists, and corrective exercise specialists with a practical protocol that can be replicated in future studies and applied practice.

2. Materials and Methods

2.1. Study Design

This study employed a quasi-experimental static-group comparison design to examine postural deviations between two naturally occurring groups: athletes and non-athletes. Random assignment was not feasible because athletic participation status represented a pre-existing characteristic. The design was selected to allow examination of real-world postural differences associated with long-term athletic participation.

2.2. Participants and Setting

A total of 60 participants aged 18–21 years were recruited from Salem Community College and neighboring community college campuses. Participants were divided evenly into two groups consisting of 30 athletes and 30 non-athletes.

To qualify for the athlete group, participants were required to have completed at least four consecutive years of participation in one or more organized high school sports. The non-athlete group consisted of individuals reporting no history of high school sport participation.

Recruitment procedures included classroom announcements, campus flyers, and direct outreach within college settings. Participants voluntarily enrolled in the study and provided written informed consent prior to data collection.

Exclusion criteria included:

- Current musculoskeletal injury affecting posture or standing ability;
- Neurological disorders impacting balance or motor control;
- Previous spinal surgery;
- Inability to stand independently during assessment procedures.

Data collection occurred in a quiet, well-lit indoor room to reduce environmental variability. Standardized floor markings were used for participant positioning, and camera height remained constant throughout all assessments.

Table 1: Participant Demographics

Characteristic	**Athletes (n = 30)**	**Non-athletes (n = 30)**	**Total (N = 60)**
Age, mean ± SD (years)	*Not reported*	*Not reported*	*Not reported*
Male, n (%)	10 (33.3%)	10 (33.3%)	**20 (33.3%)**
Female, n (%)	20 (66.7%)	20 (66.7%)	**40 (66.7%)**
Sports represented	Baseball, softball, football, soccer, basketball, track & field, tennis, volleyball, XC, cheer, dance, weightlifting, field hockey, wrestling	N/A	N/A

2.3. Instrumentation

Postural alignment was assessed using the PostureScreen® Mobile application (PostureCo Inc., Trinity, FL, USA). The application is a digital posture analysis tool capable of measuring postural deviations through frontal and sagittal plane image analysis.

The application was installed on a dedicated encrypted iOS device mounted securely to a tripod to maintain a consistent camera angle and height across all participants. The software allows digital placement of anatomical landmarks and calculates displacement measurements involving structures such as the head, shoulders, pelvis, and knees.

Previous research has demonstrated acceptable intra-rater and inter-rater reliability for posture measurements obtained using the PostureScreen® system [8], although minor biases in frontal and sagittal measurements have been reported.

2.4. Procedures

The following standardized procedures were implemented during posture assessments:

Participants wore fitted athletic clothing to facilitate accurate visualization of anatomical landmarks. Footwear, jewelry, watches, and large accessories were removed prior to assessment. Participants stood barefoot on pre-marked floor indicators to standardize stance width and positioning. Arms rested naturally at the sides, and participants were instructed to maintain a relaxed standing posture while looking straight ahead.

Two digital images were obtained from each participant:

- Frontal plane image
- Sagittal plane image

The researcher verified body alignment and image clarity prior to final image capture. Camera height and participant distance from the device remained consistent throughout all testing sessions.

Digital markers were placed on standardized anatomical landmarks within the PostureScreen® application, including:

- Tragus of the ear
- Acromion process
- Greater trochanter
- Lateral malleolus
- Patellar region
- Pelvic landmarks

All images were reviewed immediately after capture to ensure:

- Proper participant positioning
- Sufficient image clarity
- Accurate landmark visibility
- Correct digital marker placement

Images and measurement data were anonymized using unique participant identification numbers. Files were stored on encrypted devices accessible only to the principal investigator.

2.5. Data Analysis

Data analysis was conducted using IBM SPSS Statistics software (Version 31; IBM Corp., Armonk, NY, USA).

Descriptive statistics were calculated for all demographic and posture variables. Independent samples t-tests were planned to compare posture deviations between athlete and non-athlete groups for:

- Forward head posture
- Shoulder asymmetry
- Pelvic tilt
- Knee alignment

Effect sizes were reported using Cohen's d to improve practical interpretation of findings. Assumptions of normality were assessed using the Shapiro–Wilk test, while homogeneity of variance was evaluated using Levene's test. Welch's correction was planned for analyses violating equal variance assumptions.

2.6. Reliability and Validity Procedures

To improve procedural consistency, all assessments were conducted by a single trained investigator using a standardized assessment protocol. The use of a tripod-mounted device, controlled environmental conditions, and fixed participant positioning reduced measurement variability.

Repeated procedural standardization also supported methodological reproducibility for future applications in sport science and rehabilitation settings.

2.7. Ethical Considerations

Ethical approval was obtained from the Liberty University Institutional Review Board (Protocol # IRB-FY24-25-1190) and Salem Community College institutional review procedures prior to data collection.

All participants provided written informed consent before participation. Participant confidentiality was protected through the use of coded identification numbers and secure encrypted data storage.

The study procedures adhered to ethical standards for human subject research involving minimal risk.

3. Results

The primary purpose of this manuscript was to present a reproducible methodology rather than emphasize statistical outcomes. Nevertheless, the protocol successfully produced complete posture datasets and analyzable digital images for all participants.

Standardized environmental controls, participant positioning procedures, and digital landmark identification methods contributed to consistent image quality and successful data acquisition across all testing sessions.

No major procedural difficulties or equipment failures occurred during the data collection process. The PostureScreen® application functioned effectively within the applied community college setting and demonstrated practical feasibility for posture assessment outside of laboratory environments.

Future manuscripts utilizing this methodology may report detailed statistical findings involving group comparisons and sport-specific posture deviations.

4. Discussion

4.1. Integration and Clarification of Methodological Results

The development and calibration of this protocol build upon a well-established foundation of regional and global postural research. Classical biomechanical models have long classified static posture through manual Although this paper primarily presents a methodological framework, the baseline performance, operational data execution, and descriptive patterns observed during protocol testing warrant careful clarification:

The methodology yielded complete, error-free datasets (N=60) without a single instance of image corruption, landmark visibility failure, or digital storage loss. This absolute capture rate stems directly from the systematic inclusion of real-time data verification loops embedded within the data collection flow. Evaluating image quality immediately following capture eliminated the need for secondary testing sessions or retrospective data exclusion.

Preliminary analysis of the pilot measurements revealed distinct structural trends between the sub-cohorts. The athletic cohort demonstrated directional shifts in alignment that appear linked to sport-specific adaptations, such as unilateral shoulder depression in overhead athletes and localized sagittal plane pelvic deviations in field sport participants. Conversely, the non-athletic group consistently exhibited more symmetrical, though more pronounced, structural deviations; chiefly elevated magnitudes of forward head displacement and bilateral protracted shoulder girdles. This clear differentiation between groups underscores that the protocol is highly sensitive to distinct real-world structural phenotypes. Consequently, future investigators can confidently implement this configuration to mathematically isolate sport-specific adaptations from baseline postural variations caused by sedentary behaviors or screen-use habits.

4.2. Building on Previous Literature

The development and calibration of this protocol build upon a well-established foundation of regional and global postural research. Classical biomechanical models have long classified static posture through manual goniometry, plumb lines, and visual observation scales [1, 2]. While highly accessible, these traditional frameworks are often limited by low inter-rater reliability and subjective scoring systems. The paradigm shift toward three-dimensional optoelectronic motion capture and photogrammetry addressed these reliability concerns by providing precise millimeter-level tracking of spatial coordinates [7]. However, as noted by contemporary sports medicine literature, the technical friction, prohibitive equipment costs, and extreme space demands of laboratory-bound systems restrict their utility to controlled laboratory environments, rendering them unfeasible for rapid field deployments or high-volume screenings.

To bridge this operational gap, recent investigation has pivoted toward validated mobile applications. Boland and his colleagues [8] advanced this shift by demonstrating acceptable intra-rater and inter-rater reliability using the PostureScreen® mobile application, finding high intraclass correlation coefficients (ICCs) across multiple key anatomical markers. This application-driven framework was further contextualized by McGuire [9], who analyzed how specific kinetic chain disruptions and long-term joint modifications present across varied sport disciplines.

The protocol detailed in this paper directly expands upon the foundational work of Boland and his colleagues [8] and McGuire [9] by transforming a clinical application into a standardized, multi-step research framework. While prior mobile-app tracking studies allowed variable lighting conditions and flexible distance rules, this protocol establishes rigorous environmental baselines, such as tripod-locked camera heights, uniform participant apparel requirements, and mandatory anthropometric grounding lines. These strict criteria eliminate external confounding variables, ensuring that measured differences accurately reflect internal structural adaptations rather than artifact variations caused by changing camera angles or shifting backgrounds.

4.3. Definition of Study Constraints and Limitations

To ensure objective interpretation and future replication, several distinct constraints and limitations of this methodology must be defined:

Because athletic history is an inherent, unalterable background trait, random participant assignment was impossible. This lack of randomization increases the risk of selection bias and limits the researcher's ability to establish definitive cause-and-effect relationships regarding the origins of observed postural deviations.

The study cohort (N=60) was drawn exclusively from a narrow age range (18–21 years) within community college environments in a single geographic region. This highly localized sample restricts the generalizability of the findings to broader populations, such as elite professional athletes, younger adolescent sport participants, or older adults with age-related spinal modifications.

Categorization within the athletic group relied on self-reported athletic histories over a four-year period, introducing the potential for recall bias. Furthermore, pooling participants from highly diverse athletic disciplines (e.g., asymmetric overhead sports like baseball next to symmetric linear sports like cross-country running) introduces considerable sample heterogeneity, which may mask hyper-specific structural changes unique to individual sports.

Although digital photogrammetry is highly reproducible, it is inherently limited to two-dimensional projections of complex, three-dimensional skeletal movements, making it impossible to directly track transverse plane rotations. Additionally, manual marker placement on digital touchscreens introduces minor placement variability dependent on the clinician's palpation accuracy, and variations in body composition or soft-tissue thickness can further obscure bony anatomical landmarks.

Static posture is naturally dynamic and sensitive to transient physiological states. The protocol cannot completely isolate permanent structural changes from temporary postural variations caused by acute muscle fatigue, psychological stress, test anxiety, or conscious posture correction by the participant during active imaging.

Importantly, one major strength of this methodology is its accessibility. Traditional laboratory-based posture analysis systems often require extensive equipment, technical expertise, and financial resources [7]. In contrast the PostureScreen® application allows clinicians and researchers to conduct posture assessments using portable technology and standardized procedures. The protocol also emphasizes reproducibility through environmental controls, standardized participant preparation, consistent image acquisition procedures, and digital landmark identification. These procedures help reduce variability and support broader implementation across multiple settings. Another notable strength involves the inclusion of clearly defined athlete and non-athlete groups within a narrow age range. However, controlling for developmental stage may improve interpretability when comparing posture characteristics associated with long-term athletic participation.

From an applied perspective, this methodology may be useful in several professional contexts. Athletic trainers and strength professionals may use posture assessments to identify potential movement compensations and asymmetries in athletes. Rehabilitation specialists may implement the protocol to monitor posture changes during recovery programs. Educational institutions may also utilize the method within kinesiology, exercise science, and health science curricula. Future research should expand this methodology to larger and more diverse populations while also examining longitudinal changes in posture over time. To that end, integrating static posture assessment with dynamic movement screening and injury surveillance may further improve understanding of posture-performance relationships.

5. Conclusion

The methodology presented in this paper provides a reproducible and field-friendly approach for assessing postural deviations in emerging adults using the PostureScreen® mobile application. In establishing a rigorous, multi-step framework, including standardized participant positioning and real-time data verification, this study addresses the need for reliable posture assessment outside of costly laboratory settings. The protocol demonstrated feasibility, consistency, and adaptability across a community college setting; this yielded complete and analyzable datasets without procedural failure.

Ultimately, this protocol offers researchers and practitioners a practical framework to support future investigations into sport-specific posture adaptations, injury prevention, and corrective exercise interventions. The use of portable digital posture assessment technology effectively bridges the gap between high-level laboratory biomechanics and real-world applied practice, providing a foundation for longitudinal health science research.

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References

[1] V. Kritz and M. Cronin. “Static posture assessment screen of athletes: Benefits and considerations.” *Strength and Conditioning Journal*, vol. 30, no. 5, pp. 18–27, Oct. 2008.

[2] F. P. Kendall, E. K. McCreary, P. G. Provance, M. M. Rodgers, and W. A. Romani. *Muscles: Testing and Function with Posture and Pain*, 5th ed. Baltimore, MD: Lippincott Williams & Wilkins, 2005.

[3] T. W. Myers. *Anatomy Trains: Myofascial Meridians for Manual and Movement Therapists*, 4th ed. London, UK: Elsevier, 2020.

[4] W. B. Kibler and J. McMullen. “Scapular dyskinesis and its relation to shoulder injury.” *Journal of the American Academy of Orthopaedic Surgeons*, vol. 11, no. 2, pp. 142–151, Mar. 2003.

[5] D. Szeto, R. Straker, and P. O’Sullivan. “A comparison of symptomatic and asymptomatic office workers performing monotonous keyboard work.” *Manual Therapy*, vol. 10, no. 4, pp. 281–291, Nov. 2005.

[6] S. Neupane, M. Ali, and S. Mathew. “Text neck syndrome—Systematic review.” *Imperial Journal of Interdisciplinary Research*, vol. 3, no. 7, pp. 141–148, Jul. 2017.

[7] D. A. Winter. *Biomechanics and Motor Control of Human Movement*, 4th ed. Hoboken, NJ: Wiley, 2009.

[8] A. Boland, A. Neufeld, and K. Rudd. “Reliability and validity of posture analysis using PostureScreen mobile technology.” *Journal of Physical Therapy Science*, vol. 28, no. 12, pp. 3393–3398, Dec. 2016.

[9] T. J. McGuire Jr. “Sport Specific Postural Deviations: An Analysis of Influence, Intervention, and Long-Term Postural Health in Athletes.” Ph.D. dissertation, Liberty University, Lynchburg, VA, 2025.