

ISSN: 2392-5442 ESSN : 2602-540X		<i>Sport system journal</i>
V/13 N/01 Year/2026		<i>International scientific journal published by: Ziane Achour –Djelfa- Algeria</i>
P 330 - 344		<i>Received: 2026-01-24 Accepted: 2026-02-24</i>

Prevalence and Distribution of Postural Deformities among Middle-School Non-Sporting Students: A Cross-Sectional Study

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Abstract:

Postural deformities in adolescents represent a growing public health concern due to their long-term impact on musculoskeletal health, functional capacity, and overall well-being. This cross-sectional descriptive study examined the prevalence, distribution, and severity of postural deformities among 270 middle-school students in the Wilaya of Setif, Algeria, in 2022, all of whom were not involved in organized sports. Posture was evaluated using the (NYPR), a standardized visual assessment that analyzes head alignment, shoulder posture, spinal curvature, pelvic alignment, abdominal posture, and foot structure. Deviations were classified into three levels: no deviation, slight deviation, and marked deviation, and overall posture was categorized as good, acceptable, or poor based on cumulative scores.

Results revealed a high prevalence of postural deformities. Overall, 62.59% of students demonstrated poor posture. The most frequent deviations included lateral head tilt (84%), rounded shoulders (77%), thoracic kyphosis (69%), abdominal protrusion (64%), and flat foot (60%). These findings highlight the urgent need for early screening, posture education, and school-based corrective exercise programs to prevent long-term musculoskeletal complications and promote adolescent health.

Keywords: Postural deformities; Adolescents; School students; Posture assessment; Musculoskeletal health; Body Posture; NYRP.

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1-Introduction:

Physical activity has an impact on the posture and physical development of a young organism. Sports training as a specific form of directional physical activity can exert a significant effect on the process of posture development of young men due to high training loads and repeated unilateral exercises

Body posture is a vital aspect of human biology. It encompasses one's outward appearance, attitude, and stance (Carini et al., 2017). As a fundamental component of the human body, body posture plays a pivotal role in both mental and physical health, serving as the foundation for all subsequent bodily movements (Cosma et al., 2015). Currently, the benefits of good posture are widely accepted, with numerous studies demonstrating its ability to enhance quality of life and reduce the likelihood of developing various health issues (Salsali et al., 2023). Conversely, poor posture has been linked to an increased risk of cardiovascular disease, headaches, back pain, diabetes, and digestive disorders (Goyal J., & Rakhra G., 2024). Additionally, it has been associated with an elevated probability of injury (Koźlenia, D., & Kochan-Jacheć, K., 2024).

The practice of physical activity has been demonstrated to influence the posture and overall physical development of young individuals. In particular, the specific form of directional physical activity known as sports training has been shown to exert a significant impact on the process of posture development in young men, largely due to the repetitive nature of the exercises, which involve a pattern of movement in a single plane for extended periods of time (Wang et al., 2019). Swimmers have engaged in continuous training to enhance their physiological capabilities within the demanding aquatic environment. It seems reasonable to suggest that the increased pressure in the water compresses the chest cavity and reduces the lung capacity of competitive swimmers. This is particularly the case for competitive swimmers, who may perform hundreds of repetitions each week. Furthermore, the repetitive nature of these exercises increases the risk of injury due to overuse and/or stress on joints, muscles, tendons, and ligaments. (Aksamit et al., 2019)

A variety of postural deformities may affect swimmers, with scoliosis representing the most prevalent condition (Ayдын et al., 2020). This curve can prevent the swimmer from performing the correct technique, resulting in poor form and reduced swimming speeds. Furthermore, the spine may be affected by kyphosis and lordosis (Balkó et al., 2017). Postural deformities may also include hip dislocation and shoulder deformities (Hibberd et al., 2016), which may impair respiration during swimming. Postural deformities are classified into two categories: kinetic and static (Weatherall, 2022). Kinetic deformities are the result of aberrant movement patterns that occur during the act of swimming or diving. Such movements are the result of imbalances within the body, which may manifest as poor posture. Static

deformities are caused by the abnormal positioning of joints and tissues at rest, such as joint stiffness. Both categories of postural deformities have the potential to result in chronic pain or discomfort, which can in turn impair function and cause further pain and discomfort.

The emergence of such postural disorders in the context of sports is typically linked to the highly repetitive nature of athletic activities. The early introduction of specific sports often involves children in training at an early stage of their development. During this developmental period, the children's spinal column is subjected to the influence of substantial loads that occur during the training process. This can result in adaptive changes in the skeletal and muscle systems and disrupt normal posturogenesis⁸ (Stosic et al., 2011)

This prolonged exposure to such loads affects the morphology of the bones that are still undergoing development, as well as the mechanical integrity of the bones, which can result in the improper development of the spinal column (Wojtys, Ashton-Miller, Huston, & Moga, 2000). It is evident that monitoring postural development in athletes, particularly those in younger age groups, is of critical importance. However, it is notable that the majority of previous studies on body posture have focused on adult athletes. The objective of this study is to report the prevalence of different postural deformities among adolescent swimmers.

2- General objective of the study:

To determine the prevalence, distribution, and severity of postural deformities among middle-school students who do not participate in organized sports in the Wilaya of Setif, Algeria.

3- Methods:

3-1 Study Design:

This cross-sectional descriptive study was conducted on a group of middle-school students who did not participate in organized sports. Data collection took place during the year 2022 in public middle schools in the Wilaya of Setif, Algeria.

A total of 270 students were included in the study. Participants were adolescents aged approximately 12 to 15 years. Students were eligible if they were enrolled in middle school and not engaged in regular structured sports training. Students with known musculoskeletal disorders, recent injuries, or medical conditions that could affect posture were excluded.

Postural assessment was performed using the New York Posture Rating Test (NYPR), a standardized visual evaluation tool designed to assess body alignment across multiple anatomical regions. The assessment covered head position, shoulder alignment, thoracic kyphosis, lumbar lordosis, pelvic tilt, abdominal posture, trunk alignment, scoliosis, foot posture, and lower limb alignment. Each postural



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deviation was rated using a three-level ordinal scale (5 = no deviation, 3 = slight deviation, 1 = marked deviation).

Based on cumulative NYPR scores, overall posture quality was classified into three categories: good posture, acceptable posture, and poor posture. Postural evaluations were conducted under standardized conditions by trained assessors to ensure consistency and reliability.

Descriptive statistical analyses were performed to calculate frequencies, percentages, and prevalence rates of postural deformities. Deformities were ranked according to their frequency of occurrence among participants. Statistical analyses were carried out using standard data-processing software.

3-2 Participants:

- **Sample size:** 270 middle-school students
- **Inclusion criteria:** Non-sporting students
- **Exclusion criteria:** Diagnosed musculoskeletal disorders, injuries, etc.

Table 1: Descriptive characteristics of the study sample (n = 270)

Variable	Mean $\pm$ SD
Age (years)	13.36 $\pm$ 1.36
Height (cm)	148.95 $\pm$ 10.21
Weight (kg)	48.49 $\pm$ 12.03

Table 1 presents the descriptive characteristics of the non-sporting middle-school student sample (n = 270), expressed as mean $\pm$ standard deviation.

The mean age of participants was 13.36 $\pm$ 1.36 years, the mean height was 148.95 $\pm$ 10.21 cm, and the mean body mass was 48.49 $\pm$ 12.03 kg. These values indicate a typical anthropometric profile for adolescents in this educational stage.

These baseline characteristics provide contextual information for interpreting the prevalence and distribution of postural deformities within the study population.

3-3 Study Setting and Sampling:

Temporal Scope

Data collection was conducted in two phases. The pilot phase took place in May 2021, during which preliminary measurements were collected to test and refine assessment procedures. The main data collection phase was carried out over a four-month period, from February 2022 to May 2022, during which the full field study was implemented.

Geographical Scope

The study was conducted in Wilaya of Setif, Algeria. Postural assessments were performed among middle-school students who were not engaged in any organized sports activities. Participants were randomly selected from four public middle schools in the region to ensure adequate representation of the target population.

Distribution of the Study Sample

Table 2. Distribution of non-sporting students by school (n = 270)

School	Number of Students (Sample)	Total Male Student Population
El Ikhwa Boudiaf Middle School	86	546
Bouhafs Mabrouk Middle School	72	548
18 February Middle School	54	384
Benani El Hadj Middle School	58	385

Table 2 presents the distribution of the non-sporting student sample across participating schools.

This sampling strategy ensured that participants were drawn from multiple educational institutions, enhancing the representativeness and generalizability of the findings within the Setif middle-school population.

3-4 Postural Assessment Tool

New York Posture Rating Test (NYPR)

The New York Postural Rating (NYPR) Chart was utilized to gather data concerning age, height, weight, and a multitude of characteristics associated with postural deformities. The NYPR employs a quantitative methodology for the evaluation of the proper and improper alignment of various body segments in the anatomical position (McRoberts et al., 2013).

The New York Posture Rating test is scored on a 5-3-1 basis, with a score of 5 points assigned to the description in the left-hand column, 3 points to the description in the middle column, and 1 point to the description in the right-hand column. The final raw score, which ranges from a minimum of 13 to a maximum of 65 points, will categorize the body posture as follows: 13 to 51 points indicates a poor posture, 52 to 59 points indicates a fair posture, and 60 to 65 points indicates a good posture.



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Table 3: The study variables (Assessment items from NYRP)

items	Postural deformities
1	Rounded shoulders
2	Drop Shoulder
3	Head tilt to one side
4	Flat chest
5	Sway back
6	Flat feet
7	lordosis
8	kyphosis
9	Abdominal sagging
10	Forward head
11	Out toeing
12	Lateral pelvic tilt
13	Scoliosis

3-5 Postural Variables Assessed

In this study, postural deformities were used as indicators of the overall postural status of middle-school students. Postural assessment included 13 specific deformities, representing deviations across the head, trunk, pelvis, and lower limbs. The evaluated postural variables were:

- Lateral head tilt
- Forward head posture
- Shoulder drop
- Rounded shoulders
- Thoracic kyphosis
- Lumbar lordosis (lumbar concavity)
- Lateral spinal curvature (scoliosis)
- Trunk tilt
- Pelvic tilt
- Abdominal protrusion
- Flat feet
- Lateral foot deviation
- Flattened chest



These variables were selected to provide a comprehensive evaluation of body alignment, allowing for the identification of segmental postural imbalances and an overall classification of postural health.

4 -Data Collection Procedure

Postural data were collected using the New York Posture Rating (NYPR) method during regularly scheduled assessment sessions conducted in designated areas within the participating middle schools under standardized and controlled conditions. All assessments were performed by a single trained examiner with a degree in sport science, ensuring consistency in evaluation and minimizing inter-rater variability.

Prior to assessment, the testing area was prepared by suspending a plumb line from a fixed vertical support, ensuring that the tip of the line touched the floor. A reference line was marked on the floor using adhesive tape, extending approximately 2 meters from the plumb line toward the examiner's position. This setup provided a vertical and horizontal reference framework to facilitate accurate observation of postural alignment in both frontal and sagittal planes.

Participants were instructed to stand in a natural, relaxed posture, barefoot, with their body positioned near the plumb line and aligned with the reference line. The examiner stood at a distance of approximately 3 meters from the participant, allowing a clear and standardized view of overall body alignment. Initially, the participant was assessed in the frontal plane, with the examiner visually observing head position, shoulder alignment, trunk symmetry, pelvic alignment, and lower limb posture relative to the plumb line.

Following the frontal plane assessment, participants were instructed to rotate 90 degrees to the left, positioning the lateral aspect of the body adjacent to the plumb line and perpendicular to the reference line. This position allowed the examiner to evaluate sagittal plane alignment, including forward head posture, thoracic curvature, lumbar curvature, abdominal posture, and overall body alignment.

Each anatomical segment was evaluated according to the standardized criteria of the New York Posture Rating chart, using visual observation and comparison with reference illustrations. Scores were recorded on the NYPR assessment form using the standardized three-level grading system (5 = normal posture, 3 = slight deviation, 1 = marked deviation). This procedure enabled a comprehensive and systematic assessment of overall postural status and individual postural deformities.

4-1 Fieldwork Procedure

Field data collection was conducted within the participating middle schools under standardized and controlled conditions. The school administrations provided appropriate facilities to ensure that assessments were performed in designated



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indoor rooms, allowing for a controlled environment while maintaining the privacy, comfort, and safety of the students.

To ensure accurate postural observation, students were assessed individually in a private assessment area. Participants were provided with appropriate attire, including shorts, to allow clear visualization of anatomical landmarks necessary for postural evaluation. Additionally, a dedicated space was provided for students to change clothing before the assessment.

All measurements were conducted following a systematic and standardized protocol, ensuring consistency in data collection across all participating schools. This controlled setup allowed the examiner to perform reliable visual postural assessments according to the criteria of the New York Posture Rating method, ensuring accuracy and methodological rigor throughout the fieldwork process.

4-2 Additional Verification Procedures

To enhance the accuracy of postural assessment and improve the validity of visual observations, the examiner employed additional functional screening tests in selected cases when further confirmation was required. These complementary assessments included the footprint test in both seated and single-leg standing positions, used to evaluate foot arch characteristics, and the forward trunk flexion test, used to assist in detecting potential lateral spinal deviations, such as scoliosis. These additional procedures were used to support and verify the findings obtained through the New York Posture Rating (NYPR) method, which is primarily based on visual observation and examiner judgment. As the NYPR is considered a subjective posture assessment tool, relying on standardized visual criteria and examiner interpretation, the use of complementary tests helped improve diagnostic confidence and reduce the risk of observational bias.

The integration of visual assessment with targeted functional screening tests contributed to a more comprehensive and reliable evaluation of postural deformities among the study participants.

4-3 Statistical Analysis

The obtained data were recorded and analyzed using SPSS version 25 software. Descriptive statistics were used, and variables were presented as numbers and percentages. The variables were assessed using the percentage method.

5- Results

Table 4 presents the frequency, percentage, and ranking of postural deformities observed among non-sporting middle-school students. The results indicate a high prevalence of postural deviations, with multiple anatomical regions affected across the sample.

The most prevalent deformity was lateral head tilt, observed in 226 students (84%), ranking first among all assessed variables. This was followed by rounded shoulders, affecting 209 students (77%), and thoracic kyphosis, observed in 187 students (69%), ranking second and third, respectively.

Abdominal protrusion was identified in 174 students (64%), ranking fourth, while both flat foot and flattened chest were observed in 163 students (60%) and 162 students (60%), respectively, ranking fifth and sixth.

Moderate prevalence rates were observed for pelvic tilt (140 students, 52%) and trunk tilt (135 students, 50%), followed by forward head posture, affecting 127 students (47%). Additionally, lateral spinal curvature (scoliosis) was detected in 117 students (43%), indicating a notable presence of spinal asymmetry within the sample.

Lower prevalence rates were recorded for lateral foot deviation, observed in 108 students (40%), and shoulder drop, affecting 107 students (40%). The least prevalent deformity was lumbar lordosis (lumbar concavity), identified in 101 students (37%).

Overall, these findings demonstrate that postural deformities are highly prevalent among non-sporting middle-school students, particularly affecting the head, shoulder, and spinal regions, which play a critical role in maintaining proper biomechanical alignment.

Table 4. Frequency, percentage, and ranking of postural deformities (n = 270)

Rank	Postural deformity	Frequency (n)	Percentage (%)
1	Lateral head tilt	226	84%
2	Rounded shoulders	209	77%
3	Thoracic kyphosis	187	69%
4	Abdominal protrusion	174	64%
5	Flat foot	163	60%
6	Flattened chest	162	60%
7	Pelvic tilt	140	52%
8	Trunk tilt	135	50%
9	Forward head posture	127	47%
10	Scoliosis	117	43%
11	Lateral foot deviation	108	40%
12	Shoulder drop	107	40%



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13	Lumbar lordosis	101	37%
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Table 4 presents the frequency and percentage distribution of overall postural status among non-sporting middle-school students, as assessed using the New York Posture Rating method.

The results indicate that a substantial proportion of students exhibited poor posture, affecting 169 students (62.59%), representing the majority of the sample. This was followed by acceptable posture, observed in 90 students (33.33%). In contrast, only 11 students (4.07%) were classified as having good posture, representing a very small proportion of the study population.

These findings highlight a high prevalence of inadequate postural alignment, with nearly two-thirds of the students demonstrating poor postural status. This distribution suggests that postural health represents a significant concern among non-sporting middle-school students and underscores the importance of early identification and preventive interventions.

Table 5. Overall postural status classification of non-sporting students (n = 270)

Postural status	Frequency (n)	Percentage (%)
Good posture	11	4.07%
Acceptable posture	90	33.33%
Poor posture	169	62.59%
Total	270	100%

6- Discussion

The present study aimed to identify the prevalence and characteristics of postural deformities among middle-school students who do not participate in organized sports. The findings revealed a high prevalence of postural deformities, with 62.59% of students classified as having poor posture, while 33.33% exhibited acceptable posture, and only 4.07% demonstrated good postural alignment. These findings indicate that the majority of non-sporting students present postural deviations that may compromise musculoskeletal health and increase the risk of further deterioration if not addressed.

These results are consistent with previous studies reporting a high prevalence of postural deformities among school-aged children. For example, Adi Jasem Hassan (2012) reported a prevalence rate of 69.25%, while Louh Hicham (2010) observed postural deformities in 77.67% of middle-school students. Similarly, Maisoon Alwan et al. (2010) reported a prevalence of 58%, which closely aligns with the findings of the present study. In addition, Li Yang (2020) reported a prevalence of

65.3% among children and adolescents in China, further confirming that postural deformities represent a widespread global concern. Other studies conducted by Hamdi Mohamed (2016), Ziani Mohamed (2017), Sahar Saad (2021), and Radakovic (2017) also reported prevalence rates ranging between 53% and 78% among non-sporting schoolchildren, supporting the consistency and validity of the current findings.

Analysis of the distribution and ranking of postural deformities revealed that lateral head tilt (84%) was the most prevalent deformity, followed by rounded shoulders (77%), thoracic kyphosis (69%), abdominal protrusion (64%), and flat foot (60%). These results are generally consistent with previous research, which identified rounded shoulders and spinal deviations among the most common postural abnormalities in schoolchildren. For instance, Hamdi Mohamed (2016) and Adi Jasem Hassan (2012) also reported rounded shoulders as one of the most prevalent deformities, while Louh Hicham (2010) identified thoracic kyphosis and head misalignment among the most frequent postural alterations.

The high prevalence of thoracic kyphosis and abdominal protrusion observed in this study may be associated with increased sedentary behavior and reduced physical activity. Prolonged sitting during school hours and leisure activities can weaken postural muscles and alter spinal alignment, contributing to spinal curvature abnormalities. Additionally, the anthropometric characteristics of the sample indicated relatively higher body mass among non-sporting students, which may increase mechanical load on the spine and contribute to postural imbalance, particularly abdominal protrusion and spinal curvature deviations.

The high prevalence of lateral head tilt observed in this study may also be attributed to prolonged static postures and repetitive visual focus, such as maintaining fixed head positions while looking at classroom boards, mobile devices, or computers. These sustained postural habits can lead to muscular imbalance, particularly in the cervical region, resulting in asymmetric muscle shortening and postural deviation. Furthermore, lifestyle factors such as insufficient physical activity and poor nutritional habits may contribute to the development of postural deformities. During adolescence, rapid growth combined with reduced muscular strength and improper posture habits increases vulnerability to postural deviations. As noted by Homam (1984), this developmental stage is characterized by increased appetite and physiological changes that may contribute to increased body mass and abdominal protrusion if not accompanied by adequate physical activity.

Although the general prevalence patterns observed in this study are consistent with previous research, some differences in the ranking of specific deformities were identified. For example, shoulder drop was among the least prevalent deformities in this study, whereas it was reported as one of the most prevalent deformities in studies conducted by Li Yang (2020), Louh Hicham (2010), and Hamdi Mohamed (2016). These differences may be explained by variations in sample characteristics,



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including age distribution, lifestyle habits, and environmental factors. Additionally, postural deformities develop progressively over time, and prolonged exposure to poor posture habits, such as improper backpack use during earlier school years, may contribute to variations in deformity patterns across different age groups.

Overall, the findings of this study confirm that postural deformities are highly prevalent among non-sporting middle-school students. These results highlight the critical role of physical activity, proper posture habits, and early preventive interventions in maintaining musculoskeletal health during adolescence. Without appropriate intervention, mild postural deviations may progress into more severe musculoskeletal disorders, potentially affecting functional capacity and long-term health outcomes.

7- Recommendations for Prevention

- **Early Screening.** Systematic posture checks in schools (e.g., simple observation and the Adams forward-bend test for spinal alignment) should be implemented to detect deformities early. Early identification can prompt timely referral to physiotherapy and prevent progression.
- **Posture Education.** Incorporate back-health and ergonomics education into the curriculum. Teaching students proper sitting posture, correct backpack use, and the importance of movement can empower them to self-correct poor habits. In fact, back-health programs that cover body mechanics and safe lifting/carrying have been shown to improve knowledge and reduce harmful postures. School-based curricula can provide hands-on lessons (e.g., adjusting chair and desk heights, avoiding slouching) so that posture knowledge is reinforced across years.
- **Corrective Exercise Integration.** Physical education classes should include specific exercises to strengthen postural muscles and counteract common deformities. Core stabilization, back-strengthening and stretching routines (for example, exercises against a wall, planks, shoulder retractions) can be taught regularly. Embedding posture-focused exercises in PE not only addresses existing deficits but also builds resilient muscle balance as children grow.
- **Ergonomic Improvements.** Adjust the school environment to fit children: provide lockers to reduce bag loads, use adjustable-height desks and chairs, and schedule frequent activity breaks so students do not sit statically for too long.

These school-based measures – screening, education, and exercise – are recommended by experts as key components of a preventive strategy. In practice,

combined interventions (back-care lessons plus core exercises) have shown promise in small trials, suggesting they could reduce back pain incidence if widely adopted.

8- Conclusion and Future Directions

The findings from this study underscore an urgent need to curb the rise of postural deformities in Algerian youth. In conclusion, two main actions are warranted. First, prospective longitudinal studies are needed to track how these posture problems evolve over time and respond to interventions. As one recent review notes, “cohort studies are needed to identify the impact of environmental factors or lifestyle changes that cause the onset of postural disorders in children”. Such research would clarify causality (e.g., how much heavy backpack usage in early teens predicts problems later) and quantify the benefit of prevention programs. Second, structured intervention research must be conducted in this population. There is a clear need for randomized trials of school-based posture interventions (combining education, ergonomic adjustments, and exercise) in similar middle-school settings. By rigorously testing and tailoring such programs, we can move beyond cross-sectional data and develop evidence-based strategies to reverse this troubling trend.

In summary, the exceptionally high rates of postural deformities we observed signal a public health priority. Without action, a generation of adolescents in Sétif may carry forward preventable spine problems into adulthood. Implementing early screening, posture education, and strengthening exercises in schools – and studying these measures prospectively – are critical next steps to protect the musculoskeletal health of children.

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