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Prevalence of Postural Deformities Among Adolescents Swimmers

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Abstract:

This study aimed to determine the prevalence of postural deformities among adolescent swimmers. A total of 128 adolescent swimmers aged 12-18 years were selected to participate in this study during the year 2022 at El Bez Olympic Swimming Pole in Wilaya of Setif. we asked them to complete a questionnaire about their sports practice, BMI, and the (NYPR). The results showed that there was a high percentage of postural deformities among adolescent swimmers with 68% in study cases.

Key words: Body Posture; Athletes; Adolescents; Swimming; NYPR.

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 (Aydın 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. Method

This cross-sectional study was conducted on a group of adolescents who regularly participated in swimming classes with a minimum of three years of training experiences, including at least three sessions per week. A total of 128 adolescent male swimmers were observed over a period of 10 days at the National School of Olympic Sports- Setif (the Olympic Swimming Pool El Bez).

All participants were between the ages of 12 and 18 years old. The mean age was 15.76±1.47 years old (range: 12-18). There were no significant differences in height or weight between males in the same group of age participants ($p>0.05$). The mean body mass index (BMI) was 21.42±2.64 kg/m2 (range: 15-24).

Variables	**Adolescents Swimmers**
Age (years)	15.76±1.47
Weight (Kg)	51.23±11.85
Height (cm)	166.71±12.66
Body mass index (Kg/m2)	21.42±2.64

Table 1 Demographic characteristics of studied population

All the study participants were members of structured developmental and competitive swimming clubs and trained several times a week, with each session lasting between 90 and 120 minutes. To be included in the sample, participants had to meet the following three criteria:

1. Regular swimming experience for a minimum of five years.
2. No regular participation in any other sport or physical activity.
3. No history of injury or congenital musculoskeletal abnormalities

.

The participants were selected from 10 different clubs from Wilaya of Setif (MSBEE, MRS, HIDAB, CASUC, COS, WRS, CRS, ASSO, CNS, ESS/N.P)

Clubs	Studied participants
MRS	18
HIDAB	17
MSBEE	15
CASUC	14
COS	12
WRS	9
ASSO	16
CNS	10
ESS/N.P	17

Table 2 The swimmers participants clubs

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.

items	Body part	Postural deformities
1	Head	Forward head
2	Shoulders	Drop Shoulder
3	Spine	Scoliosis, Sway back, lordosis, kyphosis
4	Hips	Lateral pelvic tilt
5	Feet Pointed	Out toeing
6	Feet arches	Flatfeet
7	Neck	Head tilt to one side
8	Chest	Flat chest
9	Shoulders	Rounded shoulders
10	Abdominal	Abdominal sagging

Table 3 The study variables (Assessment items from NYRP)

3. Data Collection Procedure

The data were collected using the New York Posture Rating (NYPR) method during regularly scheduled assessment sessions at El Bez Olympic Swimming Pool under controlled conditions. All of the assessments were performed by one trained examiner with a degree in sport science to ensure consistency and reduce inter-rater variability. Furthermore, before the assessment, the testing area was prepared by hanging a plumb line from a stationary object in front of a vertical screen so that the tip of it touched the floor. In addition, a straight line was marked on the floor using tape for reference. Also, the reference line extends approximately 2 meters from the plumb line and continues toward the examiner's position, as shown in Figure 3.

To begin the assessment, participants were instructed to stand naturally in a relaxed posture somewhere in between the screen and the plumb line (with their back facing the plumb line). Additionally, the examiner stood 3 meters away along the same line as the participants, with the plumb line being positioned halfway between him and the swimmers in order to view the lateral postural alignment and foot placement. After that evaluation, participants were instructed to make a 90-degree left turn so that the left side of the body was beside the plumb line and the feet were perpendicular to the floor's reference line, allowing the examiner to have a direct view and standardized observation of sagittal plane alignment. Subsequently, each body segment was assessed according to the NYPR Chart by visually observing each participant and referring to the standardized illustrations and descriptive criteria provided by the chart before recording the corresponding scores on the posture rating form.

4. Statistical Analysis

Obtained data was recorded and analyzed using SPSS version 25 software. Descriptive statistics were used, variables were presented as number and percentage. The variables were assessed using the percentage method.

5. Results

The study sample consisted of 120 adolescent swimmers aged between 12 and 18 years (mean age: 15.76±1.47 years), with a mean body mass of (51.23±11.85 kg) and a mean height of (166.71±12.66 cm).

Postural deformity	Frequency (n)	Percentage (%)	Rank
Rounded shoulders	82	68.3	1st
Drop Shoulder	80	66.7	2nd
Head tilt to one side	73	60.8	3rd
Flat chest	68	56.7	4th
Sway back	59	49.2	5th
Flat feet	54	45.0	6th
lordosis	52	43.3	7th
kyphosis	41	34.2	8th
Abdominal sagging	37	30.8	9th
Forward head	34	28.3	10th
Out toeing	31	25.8	11th
Lateral pelvic tilt	29	24.2	12th
Scoliosis	23	19.2	13th

Table 4 Frequency, percentage, and ranking of postural deformities among adolescent swimmers assessed using the New York Posture Rating (NYPR) (N = 120)

Table 4 illustrates the frequency, percentage, and ranking of postural deformities among adolescent swimmers. The highest percentage of postural deformities was rounded shoulders at (68.3%), followed closely by shoulder drop (66.7%). Moreover, head tilt to one side was observed 73 times at a rate of 60.8%. Other frequently noted deformities were Flat chest (56.7%) and trunk lean (49.2%). On the other hand, the lowest percentages of postural deformities were lateral pelvic tilt, which was observed at (24.2%), and scoliosis at (19.2%) of the respondents.

Postural status	Frequency (n)	Percentage (%)
Good posture	15	12.5
Fair posture	55	45.8
Poor posture	50	41.7
Total	120	100.0

Table 5 Distribution of postural status among adolescent swimmers according to the New York Posture Rating (NYPR) (N = 120)

As shown in Table 5, the New York Posture Rating (NYPR) assessment indicated that (41.7%) of adolescent swimmers were classified as having poor posture, and (45.8%) had fair posture,

while only (12.5%) were categorized as having good posture.

6. Discussion

The present study provides a comprehensive overview of the prevalence and distribution of postural deformities among adolescent swimmers aged between 11 and 15 years. The New York Posture Rating (NYPR) identified a significant number of participants with postural deviations, including almost half (41.7%) of all participants having poor posture and nearly 46% with fair posture, but only 12.5% displaying good posture. These results indicate that swimming, while beneficial from many perspectives, postural deviations remain common during adolescence. Furthermore, the most common postural deformities found after the analysis were rounded shoulders and shoulder drop, followed by head tilt to one side, flat chest, and trunk lean. This distribution points to more upper-body postural deformities than lower-body ones, particularly in the shoulder girdle, cervical spine, and upper thoracic spine. Supporting that, previous studies on swimmers has indicated that the shoulder position and head alignment are the two most common postural deformities found in swimmers from all the ages studied (Yang et al., 2020). Moreover, findings from the present study suggest that the relatively high occurrence of shoulder deformities is likely attributed to the biomechanical and functional demands associated with swimming.

With swimming being a sport characterized by numerous repetitions of upper limb movements (primarily at the shoulders), swimmers will repeatedly position their arms in a shoulder flexed, internally rotated and protracted position. This repetitive use of shoulder flexors and extensive physical strain would suggest that the prolonged, excessive engagement of the anterior shoulder and chest muscles could eventually develop muscular imbalances between the anterior and posterior muscle groups. Therefore, the cumulative effect of these muscular imbalances causes hunched, rounded shoulders, shoulder asymmetry, and altered head position. This is consistent with what has been described in the literature as upper crossed syndrome, which is a condition frequently seen among many athletes who partake in swimming and other sports that require significant amounts of overhead activity (Hibberd et al., 2016). Nevertheless, the presence of postural deformities in the pelvis, lower limbs, and spine, including lateral pelvic tilt, out-toeing, and scoliosis, were found to be among the least frequent deviations within the current study sample. This finding is consistent with prior research indicating that swimming has a more positive effect on lower-limb alignment and spinal symmetry than it does on the upper body

(Wang et al., 2019). Similarly, the moderate prevalence of thoracic kyphosis suggests that swimming may help mitigate the severity of specific spinal deviations; however, there is still a possibility that these deviations will occur (Aydın et al., 2020).

Based on the results obtained from this research, swimming may help prevent or reduce the prevalence or severity of certain deformities, such as those of the trunk and lower body. At the same time, it may also increase the risk of developing upper-body postural deviations due to the repetitive and asymmetric nature of the movements of swimming. Therefore, this showcases swimming as a sport-specific physical activity with both benefits and limitations in relation to postural health, creating an important balance between the potential to practice it as a protective activity and the need for additional corrective or strength training to address upper-body posture deficiencies during the adolescent years.

7. Practical Applications

The findings of the present study suggest numerous applications that can help decrease the frequency of postural deformities in adolescent swimmers and enhance postural health during the important period of development (adolescence).

To begin with, swimming is generally thought to be a full-body workout; however, it does not guarantee that there is equal effort applied to all muscle groups. Therefore, to ensure an even distribution of muscle use, swimmers should add a structured land-based conditioning training program to their water training. Specifically, implementing strength and corrective exercises can assist swimmers in correcting muscle imbalance issues and improving their postural stability. On top of that, it is recommended to use regular postural screening using reliable assessment tools such as the New York Posture Rating (NYPR). The reason for this is that rapid growth and musculoskeletal changes increase the risk of developing postural deviations, especially during adolescence period. By identifying these deviations at an early stage, it allows for timely corrective intervention before the postural deformity is more pronounced.

In addition to that, it is imperative for coaches and trainers to incorporate exercises focusing on posture with particular emphasis on the shoulder girdle, trunk, and core muscles. Moreover, athletes can also benefit from improved recruitment of underactive muscle groups to perform better by improving neuromuscular control to counteract the repetitive movement patterns inherent in swimming. Another thing that is worth mentioning is that swimmers who already exhibit postural deformities should be advised to consult

with qualified and certified professionals (coaches, physiotherapists, or sport rehabilitation specialists) to tailor their training based on their individual postural needs. In this regard, swimming should not be viewed in isolation as a standalone corrective intervention, especially where conditions such as lumbar hyperlordosis or shoulder asymmetries are concerned.

8. Conclusion:

The present study aimed to report the prevalence and distribution of postural deformities among adolescent swimmers aged 11–15 years using the New York Posture Rating (NYPR). The findings demonstrated 41.7% prevalence of postural deviations within this population, with of the swimmers classified as having poor posture and only a small proportion presenting good postural alignment.

Rounded shoulders, shoulder drop, head tilt to one side, and flat chest were the most frequently observed postural deformities, indicating a predominance of upper-body postural alterations among adolescent swimmers. In contrast, deformities affecting the pelvis and spinal alignment, such as lateral pelvic tilt and scoliosis, were less prevalent.

In conclusion, postural deformities are common among adolescent swimmers, highlighting the importance of systematic postural screening in this population. These findings provide baseline data on postural characteristics in young swimmers and may serve as a reference for future research examining postural development in youth sports.

9. References

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Appendices:

Figure 1: The New York Posture Rating Chart

السن	13	الطول	158	الوزن	52

اختبار ولاية نيويورك للحالة القوامية

			الانحراف اث القوامية	لا يوجد	يوجد	
		Profile		Good	Fair	Poor
				5	3	1
الوضع الجانبي Lateral Posture	1	Head	تصعر العنق			
	2	Shoulders	سقوط أحد الكتفين			
	3	Spine	الانحناء الجانبي (الالتواء الجانبي)			
	4	Hips	ميل الحوض للجانب			
	5	Feet pointed	انحراف القدم للجانب			
	6	Feet arches	تفلطح القدمين			

الوضع الأمامي Anteroposterior Posture	7	Neck	سقوط الراس اماما او خلفا		
	8	Chest	تسطح الصدر		
	9	Shoulders	استدارة الكتفين (المنكبين)		
	10	Upper back	تحدب الظهر		
	11	Trunk	ميل الجذع للامام أو الخلف		
	12	Abdomen	ترهل البطن		
	13	Lower back	التقعر القطني		
		المجموع			

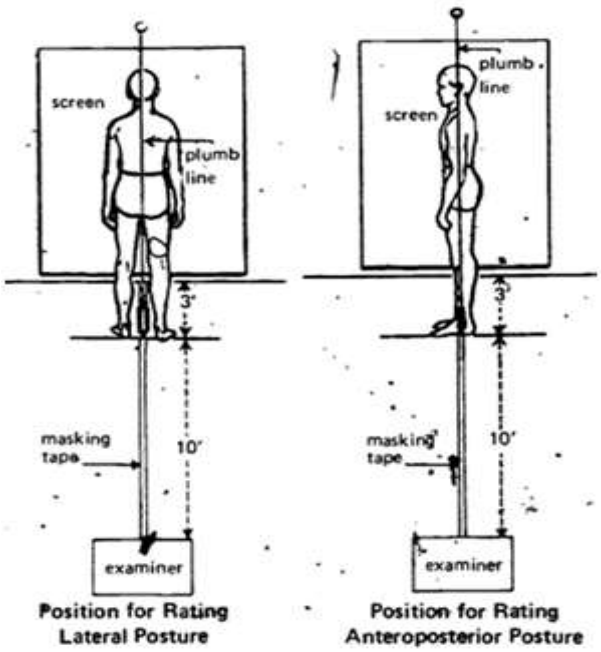

Figure 2: The swimmers clubs (Wilaya of Setif)

Fédération Algérienne de Natation

Direction du développement et de la formation

Fiche technique (statistique par ligue)

1- Etat des entraineurs par ligue :

ligues	Clubs Affiliés	Initiateurs	1er degré	2ème degré	3ème degré	Educateurs	Licencier	TSS	CS	Autre
SETIF	13	22	12	00	00	08	14	04	05	00

2- Etat des athlètes Licenciés :

CLUB	E/F	E/G	P/F	P/G	B/F	B/G	M/F	M/G	J/F	J/G	S/F	S/G	W.P	TOT
M.S.B.E.E	19	58	05	30	08	28	00	10	00	10	00	01	57	226
M.R.S	23	121	07	18	02	16	02	10	01	03	03	05	00	211
C.A.S.U.C	32	90	04	05	04	10	00	01	00	00	00	00	57	203
C.O.S	24	102	05	14	06	10	02	04	01	00	00	00	00	169
W.R.S	19	69	03	05	00	00	00	00	00	00	00	00	57	153
HIDHAB	38	59	07	11	05	11	06	06	00	07	00	00	00	150
O.M.R	00	36	00	16	00	15	00	03	00	01	00	01	00	72
C.R.S	13	17	02	08	05	08	01	01	00	00	00	00	00	55
I.R.C.S	07	30	00	03	00	01	00	00	00	00	00	00	00	41
S.A.F.A /AZEL	00	27	00	02	00	07	00	03	00	00	00	00	00	39
HODNA MSILA	00	00	00	00	09	10	00	08	03	04	00	00	00	34
DPH / BBA	00	00	00	05	00	10	00	05	00	06	00	04	00	30
N.C.R.B A/AZEL	00	18	00	04	00	06	00	02	00	00	00	00	00	30
TOTAL	175	621	33	121	39	132	11	43	05	31	03	11	171	1413

Figure 3