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Postural response and behavioral habits in adolescent girls at public and international schools. An observational case control study

Odpowiedź posturalna i nawyki behawioralne u nastolatek uczęszczających do szkół publicznych oraz międzynarodowych. Kliniczno-kontrolne badanie obserwacyjne

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Abstract

Background. The impact of behavioral risk factors, specifically postural habits and the presence of postural changes, has been identified as a significant concern for adolescent females, particularly in public school settings.
Purpose of the study. This study aims to conduct a comparative analysis of postural changes, behavioral postures, back pain, and behavioral habits between adolescent females in public and international schools.
Methods. A case-control study was executed, involving 200 adolescent females aged 13–17 years. The participants were divided into two groups: Group (A) from public schools and Group (B) from international schools. The evaluation process employed a combination of video and image analysis using Kinova and the Back Pain and Body Posture Evaluation Instrument.
Results. Statistical analysis revealed a lack of significant difference between Groups (A&B) concerning forward head posture (cranio-vertebral angle by Kinova). However, a notable distinction was observed between the groups in terms of back pain, behavioral habits, hereditary factors, and socioeconomic status.
Conclusion. While both groups exhibited a prevalence of forward head posture among adolescent females, Group (A) from public schools demonstrated a higher incidence of back pain, associated with behavioral habits, socioeconomic factors and hereditary influences on back pain. Postural changes and back pain in public schools were attributed to factors such as load, duration of TV watching, lack of exercise, backpack-carrying duration, hereditary factors, and socioeconomic status (parents' education level up to secondary schools).

Keywords

postural response, behavioral habits, adolescent females, public schools, international schools

Streszczenie

Cel badania. Przeprowadzenie analizy porównawczej w zakresie: zmian posturalnych, nawyków i postaw behawioralnych, a także bólu pleców u nastoletnich uczennic szkół publicznych oraz międzynarodowych.
Metody. Badanie kliniczno-kontrolne przeprowadzono z udziałem 200 nastoletnich dziewcząt w wieku 13–17 lat. Uczestniczki zostały podzielone na dwie grupy: Grupę (A) – uczennice szkół publicznych, a także Grupę (B) – uczennice szkół międzynarodowych. Proces oceny obejmował analizę wideo i obrazów z pomocą Kinova oraz Narzędzi Oceny Bólu Pleców i Postawy Ciała (BackPEI).
Wyniki. Analiza statystyczna nie wykazała istotnych różnic między grupami (A i B) pod względem postawy z wysuniętą głową (kąt czaszkowo-kręgowy mierzony przez Kinova). Zauważono jednak znaczną różnicę w zakresie: bólu pleców, nawyków behawioralnych, czynników dziedzicznych i statusu społeczno-ekonomicznego.
Wnioski. W obu grupach potwierdzono występowanie postawy z wysuniętą głową. W Grupie (A) wskaźnik bólu pleców (spowodowanego nawykami behawioralnymi, czynnikami społeczno-ekonomicznymi i dziedzicznymi) okazał się jednak wyższy. Zmiany posturalne i dolegliwości bólowe przypisano tu czynnikom, takim jak: obciążenie, czas oglądania telewizji oraz noszenia plecaka, brak ćwiczeń, czynniki dziedziczne i status społeczno-ekonomiczny (wykształcenie rodziców na poziomie szkoły średniej).

Słowa kluczowe

odpowiedź posturalna, nawyki behawioralne, nastolatki, szkoły publiczne, szkoły międzynarodowe

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Introduction

Posture plays a pivotal role in maintaining the health of the musculoskeletal system [1]. It is a dynamic outcome of the interplay between gravity and the positioning of the body's limbs, subject to changes over time. The onset of bodily growth and development typically initiates during the school-age period [2]. The genesis of postural changes and pain can be attributed to persistent improper sitting positions, misuse of furniture, and the burden of backpack weight, potentially acting as precursors to degenerative spinal conditions in adulthood [3].

Furthermore, the type of school and the nature of furniture may act as predisposing factors for postural changes during the school-age period [4]. Static postural changes are closely linked to risk factors for spinal issues, emphasizing the critical importance of early detection as a primary preventive measure against conditions that may lead to the development of spinal disorders [3, 5]. Risk factors associated with poor posture include behavioral changes stemming from modernization processes, impacting lifestyle habits such as reduced physical activity, increased likelihood of obesity, prolonged screen time, and frequent use of automobiles [6].

A high incidence of postural deviations in school-age students, attributing these asymmetries to daily physical demands that can adversely impact their quality of life [7]. Additionally, a prior study highlighting a high prevalence of back pain among Egyptian school girls underscores the relevance of investigating postural issues in adolescents [8].

In the context of adolescents, centering backpacks at waist level recommended as an optimal position to actively reduce loads, thereby minimizing postural displacement and spinal pain [9]. This underscores the importance of disseminating information to parents and teachers about the significance of maintaining good posture [7].

Given the critical nature of growth spurts during adolescence, characterized by numerous adjustments, adaptations, and psychosocial and physical changes, the early detection of static postural changes becomes imperative [10, 11]. Adolescent females were chosen as the focal group for this study based on existing research indicating their heightened susceptibility to pain and posture-related issues. Consequently, this study seeks to elucidate the varied mechanical posture changes, back pain, and behavioral risk factors among adolescent females in public schools as compared to their counterparts in international schools.

Materials and methods

An observational case-control study was meticulously designed, securing approval from the Institutional Review Board at the Faculty of Physical Therapy, Cairo University, before initiation (Approval No: P.T.REC/012/004871). The study adhered strictly to the Guidelines of the Declaration of Helsinki for human research. The data collection period spanned from March 2019 to December 2019.

Participants

A carefully selected sample of 200 adolescent female subjects, meeting the following criteria: aged 13 to 17 years, BMI ranging from 20 to 30 kg/m² (to mitigate the impact of obesity on posture changes) and demonstrated regular menstruation for a duration of at least 6 months to 3 years. Each participant completed a comprehensive questionnaire addressing aspects such as sports engagement, TV-watching hours, body posture during various activities, parental education level, and backpack style and carrying methods. Consent for participation was obtained from school principals, and all participants willingly agreed to partake in the study.

Personal data, including age, height, weight, BMI, and menstrual history, were meticulously recorded on a dedicated data sheet. The adolescent females were categorically divided into two equal groups: Group (A) representing public schools and Group (B) representing international schools. Exclusion criteria encompassed chronic respiratory disease, a history of upper and lower limb problems, back deformities, underweight status, and females without a menstrual cycle or experiencing severe dysmenorrhea pain.

Procedures and outcomes

A single examiner consistently conducted evaluations, employing the same methodology for all participants. Posture examination utilized Kinovea, a specialized video analysis software designed for sports-related assessments. The craniovertical angle (CVA) was measured, utilizing Kinovea which is a validated method for assessing forward head posture [12, 13]. The software allowed frame-by-frame analysis, enabling precise evaluation with lines and arrows added for accurate measurements. The computer program was installed on an Acer laptop with specific technical specifications.

To assess pain level, Visual Analogue Scale (VAS) for back pain assessment, were administered after identification. The VAS, a validated and reliable measure, utilized a 10 cm horizontal line with endpoints representing "no pain" (0) and "worst pain" (10), enabling graphic and numerical analyses [14].

To assess postural changes, the Back Pain and Body Posture Evaluation Instrument [BackPEI], a self-administered questionnaire, consisting of 21 closed questions addressing various factors, including back pain, demographics, socioeconomic status, behavioral factors, postural factors, and hereditary factors, was utilized to determine the prevalence of back pain and identify behavioral and postural habits [15].

Statistical analysis

The study analyzed data using SPSS® software. Mann Whitney test was used to assess changes in forward head posture between two groups. Chi Square test was used to assess changes in physical exercise practice, frequency, and direction. The study also examined factors such as sleep patterns, TV time, computer usage, and posture during sleep. The results showed significant differences in postures and behaviors between the two groups, including back pain rating, anxiety, stress, and physical exercise practice.

Results

Forward head posture Sagittal by kinovea

Table 1. displays the median interquartile range (IQR) of the total shift in the sagittal view for "Group A" as 45.00 (5.0), and for "Group B" as 45.00 (4.75.The Mann-Whitney U test was employed to compare the forward head posture between

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the two groups, revealing no statistically significant difference (U-value = 4786 Z-value = −0.524, p = 0.6*).

Back pain rating by VAS

Back Pain Rating by VAS: Table 1. shows the interquartile range (IQR) of pain scoring for "Group A" as 5.00 (1.00) and for "Group B" as 2.00 (2.75). A statistically significant increase in back pain was observed in favor of "Group A" compared to "Group B".

Table 1. Comparison between group A and group B values of forward head and pain scoring

Variable	Group (A) Median (IQR)	Group (B) Median (IQR)	Z-value	P-value
Forward head	45 (5)	45 (4.75)	−0.524	0.6
Pain scoring	5 (1)	2 (2.75)	−6.65	0.0001*

IQR: interquartile range, U-value: Mann-Whitney U, p-Value = Probability level, Z-value: Z score, S: Significant. NS: non-Significant

Back PEI outcomes:

Presence of back pain in the last three months

Table (2) illustrates the results of the chi-square test, indicating a significant difference in the presence of back pain between the two groups with (p = 0.000 and x^2 = 16.044). The analysis underscores a notable variation in the prevalence of back pain over the last three months, with statistical significance.

Socioeconomic status (educational level of parents/guardians and school type)

Table 2. demonstrates the results of the chi-square test, revealing a significant difference in the educational level of fathers and educational level of mothers between both groups.

Behavioral factors (physical activity, reading/studying in bed, hours/day watching television and at the computer, hours of sleep per night)

The chi-square test in Table 2. indicates a significant difference in physical exercise practice, frequency of physical exercise, competitive physical exercise practice, daily time spent watching TV, daily time spent using a computer, the time of sleep per night between both groups. Unless there is no significant difference in reading/studying in bed between both groups.

Postural factors (manner of sitting to write and to use the computer, means and manner of carrying school materials, manner of sleeping and manner of sitting on a bench)

Significant differences in sleeping posture and carrying a school backpack between the two groups are illustrated in Table 2. while there is No significant difference in the seated writing posture, the seated position on a stool, seated computer posture, posture to pick objects from the floor and carrying school supplies.

Hereditary factors (occurrence of back pain in parents)

The chi-square test reveals a significant difference in hereditary factors (occurrence of back pain in parents) between both groups as shown in Table 2. The results presented in Table 2. provide a comprehensive overview of the significant differences in socioeconomic status, behavioral factors, postural factors, and hereditary factors between "Group A" and "Group B."

Table 2. Comparison between group A and group B values of back PEI Questionnaire

Variable		Group (A) Number (Percent)	Group (B) Number (Percent)	χ2 value	p value
Presence of back pain	Yes	86 (86%)	61 (61%)	16.044	0.000*
	No	14 (14%)	39 (39%)		
Father education	He did not attend school	6 (6%)	1 (1%)	153.785	0.000*
	Primary school	28 (28%)	1 (1%)		
	Secondary school	54 (54%)	0 (0%)		
	Higher education	12 (12%)	90 (90%)		
	I don't know	0 (0%)	7 (7%)		
	I don't have a male parent	0 (0%)	1 (1%)		

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Variable		Group (A) Number (Percent)	Group (B) Number (Percent)	χ2 value	p value
Mother education	She did not attend school	22 (22%)	0 (0%)	160.256	0.000*
	Primary school	25 (25%)	0 (0%)		
	Secondary school	43 (43%)	88 (88%)		
	Higher education	10 (10%)	10 (10%)		
	I don't know	0 (0%)	0 (0%)		
	I don't have a male parent	0 (0%)	1 (1%)		
Physical exercise practice	Yes	20 (20%)	50 (50%)	19.780	0.000*
	No	80 (80%)	50 (50%)		
Frequency of physical exercise	No	81 (81%)	50 (50%)	25.863	0.000*
	1-2 days a week	11 (11%)	14 (14%)		
	3-4 days a week	4 (4%)	2 (2%)		
	5 or more day a week	3 (3%)	29 (29%)		
	It varies by	1 (1%)	5 (5%)		
Competitive physical exercise practice	Yes	0 (0%)	28 (28%)	32.558	0.000*
	No	100 (100%)	72 (72%)		
Time of TV watching a day	0-1 hour a day	21 (21%)	39 (39%)	52.968	0.004*
	2-3 hours a day	45 (45%)	12 (12%)		
	4-5 hours a day	18 (18%)	10 (10%)		
	6-7 hours a day	11 (11%)	6 (6%)		
	8 hours or more a day	1 (1%)	33 (33%)		
	I do not know	2 (2%)	0 (0%)		
Computer using frequency	0-1 hour a day	37 (37%)	29 (29%)	38.556	0.004*
	2-3 hours a day	25 (25%)	18 (18%)		
	4-5 hours a day	4 (4%)	9 (9%)		
	6 or more hours a day	31 (31%)	11 (11%)		
	I do not know	3 (3%)	33 (33%)		
Sleeping time / night frequency	0-6 hour	17 (17%)	12 (12%)	39.431	0.000*
	7 hours	62 (62%)	10 (10%)		
	8-9 hours	14 (14%)	34 (34%)		
	10 or more	0 (0%)	16 (16%)		
	I do not know	5 (5%)	28 (28%)		

χ^2-value: Pearson Chi-Square value, p-Value = Probability level, S: Significant

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Variable		Group (A) Number (Percent)	Group (B) Number (Percent)	χ2 value	p value
Read / study in bed	Yes	51 (51%)	48 (48%)	0.180	0.695
	No	49 (49%)	52 (52%)		
	Sometimes	33 (33%)	35 (35%)		
Sleeping posture	On my side	16 (16%)	35 (35%)	15.860	0.000*
	Face up	17 (17%)	21 (21%)		
	Face down	17 (17%)	2 (2%)		
	It varies	17 (17%)	7 (7%)		
Seated position while writing posture	Inadequate	90 (90%)	91 (91%)	0.810	0.058
	Adequate	10 (10%)	9 (9%)		
Seated position on a stool posture	Inadequate	90 (90%)	90 (90%)	2.222	0.681
	Adequate	10 (10%)	8 (8%)		
	Could not identify one among these	0 (0%)	2 (2%)		
Posture in the seated position on the computer	Inadequate	86 (86%)	89 (89%)	1.099	0.384
	Adequate	11 (11%)	10 (10%)		
	Could not identify one among these	3 (3%)	1 (1%)		
Posture to pick object from floor	Inadequate	87 (87%)	83 (83%)	1.404	0.348
	Adequate	13 (13%)	16 (16%)		
	Could not identify one among these	0 (0%)	1 (1%)		
Carrying school supplies	Backpack with 2 Straps	95 (95%)	99 (99%)	2.749	0.098
	Backpack with 1 Strap	5 (5%)	1 (1%)		
Carrying school backpack	Inadequate	29 (29%)	59 (59%)	18.263	0.000*
	Adequate	71 (71%)	41 (41%)		
Hereditary factors	Yes	97 (97%)	48 (48%)	60.617	0.000*
	No	3 (3%)	31 (31%)		
	I don't know	0 (0%)	21 (21%)		

χ^2-value: Pearson Chi-Square value, p-Value = Probability level, S: Significant

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Discussion

Posture is a crucial aspect of health, representing the proper alignment of body parts and a fundamental motor habit in daily activities. The mastery of postural control is essential for engaging in physical activities [16].

Adolescence, characterized by accelerated physical growth, changes in adipose tissue distribution, increased bone length, and higher joint forces, is a critical developmental stage. Onset around age 11 in females, early adolescence poses an increased risk of lower extremity injuries compared to males [17]. External forces applied to the body often lead to postural deviations, causing misalignment with the gravitational axis [9]. Unhealthy lifestyles, technological advancements, excessive academic work, and low physical activity levels in today's children contribute to postural alterations during adolescence. The resulting postural deviations pose significant health and social challenges, particularly in the realms of primary care and education [10]. Large postural changes in spinal alignment play a role in the development of back pain [18].

Several studies have highlighted the vulnerability of adolescent females to postural changes and associated pain, with forward head carriage being a common occurrence [9, 11, 18, 19]. Proper posture habits and training are crucial in schools to prevent neck and shoulder pain and functional disorders [20].

Consequently, early evaluation of postural changes in adolescent females becomes essential in school settings. The current study aimed to assess such postural changes among girls attending both public and international schools.

The measurement of the cranio-vertebral angle (CVA) using Kinovea in the current study revealed that there was no significant difference in forward head deviation between the two groups (A&B). The majority of females in both groups exhibited forward head posture.

However, statistical analysis indicated significant differences between both groups (A&B) at back pain and behavioral habits, hereditary factors and socioeconomic status. Group (A) had high prevalence of back pain than group (B). But there is no difference between both groups at postural habits, because both of them hadn't postural education. The adolescent females at both public and international schools have forward head from lateral view by kinovea. In current study, adolescent females at public schools have more posture changes and back pain than international schools.

A study supporting the assertion that socioeconomic factors, including school type and parental education, influence posture and musculoskeletal health. Higher prevalence of postural changes and antero-posterior deviations was noted in students from public schools, where parental education levels were lower. This underscores the importance of routine postural assessments in schools and the role of health professionals, including physical education teachers, in conducting these assessments [4, 21].

In agreement with current study, a previous study at public school showed that nonspecific low back pain is associated with perceptions of a heavy school bag, duration of school bag carriage, no sports participation, prolo1nged sitting on entertainment activities. These findings add to the importance of promoting physical activity at school or home especially aimed at improving muscle flexibility [22].

The current study's findings align with previous research indicating that Improper postures adopted by children at home and school can result in musculature imbalances, leading to lasting postural abnormalities and painful syndromes in adulthood, impacting long-term health [23].Studies have also noted descend in mean thoracic kyphosis during the descending phase of peak spine growth in females in which female students are reported to have more frequent lower extremity and back complaints than their male counterparts [24, 25].

In addition, a study found that the prevalence of antero-posterior postural changes was higher in female adolescents from public schools and was associated with school type and parents' education levels. This is due to a relationship between back pain, school bag weight, and unhealthy habits in governmental preparatory schools which influences activities of daily life [21, 26].

Moreover, the study emphasizes the multifactorial nature of musculoskeletal disorders in adolescents, involving factors such as sports participation, sedentary behavior, poor posture, and heavy backpack use, watching television and using the computer [24, 27, 28, 29].

The results also corroborate the impact of hereditary factors on musculoskeletal health, with a higher prevalence of back pain in adolescents from public schools. The study underscores the need for interventions, such as postural education and early detection of musculoskeletal changes, to prevent long-term health issues [30]. The Back Pain and Body Posture Evaluation Instrument (Back PEI) proved valuable in assessing a range of risk factors associated with back pain in school-age children [31].

In agreement with previous studies, the current research highlights the influence of backpack use on cervical and shoulder posture in adolescent students [32]. The weight and style of backpacks, along with improper postural habits during activities of daily living, contribute to the occurrence of back pain [33]. The study's findings support the need for encouraging postural assessment and early detection of changes to mitigate long-term impacts on musculoskeletal health [30].

Limitations of the study include the lack of a longitudinal design and potential confounding factors not considered in the analysis. Additionally, the findings may not be generalizable to all adolescent populations.

This study had some strength points. It was carried out on 200 adolescent females and the determination of anatomical land markers was detected by reflected land marker accurately. Almost of females were not obese so, it was easy to detect land marker. The majority of the female although, with clothes were allowed to specify points of land marker.

In conclusion, this study contributes valuable insights into the prevalence of postural changes, back pain, and associated factors in adolescent females attending public and international schools. The results emphasize the need for routine postural assessments in schools, targeted interventions, and early detection of musculoskeletal changes to promote long-term health and prevent postural-related issues in adulthood. Health professionals, educators, and parents should collaborate to implement strategies that foster proper posture habits and overall musculoskeletal well-being in adolescents.

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Conclusions

Adolescent females have postural changes (deviations) at age of school. Adolescent females have forward heads at both public and international schools there's significant difference between both groups (A&B) at back pain and behavioral habits, hereditary factors, and socioeconomic status. Group (A) had high prevalence of back pain than group (B). But there is no difference between both groups at postural habits because both hadn't postural education.

In light of these findings, it is recommended that interventions promoting postural exercises and ergonomic practices be implemented in both public and international schools. Such measures aim to mitigate the occurrence of musculoskeletal disorders and pain among adolescent females.

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