Prevalence of Scoliosis among High School Students

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Objective: *This study aimed to survey the prevalence of scoliosis in Thai high school students.*
Material and Method: *Physical therapists assessed the postural alignment in three planes during standing position by observation, palpation, and Adam's forward bending test. The data were analyzed using descriptive statistics and Chi-square analysis.*
Results: *Three hundred and seventy-four high school students (297 males and 77 females) were recruited from three schools in the Bangkok Metropolitan Area. The prevalence of scoliosis was 22.7%. A significant difference was observed between sex and scoliosis prevalence ($\chi^2 = 6.73$, $p<0.05$) with a prevalence ratio (female:male) of 1.70. A significant difference of scoliosis prevalence was found between school 1 and school 3 ($\chi^2 = 4.33$, $p<0.05$) with a ratio of 1.74. Most scoliosis levels were found at the thoracolumbar level. The assessments of 84.7% for waist form, 76.5% for scapular border, and 71.8% for thoracic scoliosis were the most common anomaly of postural alignment in the scoliosis group.*
Conclusion: *The prevalence of scoliosis in females was higher than in males at a ratio of 1.70. A significant difference was revealed among schools that might be affected by environmental factors.*

Keywords: *Scoliosis, Structural scoliosis, Functional scoliosis, Adam's forward bending test*

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Scoliosis is a condition of the three-dimension spinal deviation from the midline. Nowadays, school screening programs operate in many countries[1-4]. Scoliosis screening has been accomplished using several screening tests such as observation, palpation, Adam's forward bending test, scoliometer, surface topography, Cobb's method, etc. The most common methods are Adam's forward bending test and scoliometer because these methods are simple, fast, and reliable[2,5-7].

Previous scoliosis survey studies in Thailand, did not investigate high school students between 14-19 years old[8-10]. These students are preparing to enter the university and develop their self-esteem. Studies have illustrated that scoliosis is associated with increased back pain, stress level, and lowered quality of life[11]. Early detection of scoliosis is important to prevent progressive scoliosis, its complication and promote health. Therefore, the purposes of this study were to study the prevalence and survey scoliosis using a developed assessment form among high school students.

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Material and Method

This study was approved by the Mahidol University Institutional Review Board (MU-IRB COA. NO. 2013/035.2504). Convenience sampling was used. The subjects were recruited from three Thai high schools in the Bangkok Metropolitan Area near the campus of the Faculty of Physical Therapy, Mahidol University. The researchers announced information to all of the 10^{th}-12^{th} grade students in three high schools after receiving permission from the headmasters in each school. Students interested to participate in the study were provided information sheets and consent forms that they brought to their parents or guardians to be signed. The inclusion criteria included studying in grade 10^{th}-12^{th}. Those subjects who were unable to follow simple instructions such as standing for 10 minutes, and performing forward trunk bending were excluded. The surveys were conducted from October 2013 to April

2014. The collected data included age, sex, body weight, body height, leg length, dominant hand, previous injury, and vision. The subjects wore shorts at a length above their ankles. Males were asked to take off their shirts and females were asked to wear backless shirts that were prepared to judge the spinal alignment clearly (Fig. 1). Five certified Schroth physical therapists with more than three years' experience participated in the study. The assessment form was developed by the Faculty of Physical Therapy, Mahidol University and the reliability of the physical therapists was ascertained in a previous study[12]. The physical therapist screened the alignment of the whole body part of a subject in posterior, anterior, and lateral views. The subjects stood still for 10 minutes. The subjects, who had abnormal alignment of the spine and positive resulting from the Adam's forward bending test, were evaluated for the degree of spinal deviation using a scoliometer. Then they received advice for preventing progressive scoliosis. The screening data were reported to subjects and their parents or guardians by a summary report.

Descriptive statistics and Chi-square analysis were used to determine the prevalence and the associations between schools, sex, and scoliosis occurrence using SPSS version 21.0.

Results

Three hundred and seventy-four high school students participated in this study comprising 297 males and 77 females between 14 and 19 years old (15.76±1.01). School 1 and 2 were co-educational schools, whereas school 3 was a male only school. School 2 was a boarding school. Table 1 illustrates the demographic data of the subjects. The prevalence of

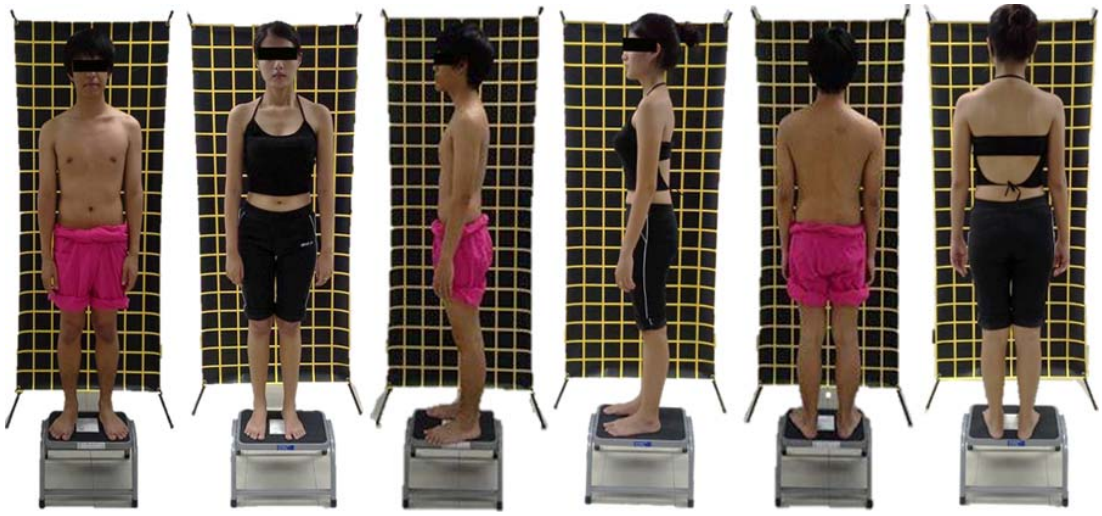

Fig. 1 Dress and position of subjects.

Table 1. Demographic data of subjects (n = 374)

	School 1	School 2	School 3	Total
Age (year), mean ± SD	17.4±0.58	16.17±0.95	15.2±0.51	15.47±0.81
Male, n (%)				
Normal	10	50	178	238 (80.1)
Functional scoliosis	1	5	4	10 (3.4)
Structural scoliosis	4	7	27	38 (12.8)
Risk to scoliosis	-	2	9	11 (3.7)
Female, n (%)				
Normal	22	29	-	51 (66.2)
Functional scoliosis	1	1	-	2 (2.6)
Structural scoliosis	9	9	-	18 (23.4)
Risk to scoliosis	-	6	-	6 (7.8)

Table 2. Chi-square associations between schools and type of scoliosis

Type of scoliosis	Statistic	School		
		1 and 2	1 and 3	2 and 3
Scoliosis	Chi-square	0.31	4.33	3.64
	p-value	0.58	0.04*	0.06
Functional scoliosis	Chi-square	0.11	1.02	3.30
	p-value	0.75	0.31	0.07
Structural scoliosis	Chi-square	3.66	7.04	0.34
	p-value	0.06	0.01*	0.56
Risk to scoliosis	Chi-square	3.64	2.01	1.52
	p-value	0.06	0.16	0.22

* *p*-value <0.005

scoliosis in this study was 22.7% (85 of 374 students). A significant difference between sexes and scoliosis prevalence, with a female to male ratio of 1.70 ($\chi^2 = 6.73$, $p<0.05$). A significant association was revealed between scoliosis and school 1 and school 3 ($\chi^2 = 4.33$, $p<0.05$) with a prevalence ratio of 1.74 (Table 2).

The results found three indices that had the most common anomaly in this survey, namely, shoulder level (76.7%), scapular movement (retraction and protraction) (69.3%), and pelvic tilt (68.7%). The three uppermost indices showed an aberration of postural alignment specifically in students with scoliosis comprising the waist form (the line between waist curve and arm) (84.7%), scapular border (space between the scapular border and spine) (76.5%), and thoracic scoliosis (71.8%). Most scoliosis levels were found at the thoracolumbar level.

The results of scoliosis were categorized in three groups: functional scoliosis (FS) defined as structurally normal spine appearing curved due to underlying condition, structural scoliosis (SS) defined as positive Adam's Forward Bending test $\geq 7°$, and risk to scoliosis (RS) defined as positive Adam's Forward Bending test $<7°$. The results found the prevalence of FS, SS, and RS was 14.1%, 65.9%, and 20%, respectively.

Discussion

The prevalence of this survey was higher than that of previous studies[1,2,13]. Zurita et al[1] reported the prevalence of scoliosis among Mexican school children was 14.2%. Adobor et al[2] performed a school screening among Norwegian children aged 12 years, and they reported that the prevalence of scoliosis was 0.55%. Zhang et al[11] indicated that the prevalence of scoliosis might vary in different areas. High prevalence of scoliosis in the present study might relate to school scoliosis screening. This survey was conducted only for interested participants so that they would know their abnormal posture and desire to recheck in their school survey program. Grivas et al[14] suggested that school scoliosis screening is the best effective method for early detection and prevention of scoliosis. Considering these factors, education is necessary, and the conclusion should be confirmed by a large, multiple-area epidemiological study.

The result revealed significant differences between school 1 and school 3. School 1 was a co-educational school, and school 3 was a school for males only. Both schools were government schools. Hermus et al[15] discussed the etiology of scoliosis remained uncertain, but might be changed by environmental factors. Therefore, the differences of scoliosis incidence in two schools might relate to factors such as equipment and instructional devices, e.g., projector, computer, blackboard, table, and sport activities. However, the researchers did not collect information regarding these factors. Thus, this data should be investigated in further studies.

In the present study, the prevalence of scoliosis among females was higher than males. This finding was in accordance with previous studies[11,16,17]. Anderson[16] revealed most idiopathic scoliosis was among females. Reamy et al[17] stated that the ratio of scoliosis in females tends to increase more than males with curves greater than 30 degrees. Zhang et al[11] suggested that the prevalence of scoliosis was significantly higher in females than in males after the

age of 10 years and then tended to equalize after the age of 17 years.

In this survey, the results presented a high percentage anomaly of shoulder level, scapular movement, and pelvic tilt in both groups. It related to a previous study reporting that uneven shoulder level was the most frequently observed in the posture deviations of adolescents[18]. All of these anomaly indices might relate to daily activities and musculoskeletal balance. In the scoliosis group, waist form, scapular border, and thoracic scoliosis were observed at a high proportion. Scapular border and thoracic scoliosis were the indices found in the scoliosis group. However, waist form was the index found at the highest percentage of postural deviation among scoliosis students. A previous study found waist form was an index that was easy to observe anatomically[12]. Concerning structural scoliosis (SS), 47 of 56 students (83.9%) had an asymmetry of the waist form. It related to the study result that the greatest level of scoliosis was shown at the thoracolumbar level. Thus, uneven waist form was caused by the compensation of the spine and related kinematic chain.

One limitation of this study was that the subjects recruited only volunteered from three high schools in the Bangkok Metropolitan Area. Further studies should screen all students in multiple-areas and develop a questionnaire to detect scoliosis.

Conclusion

The prevalence of scoliosis among females was higher than in males at the ratio of 1.70. A significant difference was found in schools that might be affected by environmental factors. In Thailand, school scoliosis screening is not given a high priority in schools, whereas this study found a high prevalence of scoliosis among high school students. Therefore, earlier detection could be an important process for to promote health and prevent scoliosis among students.

What is already known on this topic?

The prevalence of scoliosis in females was higher than in males. The anomaly of scapular border and thoracic scoliosis were the indices commonly found in scoliosis, especially at the level of the thoracic spine. Waist form was an index that was easily observed anatomically.

What this study adds?

Waist form index was found at a high proportion in the scoliosis group. Thus, waist form might be an additional index to rule out when screening the faulty posture of scoliosis among high school students.

Potential conflict of interest

None.

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ความชุกของภาวะกระดูกสันหลังคดในนักเรียนมัธยมศึกษาตอนปลาย

วิมลรัตน์ สกุลเลิศผาสุข, ชมพูนุท สุวรรณศรี, ลัดดาวัลย์ แซ่ตั้ง, นุชจรี ศิริ, ภัทรจรี จันทรศิริ, ศิริวรรณ ยศสูงเนิน, ปรัธยาน์ ภาคภากร, มีนา โตศิริพัฒนา

วัตถุประสงค์: *การศึกษานี้เพื่อสำรวจภาวะกระดูกสันหลังคดในนักเรียนมัธยมศึกษาตอนปลายของไทย*

วัสดุและวิธีการ: *นักกายภาพบำบัดประเมินโครงสร้างทั้ง 3 ระนาบในขณะยืนโดยการสังเกต คลำ และการทดสอบ Adam's forward bending วิเคราะห์ข้อมูลโดยใช้ descriptive statistic และ Chi-square*

ผลการศึกษา: *นักเรียนมัธยมศึกษาตอนปลาย 374 คนจาก 3 โรงเรียน ในกรุงเทพฯและปริมณฑลที่อาสาสมัครเข้าร่วมวิจัย ชาย 297 คน และหญิง 77 คน ความชุกของภาวะกระดูกสันหลังคิดเป็นร้อยละ 22.7 มีความแตกต่างอย่างมีนัยสำคัญทางสถิติระหว่างเพศและการเกิดกระดูกสันหลังคด และอัตราส่วนระหว่างเพศหญิงต่อเพศชายคือ 1.70 (χ^2 = 6.73, p<0.05) ความแตกต่างอย่างมีนัยสำคัญทางสถิติของการเกิดกระดูกสันหลังคดระหว่างโรงเรียนที่ 1 และ โรงเรียนที่ 3 อัตราส่วน 1.74 (χ^2= 4.33, p<0.05) ภาวะกระดูกสันหลังคดพบมากที่สุดที่ระดับรอยต่อออกและเอว การตรวจประเมินพบร้อยละ 84.7 ระยะระหว่างเอวและแขน, ร้อยละ 76.5 ระยะขอบด้านในของสะบักและแนวกระดูกสันหลัง, และร้อยละ 71.8 การคดที่ระดับอกที่แสดงความผิดปกติของแนวร่างกายในกลุ่มที่เป็นกระดูกสันหลังคด*

สรุป: *ความชุกของภาวะกระดูกสันหลังคดในเพศหญิงสูงกว่าเพศชายในอัตราส่วน 1.70 มีความแตกต่างอย่างมีนัยสำคัญทางสถิติระหว่างโรงเรียน ซึ่งอาจเกิดจากปัจจัยทางสิ่งแวดล้อม*