Original Article

Effects of Instituting a Brief Educational Video and a Short Quiz in the Context of a School Screening Program for Scoliosis

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ABSTRACT

Objectives: To evaluate the effects of administering an educational program about scoliosis and spinal health during a scoliosis school screening. To study prevalence of scoliosis in Thai pupils aged 11-18 years.

Study design: Cross-sectional study.

Setting: Rajavinit Mathayom School, Bangkok, Thailand.

Subjects: Thai pupils aged 11-18 years.

Methods: The data from a scoliosis school screening conducted at a secondary school in Bangkok were retrospectively analyzed. All pupils were asked to complete a 10-True/False quiz about spinal health and watch an educational video about scoliosis. Thereafter they were examined with Adam's forward bending test. A scoliometer was used to measure trunk asymmetry. The pupils with angles of trunk rotation (ATR) greater than or equal to 10º were classified as having scoliosis. Those with ATR between 7º to 9º were classified as at risk and follow up examinations were scheduled for this group. Pupils with ATR less than 7º were classified as normal and required no further re-examination. Then after the back examination, the same quiz was administered a second time in order to assess whether pupils' knowledge has improved.

Results: An average of 69.6% and 84.4% of the questions were answered correctly at the pre and the post tests. The 14.8% increase in the pupils' correct answers after watching the video attains a statistical significance at $p < 0.001$. The three questions that most participants answered incorrectly were about basic pathophysiology, health impact and proper treatments of scoliosis. The prevalence of adolescent idiopathic scoliosis of 2,042 Thai pupils aged 11-18 years was 0.59%. The female to male ratio was 1.1:1.

Conclusion: A brief educational video combined with a short pre- and post-quiz can significantly improve pupils' essential knowledge about idiopathic scoliosis. When screening with the Adam's forward bend test and measuring an angle of trunk rotation with a scoliometer, the prevalence of adolescent idiopathic scoliosis in Thai pupils aged 11-18 years was 0.59%.

Keywords: scoliosis, adolescent, health education, prevalence

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Introduction

Scoliosis is a condition marked with abnormal spinal curvature of greater than 10º Cobb angle in coronal plane radiography.[1] When specific causes such as congenital spinal malformation, neuromuscular disease, and mesenchymal tissue insufficiency are ruled out, a diagnosis of idiopathic scoliosis can be made.[2] Currently, 90% of idiopathic scoliosis cases are present in adolescence, coinciding with the period of maximal growth rate. The global prevalence of adolescent idiopathic scoliosis is 0.47-5.2%. The female to male ratio ranges from 1.5:1-3:1.[2] Without treatment, spinal curves progress and diminish the quality of life.[3] Scoliosis may cause frequent back pain,[3,4] postural instability,[5] and increased expenditure of energy when walking.[6] Those with severe scoliosis experience serious cardiopulmonary problems due to chronic restriction of rib cage expansion.[3,7] Lower self-esteem and depression are other common issues in female patients.[3,8]

According to the 2016 International Scientific Society on Scoliosis Orthopedic and Rehabilitation Treatment (SOSORT),[1] there is growing evidence to support the effectiveness of non-operative treatment for scoliosis patients. These include physiotherapeutic scoliosis-specific exercises (PSSE),[9] and bracing.[10] Failure of conservative treatment and cosmetic concerns are other common reasons for surgery.[3,7] Although surgical correction is an effective treatment that can significantly improve and/or curb curve progression, it is not entirely risk free.[11] There is evidence that patients with scoliosis identified through screening are less likely to need surgery than those who were never screened.[10,12] The most widely accepted screening technique is Adam's forward bend test in which a patient bends forward while an examiner visually checks for any asymmetry in the contour of bilateral paraspinal areas.[10] Visual observation of trunk rotation resulted in 92% sensitivity and 60% specificity.[13] To improve the reliability of the test, the maximal angle of trunk rotation can be measured with a type of inclinometer known as a

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scoliometer.[13] Compared with a Cobb's angle measurement from a spine radiograph, the measurement with a scoliometer method used in the Adam's forward bend test has a 71% sensitivity and 83% specificity in detecting significant spinal curves.[13]

The prevalence was higher (8.91% up to 19.37%) when the diagnosis was based on Adam's forward bend test combined with the scoliometer.[14,15] Interestingly, the female-to-male ratio differed among the various studies performed. In recent studies from 2015 and 2016, the prevalence in females was almost the same as in males (1.7:1 and 0.94:1).[15,16] This contradicts the findings from 1996 which showed a female-to-male ratio of 5:1.[17]

Effective self-management and compliance are necessary for successful scoliosis rehabilitation.[18] Thus, patients need sufficient knowledge about the disease as well as an awareness of diagnostic and treatment options. Nowadays, videos have become an essential learning tool at all levels of education, from kindergarten to university and beyond.[19,20] The availability of targeted and easily understandable videos helps patients manage an ever-increasing number of diseases.[19,20]

In 2019, the Samrong Ruam Jai Foundation initiated a free scoliosis screening program for pupils. It was planned as an ongoing long-term project intended to be made available to increasing numbers of pupils. A five-minute educational video about scoliosis was created for the pupils to watch while waiting for their screening. A quiz designed to assess the pupils' knowledge about idiopathic scoliosis was administered before they watched the video. Then, after completing their back examinations, the pupils repeated the same quiz. The True/False quiz consisted of ten separate statements about scoliosis. The video was carefully constructed to ensure that the pupils would retain the knowledge imparted. Since humans' working memory has a limited capacity for data processing, any informational video should minimize cognitive load, increase engagement and promote active learning. [21] The total length of the video was kept under 6 minutes. Conversational language was used instead of technical jargon. Information was presented in a well-planned sequence so that the concepts followed on logically from one to the next. Distracting visual and audio elements were edited out. Clear audio and/or visual cues were delivered when important information was presented. Images and captions were placed close together to reduce the need for visual scanning. The video purposely included no audio narration. The poor acoustics in the gym where the screening took place were not conducive to an audio presentation.

To our best knowledge, there are no published studies on how educational videos can help adolescent with idiopathic scoliosis to understand the condition better. One objective of this study was to evaluate whether a brief educational video and a short quiz administered twice during a school screening can improve secondary school pupils' knowledge about idiopathic scoliosis. Other objectives were to use retrospective data analysis to estimate the current prevalence of adolescent idiopathic scoliosis in Thai pupils, as well as the female-to-male ratio, and the most common location of maximum deformity.

Methods

The study was conducted after receiving an approval by the ethics committee of Samrong General Hospital, Samut Prakan.

Participants

The pupils at Rajavinit Mathayom School who participated in the Scoliosis School Screening project by Samrong Ruam Jai Foundation in August 2019. Those who were present at the school on the day of screening and whose parents gave informed consent to participate in the screening program, were included in the study.

Study protocol

The pupils' weight and height were measured. Each pupil took a quiz before and after watching a brief educational video about idiopathic scoliosis. They then underwent Adam's forward bending test. During the test, pupils were instructed to bend forward from the hip and waist as far as they comfortably could, while keeping their knees straight. The scoliometer was then placed on the midline, tangentially to the surface of the back.[13] The angles of inclination were read and recorded separately for the upper thoracic, mid thoracic, lower thoracic and lumbar regions.[13] All scoliometers used in this screening were "Baseline" model (Fabrication Enterprises, White Plains, New York, U.S.A.). To ensure their techniques were as consistent as possible, the six physiotherapists who performed the measurements participated in a hands-on practical workshop prior to the start of research.

Notification letters were sent to parents of any pupils who presented with a maximal angle of trunk rotation greater than or equal to 10°. These pupils were offered a free spinal radiography as well as a detailed consultation with a rehabilitation physician regarding appropriate strategies for future management. Those pupils with trunk rotation angles between 7° to 9° received appointments for a 6-month follow-up assessment.

Statistical analysis

Statistical analysis was assessed using the SPSS version 18.0 for Windows. The percentage of correct answers given for each quiz statement was calculated and its statistical significance analyzed with a Chi-square test. The prevalence of spinal rotation was expressed as numerical averages or percentages. Descriptive statistics were used to analyze.

Results

A total of 2,042 pupils (1,057 males and 985 females) participated in this scoliosis school screening. On average 69.6% and 84.4% of the quiz statements were answered correctly at the pre- and the post- tests. Statement numbers 1, 3 and 2 respectively had the highest numbers of incorrect answers. After watching the short educational video, the average scores improved significantly for all 10 statements except statements number 4 and 8. The percentage of pupils who gave correct answers for each statement at the pre- and the post- tests is detailed in Table 1.

The number and percentage of male and female pupils in each age and ATR severity group can be seen in Table 2. Among the pupils who underwent screening, 1,970 (9%), 65 (3.2%), and 12 (0.6%) were classified respectively as normal, at-risk, and having scoliosis. The 14 year-olds were the only age group wherein the difference of curve severity distribution between males and females reached a statistical significance of $p < 0.05$.

Spinal curve type distributions from the 12 pupils with scoliosis and the 65 at-risk are presented in Tables 3 and 4 respectively. Right middle thoracic and left thoraco-lumbar were the most common locations of maximum trunk rotation. The difference in curve types between male ($p = 0.061$) and female pupils ($p = 0.532$) was not statistically significant.

Discussion

This study evaluated the effectiveness of a brief educational video about idiopathic scoliosis during a scoliosis screening at a secondary school. The same short 10-True/

Table 1. Percentage of correct responses of the pretest and the posttest of the True/False quiz about idiopathic scoliosis (n=2,031)

Question	Content of quiz	T/F	Pretest	Posttest	% Change	*p*-value
1	Scoliotic spinal deviation happens in three planes	T	22.4%	64.8%	42.4%	< 0.001
2	Adolescence carries a higher risk than other age groups	T	67.1%	91.2%	24.1%	< 0.001
3	Otherwise healthy persons can develop scoliosis	T	45.1%	84.7%	39.6%	< 0.001
4	Only specialist can detect scoliosis	F	66.1%	61.3%	4.7%	0.002
5	Scoliosis cannot be treated effectively	F	89.6%	93.5%	3.8%	< 0.001
6	Habitually carrying heavy bags on one shoulder does not cause scoliosis	F	87.8%	93.7%	5.9%	< 0.001
7	Prolonged sitting can cause scoliosis	T	74.5%	94.3%	9.9%	< 0.001
8	Tossing and turning a lot during the night cause scoliosis	F	74.7%	75.6%	0.9%	0.561
9	Surgery is one of the treatment options for scoliosis	T	78.6%	89.0%	0.4%	< 0.001
10	Exercising and changing postural habits can ameliorate scoliosis.	T	89.9%	95.8%	5.9%	< 0.001
Average			69.6%	84.4%	14.8%	< 0.001

T, True; F, False

Table 2. Distribution of scoliometer finding by age, sex, and severity of ATR (angle of trunk rotation) classified as normal, at-risk and scoliosis

Age (year)	Male			Female			Total	*p*-value
	Normal	At-risk	Scoliosis	Normal	At-risk	Scoliosis		
11	6 (100)	-	-	2 (100)	-	-	8 (0.4)	-
12	154 (97)	4 (2)	1 (1)	134 (99)	2 (1)	-	29(14.4)	0.690
13	210 (98)	4 (2)	-	183 (96)	8 (4)	-	405(19.8)	0.241
14	213 (99)	2 (1)	1 (1)	176 (94)	9 (5)	3 (1)	404(19.8)	0.022
15	159 (94)	9 (5)	1 (1)	136 (94)	7 (5)	1 (1)	313 (15.3)	1.000
16	148 (95)	6 (4)	1 (1)	143 (96)	4 (3)	1 (1)	303 (14.8)	0.875
17	103 (94)	5 (4)	2 (2)	136 (98)	2 (2)	-	248 (12.1)	0.086
18	25 (89)	3 (11)	-	37 (97)	-	1 (3)	66 (3.2)	0.072
Sum	1,018	33	6	947	32	6	2,042	0.124

Number (%) sorted by age, ATR, and sex
Comparison between age and ATR by using Chi-square test.
p-value analyzed with Chi-square test.

Table 3. Spinal curve types among those with scoliosis (n=12)

Curve type	Right				Left				Bouble	Total	*p*-value
	UT	MT	LT	L	UT	MT	LT	L			
Male	-	2 (33)	-	-	-	-	1 (16)	3 (50)	-	6	0.061
Female	-	6 (100)	-	-	-	-	-	-	-	6	

Number (% sorted by gender)
UT, upper thoracic (T1-T4); MT, middle thoracic (T5-T8); LT, lower thoracic (T9-T12); L, lumbar (L1-L5)

Table 4. Spinal curve types among those at risk of scoliosis (n=65)

Curve type	Right				Left				Bouble	Total	*p*-value
	UT	MT	LT	L	UT	MT	LT	L			
Male	-	8 (24)	2 (6)	-	-	4 (12)	7 (21)	9 (27)	3 (9)	33	0.532
Female	1(3)	14 (44)	3 (9)	1 (3)	-	3 (9)	5 (16)	4 (13)	1 (3)	32	

Number (% sorted by gender)
UT, upper thoracic (T1-T4); MT, middle thoracic (T5-T8); LT, lower thoracic (T9-T12); L, lumbar (L1-L5)

False quiz was administered to the pupils twice: once before watching the video and once afterwards. The average percentage of correct responses after watching the video was 18.4% higher than beforehand. This result indicates that a well-designed and easily understandable educational video helps the pupils have a better understanding of idiopathic scoliosis. Watching the video while waiting for their back examination as well as taking the accompanying before and after quiz, seems to have increased the pupils' level of engagement and active participation in learning. However, these authors speculated that watching such a video and giving the quiz outside the context of school screening could be less effective.

An analysis of the pupils' responses to the True/False quiz suggested areas where the video could be improved. For example, in the quiz given after the video, more students marked the question "Only specialist can detect scoliosis." as TRUE than they had before watching the video. In fact, everyone can and should learn how to look for signs of scoliosis, but only specialists can confirm a diagnosis and suggest a proper treatment plan. The video has been edited to communicate these important points more clearly. And now, the latest Thai version of this video is available online (https://m.facebook.com/story.php?story_fbid=3001864509922087&id=1084082001700357.)

Even after watching the video, approximately a quarter of all students incorrectly answered the True/False statement, "Tossing and turning a lot during the night cause scoliosis." A review of the video script revealed that a correct statement was accidentally omitted in the video. Thus, the video has now been revised to say that idiopathic scoliosis is not caused by sleeping position or other habitual postures. However, once a diagnosis of scoliosis has been made, maintaining correct postures throughout the day can reduce the curve progression.

This study showed the prevalence of scoliosis as detected by angle of trunk rotation of 10° or greater was 0.59% and the prevalence of 7° to 9° trunk rotation was 3.18%. These figures are lower than findings from previous studies using ATR > 10° as scoliosis,[14,17] but the discrepancy is not surprising. The variations in prevalence figures in the different studies are probably related to the small sample sizes. We look forward to accumulating more data from ongoing Samrong Ruam Jai Foundation school screening programs. According to our statistical calculations, a study of 9,508 children will be needed to assess the prevalence of scoliosis in Thailand.

Another interesting finding from the current study is the 1.1 female per 1 male ratio of scoliosis prevalence by sex. This is in line with other studies using ATR > 5° and > 7° as scoliosis in the last decade, which showed 0.94:1 and 1.7:1 female to male ratio.[15,16] But, it is in stark contrast to the 1966 study using ATR > 10° as scoliosis in which the female to male ratio was 5:1.[17] This change of gender ratio might be explained by the increasingly sedentary lifestyle of pupils, especially those who present with less than optimal spinal postural control in the first place. We hypothesized that lack of physical activity can potentially aggravate and perhaps fixate this abnormal habitual spinal curve until the scoliosis worsens and becomes clinically apparent. Traditionally, boys tended to be more physically active than girls which probably explains why the prevalence of scoliosis in males used to be several times lower than in females. We postulate that the longer static sitting times associated with increased use of smartphones and portable computers might contribute to reducing the sex differences found in recent studies. Further investigations should focus on the correlation between physical activity and occurrence of scoliosis.

One compelling theory states that those with inborn subclinical postural control deficit due to small central nervous system lesions may be at higher risk to develop scoliosis.[22,23] Incidence of scoliosis in cerebral palsy correlates with the severity of neurological deficit.[24] Additionally, scoliosis occurs more commonly in conjunction with other existing malformations such as malocclusion[25] and pectus deformity.[26]

This novel combination of brief interactive educational activity in the context of screening that we describe herein has other potential applications beyond early detection of new scoliosis cases. It can also serve to increase awareness and motivate pupils with mild trunk deformity to be more mindful of their posture during daily activities. This in turn has the potential to reduce the progression of the spinal curve. Further follow-up of these pupils from this study are needed to assess the long-term effects of such programs.

Regarding limitation, the current study had a low number of participants and the power of prevalence estimation was 44.9%. According to statistical calculations, a study of 9,508 children will be needed to reveal a more reliable prevalence of scoliosis among adolescent group in Thailand. We look forward to accumulating more data from the ongoing Samrong Ruam Jai Foundation school screening programs. In addition, the revised short video with 10-True/False quiz should be tested to confirm it benefits.

In conclusion, a brief educational video that includes a short pre and post quiz has been shown to significantly improve students' essential knowledge about idiopathic scoliosis. By measuring an angle of rotation with a scoliometer, the prevalence of adolescent idiopathic scoliosis in 2,042 Thai pupils aged 11-18 years was 0.59%. The female to male ratio was 1.1:1.

Disclosure

The researchers have no conflict of interest to declare.

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