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Knowledge and management of adolescent idiopathic scoliosis among practising physiotherapists

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Abstract

It is essential for physiotherapists, who have an important role in the management of adolescent idiopathic scoliosis (AIS), to have adequate knowledge about AIS. Therefore, in this study, we aimed to evaluate the competency of a group of practicing physiotherapists in AIS in Türkiye. A total of 168 physiotherapists working in different health centers between September 2021 and December 2021 were included in the study. The data of this descriptive study were collected with the help of an online questionnaire. The online questionnaire regarding AIS consists of 20 questions prepared by the researchers after the literature review on this subject. Most of the participants were able to correctly answer the questions asked about AIS, including the definition (87.5%), the unknown etiology (72.6%), the age at which it occurs most often (81.5%), how the diagnosis of scoliosis was made (59.5%), the type of exercise recommend (61.3%), when brace can be recommended (73.8%). However, the knowledge level regarding the frequency of idiopathic scoliosis among all scoliosis cases was low (36.3%). AIS-related knowledge level scores of physiotherapists in age and years of clinical experience groups were similar ($p < 0.05$). In addition, male physiotherapists working in a training and research hospital and dealing with a small number of AIS patients had significantly lower levels of AIS-related knowledge ($p < 0.05$). In conclusion, with 67.5% of students able to answer >70% of the survey questions correctly, we demonstrated that the majority of practicing physiotherapists have a good level of knowledge about the definition, diagnosis, and management of AIS; however, some topics need to be improved with some theoretical and practical training after graduation. Physiotherapists need to be improved with some theoretical and practical training after graduation.

Keywords: Adolescent idiopathic scoliosis, knowledge, physiotherapist, physiotherapy, survey

Introduction

Scoliosis is a three-dimensional spinal deformity that causes postural disorders in varying degrees depending on the severity of the disease, affecting humans from infancy to adulthood. It is defined as a 10-degree or more curvature of the spine in the coronal plane measured radiologically by the Cobb angle method [1,2]. It is a complex pathology, thought to develop due to multifactorial causes during the rapid growth period of healthy children. This deformity, which is usually painless, is asymptomatic and easily overlooked. In progressive and untreated cases, the risk of developing essential health problems

such as acute/chronic back and low back pain, cardiopulmonary dysfunction, functional limitation, depression due to cosmetic deformity, and deterioration in the quality of life is high [3]. The pathophysiology causing scoliosis cannot be clearly explained in most patients. Therefore, it is called idiopathic scoliosis, and 75-80% of all scoliosis are in this group [1]. Traditionally, the classification of idiopathic scoliosis is based on the age at which the deformity is first diagnosed: infantile (<3 years), juvenile (3-9 years), adolescent (10-17 years), adult (18 years and older). 80-90% of idiopathic scoliosis occurs during adolescence. The prevalence of adolescent idiopathic scoliosis (AIS) in healthy children is estimated to be between 2% and 3% worldwide, and

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the frequency and severity of this disease are higher in girls [4]. While the prevalence of AIS in children aged 10-15 years is 2.3% in our country, this rate is 3.07% in girls and 1.49% in boys [5].

The treatment of idiopathic scoliosis aims to prevent the progression of the curvature or reverse it at an optimal angle and to provide aesthetic and postural correction, especially during puberty, with early diagnosis. In progressive curves, the aim is to prevent spinal pain, possible physical problems, and respiratory dysfunction. The management of scoliosis is determined by the age, gender, puberty, degree, and direction of the curvature, type, and risk of progression of scoliosis. Follow-up, brace use, scoliosis-specific exercise, or surgical treatment options can be used depending on the degree of scoliosis angle [6].

Early diagnosis of scoliosis and referral to the appropriate center or specialist may prevent the progression of scoliosis and the need for surgical treatment. Therefore, health care professionals, dealing directly with various musculoskeletal problems, including AIS, should have basic competency in recognition and management of this disease. It is crucial for physiotherapists, who have an essential role in the management of scoliosis, to have adequate knowledge about the definition, findings, epidemiology, and management of scoliosis for early diagnosis, correct referral, and appropriate treatment. There are limited studies in the literature evaluating the knowledge level of practicing physiotherapists [7,8] or physiotherapy students [9,10] about AIS. To the best of our knowledge, in our country, there is no study that measured the knowledge level of practicing physiotherapists about AIS. Therefore, in this study, we aimed to evaluate the knowledge level of a group of practicing physiotherapists about AIS in our country.

Material and Methods

There was no clear literature information about the sample size for our study. Since the value of n in the formula will increase as the p .q value increases, $p=0.5$ is accepted in the absence of any prior information so that the sample size can be maximized. According to this information, the minimum number of participants required to be included in the study for 5% type 1 error and 5% type 2 error (95% strength) was found to be 384. In our study, a total of 168 physiotherapists working in different health centers between December 2021 and February 2022 were included in the study. The participants included in the study were first given detailed information about the purpose of the study. The informed consent form was sent to all participants online, and those who ticked the "I agree to participate in the study" box were included in the study. Ethical approval was obtained from the local ethics committee for this study (University of Health Sciences, Gaziosmanpasa Training and Research Hospital Ethics Committee (24.11.2021/383)).

The data of this descriptive study were collected with the help of an online questionnaire (SurveyMonkey) between December 2021 and February 2022. The online questionnaire regarding AIS consists of 20 questions prepared by the researchers after the literature review on this subject. Sociodemographic data such as age, gender, years of clinic experience, and the type of health center they work were asked in the first 4 questions to the participants. The fifth, sixth, and seventh questions examined the

number of scoliosis patients hospitalized in a month (Q5), the method by which scoliosis patients were referred (Q6), and the most common complaints of the patients (Q7). The 7-question part, from the 8th to the 14th questions, includes evaluating the basic knowledge level related to AIS, including definition, diagnosis, and management of AIS. Basic treatment strategies for patients referred for AIS, such as exercise and bracing, were questioned in the 5-question section between the 15th and 19th questions. In the last question, they were asked what they thought about their competence in AIS and whether they needed supportive training regarding this topic. The seven questions (questions between 8th-14th) of the survey are questions that measure the level of knowledge about the AIS, consisting of five options and one correct answer. A total of 100 points is obtained from correctly answering all seven questions. The participant scored 14.3 points for each correct answer (100/7) and zero points for each incorrect answer. There was no missing data, erroneous data or excluded participants. The survey questions were answered completely and correctly by the participants.

SPSS 26.0 (IBM Corporation, Armonk, New York, United States) program was used to analyze the variables. The distribution of the data was evaluated with the Shapiro-Wilk Francia test. Mann-Whitney U with Monte Carlo tests was used to compare the quantitative data of two independent groups. While Jonckheere-Terpstra Test and Monte Carlo test were used to compare more than two groups according to quantitative data, Dunn's Test was used for Post Hoc analysis. Quantitative variables were expressed as mean (standard deviation) and median (minimum/maximum or 25th percentile/75th percentile), while categorical variables were shown as number (n) and frequency (%). The variables were analyzed at a 95% confidence level, and a p -value less than 0.05 was considered significant.

Results

One hundred and twenty-four (73.8%) women and 44 (26.2%) men were included in the study. While 63.1% of the participants were between the ages of 20-29 years, 25.0% were between the ages of 30-39 years. There were 3 (1.8%) participants aged over 50 years. Consideration of the working period of the participants after graduation, it was determined that most of them (73, 43.5%) had been working as physiotherapists for 4-9 years. The rate of physiotherapists working for three years or less was 32.1%, the rate of working for 10-19 years was 18.5%, and the rate of working for over 20 years was 6.0%. Considering the distribution of the health centers where the participants worked, most of those included in the study (113 people, 67.3%) were working in specialized branch centers. The majority (76, 45.5%) of the physiotherapists participating in the study stated that they dealt with <5 AIS patients on average in a month, while 13.2% of the participants stated that they had never encountered AIS patients. It was noted that AIS patients were mostly referred to physiotherapists by specialists in Physical Medicine and Rehabilitation (72, 43.1%) or Orthopedics and Traumatology (54, 32.3%). The most common complaints of patients referred to physiotherapists for AIS were usually poor posture (68.5%), back pain (49.4%), and aesthetic anxiety (36.9%) (Table 1).

Table 1. Demographic characteristics of the participants and complaints of the evaluated AIS patients

	n	%
Q1. Gender		
Female	124	73.80%
Male	44	26.20%
Q2. Age (Years)		
20-29	106	63.10%
30-39	42	25.00%
40-49	17	10.10%
50-59	2	1.20%
60+	1	0.60%
Q3. Years of clinical experience		
≤3 years	54	32.10%
4-9 years	73	43.50%
10-19 years	31	18.50%
≥20 years	10	6.00%
Q4. In which health center do you work?		
State Hospital	12	7.10%
University Hospitals	14	8.30%
Private Hospital	16	9.50%
Training and Research Hospital (Tertiary center state hospitals)	8	4.80%
Foundation-affiliated university hospitals (Foundation universities)	5	3.00%
Specialized branch centers (special education and rehabilitation centers, private branch-specific healthcare centers, rehabilitation centers, physical therapy and rehabilitation special branch centers etc.)	113	67.30%
Q5. What is the monthly average number of adolescent idiopathic scoliosis patients you are dealing with?		
None	22	13.20%
<5	76	45.50%
5-10	36	21.60%
11-20	13	7.80%
>20	20	12.00%
Q6. Which physicians do adolescent idiopathic scoliosis patients usually refer to you?		
Physical Medicine and Rehabilitation	72	43.10%
Orthopedics and Traumatology	54	32.30%
Brain surgeon	2	1.20%
Pediatrician	2	1.20%
Other Physiotherapists	11	6.60%
Social media	24	14.40%
Other (please specify)	2	1.20%
Self-referral (n=1), Guidance and Research Centers (n=1)		
Q7. What are the most common complaints of adolescent idiopathic scoliosis patients you care about? (You can tick more than one option)		
Neck pain	20	11.9
Back pain	83	49.4
Backache	41	24.4
Shoulder pain	3	1.8
Headache	2	1.2
Posture disorder	118	68.5
Aesthetic anxiety	62	36.9

The frequency of accuracy in the answers obtained from the 8th to the 14th questions, in which the level of knowledge related to AIS was evaluated, are as follows: 87.5% of the participants correctly stated the definition of scoliosis (Q6), 72.6% of the participants answered the etiology of scoliosis correctly (Q7), 81.5% of the participants knew correctly that scoliosis mostly appeared in childhood or adolescence, 36.3% of participants correctly identified the frequency of idiopathic scoliosis among all scoliosis cases. In addition,

59.5% of the participants knew how the diagnosis of scoliosis was made, 61.3% of the participants correctly knew the type of exercise recommended in idiopathic scoliosis, and 73.8% of the participants correctly stated when brace could be recommended in scoliosis patients (Table 2). After the participants' total scores were evaluated, the frequency of those who received 90-100% points was 14.9%, those who received between 80-90% points was 22.6%, and those who received 70-80% points were 22.0% (Table 2).

Table 2. Evaluation of the participants' level of knowledge about the definition, diagnosis, and management of AIS

	True/False	n	%
Q8. What is the definition of idiopathic scoliosis?			
Three-dimensional rotational deformity of the spine	True	147	87.50%
Lateral curvature of the spine	False	8	4.80%
The most common two-dimensional spinal deformity	False	9	5.40%
Deformity in the frontal plane	False	1	0.60%
I am not sure	False	3	1.80%
Q9. What are the causes of adolescent idiopathic scoliosis?			
It develops secondary to congenital, vertebral or rib malformation and/or various systemic or neuromuscular disorders	False	30	17.90%
A spinal malformation appeared between the third and sixth weeks of pregnancy with unknown pathology	False	4	2.40%
Structural scoliosis of the spine without a specific cause	True	122	72.60%
Multifactorial etiology due to shortening of the lower extremities, increased paraspinal muscle tone, or malformation of the rib cage.	False	8	4.80%
I am not sure	False	4	2.40%
Q10. When does idiopathic scoliosis commonly develop?			
Idiopathic scoliosis occurs in adulthood	False	4	2.40%
Occurs in the 3rd-6th week of pregnancy	False	7	4.20%
Idiopathic scoliosis occurs during childhood and adolescence.	True	137	81.50%
The development of idiopathic scoliosis is a compensatory pathology/disease	False	9	5.40%
I do not know	False	11	6.50%
Q11. What is the prevalence of adolescent idiopathic scoliosis among scoliosis patients?			
20% of all scoliosis cases	False	20	11.90%
60% of all scoliosis cases	False	24	14.30%
80% of all scoliosis cases	True	61	36.30%
40% of all scoliosis cases	False	14	8.30%
I do not know	False	49	29.20%
Q12. How is the diagnosis of idiopathic scoliosis confirmed?			
Cobb angle greater than 20 degrees	False	4	2.40%
Observation of gibosity in individuals and lateral curvature of the spine in X-Ray	False	13	7.70%
Inequality in the crista iliaca levels, Cobb angle greater than 20 degrees, and lateral curvature on X-Ray	False	42	25.00%
Cobb angle greater than ≥ 10 degrees and concomitant rotation on X-Ray	True	100	59.50%
I do not know	False	9	5.40%
Q13. What should be the conservative exercise treatment content of adolescent idiopathic scoliosis?			
Exercises to stretch the concave side of the primary curve and strengthen the convex side	False	19	11.30%
Three-dimensional auto-correction exercises for stopping/preventing progression	True	103	61.30%
Postural training, rotational breathing and stretching exercises	False	41	24.40%
Observation and core stabilization exercises	False	2	1.20%
I do not know	False	3	1.80%
Q14. When should brace application be recommended to patients with adolescent idiopathic scoliosis?			
If the Cobb angle of the major curve is between 5-10 degrees	False	3	1.80%
In the case of functional scoliosis due to lower extremity shortness of more than 6 mm	False	2	1.20%
When the Cobb angle of the major curve is 45 degrees or higher	False	25	14.90%
If the Cobb angle of the major curve is 20 (± 5) degrees and there is a risk of progression	True	124	73.80%
I do not know	False	14	8.30%
Total scores (%) (10-point intervals)			
0-1	-	2	1.20%
10-20	-	3	1.80%
20-30	-	13	7.70%
30-40	-	0	0.00%
40-50	-	23	13.70%
50-60	-	27	16.10%
60-70	-	0	0.00%
70-80	-	37	22.00%
80-90	-	38	22.60%
90-100	-	25	14.90%
		Mean (SD.)	Median (Min-Max)
Total Scores (%)		67.5 (23.7)	71.4 (0-100)

AIS-related knowledge level scores of physiotherapists in age and years of clinical experience groups were similar ($P<0.05$) (Table 3). In addition, male physiotherapists working in a training and research hospital and dealing with a small number of AIS patients had significantly lower levels of AIS-related knowledge ($p<0.05$) (Table 3).

Of the physiotherapists participating in the study, 85.7% recommended pilates, 53.0% recommended yoga, and 55.4%

recommended swimming. 68.5% of the participants stated that they knew well the scoliosis-specific exercises taught during their university education program. 85.7% of the participants were appropriately applying mobilization to their patients. Most study participants (73.2%) were familiar with the Milwaukee brace, and 62.9% were performing rehabilitation before and after scoliosis surgery. 17.3% of the physiotherapists participating in the study considered themselves competent in AIS, and 52.4% of all required supportive education regarding AIS (Table 4).

Table 3. Comparison of participants' adolescent idiopathic scoliosis knowledge level by subgroups

		Score		
		Median (min-max)		
Gender				0.042 ^a
Woman	124	71.43 (0-100)		
Man	44	57.14 (0-100)		
Age (years)				0.775 ^k
20-29	106	71.43 (0-100)		
30-39	42	71.43 (14.29-100)		
40-49	17	71.43 (28.57-100)		
50-59	2 ^(Excluded)	57.14 (42.86-71.43)		
60+	1 ^(Excluded)	42.86 (42.86-42.86)		
Years of clinical experience				0.917 ^k
≤3 year	54	71.43 (0-100)		
4-9 year	73	71.43 (0-100)		
10-19 year	31	71.43 (14.29-100)		
≥20 year	10	78.57 (28.57-100)		
In which health center do you work?				0.012 ^k
A. State Hospital	12	57.14 (14.29-100)	P(A vs B)=0.999	P(B vs F)=0.999
B. University Hospitals	14	71.43 (42.86-100)	P(A vs C)=0.999	P(C vs D)=0.047
C. Private Hospital	16	71.43 (28.57-100)	P(A vs D)=0.999	P(C vs E)=0.999
D. Training and Research Hospital (Tertiary center state hospitals)	8	28.57 (14.29-100) ^{a,b,c,e,f}	P(A vs E)=0.926	P(C vs F)=0.999
E. Foundation-affiliated university hospitals (Foundation universities)	5	85.71 (42.86-100)	P(A vs F)=0.999	P(D vs E)=0.037
F. Specialized branch centers (special education and rehabilitation centers, private branch-specific healthcare centers, rehabilitation centers, physical therapy and rehabilitation special branch centers etc.)	113	71.43 (0-100)	P(B vs C)=0.999 P(B vs D)=0.036	P(D vs F)=0.023 P(E vs F)=0.999
What is the monthly average number of AIS patients you are dealing with?				<0.001 ^k
A. None	22	57.14 (0-85.71) ^{b,c,d,e}	P(A vs B)=0.999	P(B vs D)=0.066
B. <5	76	57.14 (14.29-100) ^{c,e}	P(A vs C)=0.004	P(B vs E)=0.002
C. 5-10	36	85.71 (28.57-100)	P(A vs D)=0.039	P(C vs D)=0.999
D. 11-20	13	85.71 (42.86-100)	P(A vs E)=0.002	P(C vs E)=0.999
E. >20	20	85.71 (0-100)	P(B vs C)=0.002	P(E vs D)=0.999

^k: Kruskal Wallis H Test (Monte Carlo); Post Hoc Test: Dunn's Test, ^a:Mann-Whitney U Test (Monte Carlo), Min: minimum, Max: maximum, ^{a,b,c,d,e,f}: expresses significance according to related groups

Table 4. Evaluation of the exercise recommendations and methods used by the participants in idiopathic scoliosis and questioning their self-confidence in disease management

	Yes n (%)	No n (%)
Q15. Which physical activity/sports do you recommend to the adolescent idiopathic scoliosis patient? (You can tick more than one option)		
Pilates	144 (85.7)	24 (14.3)
Yoga	89 (53.0)	79 (47.0)
Swimming	93 (55.4)	75 (44.6)
Volleyball	28 (16.7)	140 (83.3)
Basketball	22 (13.1)	146 (86.9)
Ballet	14 (8.3)	154 (91.7)
Gymnastics	25 (14.9)	143 (85.1)
Martial arts	7 (4.2)	161 (95.8)
Q16. Which conservative treatment methods do you know in the treatment of adolescent idiopathic scoliosis? (You can tick more than one option)		
Scoliosis exercises taught in undergraduate education	115 (68.5)	53 (31.5)
Scientific Exercises Approach to Scoliosis (SEAS) method (Italy)	23 (13.7)	145 (86.3)
International Schroth 3 Dimensional Scoliosis Therapy (ISST) (Germany)	77 (45.8)	91 (54.2)
Barcelona Scoliosis Physical Therapy School (BSPTS) (Spain)	23 (13.7)	145 (86.3)
Lyon method (France)	15 (8.9)	153 (91.1)
Dobomed method (Poland)	5 (3.0)	163 (97.0)
Side shift (UK)	7 (4.2)	161 (95.8)
Functional Individual Therapy Scoliosis (FITS) (Poland)	7 (4.2)	161 (95.8)
Schroth Best Practice	29 (17.3)	139 (82.7)
I dont know	3 (1.8)	165 (98.2)
Q17. What techniques do you use when treating adolescent idiopathic scoliosis? (You can tick more than one option)		
Mobilization	144 (85.7)	24 (14.3)
Manipulation	21 (12.5)	147 (87.5)
Traction	72 (42.9)	96 (57.1)
Sensory integration techniques	26 (15.5)	142 (84.5)
Osteopathic approaches	33 (19.6)	135 (80.4)
Kinesiotaping	86 (51.2)	82 (48.8)
Cupping therapy	12 (7.1)	156 (92.9)
None	11 (6.5)	157 (93.5)
Q18. Which of the following brace types do you know? (You can tick more than one option)		
Milwaukee brace	123 (73.2)	45 (26.8)
Cheneau brace	60 (35.7)	108 (64.3)
WCR (Wood Cheneau Rigo) brace	33 (19.6)	135 (80.4)
Gensingen brace	30 (17.9)	138 (82.1)
Boston brace	109 (64.9)	59 (35.1)
Night overcorrection brace	44 (26.2)	124 (73.8)
Sforzesco brace	13 (7.7)	155 (92.3)
Lyon brace	46 (27.4)	122 (72.6)
Lyon ARTbrace	30 (17.9)	138 (82.1)
Dynamic derotation brace	54 (32.1)	114 (67.9)
Passive correction brace	35 (20.8)	133 (79.2)
I don't know any	19 (11.3)	149 (88.7)
Q19. Do you apply preoperative and post-operative rehabilitation in scoliosis surgery?		
	105 (62.9)	62 (37.1)
Q20. Do you think your knowledge about adolescent idiopathic scoliosis is sufficient? (You can tick more than one option)		
Definitely yes	29 (17.3)	139 (82.7)
No, my level of knowledge about AIS is not sufficient.	97 (57.7)	71 (42.3)
I need education about adolescent idiopathic scoliosis.	88 (52.4)	80 (47.6)

Discussion

Regarding treating musculoskeletal issues, including AIS, physiotherapists play a crucial role among medical experts. For this reason, physiotherapists must devote time to AIS during their university education and after graduation. In this study, we investigated the knowledge levels of physiotherapists working in different health centers in our country about AIS and their competencies in the management of this disease. Most of the physiotherapists gave correct answers to the questionnaires we prepared regarding AIS according to the widely accepted the International Society on Scoliosis Orthopaedic and Rehabilitation Treatment (SOSORT) guidelines. The question asked about the prevalence of AIS in all scoliosis cases was the most unsuccessful question of the participants. Taken together, this study showed that physiotherapists in our country have sufficient knowledge about the definition, causes, development, diagnosis, and management of AIS. However, they have less knowledge about the prevalence of the disease.

In the literature, a limited number of studies were conducted in several countries evaluating the competence of physiotherapy students or practicing physiotherapists regarding AIS [7,8,10,11]. Ciazynski et al. [10] conducted a study with 37 physiotherapy students (attending the third year of the first degree, aged 22-25). They demonstrated that the average level of knowledge of AIS was reported to be unsatisfactory. Drake et al. [11] applied a 10-question multiple choice survey they prepared for the diagnosis and treatment of AIS to 178 physiotherapy students. In this study, only 15 (8.4%) students answered more than 70% of the survey questions correctly.

Black et al. [9] applied the same 10-question survey, which was created in the study of Drake, to 206 physiotherapy students from 12 institutions in the UK and reported that only 7% of the students could answer more than 50% of the survey questions correctly. All these studies conducted in the United States, the UK, and Poland suggested that physiotherapy students are not adequately trained in AIS. Additionally, the overall correct data score was 43%, and all of these facts indicate that the participant's understanding of the diagnosis and treatment of AIS was insufficient.

There are two studies evaluating the level of knowledge about AIS in post-graduate physiotherapists [7,8]. The first was conducted by Thérout et al. [7] in Québec, Canada, where various health care professionals, including family physicians, pediatricians, chiropractors, and physiotherapists, were included. They noted that physiotherapists' understanding of AIS was poorer than other health professionals, particularly in terms of clinical symptoms and risk factors. They emphasize the critical need for training programs to expand physiotherapists' knowledge of musculoskeletal illnesses. The second study was conducted by du Toit et al. [8] with 223 physiotherapists in South Africa and reported that only 33.6% of the participants were able to answer more than 50% of the questions, and 16.5%

of the participants were able to answer more than 70% of the questions correctly. These findings, similar to the previous study, support that practicing physiotherapists are not proficient in AIS diagnosis and treatment. The knowledge level of the physiotherapists in our study about AIS is much better than the results attained from physiotherapy students and practicing physiotherapists in previous studies, as shown by the fact that 67.5% of the physiotherapists correctly answered more than 70% of the questions. In addition, in terms of clinical experience of physiotherapists, 45.3% of physiotherapists in the study of du Toit had less than ten years of clinical experience. In comparison, this rate was 55.6% in our study. These findings suggest that although the physiotherapists in our study had less clinical experience, their knowledge of level AIS was better, and the physiotherapists in Turkey might be better trained and better equipped to evaluate and manage patients with AIS.

In our study, when the relationship between the demographic data of physiotherapists and the level of AIS knowledge was investigated, it was shown that age and years of clinical experience did not affect the level of AIS knowledge. Physiotherapists working in a training and research hospital and dealing with a smaller number of AIS patients had significantly lower AIS knowledge levels. The reason why no relationship was found between age and clinical experience and AIS knowledge level can be explained by the lower number of participants with advanced age and clinical experience of more than ten years. In addition, the level of knowledge of the participants who dealt with more AIS patients was found to be significantly higher, as expected. The physiotherapists working in Training and Research Hospital (tertiary-center state hospital) reveal the difference in knowledge level in terms of the center where they work. The median knowledge level score of the participants in this group was found to be the lowest at 28.57. This result can be explained by the very low number of participants in this group (n=8) and the fact that it is a center that is less interested in AIS. Moreover, thus physiotherapists working in this center encounter AIS patients less frequently.

According to SOSORT guideline, physiotherapeutic scoliosis-specific exercises (the most crucial part of which is auto-correction in 3D) have an important place in the treatment of scoliosis [6,12]. In line, 61.3% of the physiotherapists in this study stated that three-dimensional auto-correction exercises should be performed to stop or prevent scoliosis progression. In the study of Ciazynski et al. [10], 54% of the students stated that extensor strengthening exercises are suitable for idiopathic scoliosis. Black et al. [9] stated that only 7% of physiotherapy students should be treated with 3-dimensional auto-correction and progression-preventing exercises, which is relatively low frequency compared to our study. In the same study of Black, physiotherapy students stated that swimming, pilates, and yoga were the most beneficial for scoliosis [9]. In the study of Cieszynski, physiotherapy students stated that especially swimming (93%), followed by yoga and combat sports, were beneficial for scoliosis [10]. In our study, the

majority of the participants stated that they recommended pilates (85.7%), yoga (53.0%), and swimming (55.4%) in the treatment of AIS. In addition, 68.5% of the participants stated that they knew well the scoliosis-specific exercises taught during their university education.

The use of a brace in the treatment of scoliosis is of vital importance in slowing or stopping the progression of scoliosis. Bracing is recommended to treat patients with curves above $20^{\circ} \pm 5^{\circ}$ Cobb, still growing, and with demonstrated progression of deformity or elevated risk of worsening, unless otherwise justified in the opinion of a clinician specialized in conservative treatment of spinal deformities [6]. It is emphasized that in brace treatment, duration of daily use (dosage), quality of brace, compliance with treatment, type of scoliosis, and family history are important [6]. Although different types of braces can be used in the treatment of scoliosis, it is not possible to claim which brace is more effective than the other as a result of numerous studies [6]. 73.8% of the participants in our study could determine the indication of brace treatment correctly. However, this rate was 42% in du Toit's study. In addition, in our study, most participants (73.2%) were familiar with the Milwaukee brace. Finally, 17.3% of the physiotherapists participating in the study considered themselves competent in AIS, and 52.4% wanted to receive supportive education regarding AIS, suggesting that despite the acceptable level of knowledge according to the survey results of our study, most of the participants do not consider themselves sufficient.

This study has some limitations that must be acknowledged. First, because there is no internationally standardized questionnaire about the knowledge in AIS. Therefore we created a questionnaire as a result of the current literature review, that can measure the level of knowledge about AIS in practicing physiotherapists, which is one of the most important limitations of our study. From this point of view, the validity and reliability analysis of this questionnaire we developed in our study is essential to perform in a future study. Second, the subject numbers are quite different when the participants are grouped in terms of gender and the center where they work, which may have negatively affected the results of the comparisons made according to the subgroups. Third, the number of cases included in the study was relatively low compared to our sample size calculation. Finally, this study did not examine the impact of the various knowledge levels in primary education on scoliosis findings and treatment at the universities from which the participants graduated.

Conclusion

In conclusion, with 67.5% of students able to answer >70% of the survey questions correctly, we demonstrated that the majority of practicing physiotherapists have a good level of knowledge about the definition, diagnosis, and management of AIS. However, some topics need to be improved with some theoretical and practical training after graduation. In addition, it was shown that the level of knowledge related to AIS was associated with the type of health center employed and the number of AIS patients

cared for per month. Although most of the participants had an acceptable level of knowledge about AIS, their self-confidence in managing the disease was insufficient. For this reason, it is crucial to carry out educational activities to improve the deficient knowledge of physiotherapists in our country and gain self-confidence in detecting and managing AIS.

Conflict of Interests

The authors declare that there is no conflict of interest in the study.

Financial Disclosure

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Ethical Approval

Ethical approval was obtained from the local ethics committee for this study (University of Health Sciences, Gaziosmanpaşa Training and Research Hospital Ethics Committee (24.11.2021/383)).

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