Pain Management Nursing 22 (2021) 522–530

Contents lists available at ScienceDirect

Pain Management Nursing

journal homepage: www.painmanagementnursing.org

Research Article

Musculoskeletal Pain, Related Factors, and Posture Profiles Among Adolescents: A Cross-Sectional Study From Turkey

Serpil Ozdemir, RN, PhD *, Dercan Gencbas, RN, PhD †, Betul Tosun, RN, PhD ‡, Hatice Bebis, RN, PhD §, Ozlem Sinan, RN, PhD ||

* Department of Public Health Nursing, University of Health Sciences Turkey, Ankara, Turkey
† Department of Nursing, Atilim University, Ankara, Turkey
‡ Department of Nursing, Hasan Kalyoncu University, Gaziantep, Turkey
§ Public Health Nursing Department, Near East University, Nicosia, Cyprus
|| Department of Public Health Nursing, Yildirim Beyazit University, Ankara, Turkey

ARTICLE INFO

Article history:
Received 27 March 2019
Received in revised form
19 September 2020
Accepted 29 November 2020

ABSTRACT

Purpose: The aim of the study was to evaluate musculoskeletal pain due to mechanical reasons and related risk factors in adolescents and to define posture profiles of adolescents.
Design: A cross-sectional study.
Methods: The study was conducted with 2221 adolescents between February 2015 and May 2015. The questionnaire used to collect data consisted of three parts: (1) descriptive characteristics of the participants, (2) pain assessment of 14 parts of the body, and (3) Back Pain and Body Posture Evaluation Instrument (BackPEI).
Results: The prevalence of low back pain among the participants was 73.3% (n = 1,343), while the prevalence of back pain was 68.4% (n = 1,254). The participants attributed their pain to their poor sitting postures at school (38.1%, n = 847) and carrying school backpacks (84.1%, n = 1,713). There was a statistically significant difference in the physical activities of adolescents and the BackPEI score ($z = 4.40$; $p = .001$). Posture factors of the BackPEI score increased while school desk comfort score increased (Spearman's rho = 0.148; $p = .001$), but it decreased while the school grades of the adolescents increased (Spearman's rho [ρ] = −0.161; $p = .001$).
Conclusions: According to this study, body posture was related to musculoskeletal pain and was correlated with physical activities, school desk comfort, and school grades of the adolescents. It is suggested that correct posture and ergonomic positions should be taught to adolescents when using computers, carrying school backpacks, and sitting in school chairs to prevent musculoskeletal pain.

Low back pain is the most common cause of musculoskeletal discomfort for all age groups. It is reported that musculoskeletal pain is a medically and economically high-cost, global public health problem that deteriorates an individual's quality of life. Prolonged musculoskeletal pain causes functional disability and loss in the labor force (Huguet et al., 2016; Maher et al., 2017; Yang & Haldeman, 2017). The lifetime prevalence of low back pain is between 13.8% and 80%, and the one-year prevalence is between 0.8% and 82.5% among adults (Hoy et al., 2010; Verhagen et al., 2016). Low back pain in childhood and adolescence increases the risk of experiencing low back pain in adulthood (Maher et al., 2017). The prevalence of musculoskeletal pain in adolescence has increased in the last two decades and become similar to the prevalence in adulthood, with a range reported to be from 4%-70% (Dekker et al., 2018; Huguet et al., 2016; Pellise et al., 2009). The prevalence of low back pain is reported to increase with age and peak at 14 years (Clinch, 2009; Jackson et al., 2011; McBeth & Jones, 2007). Half of the adolescent population is estimated to suffer from low back pain by the age of 20 years (Jones & Macfarlane, 2005; Mikkonen et al., 2016). It is reported that back pain prevalence among adolescents is approximately five in ten according to local research results conducted in Turkey (Cavlak et al., 2006; Gencbas & Bebis, 2019). Thus, evaluating musculoskeletal pain when it emerges at early ages and defining the risk factors for musculoskeletal pain has become the focus of pain prevention, early detection, and pain management

Address correspondence to Serpil Ozdemir, RN, PhD, University of Health Sciences Turkey, Department of Public Health Nursing, Etlik, Ankara 06010, Turkey.
E-mail address: serpilozdemir327@gmail.com (S. Ozdemir).

https://doi.org/10.1016/j.pmn.2020.11.013
1524-9042/

strategies (Dianat et al., 2018; Huguet et al., 2016; Wirth et al., 2013).

Risk factors for musculoskeletal pain among adolescents are gender, family history, anthropometric measures, spinal mobility and flexibility, poor posture, physical and sports activities, smoking status, psychosocial factors, and a sedentary lifestyle, such as overuse of computer (Adami et al., 2015; Dianat et al., 2018; Murphy et al., 2007). A systematic review reported that there were inconsistent results on the risk factors of musculoskeletal pain among adolescents because of methodological differences, inappropriate terminology, and definitions of pain among recent studies (Huguet et al., 2016). Although there is evidence that poor sitting posture and ergonomic factors are related to musculoskeletal pain, some researchers have found that these risk factors are not related to musculoskeletal pain among adolescents (Huguet et al., 2016; Prins et al., 2008). Additionally, gender, psychosocial factors, poor posture, ergonomic factors, and physical activity are reported to be risk factors for musculoskeletal pain, but there is still uncertainty about what factors cause musculoskeletal pain (Brink & Louw, 2013; Huguet et al., 2016; Murphy et al., 2004; Prins et al., 2008). There is limited study on musculoskeletal pain risk factors among Turkish adolescents. It is reported in a study; transportation to/from school methods, body mass index, type of bed, and duration of studying as more important musculoskeletal pain risk factors among Turkish adolescents (Akdag et al., 2011). Well-designed studies that enlighten the risk factors for musculoskeletal pain among adolescents are required (Dianat et al., 2018; Huguet et al., 2016; Prins et al., 2008).

There may be several reasons for musculoskeletal pain, especially during the early adolescence period (Sperotto et al., 2015). These reasons may be categorized as mechanical, developmental, genetic, inflammatory, tumoral, and psychological factors (Clinch, 2009; Jones et al., 2005; Sperotto et al., 2015; Watson et al., 2003). Body postures maintained during daily life and school activities are considered as risk factors for the occurrence of back pain by health professionals (Noll et al., 2013). Studies on the effects of these mechanical factors on other parts of the body, such as the neck, shoulders, arms, legs, or knees, are limited (Dianat et al., 2018; Mwaka et al., 2014; Straker et al., 2009; Taylor et al., 2006). A posture of a child/adolescent sitting at a school desk that is not compatible with anthropometric features deteriorates over time, the body load becomes asymmetrically distributed, a compensatory posture develops to maintain balance, and the individual experiences pain in the low back and other parts of the body (Mete et al., 2016; Jackson et al., 2011; Murphy et al., 2004; Panagiotopoulou et al., 2004). Likewise, in this age group, school backpacks exceeding 10%-15% of body weight, non-ergonomic backpacks, and carrying the backpacks with a poor posture for an extended duration can lead to pain in the neck, shoulders, and lower extremities but especially in the low back (Mackie et al., 2003; Mwaka et al., 2014).

Musculoskeletal pain may have a negative effect on adolescents' quality of life, daily life activities, and physical activity (Holden et al., 2018). In the literature, musculoskeletal pain has been reported to increase adolescents' absenteeism and decrease their academic performance (Huguet et al., 2016; Minghelli, 2017). In this context, the discomfort and medical care needs of adolescents also increase (Agüero et al., 2017). Detecting pain as early as possible and effective elimination of the cause of the pain can influence the individual's future life and enable the preservation and promotion of health (Clinch, 2009; Dianat et al., 2018).

The population of 10- to 19-year-old individuals accounts for 25% of the total population in Turkey (Ardic & Esin, 2016; Turkish Statistical Institute, 2013). In other words, one of four individuals in our country spends a significant part of his/her life carrying a school backpack and sitting statically for learning activities at school. This lifestyle risks the musculoskeletal health of a considerable population of adolescents. Despite this fact, there are very few studies that assess the frequency of musculoskeletal pain and its causes in this age group in Turkey (Akdag et. al., 2011; Gencbas & Bebis, 2019; Mete et al., 2016).

Furthermore, the majority of the studies in the literature on adolescents have focused on low back pain, and studies that comprehensively evaluate pain in other parts of the body and low back pain are lacking (Dianat et al., 2018). Meta-analyses and systematic reviews have reported the need for studies clearly defining the risk factors for musculoskeletal pain in this age group (Huguet et al., 2016; Jones et al., 2005; McBeth et al., 2007; Trevelyan & Legg, 2006).

The aim of this study was to identify risk factors for musculoskeletal pain and define posture profiles of Turkish adolescents. For this aim the association between sociodemographic factors, such as gender, grade, and perception of economic status, and mechanical factors, such as poor posture and carrying a school backpack, with musculoskeletal pain was determined. The study target was to find answers to the following research questions:

1. What are the pain experience and pain levels of Turkish adolescents regarding the musculoskeletal system?
2. What is the relationship between sociodemographic factors and body mechanical factors with musculoskeletal pain among Turkish adolescents?
3. How are the posture profiles of Turkish adolescents?

Methods

Design and Sample

This cross-sectional study was conducted from 16 February 2015 to 3 May 2015, and institutional permission was given by the Ankara Provincial National Education Directorate. Permission to conduct this research at schools was given by the Directorate of the Ministry of National Education in Turkey. This study was conducted in the Kecioren district of the city of Ankara, Turkey, which has the second-largest population in the capital city. There are 30 public high schools in this district, and 33,828 adolescents were educated in these schools during the 2014-2015 academic year. All the public schools' furniture manufactured in Turkey is approximately similar.

The study population consisted of adolescents who were educated in the public high schools in Kecioren district of the city of Ankara. All schools in this district had similar features regarding the school environment, cultural dynamics, and socioeconomic characteristics. In the current study, the cluster sampling method was used for determining the sample. To determine which schools would take part in the study, all schools were divided into clusters by grade (9th to 12th). Each grade represented a cluster, and it was determined that there were 120 clusters. It was calculated that the study required 24 clusters by an expert statistician. Then, all clusters were listed randomly, and 24 clusters were selected using a simple random sampling method. The study was conducted in 12 public high schools and a total of 2,221 adolescents met the inclusion/exclusion criteria for participation in the study. The inclusion and exclusion criteria of the study were determined following a literature review (Jones et al., 2005; Noll et al., 2013; Trevelyan et al., 2006). The inclusion criteria were as follows:

- Adolescents who volunteered to participate in the study;
- Adolescents who had their parents' informed consent if they were younger than 18 years old;

- Adolescents who were able to read and write in Turkish; and
- Adolescents who completed the questionnaire properly.

The exclusion criteria were orthopedic and mental disabilities. Thirty adolescents who did not complete the questionnaire and 45 adolescents who had an orthopedic or mental disability were excluded from the study.

Sample Size

To strengthen the design of the study, the sample size was determined to be compatible with the cluster sampling method by an expert statistician. Each grade in each school was considered a cluster in the study. There were 120 clusters in total. The design effect of cluster sampling method was two. A total of 24 clusters were needed for the study to be conducted. To minimize the bias associated with cluster sampling, 50% of the adolescents in each cluster were randomly enrolled in the study; thus, the calculated sample size was 2,743 adolescents with ± 2.5 tolerance and 95% confidence (http://www.raosoft.com/samplesize.html). Simple randomized numbers were used to choose the cluster to enroll. At the end of the study, 2,221 adolescents were included, accounting for 81% of the calculated sample size.

Procedures

Information forms that included the contents and aim of the study were sent to the parents of the participants 10 days before the study was initiated. Adolescents whose parents signed and returned the approval form to the nurses were asked for their consent to participate in the study. To collect data a questionnaire form developed by researchers and based on the related literature was used in the study (Noll et al., 2013; Straker et al., 2009; Watson et al., 2003; Widhe, 2001; Zapata et al., 2006). The content of the questionnaire was reviewed by a child healthcare nurse specialist and a physical therapy doctor. To evaluate the appropriateness of the questionnaire, a pretest was conducted face-to-face with 28 adolescents who were in the same age group as the participants and who were excluded from the study. Then, the required corrections about the sociodemographic characteristics part of the questionnaire were made by the researchers, and the questionnaire was adapted to a final version.

Before applying the questionnaire, adolescents were informed that they could decline to participate in the study at any time. Adolescents who met the inclusion criteria were invited to study. These volunteer adolescents also had their parents' consent. Then the aim and importance of the study was explained to the adolescents. The questionnaire forms were given to adolescents in the classroom setting. Afterward, adolescents were told to choose and write the most appropriate answer for each question that was compatible with their own daily lives. The questions of adolescents regarding filling in the form were answered by the researchers. The questionnaire form was applied under researchers' observation. Adolescents anonymously completed the questionnaire form in approximately 30 minutes in a silent classroom setting.

Measures

Data Collection

The questionnaire was used to collect data and consisted of three parts: (1) descriptive characteristics of the adolescents (16 questions); (2) pain assessment (28 questions); and (3) the postural factors of BackPEI (five questions). The first part of the questionnaire contained descriptive characteristics of the adolescents, such as their date of birth, sex, education status of their parents, family structure (nuclear/extended/other), economic status, and medical history. In the study the education level of the parents was found to be 8 years or less and more than eight years, because compulsory primary education in Turkey is 8 years. The second part of the questionnaire included figures of the upper extremity (upper arm, elbow, lower arm, wrist, and fingers), head and torso (neck, shoulders, back, and low back) and lower extremity (thigh, knee, calf, ankle, and toes). In this part, each participant was asked to evaluate her/his pain intensity experienced during the last month, using a visual analog scale (VAS) in the related parts of their bodies shown in the figures. In the literature, there were outcomes regarding musculoskeletal pain occurrence in adolescents questioned "during the last year, last three months, and last month" (Gencbas et al., 2019; Noll et al., 2016, Pollock et al., 2011, Trevelyan & Legg, 2010). In order to eliminate the memory factor, participants were asked to assess the intensity of the pain experienced "during the last month" (Pollock et al., 2011, Trevelyan & Legg, 2010). To assess the frequency of pain, five scoring methods were utilized. In addition, adolescents were asked about their pain history with questions, such as the cause of the pain, effects of pain on daily life activities, and coping methods for pain. They were also asked to evaluate the comfort of their school desk with a VAS (0-10). Furthermore, there were questions about the amount of time spent using a device with a screen such as a computer and a television, feeling rested when waking up, the use of a motor vehicle for school transportation, whether they carried school backpacks or not, and the positions they used to carry school backpacks.

The third part of the questionnaire included the postural factors of the BackPEI, which was used to evaluate the participants' postural habits. The postural factors of the BackPEI contains positions illustrated in photographs of the five most common activities in the school setting and reflected the perceptions of participants' own postures in the study. Each school activity was illustrated, and questions regarding different positions were asked to determine the participants' body posture habits. These photographs were about sitting posture at a school desk while writing, listening/talking, or using the computer, body posture while lifting something from the floor, and body posture while carrying a school backpack. In the questionnaire, for each school-related activity, the correct body posture was only shown in one photograph, while the other body postures were inadequate. The participants who marked the correct positions illustrated in the photograph got one point, while those who marked it wrong received zero points (Fig. 1).

Assessment of Pain

The VAS is a widely used, valid, and reliable measurement tool for pain assessment (Desouzart & Gagulic 2017; Noll et al. 2013). To evaluate pain intensity, a 10-point VAS was used in the current study. Each participant scored the intensity of pain from 0 to 10 on a VAS-related part of their bodies. Using a five-point scale to evaluate pain frequency is a commonly accepted method in the literature (Desouzart & Gagulic, 2017; Noll et al., 2013). In this study, a five-point scale was used for evaluating the frequency of pain (0 = never, 1 = once, 2 = rarely, 3 = sometimes, 4 = often).

Back Pain and the Body Posture Evaluation Instrument (BackPEI)

Determining the relationship between body posture and musculoskeletal pain using valid and reliable instruments was recommended in the literature (Noll et al., 2016; Noll et al., 2013). The BackPEI constitutes a valid instrument that was developed by Noll and his colleagues in 2013. The BackPEI consists of six parts. These parts are written in order: (1) demographic data; (2) socioeconomic status; (3) behavioral factors (physical activity, watching TV duration, using computer duration, etc.); (4) low back pain in the last three months (occurrence, frequency, and intensity; (5) postural factors (sitting position while writing or using a computer or talking on the school furniture etc.); (6) genetic factors.

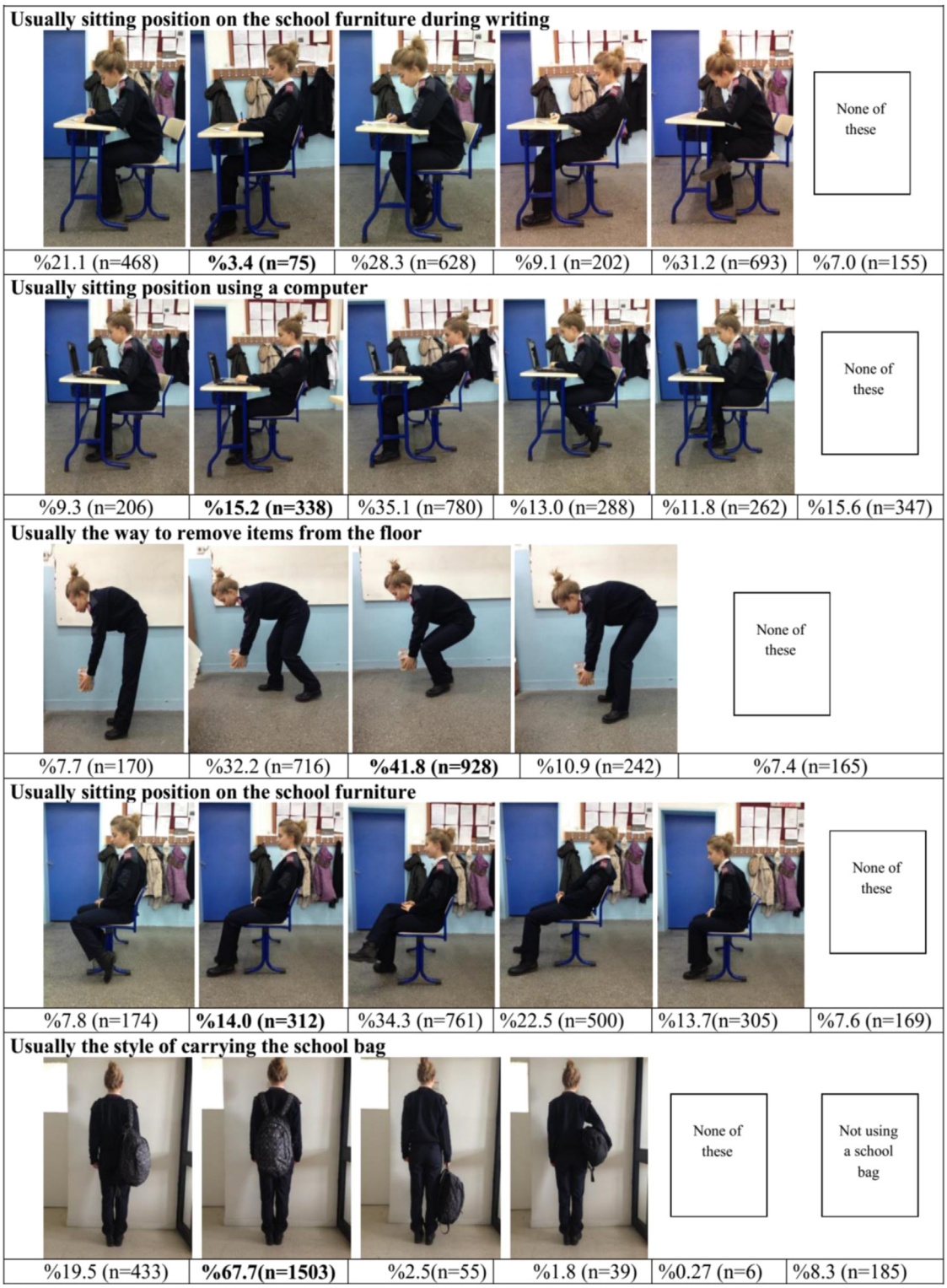

Figure 1. The distribution of the posture profile of Adolescents.

For determining the postural habits of participants, the postural factors of the BackPEI were utilized in the current study. The original version of the postural factors of the BackPEI illustrated six different postures during school activities in photographs. The content and construct validity and reliability of the Turkish version of the BackPEI were investigated first by Akpunar and Bebis in 2015 and published by Gencbas and Bebis in 2019. The postural factors of the BackPEI were reduced from six to five postures when culturally adapted to Turkish by Akpunar and Bebis (2015). In the Turkish version of the postural factors of the BackPEI, the postures were: (1) Sitting position on school furniture while writing; (2) Sitting position using computer; (3) Position adopted when lifting an object from the floor;

Table 1
Socio-Demographic Characteristics of Adolescents. (N = 2,221)

	Mean ± SD	Minimum to Maximum
Age (years)	16.67 ± 1.16	15-19
	n	%
Sex		
Female	1,110	50.0
Male	1,111	50.0
School grade		
9th grade	503	22.6
10th grade	692	31.2
11th grade	601	27.1
12th grade	425	19.1
Family type		
Core family	1,952	87.9
Large family	244	11.0
Other	25	1.1
Education level of mother		
Eight years or less	1,441	64.9
More than eight years	780	35.1
Education level of father		
Eight years or less	1,070	48.2
More than eight years	1,151	51.8
Perception of economical status		
Very good	112	5.0
Good	1,048	47.2
Moderate	1,004	45.2
Bad	57	2.6

SD = standard deviation.

(4) Sitting position on the school furniture while talking; (5) The style used fpr carrying school backpacks (Fig. 1). In validity and reliability of the Turkish version of the BackPEI study, one position of carrying things in a small handbag was found inappropriate for Turkish adolescents and was excluded. According to the BackPEI, the correct body posture (adequate) was coded as "1", and poor postures were coded as "0." The total score from five questions, ranging from 0 to 5, was accepted as the posture score of each participant, and a higher score represented correct postural habits according to the Turkish version of the postural factors of the BackPEI.

Ethical Considerations

An ethical approval certificate numbered 1,491-31-14/1648.4-48 was obtained from the institute at which the researchers were employed. Volunteering parents and adolescents signed the consent form and were enrolled in the study.

Analytic Strategy

Descriptive statistics were reported as frequencies (n) and percentages (%) and the mean ± standard deviation for categorical and continuous variables. The single sample Kolmogorov-Smirnov test was used to determine whether continuous variables were normally distributed. It was determined that the data of the study did not show normal distribution. For that reason, the non-parametric test Spearman's correlation was used to analyze the relationship between the posture score and independent variables. Mann–Whitney *U* test and Kruskal Wallis test were used for determining the differences of the groups. It was accepted a p value < .05 was taken as significant. Intergroup differences between categorical variables were evaluated with the chi-square test. The results were analyzed using SPSS, version 22.0 (SPSS Inc., Chicago, IL, USA).

Results

Participants' Characteristics

The mean age of adolescents in the study was 16.67 ± 1.16 years (15 to 19 years), and 50% (n = 1,111) were male. Tenth grade students accounted for 31.2% (n = 692) of the adolescents (Table 1).

Relationship Between the Socio-Demographic Characteristics and Mechanical Factors With Musculoskeletal Pain

The majority of the adolescents in the study (82.5%, n = 1,832) reported at least one pain experienced in some parts of their bodies during the last month. The prevalence of low back pain among the participants was 73.3% (n = 1,343), whereas the prevalence of back pain and neck pain were 68.4% (n = 1,254) and 67.2% (n = 1,231), respectively. Regarding the mean score of the pain severity, the most commonly affected locations were the low back (3.95 ± 3.40), back (3.71 ± 3.43), and neck (3.46 ± 3.36). Considering the frequency of pain in the low back, back, and neck, "often" and "sometimes" were the most common frequencies (Table 2).

Table 2
Severity of Pain and Characteristics of Pain Reported by Adolescents

								Yes				No			
								n	%			n	%		
Do you have pain in any of the following body parts during the last month?								1,832	82.5			389	17.5		
	Do You Have Pain?*				Pain Severity*	Pain Frequency*									
	Yes		No		Mean ± SD	Often		Sometimes		Rarely		Once		Never	
	n	%	n	%		n	%	n	%	n	%	n	%	n	%
Upper arm	704	38.4	1,128	61.6	1.68 ± 2.67	89	4.9	286	15.6	288	15.7	41	2.2	1,128	61.6
Elbow	465	25.4	1,367	74.6	1.00 ± 2.19	53	2.9	161	8.8	186	10.2	65	3.5	1,367	74.6
Lower arm	553	30.2	1,279	69.8	1.21 ± 2.30	80	4.4	194	10.6	225	12.3	54	2.9	1,279	69.8
Wrist	823	44.9	1,009	55.1	2.07 ± 2.92	158	8.6	325	17.7	284	15.5	56	3.1	1,009	55.1
Hand Fingers	728	39.7	1,104	60.3	1.91 ± 2.96	192	10.5	260	14.2	231	12.6	45	2.5	1,104	60.3
Neck	1,231	67.2	601	32.8	3.46 ± 3.36	302	16.5	468	25.5	407	22.2	54	2.9	601	32.8
Shoulder	1,043	56.9	789	43.1	2.95 ± 3.36	289	15.8	377	20.6	329	18.0	48	2.6	789	43.1
Back	1,254	68.4	578	31.6	3.71 ± 3.43	350	19.1	500	27.3	372	20.3	32	1.7	578	31.6
Low back	1,343	73.3	489	26.7	3.95 ± 3.40	402	21.9	512	27.9	380	20.7	49	2.7	489	26.7
Thigh	756	41.3	1,076	58.7	1.96 ± 2.99	136	7.4	251	13.7	301	16.4	68	3.7	1,076	58.7
Knee	784	50.8	1,048	57.2	2.02 ± 3.01	142	7.8	271	14.8	310	16.9	61	3.3	1,048	57.2
Calf	719	39.2	1,113	60.8	1.87 ± 2.94	145	7.9	234	12.8	272	14.8	68	3.7	1,113	60.8
Ankle	636	34.7	1,196	65.3	1.58 ± 2.74	124	6.8	186	10.2	246	13.4	80	4.4	1,196	65.3
Toes	412	22.5	1,420	77.5	1.00 ± 2.36	93	5.1	100	5.5	164	9.0	55	3.0	1,420	77.5

SD = standard deviation.
* n = 1,832.

There were statistically significant differences in gender, school grade (reflecting age), perception of economic status, physical activity, reading while lying down, feeling rested after waking, using motor vehicles or walking on the way to school, and school bag carrying position associated with the pain experiences of adolescents ($p < .05$) (Table 3). Approximately 91.7% (n = 2,036) of adolescents were carrying school backpacks. Pain experienced while carrying a school bag was reported by 84.1% (n = 1,713) of the adolescents (Table 3). The mean score for pain severity while carrying a school backpacks which was measured by VAS was 3.67 ± 3.15 (0 to 10).

Half of the adolescents (50.6%, n = 927) experiencing pain reported that they were using analgesic pills or ointments. It was found that 26% (n = 479) of the adolescents reported that pain limited their mobility, 15.5% (n = 284) reported that they practiced warm/cold application, and 7.8% (n = 142) reported that they just waited for the pain to resolve. Because of musculoskeletal pain, 36.9% (n = 676) of the adolescents experienced absenteeism, 41.7% (n = 764) reported visiting a medical facility due to pain, and 47.9% (n = 878) reported limitations in daily life activities due to pain.

The Posture Factors of the BackPEI: "Posture Habit Profile"

The mean posture factors of the BackPEI score of adolescents in the study was 1.42 ± 0.98 (minimum: 0, maximum: 5). Almost all of the adolescents (96.6%) had poor posture while writing at school desks. It was determined that 86% of adolescents (n = 2,146) had poor sitting postures at their school desk while listening to teacher and 84.4% (n = 1,883) of adolescents while using a computer (Table 4).

Less than half of the adolescents (38.1%, n = 847) responded to the question "What is the cause of your pain?" by citing sitting with a poor posture during school hours. The mean comfort score of school desks was measured by VAS to be 2.91 ± 2.94 (0-10) according to the adolescents' statements. A statistically significant positive correlation was found between the posture factors of the BackPEI score of adolescents and the school desk comfort score in the Spearman's correlation analysis (Spearman's ρ = 0.148; $p = .001$) (Table 5). Comparing the school grade of adolescents with the posture factors of the BackPEI score, there was a statistically significant negative Spearman's correlation between the posture score and school grade (Spearman's ρ = -0.161; $p = .001$) (Table 5). A statistical significance was found between the posture score and grades ($z = 57.92$; $p = .001$) (Table 6). Additionally, a statistically significant difference was found in the physical activities of adolescents and the posture factors of the BackPEI score ($z = 4.40$; $p = .001$) (Table 6). The mean the posture factors of the BackPEI score of adolescents reporting physical activity (1.50 ± 1.02) was significantly higher than that of those who did not report physical activity (1.29 ± 0.90) ($p < .05$). No statistically significant difference was found in gender, parent education status posture factors family type, economic status or pain experience regarding the posture factors of the BackPEI of adolescents ($p > .05$).

Table 3
Musculoskeletal Pain Experience of Adolescents in Regard to Some Characteristics (N = 2,221)

Characteristics	Pain		No Pain		X^2	*p* Value
	n	%	n	%		
Sex						
Female	1,021	92.0	89	8.0	138.52	.001*
Male	811	73.0	300	27.0		
Grade						
9th grade	430	85.5	73	14.5	9.85	.02*
10th grade	582	84.1	110	15.9		
11th grade	475	79.0	126	21.0		
12th grade	345	81.2	80	18.8		
Perception of economic status						
Very good	77	68.8	35	31.3	23.67	.001*
Good	847	80.8	201	19.2		
Moderate or bad	908	85.6	153	14.4		
Physical activity†						
Yes	1,080	79.5	278	20.5	21.15	.001*
No	752	87.1	111	12.9		
Reading while lying						
Yes	558	86.5	87	13.5	26.96	.001*
Sometimes	866	83.7	169	16.3		
No	408	75.4	133	24.6		
Feeling rested after waking						
Yes	509	76.1	160	23.9	27.59	.001*
No	1,323	85.2	229	14.8		
Use for motor vehicles on the way to school						
Yes	1,141	84.0	218	16.0	5.26	.02*
No	691	80.2	171	19.8		
Carrying school backpacks						
Yes	1,713	84.1	323	15.9	46.07	.001*
No	119	64.3	66	35.7		

* Engaging in regular physical activity at least 30 minutes and three times per week.
† $p < .05$.

Table 4
BackPEI Posture Scores and Characteristics of Adolescents (N = 2,221)

	Mean ± SD	Minimum-Maximum.
BackPEI posture score	1.42 ± 0.98	0-5
	n	%
Sitting posture while listening teacher on desk		
Correct body posture	312	14.0
Poor posture	1,909	86.0
Sitting posture while writing on desk		
Correct body posture	75	3.4
Poor posture	2,146	96.6
Sitting posture while using computer		
Correct body posture	338	15.2
Poor posture	1,883	84.8
Posture while grabbing something on the floor		
Correct body posture	928	41.8
Poor posture	1,293	58.2
Posture while carrying a school backpacks* (n = 2,036)		
Correct body posture	1,448	71.1
Poor posture	588	28.9

SD = standard deviation.
* Adolescents who carry a school backpacks.

Discussion

Today, symptoms of musculoskeletal system disorders have become a worrisome health problem that is seen in early age and has life-lasting effects (Diepenmaat et al., 2006). In this study, the majority of the adolescents aged 15 to 19 years (82.5%) were found to experience pain in the upper extremities, neck, back, low back, and lower extremities. Similar to these findings, musculoskeletal pain in adolescents has been reported to be a common condition in the literature (Hakala et al., 2006; Huguet et al., 2016; McBeth et al.,

Table 5
Correlation Between Adolescents School Desk Comfort Score, Grade, and BackPEI Posture Score (N = 2,221)

	BackPEI Posture Score	
	Spearman's rho*	*p* Value
School desk comfort score	0.148	.001†
Grade	−0.161	.001†

* Spearman's correlation analysis.
† $p < .05$.

Table 6
Comparing Adolescents BackPEI Posture Score With Grade and Physical Activity Status (N = 2,221)

Characteristics		BackPEI Posture Score		
		Mean ± SD	Test	*p* Value
Grade	9th	1.65 ± 1.00	57.92*	.001†
	10th	1.47 ± 0.98		
	11th	1.34 ± 0.93		
	12th	1.19 ± 0.98		
Physical activity‡	Yes	1.50 ± 1.02	4.40§	.001†
	No	1.29 ± 0.90		

SD = standard deviation.
* Kruskal Wallis Test.
† $p < .05$.
‡ Engaging physical activity at least 30 minutes and three times per week.
§ Mann–Whitney U Test.

2007; Pellise et al., 2009). Studies on musculoskeletal pain in adolescents are mostly focused on low back, and studies on other parts of the body are rare (Diepenmaat et al., 2006; Mwaka et al., 2014, Roth-Isigkeit et al., 2005; Straker et al., 2009; Wirth et al., 2013). In the current study, in addition to considering low back, the musculoskeletal system, which could be affected by mechanical factors, was considered as a whole. These findings showed that despite the varying pain severity and frequency, adolescents experienced pain in the upper extremities, neck, back, low back, and lower extremities. In the literature, the low back, back, and neck have been reported to be the leading locations of pain (Diepenmaat et al., 2006; Mwaka et al., 2014; Roth-Isigkeit et al., 2005; Watson et al, 2003; Wirth et al., 2013). The mean pain severity in the low back, back, and neck reported in this study was mild, but nearly half of the adolescents with pain reported experiencing pain "often" or "sometimes". Similar to the literature, in the current study, adolescents stated that they experienced pain in the upper and lower extremities with a frequency ranging from 22.5% to 67.2% (Fuglkjær et al., 2017). These findings suggest that musculoskeletal pain is common in Turkish adolescents and that there is a potential health risk for the future adult population.

Sex, age, poor posture, ergonomic factors, and physical activity have been reported to be risk factors for musculoskeletal pain; however, there is still uncertainty regarding the direct cause of musculoskeletal pain (Brink et al., 2013; Huguet et al., 2016; Murphy et al., 2004; Prins et al., 2008). In the current study, female adolescents, adolescents in lower school grades, adolescents with lower economic statuses, and those who read while lying down, had inadequate physical activity, used motor vehicles or walked on the way to school and carried school backpacks were high-risk groups that cannot be ignored ($p < .05$). In contrast to the literature, parent education status, family structure, watching television, using a computer, and feeling rested after waking were not found to affect pain experiences ($p > .05$) (Hakala et al., 2006; Jackson et al., 2011; Mwaka et al., 2014; McBeth et al., 2007; Wirth et al., 2013; Zapata et al., 2006). These differences might be due to variation in the study design, lifestyles, and cultural differences in the time and place the studies were conducted. This is the first study to evaluate musculoskeletal system pain among 15 to 19 year-old healthy Turkish adolescents and establishes these data as the first step for future field studies.

Given the long time spent by adolescents sitting in school chairs and carrying heavy school backpacks, mechanical reasons are considered the most common cause of pain (Adami et al., 2015; Clinch, 2009; Gouvali et al., 2006; Jackson et al., 2011; Widhe, 2001). A significant portion of the general population spends their lives carrying school backpacks and sitting for a long time during the adolescence period (Ardic et al., 2016; Guler, 2004; Parcells et al., 1999). Several studies have reported incompatibility in the anthropometric features of adolescents and school furniture (Murphy et al., 2007; Panagiotopoulou et al., 2004; Parcells et al., 1999). Incompatibility in anthropometric features and school furniture is known to cause poor body posture. Long exposure to incompatible school furniture causes pain by negatively affecting body posture (Adami et al., 2015; Gouvali et al., 2006; Guler, 2004; Jackson et al., 2011; Murphy et al., 2007). Carrying school backpacks asymmetrically can also cause musculoskeletal pain by affecting body posture (Guler, 2004; Jackson et al., 2011; Jones et al., 2005; Trevelyan et al., 2006). As seen in the literature, every four adolescents out of ten in our study reported that the cause of their pain was sitting position on the chair and uncomfortable school desks. The vast majority of the adolescents in our study reported that they experienced musculoskeletal pain while carrying school backpacks. Today, school desks and school backpacks are still a noteworthy ergonomic problem and a mechanical and prognostic factor that affects musculoskeletal health in adolescents. It is suggested that healthy and ergonomic school furniture replace standard school furniture for adolescent health promotion.

Musculoskeletal pain can cause absenteeism, limitations in daily life activities, the need for pain killers, and avoidance of social and sports activities (Clinch, 2009; Cohen et al., 2010; Roth-Isigkeit et al., 2005). Nearly half of the adolescents in our study reported limitations in daily life activities due to pain. This finding suggests that pain directs adolescents to sedentary lifestyles (Guite et al., 2007). In this study, pharmacologic assets were found to be the most common coping method for pain in half of the adolescents. Similar to the literature, four of ten adolescents in our study reported that they sought medical care, while most of them did not receive medical care (Logan & Curran, 2005). Common analgesic use for coping with pain and the inadequate demand for medical care show that effective musculoskeletal pain management is not known and/or implemented by adolescents (Clinch & Eccleston, 2009). Additionally, the low demand for medical care suggests a gap regarding the need for medical care. In this study, the frequency of students who had absenteeism because of musculoskeletal pain was determined more than in the literature (Mwaka et al., 2014; Minana-Signes & Monfort-Panego, 2016; Roth-Isigkeit et al., 2005). This finding may be because this study focused on the musculoskeletal system as a whole. Comprehensive health education about pain management led by school nurses is needed. In intervention studies, it was reported that posture education and exercise programs were effective in reducing musculoskeletal pain and maintaining good posture for adolescents (Minana-Signes & Monfort-Panego, 2016; Ruivo et al., 2017; Ruivo et al., 2016; Sellschop et al., 2018). There were limited observational studies on musculoskeletal pain and posture among adolescents conducted by nurses (Gencbas & Bebis, 2019; Smith et al., 2014;), but the interventional studies that were about adolescent's musculoskeletal health promotion were done by other health professions (Minana-Signes & Monfort-Panego, 2016; Ruivo et al., 2017; Ruivo et al., 2016; Sellschop et al., 2018). School health nurses can play a key role in pain management, promoting musculoskeletal health in adolescents. School health nurses could promote adolescents' musculoskeletal health with effective health education strategies (American Academy of Pediatrics Council on School Health [AAP-COSH], 2016). In addition, school health nurses could prevent musculoskeletal diseases such as scoliosis, kyphosis, and lordosis by introducing good postural habits to adolescents or contributing to the early diagnosis and treatment of these diseases (Abbott et. al., 2013; Gencbas & Bebis, 2019). However, it was observed that nurses did not focus enough on their research on adolescent the musculoskeletal health. Future school nursing studies may focus on pain management of musculoskeletal system for adolescent's health promotion.

Static postural changes observed in the adolescent period have been reported to be important risk factors for vertebral degenerative disorders in adulthood (Adami et al., 2015; Widhe, 2001). Sitting in a poor posture and carrying a school bag asymmetrically in adolescence have been reported to be associated with static postural changes in the sagittal and frontal planes (Adami et al., 2015). In our study, some behaviors of adolescents, such as sitting, bending to grab something on the floor, and carrying school backpacks, were evaluated. The posture profiles of adolescents in our study were defined, and the postural factors of the BackPEI scores were determined. The majority of the adolescents were found to sit with poor posture while writing, listening to a lecture, and using a computer, and half of them were found to bend with an inappropriate posture that is not suitable for body mechanics while lifting something from the floor. In addition, three out of ten adolescents in our study reported that they carried their school backpacks asymmetrically. The posture scores of adolescents in our study were quite low. Additionally, it is remarkable that the postural factors of the BackPEI scores of adolescents who participated in physical activity were higher than those of adolescents who did not perform physical activity. Studies on the posture profiles of adolescents are limited in the literature (Noll et al., 2013). It is apparent in the current study results that adolescents need ergonomic postural education in the schools; school nurses could be instrumental in promoting adolescent health.

Limitations

This study was a cross-sectional study that can be generalized to Kecioren district of the city of Ankara, which has the third-largest population in Turkey. Data on pain were based on the self-reports of adolescents. There were limited studies with which to compare our findings of adolescents' postural habits. In the literature, it was reported that the weight of school backpacks could be a factor causing musculoskeletal system pain (Mackie et al., 2003; Mwaka et al., 2014). In this study, adolescents' school backpacks were not weighed and therefore serves as a limitation.

Conclusion

In the current study, musculoskeletal system pain and related factors were evaluated, and posture profiles among adolescents were defined. Our findings show that musculoskeletal system pain is a common problem in Turkish adolescents. Gender, school grade, economic status, physical activity, school backpack usage, and posture are suggested to be factors related to pain. In general, adolescents were found to have poor postures. School furniture comfort, school grade, and physical activity may be related to posture. Notably, among adolescents, pain causes limitations in daily life activities, and the most popular coping method for pain is analgesics. Developing and systematically implementing school nursing health education programs to help adolescents to cope with musculoskeletal pain and achieve healthy lifestyles is recommended.

These findings highlight the global and the countrywide unmet need for school nurses to promote musculoskeletal health among adolescents. Developing and systematically implementing education programs that allow adolescents to achieve lifestyles that promote musculoskeletal health as part of the school health program is recommended. In addition, early diagnostic survey programs are recommended to prevent pain that lasts into adulthood. Future studies evaluating school ergonomics and the effects of school furniture that fully supports the body to prevent musculoskeletal system pain are recommended. School nurses should develop and systematically implement health education programs to help adolescents cope with musculoskeletal pain and achieve a healthy lifestyle. Through teaching and skill-building, appropriate posture and ergonomic positions when using computers, carrying school backpacks, and sitting in school chairs should be encouraged to prevent musculoskeletal pain.

Conflicts of Interest

There are no known conflicts of interest associated with this manuscript.

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