ORIGINAL RESEARCH

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Another neglected symptom among the overweight young: an analysis of the self-reported anterior knee pain scores of the secondary school children

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Abstract

Objective: Knee pain is the most common joint complaint among the young and is linked with excessive weight by the World Health Organization. The study aimed to define the prevalence of anterior knee pain in secondary school children and search its' relations to weight and academic performance.
Method: The cross-sectional and descriptive study was conducted in Adana, between Sept 15 and Oct 15, 2020. Middle school students aged between 10 and 18 years were included. Anterior knee pain was assessed using the Anterior Knee Pain Scale short form (AKPS-SF), and the numerical rating scale (NRS) was used for pain intensity. Data were collected by questionnaires sent by e-mail.
Results: There were 709 replies eligible for analysis. The NRS mean score was 0.78±1.47 for 249 (35.12 %) participants who reported knee pain. The number of students with an AKPS-SF score of ≤40 in the study group was 46 (6.40%). AKPS-SF scores showed weak negative linear associations with weight and the school year (r=-0.346/p=0.019, and r=-0.292/p=0.049, respectively), and no correlations were found with academic performance.
Conclusion: The study has shown that more than a third of the students reported various levels of knee pain. The inverse correlation of AKPS-SF with weight and the weak link with the school year might attract the attention of healthcare givers to pay more attention to knee examination and help avoid future impairments in the knee joints of school age children.
Keywords: Knee Pain, Childhood Obesity, Academic Performance

INTRODUCTION

Anterior knee pain (AKP) is the most common joint complaint among the young. The incidence is between 6 and 33 % among school-age children (1–3). The causes include Osgood–Schlatter's disease, patellar tendinitis, patellofemoral instability, and growing pains (4,5). Studies indicate that knee pain was the most prevalent self-reported complaint compared to the other body sites, and the prevalence was slightly higher for girls (2). AKP was linked with excessive weight by the World Health Organization, signifying that any BMI outside the sample population's average levels was indicative of anterior knee pain syndrome (6). Childhood obesity is associated with many comorbidities and impaired quality of life (7). The reports show strong associations between obesity and joint pain and suggest that childhood obesity impairs musculoskeletal health (8,9). Obesity leads to knee impairment by the mechanical load, resulting in wear and tear and adiposity-related inflammation. The developing osteoarthritis may advance to the symptomatic stage, including pain and functional limitation, increasing the possibility to end with joint death (10). The number of studies searching for an association between knee pain and weight gain is increasing, with many resulting in strong links (11, 12). Based on the studies, it seems that childhood obesity and knee pain are two closely interrelated conditions.

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Moreover, the duration of knee pain might have been underestimated. Rathleff et al. showed that nearly half of the adolescents with knee pain continued to experience knee pain up to 5 years (13). The studies indicate that most children with knee pain miss a significant amount of class sessions and avoid engaging in routine exercises, including physical education (14,15). Thus, pointing to a link between knee pain and academic life.

The aims were to define the prevalence of anterior knee pain in secondary school children and evaluate anterior knee pain association with weight parameters and academic performance.

METHOD

The cross-sectional and descriptive study was conducted on 709 middle school students in Adana, between Sept 15 and Oct 15, 2020. The study participants were aged between 10 and 18 and were able to perform sports activities at school. Exclusion criteria were a history of trauma, disease, or disorder affecting or limiting the functions of the lower extremity in the past three months, being on medication that affects the lower extremity, and reported chronic knee pain. Chronic knee pain was defined as knee pain existing for more than three months (16). The age, gender, height, weight, academic performance score given by the participant's teacher, the Anterior Knee Pain Scale short form (AKPS-SF), the numerical rating scale (NRS), existing chronic diseases, a history of trauma of the lower extremity and medication data were collected. AKPS-SF was a modified, dichotomous 6-item of the original 13-item AKPS, a scale commonly used to investigate patellofemoral knee pain prevalence. The 6-item form was reported to have identical classification rates compared to the longer version and could screen at close accuracy and reliability and present highly similar reliability indices to the original (17). The Turkish version of the scale is reliable and valid (18). In the evaluation of the severity of the knee pain, the NRS was placed right after the AKPS-SF questions, consisting of a line of 10 cm including the first ten numbers, starting with a zero at the left end with a text next to zero stating "No pain", and ending with ten at the right end including a text "Excruciating pain" in Turkish. The NRS was a valid and reliable tool for screening pain in children of school-age (19).

The BMI percentiles were calculated by the Children's BMI Tool for Schools at the Microsoft Office 365 Excel software via the Group BMI Calculator V1.0 file downloaded from https://www.cdc.gov/healthyweight/xls/bmi_group_calculator_metric.xls. The participants were divided into four groups based on the BMI percentiles; underweight (<5th %), healthy weight (≥5th % and <85th %), overweight (≥85th % and <95th %, and obese (≥95th %).

The structured form consisting of sociodemographic, medical history, AKPS-SF, and NRS was e-mailed to the parents' e-mail addresses for completion by the student, including an informed consent letter and a broad explanation of how to complete the survey. There were 834 replies. After eliminating the uncompleted forms and ones with exclusion criteria, the remaining 709 forms were e-mailed to the participants' teachers for academic performance scoring.

Statistical Package for the Social Sciences (SPSS) 20.0 software was used in the data analysis. In descriptive analysis, mean, standard deviation, median, frequency, percentage, minimum, and maximum values were calculated. Group comparisons were made using the independent t-test and ANOVA. The Levene test was used to verify the homogeneity of the variance. Pearson Chi-square and Likelihood ratio tests were used to analyze the association between the categorical variables. The critical significance was set as 0.05.

Table 1. The descriptive analysis results of the 709 participants

	n	%	Min	Max	Mean
Total	709		10	18	13.55±2.25
Boys	231	32.6	10	18	13.15±2.14
Girls	478	67.4	10	18	13.75±2.27
Age			10	18	13.55±2.25
Height			110	188	157.22±11.62
Weight			23	108	50.75±13.71
BMI percentiles			1.20	99.3	56.43±29.93
Underweight	37	5.2			
Healthy Weight	514	72.5			
Overweight	103	14.5			
Obese	55	7.8			
AKPS-SF			25	50	47.48±3.69
NRS			0	8	0.78±1.47
Academic Performance					
A (100-85)	495	69.8			
B (84-70)	172	24.3			
C (69-54)	37	5.2			
D (<53)	6	0.7			

BMI: Body Mass Index, AKPS-SF: Anterior Knee Pain Scale Short Form, NRS: Numerical Rating Scale

RESULTS

There were 834 replies. After eliminating the 125 inadequate forms, the remaining 709 were e-mailed to the participants' teachers for academic performance scoring. In table 1, the baseline characteristics were presented.

Table 2. The distribution of the students according to AKPS-SF scores

	< 25	26-30	31-35	36-40	41-45	46-50
Total	1	3	8	34	93	570
Boys (n)	0	0	4	10	26	192
Girls (n)	1	3	4	24	67	378
Age (years)	16	15.33±1.53	14.63±2.97	13.65±2.29	13.87±2.18	13.46±2.24
Height (cm)	164	162.00±7.55	160.75±15.57	158.97±10.52	157.44±9.86	156.96±11.93
Weight (kg)	108	59.33±9.45	58.13±23.09	52.63±14.44	51.96±13.23	50.18±13.38
BMI percentiles	99.2	70.03±26.75	60.28±37.86	58.35±32.32	58.60±31.37	55.90±29.45
Underweight (n)	0	0	0	3	6	26
Healthy weight (n)	0	3	5	24	63	423
Overweight (n)	0	0	2	4	19	74
Obese (n)	1	0	1	3	5	47
AKPS-SF	25	30.00±0.00	33.25±1.16	38.38±1.44	43.89±1.31	48.95±1.38
NRS	1	6.00±1.73	5.63±2.92	3.00±1.92	2.28±1.53	0.31±0.78
Academic score						
A (100-85)	1	2	5	24	67	396
B (84-70)	0	0	2	7	19	143
C (69-54)	0	1	1	3	5	27
D (<53)	0	0	0	0	2	4

BMI: Body Mass Index, AKPS-SF: Anterior Knee Pain Scale Short Form, NRS: Numerical Rating Scale

The number of students with a perfect AKPS-SF score (AKPS-SF total score=50) was 346 (48.80 %). Four hundred sixty participants (64.88 %) reported no pain in the NRS. The number of participants reporting knee pain with an intensity varying between 1 and 8 was 249 (35.12 %). The high number of perfect and close to perfect scores required the need to determine a cut-off for AKPS-SF and select a relatively homogenous population to conduct a reliable and valid analysis of any potential links between the AKPS-SF scores, NRS, BMI, and academic performance. The cut-off value was calculated to be 40 in the ROC analysis. The number of students with an AKPS-SF score of ≤40 in the study group was 46. The summary of the initial data according to the AKPS-SF scores was presented in table 2.

The 46 reports with AKPS-SF scores ≤40 showed no significant associations of AKPS-SF, NRS, BMI percentiles, and the overall academic performance scores between the gender groups (p>0.05). There was no significance between overall academic score and AKPS-SF, NRS, and BMI percentiles (p>0.05).

However, the results showed a relation between weight groups and gender (p=0.049). Among boys, overweight ones were statistically high in number (p=0,047). On the contrary, girls with healthy weight outnumbered others (p=0,047) (Table 3). There was also a statistical significance between the weight groups and academic performance (p=0.029). The analysis to find the link with the subgroups showed that the B score group included more overweight students (p=0.045), and their obese peers were grouped in the C score rank (p=0.048).

Table 3. The variables according to the weight groups in students with AKPS-SF scores of ≤40

		Underweight	Healthy	Overweight	Obese	p
Boys	**n**	0	6	5	3	0.049
	%	0	20.7	55.6	60.0	
Girls	**n**	3	23	4	2	
	%	100	79.3	44.4	40.0	
AKPS-SF	**min-max**	38-40	30-40	30-40	25-40	0.342
	mean	39.00±1.00	36.90±2.89	36.22±3.73	34.60±6.15	
NRS	**min-max**	1-5	1-8	1-7	1-8	0.771
	mean	3.33±2.08	3.90±2.50	3.11±2.03	3.00±2.91	
Academic score						
A (100-85)	**n**	3	22	4	3	
	%	100	75.9	44.4	60.0	
B (84-70)	**n**	0	4	5	0	
	%	0	13.8	55.6	0	0.029
C (69-54)	**n**	0	3	0	2	
	%	0	10.3	0	40.0	
Total	**n**	3	29	9	5	
	%	100	100	100	100	

AKPS-SF: Anterior Knee Pain Scale Short Form, NRS: Numerical Rating Scale

Table 4. The association between the continuous variables

	Pearson Correlation	BMI percentile	AKPS-SF	NRS
Age	**r**	0.107	-0.216	0.286
	p	0.480	0.150	0.054
Height	**r**	0.258	-0.106	0.286
	p	0.083	0.484	0.054
Weight	**r**	0.685	-0.346	0.094
	p	<0.001	0.019	0.535
BMI percentile	**r**	1	-0.143	-0.088
	p		0.343	0.561
AKPS-SF	**r**	-0.143	1	-0.320
	p	0.343		0.030
School year	**r**	0.106	-0.292	0.324
	p	0.482	0.049	0.028

BMI: Body Mass Index, AKPS-SF: Anterior Knee Pain Scale Short Form, NRS: Numerical Rating Scale

Besides, AKPS-SF scores showed weak negative linear associations with weight and the school year (r=-0.346/p=0.019, and r=-0.292/p=0.049, respectively) in the Pearson correlation analysis (Table 4). The AKPS-SF and NRS values also showed weak negative linear association (r=-0.320/p=0.030). Also, there was a weak positive linear association between the NRS and the school year (r=0.324/p=0.028).

DISCUSSION

The number of participants reporting knee pain with an intensity varying between 1 and 8 was 249 (35.12 %). Unfortunately, we have failed to find a study researching knee pain prevalence among young Turkish students conducted outside the healthcare settings to compare our results. The prevalence rate was above the reports from other countries, indicating a range between 6 and 33 % (2,3). Female students' elevated participation rate (67.42 % in the initial group and 69.56 % in the AKPS-SF≤40 group) was eye-catching. The increased female participation rate might be due to the knee pain prevalence bias, which was higher in girls, similar to other research (20, 21). Another explanation might include child-parent communication. A study by David et al. conducted on gender issues in parental involvement presented similar ratios and indicated that girls were more willing to volunteer their parents in school issues (22).

There were no associations between the gender groups in terms of AKPS-SF, NRS, and BMI percentile values in the analysis of the AKPS-SF≤40 group. Various studies reported conflicting results on gender comparison, some with similar findings, and others indicating strong links between the female gender with AKPS-SF and NRS (23–25). Besides, a significant association with the AKPS and NRS might not have been found at all. In a study researching the associations among BMI, BMI z-scores, and relative body fat percentage in the development of AKP in an adolescent female athlete population, no relationship between BMI and AKP was found (26). Similarly, Selhorst et al. noted no meaningful change in NRS at the end of a six-week AKP syndrome treatment where the AKPS showed significance (27).

On the other hand, the Pearson correlation analyses of the subgroup demonstrated weak negative linear associations between the AKPS-SF scores and weight, and NRS and AKPS-SF scores. Associations of weight with knee pain and symptoms were already demonstrated in various studies, and a similar link strength between the pain and the scale was shown by Hott et al. in a reliability and validity report (28).

The school year showed a weak negative association with AKPS-SF and a parallel positive weak link with NRS. Although age was not associated with AKPS-SF and NRS, the former findings might be explained by the increased ability to express pain and define the physical findings after receiving a more comprehensive education.

The students' NRS scores in the underweight group were below 6, which might indicate less weight developing lower pain intensity. Yet again, the results lacked an association with the AKP-SF scores in the underweight group. Nevertheless, Kim et al. showed that patellofemoral stress during walking was increased in obese children (26), favoring the finding that children bearing more weight might express more pain.

The analysis showed no association between academic scores and AKPS-SF or NRS scores (p>0.05). Despite the lack of an association with academic scores in our study, studies link decreased knee pain with successful grades. In a study focusing on reducing knee pain in children with Joint Hypermobility Syndrome, Pacey et al. have shown significant pre-post improvements in the individual domains of self-esteem and mental health of the Childhood Health Assessment Questionnaire psychosocial summary scores (29).

Regarding the links between academic performance and BMI percentiles, it was worth mentioning that the numbers of overweight students in the B score group and the obese ones in the C score group were increased, parallel to other research (30,31).

A birth cohort study of 8579 individuals who were followed up throughout childhood and adulthood demonstrated a significant association of high BMI (lower than 30) with knee pain from as early as age 11 years (32). Therefore, for such patients, pieces of advice on a well-balanced physical activity, considering the metabolic benefits against the current or potential impairment of the knee joint, should be incorporated, avoiding weight-bearing activities.

Finally, the self-reports of children should be considered carefully. The findings of a meta-analysis searched for an association between self-report pain ratings of child and parent, child and nurse and parent and nurse dyads, indicated that both parents' and nurses' perceptions of a child's pain should only be considered an estimate of the pain experienced by the child but not the same as the child's self-report (33).

This research focusing on the prevalence of anterior knee pain in school children conducted outside a healthcare setting in Turkey is a first. This novel study has shown that the prevalence of self-reported knee pain was higher than in various reports from other countries.

Limitations of the Study

Using AKPS-SF and NRS for knee pain self-reports collected via e-mail might have decreased the data accuracy. The AKPS also had a limited correlation with pain (28). In addition, young children might select unreliable numbers on an NRS due to the lack of an understanding of the quantitative significance of those numbers (34). Although many other

studies used similar data collection procedures, the study results should be commentated cautiously in the absence of clinical examination.

CONCLUSION

The study has shown that more than a third of the students reported various levels of knee pain. Concerning the analysis of the pain scores; the lack of an association with academic performance, inverse correlation with weight and the weak link with the school year might attract the attention of healthcare givers to pay more attention to knee examination and help avoid future impairments in the knee joints of the school-age children.

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Conflict of Interest

The authors declare that they have no conflict of interests regarding content of this article.

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Ethical Declaration

The study's ethical approval was given by the Adana City Training and Research Hospital Ethical Committee on Dec 4, 2019, with reference number 616. The Provincial Directorate of National Education of Adana's approval was obtained with reference number 98258552-604.01.01-E.6048517 on Mar 31, 2020. Informed consent was obtained from the parents or legal guardians.

Authorship Contributions

Concept: MCB, NAB, Design: MCB, NAB, Supervising: MCB, NAB, Financing and equipment: MCB, NAB, Data collection and entry: MCB, NAB, Analysis and interpretation: MCB, NAB, Literature search: NAB, Writing: MCB, Critical review: NAB.

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