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Spinal Posture Scan Study in Girl and Boy Students at First, Fifth and Eighth Grade of Primary School

İlköğretim Birinci, Beşinci ve Sekizinci Sınıf Kız ve Erkek Öğrencilerde Spinal Mouse ile Omurga Duruşu Taraması Çalışması

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ABSTRACT

Objective: In this study, students' spines were examined with the Spinal Mouse device. First, fifth and eighth grade students studying at Van Vakıfbank primary and secondary school in the 2018-2019 academic year were selected as subjects. The aim of the study was to evaluate the results of the measurements by performing posture analysis with the Spinal Mouse device.

Material and Method:86 first-grade students (39 girls, -47 boys), 119 fifth-grade students (58 girls, -61 boys) and 101 eighth-grade students (53 girls, -48 boys) were selected. Measurements were taken for posture evaluation in extension, flexion and erect positions by three different researchers using a Spinal Mouse device. Sacral kyphosis (SK), lumbar lordosis (LL), and thoracal kyphosis (TK) angle measurements of students in a certain age group (7, 11, 14) were determined with a Spinal Mouse device while they were standing. Normal values of continuous measurement values discussed in the study were determined by applying the Shapin-Wilk (n<50) test. Parametric tests were performed on the obtained measurement values.

Results: According to the data obtained, the presence of deformities was determined mostly in eighth grade students. The results obtained from this study were compared with previous studies on the same subject. Based on the literatures examined and the findings obtained, it was thought that students' sitting positions, carrying bags on their backs and spending too much time in front of the computer may affect the spinal structure, which continues to develop.

Conclusion: This study showed that the Spinal Mouse device can be preferred in studies to be carried out in the same direction, as it has features such as being harmless to radioactive methods in determining spinal disorders, being easy to apply and being a simple measuring device.

Keywords:*Kyphosis, Lordosis, Columna vertebralis, Posture, Scoliosis, Spinal Mouse*

ÖZET

Giriş: Bu çalışmada Spinal Mouse cihazı ile öğrencilerin omurgaları incelendi. Denek olarak 2018-2019 eğitim öğretim yılında Van Vakıfbank ilk ve orta okulunda eğitim gören birinci, beşinci ve sekizinci sınıf öğrencileri seçildi. Çalışmada Spinal Mouse cihazı ile postür analizinin yapılarak ölçümlerin sonuçlarının değerlendirilmesi hedeflendi.

Materyal ve Metot: Birinci sınıfa devam eden 86 (39 kız, -47 erkek), beşinci sınıfa devam eden 119 (58 kız, -61 erkek) ve sekizinci sınıf öğrencisi olan 101 (53 kız, -48 erkek) denek tercih edildi. Spinal Mouse cihazı kullanılarak üç farklı araştırmacı ile ekstansiyon, fleksiyon ve erekt pozisyonlarda postür değerlendirmesi için ölçümler alındı. Belirli yaş grubuna (7, 11, 14) dahil olan öğrencilerin ayakta durdukları esnada sacral kifoz (SK), lumbal lordoz (LL), ve thoracal kifoz (TK) açı ölçümleri Spinal Mouse cihazı ile belirlendi. Çalışmada ele alınan sürekli ölçüm değerlerinin normal değerleri Shapin-Wilk (n<50) testi uygulanarak tespit edildi. Elde edilen ölçüm değerlerine parametrik testler yapıldı.

Bulgular: Elde edilen verilere göre deformitelerin varlığı yoğun olarak sekizinci sınıf öğrencilerinde belirlendi. Daha önce aynı yönlü yapılan çalışmalarla bu çalışmadan elde edilen sonuçlar karşılaştırıldı. İncelenen kaynaklara ve elde edilen bulgulara dayanılarak öğrencilerin oturma pozisyonlarının, sırtta çanta taşımalarının ve bilgisayar başında fazla vakit geçirmelerinin gelişmeye devam eden omurga yapısını etkileyebileceği düşünüldü.

Sonuç: Yapılan bu çalışmada Spinal Mouse cihazının omurga bozukluklarını belirlemede radyoaktif yöntemlere zararsız olması, uygulanabilirlik kolaylığı ve basit bir ölçüm cihazı olması gibi özellikleri taşıması açısından aynı yönlü yapılacak olan çalışmalarda bu cihazın tercih edilebileceğini sergiledi.

Anahtar kelimeler: *Kifoz, Lordoz, Omurga, Postür, Skolyoz, Spinal Mouse*

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INTRODUCTION

The spine is a part of the skeletal system, which enables it to stand upright against the force of gravity that exists at every moment of human life. The spine plays an important role in all movements of the human body. It is an important part that ensures the balance of the body, transfers the body weight to the lower extremities via the pelvis and carries a large part of this weight. In addition to supporting the body mechanically, the spine also prevents damage to the spinal cord it surrounds (Arinci and Elhan, 2006).

The spine, which has important functions in sustaining a person's daily life and standing by resisting the gravitational force, is shaped by connecting the bones called vertebrae in succession on the back of the body and on the midline and connected by ligaments and joints.33 vertebrae form the spine, which forms an important part of the skeleton, and these vertebrae are lined up on top of each other to form a column with a length of approximately 72-75 cm in human. The task of transferring the weight of the head and trunk to the lower extremities belongs to the spine. Spine is also responsible for the movement required for the trunk. In addition, protecting the spinal cord by surrounding it is also among the duties of the spine (Moore and Persaud, 1998; Dere, 1999; Arinci and Elhan, 2006).

The structure of the spine is not a straight column. When the spine is examined, anterior lordosis has occurred in the neck and waist, and kyphosis has occurred posteriorly in the chest and sacral parts of adults (Arinci and Elhan, 2006).These curvatures in the spine are physiological. The curves formed in the neck and waist are formed as a result of the thick anterior parts of the discus intervertebralis. This formation is seen in the fetal period, but its prominence decreases in childhood. The curvature in the neck area becomes evident when the child starts to hold the head in the neck area, while the curvature in the lumbar region becomes evident when the child stands up. In addition, some people have pathological curvatures (scoliosis) to the right or left in their spine (Unur et al., 2009).Curvatures of the spine seen in childhood and adolescence can cause significant health problems. In addition, congenital anomalies may cause structurally impaired growth of the spine. These curvatures can cause serious problems that make life difficult in childhood and threaten life (Kose and Sevencan, 2007).

Posture is simply the position of the body. It is also known as the component of all posture points of the body (Kendall et al., 1993; Otman, 1995).In other words, posture is the position of the joints (Bohm and Luck, 1984).Posture is very important for body health and appearance (Pacelli, 1994).The central nervous system is active during movement (Frank and Earl, 1990).As a result of some factors such as the muscles being too weak to fulfill their duties and shortening of the length of the muscles, deterioration in body symmetry may occur, causing many health problems (Sakallioglu et al., 1998).There are two different headings as posture, inactive posture and active posture. The first of these, the inactive posture, is the posture that the body takes when resting and sleeping. The second, active posture, is the posture that occurs when the body is standing upright or moving. In order to ensure the continuity of these postures, many muscles must work together in harmony. These muscles need to work statically and dynamically (Otman, 1995).Static posture describes the posture that protects the body against gravity by isometric contraction of the muscles to fix the joints. In addition, static posture occurs with a regression reflex (Ergen, 1986; Muratli, 1987).Dynamic posture, on the other hand, is a type of active posture that adapts to changing environmental conditions as a result of any movement. Factors affecting posture are race, heredity, gender, nutrition, seasons, socio-economic status, occupation and occupation, fashion of time, psychological state, sleep, hygiene, fatigue, outdoor and fresh air exercises, grief, emotional joy, and distress. These are conditions such as fractures, soft tissue deformation, and normal placement angle deformation of the joint (Otman, 1995).

Spinal disorders have brought up the heavy and wrong way of carrying bags, sitting at school desks, spending a long time in front of the computer, posture and deformities brought about by the developmental age (Moore et al., 2007).The time spent at school, school environment, physical and social environment directly affect the health of children. Therefore, the provision of health services in schools is also very important. The most important of the 1st and 2nd preventive health services carried out in schools is spine health screening. Spinal health screening in schools is to detect postural disorders in the early period, to prevent spinal disorders such as kyphosis, lordosis and scoliosis, and to reduce the resulting disorders (Bunnel,1984).

Today, with the development of technology, the use of images obtained from medical imaging devices has increased while diagnosing and diagnosing many diseases. The images obtained from this system have assisted physicians in diagnosing. The results obtained from these images using some techniques are interpreted subjectively by the experience of the experts. In this study, it is aimed to determine the spinal curvatures observed in the spine during childhood and adolescence, to calculate these spinal curvatures with the Spinal Mouse (SM) device and to present the normal values.

MATERIALS and METHODS

This study was carried out by Van Yuzuncu Yil University approved dated 26/11/2019 and numbered 2019/11-03by the Social and Human Ethics Committee. Written and verbal consent was obtained from the participants before starting the study. In this study, the spines of the students were examined using the Spinal Mouse device on first, fifth and eighth class students studying at Van Vakifbank Primary and Secondary School in the 2018-2019 academic year. The age, gender, height and weight information of the students included in the study were recorded.

As first class students, 86 (47 boys, -39 girls), 119 (61 boys, -58 girls) 5th class students and 101 (48 boys, -53 girls) 8th class students participated in the study. The aim of this study was to determine the thoracic kyphosis (TK), lumbar lordosis (LL) and sacral kyphosis (SK) angle values of children in a certain age group (average 7, 11, 14 years old) while standing, using Spinal Mouse (SM) (Idiag M360, Auatrilia).Measurements were made independently by three researchers in a room with good lighting, quiet, away from anything that could cause stress, without distracting the researcher or the individual. In this study, Spinal Mouse, which is one of the computerized systems, was preferred to take measurements in the spine. This system includes a wireless mouse and bluetooth. The connection to the computer is provided via bluetooth. Spinal Mouse is a noninvasive measurement method and is an external instrument that can evaluate the spine and its mobility. Its application is practical and the results obtained are also impartial. General validity and reliability tests have been demonstrated by studies. It can evaluate the spine in two different planes, sagittal and frontal, in three different positions as standing flexion, extension and standing vertical position. All spinal protrusions from C7 to S1 are taken into consideration during the evaluation.

While the measurements were taken, the processus spinosus of all vertebrae between the 7th cervical vertebra and the 3rd sacral vertebra were marked with palpation after the back region of the individuals was opened. After these markings, the places marked with the SM device were followed and the measurements were taken in sagittal plane mode from top to bottom. Appropriate positions, flexion, vertical and extension positions were selected for taking measurements in sagittal plane mode (Figure 1, Figure 2).

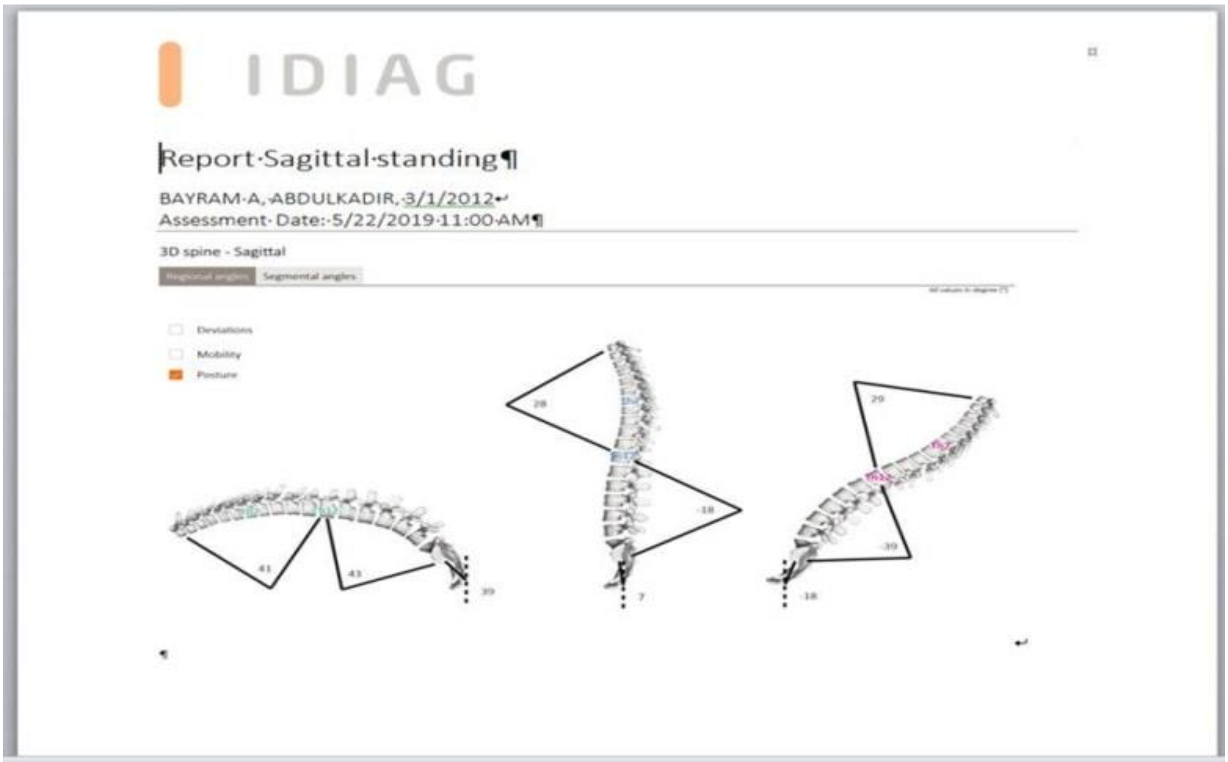

Figure 1. Example of measurement taken with the Spinal Mouse in the sagittal plane.

Table - Sagittal

All values in degree [°]

	Segment	Posture									Mobility								
Segmental	Th1/2	-5	0	11	-2	2	8	-4	0	13	-9	2	8	-9	0	12	-11	2	7
	Th2/3	-7	-2	13	-2	0	10	-3	-2	12	-11	2	12	-12	0	14	-8	2	7
	Th3/4	0	2	9	-4	6	13	-1	4	11	-9	4	9	-6	2	8	-11	2	9
	Th4/5	-1	4	9	-1	6	10	-1	6	11	-6	2	7	-6	2	7	-8	0	7
	Th5/6	0	4	8	0	3	8	-1	5	9	-5	-1	5	-6	1	6	-6	-2	5
	Th6/7	-1	3	9	0	2	9	-1	4	11	-6	-1	6	-6	1	8	-7	-2	5
	Th7/8	0	5	10	0	2	10	-1	4	12	-5	-3	7	-6	-1	8	-8	-2	7
	Th8/9	-1	4	10	1	5	11	-2	4	13	-5	1	8	-7	0	8	-7	1	9
	Th9/10	-3	3	9	1	6	12	-4	5	10	-3	3	10	-7	2	7	-5	1	12
	Th10/11	-4	2	5	0	5	10	-5	1	7	-2	3	11	-6	-1	7	-4	4	12
	Th11/12	-3	1	5	-2	3	9	-7	-1	5	-3	2	9	-9	-2	5	-4	4	14
	Th12/L1	-4	-3	5	-2	1	9	-9	-5	5	-4	4	9	-10	-2	3	-2	6	14
	L1/2	-8	-1	3	0	6	12	-11	-7	3	0	7	16	-10	-6	6	0	13	20
	L2/3	-11	0	2	2	8	14	-13	-5	0	4	8	22	-10	-5	7	6	13	23
	L3/4	-13	-3	0	2	12	17	-15	-7	-1	6	15	26	-10	-4	7	7	19	27
	L4/5	-16	-6	-1	-4	16	18	-20	-8	2	3	22	28	-14	-2	12	0	24	32
	L5/S1	-14	-5	3	-10	1	16	-20	-8	7	-6	6	23	-17	-3	16	-10	9	28
Regional	Sac/Hip	6	7	36	21	39	67	-25	-18	35	1	32	45	-46	-25	14	1	57	77
	ThSp Th12	11	28	59	26	41	74	6	29	78	-10	13	40	-29	1	43	-26	12	43
	LSp Th12	-46	-18	-10	14	43	59	-61	-39	-16	39	61	90	-37	-21	16	41	82	109
	Incl	-7	1	17	58	83	114	-39	-42	2	53	82	110	-46	-43	0	66	125	142
	Length [mm]		334			396			298			62			-36			98	

Figure 2. Example of measurement taken with the Spinal Mouse in the sagittal plane.

In order not to make mistakes in the measurements and not to lose the measurements made by the SM device, the measurement was made at the optimal speed. The SM meter has three speed levels. These are slow (5.4 cm/sec), medium (6.7 cm/sec) and fast (8.7 cm/sec).It has been reported that the SM device may cause errors when the speed exceeds 25 cm/sec, and data loss will occur in measurements with a speed above 10 cm/sec (Kellis et al., 2008).For this reason, studies were carried out at medium speed. In order to get used to this speed, researchers should practice before starting to the study. The actual measurements should be taken after this practice period. In this study, each researcher studied measurement speed for 2 weeks before measuring on individuals. The researchers made three measurements on individuals during the study and the average result was calculated by the SM software. The aim of the researchers taking three measurements was to prevent the margin of error (Schulz, 1999; Carlucci et al., 2001).All taken measurements were based on the latest available evaluation data for SM. Average values were calculated by the SM device. All calculated values were statistically evaluated (Schulz, 1999; Carlucci et al., 2001; Mannion et al., 2004; Ripani et al., 2008).

Shapiro-Wilk (n<50) test was used to check whether the continuous measurements in the study were normally distributed, and parametric tests were applied because the measurements were normally distributed. Independent T-test and One-Way Analysis of Variance (ANOVA) was used to compare group means in terms of continuous variables. Least Significant Difference (LSD) test was preferred to identify different groups following analysis of variance. SPSS (IBM SPSS for Windows, ver.23) statistical package program was used for calculations.

RESULTS

After the statistical analysis methods applied in the light of the values obtained with SM, the results of the study were summarized below.

According to Table 1, a statistically significant difference was observed in sacral flexion (SF), thoracal extension (TE), lumbal extension (LE), sacral extension (SE) measurements according to gender ($p<0.05$).It was determined that girls had higher SF values than boys. While it was seen that boys had higher TE values than girls, LE values of boys were also found to be higher than girls. In addition, it was found that the SE value was lower in girls than in boys.On the other hand, no statistically significant difference was observed in thoracal flexion (TF), lumbal flexion (LF), thoracal vertical (TV), lumbal vetical (LV), sacral vertical (SV) measurements according to gender ($p>0.05$).

Table 1. Comparison of the spine posture values of girls and boys in the 1st class group.

	Gender	N	Mean	SD	*p.
TF	Boy	47	56.957	7.040	.152
	Girl	41	54.829	6.694	
LF	Boy	47	43.489	8.715	.105
	Girl	41	40.524	8.192	
SF	Boy	47	36.596	10.567	.010
	Girl	41	42.598	10.782	
TV	Boy	47	40.479	7.971	.260
	Girl	41	42.415	7.992	
LV	Boy	47	-20.415	10.029	.097
	Girl	41	-23.841	8.960	
SV	Boy	47	7.787	6.987	.089
	Girl	41	10.512	7.891	
TE	Boy	47	52.287	8.461	.043
	Girl	41	48.622	8.216	
LE	Boy	47	-34.809	11.557	.005
	Girl	41	-41.988	11.620	
SE	Boy	47	-9.319	9.900	.001
	Girl	41	-1.963	10.506	

**p: Significance levels according to independent T-test results (N: Number of people, SD: Standard deviation,TF: Thoracic Flexion, LF: Lumbal Flexion, SF: Sacral Flexion, TV: Thoracic Vertical, LV: Lumbal Vertical, SV: Sacral Vertical, TE: Thoracic Extension, LE: Lumbal Extension, SE: Sacral Extension).*

Table 2. Comparison of the spine posture values of girls and boys in the 5th class group.

	Gende	N	Mean	SD	*p.
TF	Boy	61	57.164	7.230	.202
	Girl	58	55.612	5.840	
LF	Boy	61	40.803	8.274	.906
	Girl	58	40.974	7.514	
SF	Boy	61	36.328	8.543	.295
	Girl	58	38.172	10.523	
TV	Boy	61	41.664	8.348	.653
	Girl	58	40.931	9.377	
LV	Boy	61	-24.500	10.235	.216
	Girl	58	-26.897	10.761	
SV	Boy	61	11.541	7.363	.219
	Girl	58	13.259	7.790	
TE	Boy	61	48.008	10.626	.027
	Girl	58	43.034	13.559	
LE	Boy	61	-40.885	11.771	.072
	Girl	58	-45.741	17.065	
SE	Boy	61	-10.008	9.882	.001
	Girl	58	3.879	26.752	

**p: Significance levels according to independent T-test results (N: Number of people, SD: Standard deviation, TF: Thoracic Flexion, LF: Lumbal Flexion, SF: Sacral Flexion, TV: ThoracicVertical, LV: Lumbal Vertical, SV: Sacral Vertical, TE: Thoracic Extension, LE: Lumbal Extension, SE: Sacral Extension).*

In Table 2, a significant difference according to gender was found in TE and SE measurements ($p<0.05$). It was even determined that boys had higher TE and SE values than girls.On the other hand, no statistically significant difference was observed in TF, LF, SF, TV, LV, SV, LE measurements according to gender ($p>0.05$).

Table 3. Comparison of the spine posture values of girls and boys in the 8th class group.

	Cin	N	Mean	SD	*p.
TF	Boy	48	60.313	7.146	.151
	Girl	53	58.047	8.453	
LF	Boy	48	44.104	8.421	.001
	Girl	53	37.358	9.490	
SF	Boy	48	37.958	8.822	.033
	Girl	53	42.038	10.046	
TV	Boy	48	43.156	8.971	.230
	Girl	53	45.406	9.673	
LV	Boy	48	-24.833	9.852	.592
	Girl	53	-26.019	12.041	
SV	Boy	48	11.719	7.292	.779
	Girl	53	12.132	7.470	
TE	Boy	48	48.271	12.635	.067
	Girl	53	43.670	12.271	
LE	Boy	48	-39.833	12.569	.419
	Girl	53	-42.094	15.126	
SE	Boy	48	-10.969	10.782	.001
	Girl	53	1.509	21.389	

**p: Significance levels according to independent T-test results (N: Number of people, SD: Standard deviation, TF: Thoracic Flexion, LF: Lumbal Flexion, SF: Sacral Flexion, TV: Thoracic Vertical, LV: Lumbal Vertical, SV: Sacral Vertical, TE: Thoracic Extension, LE: Lumbal Extension, SE: Sacral Extension).*

According to Table 3, a statistically significant difference was revealed in LF, SF and SE measurements according to gender ($p<0.05$). While LF and SE values were found to be higher in boys than girls, SF values were calculated higher in girls.On the other hand, no statistically significant difference was observed according to gender in the remaining measurements ($p>0.05$).

Table 4. Comparison of the measurements in boys according to classes.

		N	Mean	SD	Min.	Max.	*p.
TF	1. Class	47	56.957[b]	7.040	40.5	70.0	
	5. Class	61	57.164[b]	7.230	41.0	71.5	.035
	8. Class	48	60.313[a]	7.146	47.0	80.0	
	Total	156	58.071	7.258	40.5	80.0	
LF	1.Class	47	43.489	8.715	22.0	62.5	
	5. Class	61	40.803	8.274	15.0	67..0	.094
	8. Class	48	44.104	8.421	28.0	72.0	
	Total	156	42.628	8.530	15.0	72.0	
SF	1. Class	47	36.596	10.567	14.5	68.5	
	5. Class	61	36.328	8.543	14.5	58.0	.636
	8. Class	48	37.958	8.822	11.0	57.0	
	Total	156	36.910	9.246	11.0	68.5	
TV	1. Class	47	40.479	7.971	20.0	58.0	
	5. Class	61	41.664	8.348	26.5	61.5	.303
	8. Class	48	43.156	8.971	22.0	62.0	
	Total	156	41.766	8.446	20.0	62.0	
LV	1. Class	47	-20.415	10.029	-42.5	0.5	
	5. Class	61	-24.500	10.235	-43.0	6.0	.057
	8. Class	48	-24.833	9.852	-42.5	16.0	
	Total	156	-23.372	10.180	-43.0	16.0	
SV	1.Class	47	7.787b	6.987	-6.0	19.5	
	5. Class	61	11.541a	7.363	-6.0	26.0	.011
	8. Class	48	11.719a	7.292	-18.5	21.5	
	Total	156	10.465	7.397	-18.5	26.0	
TE	1. Class	47	52.287	8.461	27.5	64.0	
	5. Class	61	48.008	10.626	23.5	67.5	.087
	8. Class	48	48.271	12.635	17.5	67.5	
	Total	156	49.378	10.818	17.5	67.5	
LE	1. Class	47	-34.809a	11.557	-60.0	-10.0	
	5. Class	61	-40.885b	11.771	-62.0	-3.0	.026
	8. Class	48	-39.833b	12.569	-62.5	-4.0	
	Total	156	-38.731	12.168	-62.5	-3.0	
SE	1. Class	47	-9.319	9.900	-28.5	8.5	
	5. Class	61	-10.008	9.882	-31.0	11.0	.730
	8. Class	48	-10.969	10.782	-32.5	11.5	
	Total	156	-10.096	10.127	-32.5	11.5	

**p: Significance levels according to the results of one-way ANOVA test, a,b,c: Shows the difference between groups (Duncan post-hoc test), (N: Number of people, M: Mean, SD: Standard deviation, Min: Minimum, Max: Maximum, TF: Thoracal Flexion, LF: Lumbal Flexion, SF: Sacral Flexion, TV: Thoracal Vertica, LV: Lumbal Vertica, SV: Sacral VerticaL, TE: Thoracal Extension, LE: Lumbal Extension, SE: Sacral Extension).*

In Table 4, when the comparison results of the measurements in male individuals according to classes were examined; in TF measurement, a statistically significant difference was observed according to classes ($p<0.05$).Here; 8th graders were the group that made the difference by having more TF values. Similarly, a statistically significant difference was observed in SV and LE measurements according to classes ($p<0.05$). In this table, 1st classes were the group that made the difference by having lower SV and LE values.On the other hand, no statistically significant difference was observed in the remaining measurements according to the classes ($p>0.05$).

Table 5. Comparison of measurements in girls according to classes.

		N	Mean	SD	Min.	Max.	*p.
TF	1. Class	41	54.829	6.694	36.5	65.5	
	5. Class	58	55.612	5.845	42.5	68.0	.066
	8. Class	53	58.047	8.453	39.5	76.0	
	Total	152	56.250	7.156	36.5	76.0	
LF	1. Class	41	40.524	8.192	22.0	54.5	
	5. Class	58	40.974	7.514	21.0	56.5	.059
	8. Class	53	37.358	9.490	18.0	63.5	
	Total	152	39.592	8.534	18.0	63.5	
SF	1. Class	41	42.598	10.782	19.0	66.5	
	5. Class	58	38.172	10.523	14.5	62.5	.063
	8. Class	53	42.038	10.046	18.5	62.0	
	Total	152	40.714	10.555	14.5	66.5	
TV	1. Class	41	42.415ab	7.992	21.0	68.5	
	5. Class	58	40.931b	9.377	19.5	66.0	.036
	8. Class	53	45.406a	9.673	16.5	65.5	
	Total	152	42.891	9.279	16.5	68.5	
LV	1. Class	41	-23.841	8.960	-48.5	-6.5	
	5.Class	58	-26.897	10.761	-52.0	0.5	.376
	8. Class	53	-26.019	12.041	-53.0	15.5	
	Total	152	-25.766	10.790	-53.0	15.5	
SV	1.Class	41	10.512	7.891	-6.0	32.0	
	5.Class	58	13.259	7.790	-3.0	34.5	.221
	8. Class	53	12.132	7.470	-2.0	33.0	
	Total	152	12.125	7.734	-6.0	34.5	
TE	1. Class	41	48.622	8.216	27.0	62.5	
	5. Class	58	43.034	13.559	9.0	72.5	.053
	8. Class	53	43.670	12.271	18.5	66.5	
	Total	152	44.763	12.031	9.0	72.5	
LE	1. Class	41	-41.988	11.620	-64.0	-11.0	
	5. Class	58	-45.741	17.065	-64.5	34.0	.344
	8.Class	53	-42.094	15.126	-70.0	5.5	
	Total	152	-43.457	15.091	-70.0	34.0	
SE	1. Class	41	-1.963	10.506	-23.5	19.5	
	5. Class	58	3.879	26.752	-33.5	132.5	.415
	8. Class	53	1.509	21.389	-23.5	132.0	
	Total	152	1.477	21.503	-33.5	132.5	

**p: Significance levels according to the results of one-way ANOVA test a,b,c: Shows the difference between groups (Duncan post-hoc test), (N: Number of people, M: Mean, SD: Standard deviation, Min: Minimum, Max: Maximum, TF: Thoracal Flexion, LF: Lumbal Flexion, SF: Sacral Flexion, TV: Thoracal Vertical, LV: Lumbal Vertical, SV: Sacral Vertical, TE: Thoracal Extension, LE: Lumbal Extension, SE: Sacral Extension).*

In the table above, statistical comparison results of measurements in female individuals according to classes were given. When Table 5 was examined, a statistically significant difference was observed in TV measurement according to classes ($p<0.05$). Here; 5th and 8th classes were found to be different from each other. The highest value was found in the 8th classes. On the other hand, no statistically significant difference was observed in the remaining measurements according to the classes ($p>0.05$).

Table 6. Difference between classes in all children (regardless of gender).

		N	Mean	SD	Min.	Max.	*p.
TF	1. Class	88	55.966b	6.9252	36.5	70.0	.004
	5. Class	119	56.408b	6.6102	41.0	71.5	
	8.Class	101	59.124a	7.9030	39.5	80.0	
	Total	308	57.172	7.2544	36.5	80.0	
LF	1. Class	88	42.108	8.5576	22.0	62.5	.440
	5. Class	119	40.887	7.8798	15.0	67.0	
	8. Class	101	40.564	9.5725	18.0	72.0	
	Total	308	41.130	8.6527	15.0	72.0	
SF	1. Class	88	39.392	11.0257	14.5	68.5	.087
	5. Class	119	37227	9.5633	14.5	62.5	
	8. Class	101	40.099	9.6571	11.0	62.0	
	Total	308	38.787	10.0795	11.0	68.5	
TV	1.Class	88	41.381b	7.9946	20.0	68.5	.020
	5. Class	119	41.307b	8.8344	19.5	66.0	
	8.Class	101	44.337a	9.3681	16.5	65.5	
	Total	308	42.321	8.8705	16.5	68.5	
LV	1. Class	88	-22.011a	9.6466	-48.5	0.5	.027
	5. Class	119	-25.668b	10.5192	-52.0	6.0	
	8. Class	101	-25.455b	11.0168	-53.0	16.0	
	Total	308	-24.554	10.5375	-53.0	16.0	
SV	1.Class	88	9.057b	7.5042	-6.0	32.0	.004
	5. Class	119	12.378a	7.5915	-6.0	34.5	
	8. Class	101	11.936a	7.3524	-18.5	33.0	
	Total	308	11.284	7.5989	-18.5	34.5	
TE	1. Class	88	50.580a	8.5015	27.0	64.0	.004
	5. Class	119	45.584b	12.3473	9.0	72.5	
	8. Class	101	45.856b	12.5963	17.5	67.5	
	Total	308	47.101	11.6462	9.0	72.5	
LE	1. Class	88	-38.153a	12.0703	-64.0	-10.0	.032
	5.Class	119	-43.252b	14.7335	-64.5	34.0	
	8. Class	101	-41.020ab	13.9474	-70.0	5.5	
	Total	308	-41.063	13.8699	-70.0	34.0	
SE	1. Class	88	-5.892	10.7795	-28.5	19.5	.567
	5. Class	119	-3.239	21.0702	-33.5	132.5	
	8. Class	101	-4.421	18.2145	-32.5	132.0	
	Total	308	-4.385	17.6861	-33.5	132.5	

**p: Significance levels according to the results of one-way ANOVA test a,b,c: Shows the difference between groups (Duncan post-hoc test), (N: Number of people, M: Mean, SD: Standard deviation, Min: Minimum, Max: Maximum, TF: Thoracal Flexion, LF: Lumbal Flexion, SF: Sacral Flexion, TV: Thoracal Vertical, LV: Lumbal Vertical, SV: Sacral Vertical, TE: Thoracal Extension, LE: Lumbal Extension, SE: Sacral Extension).*

When the comparison results of the measurements in all individuals according to the classes in the table above (Table 6) were examined statistically, a statistically significant difference was observed in the TF measurement according to the classes ($p<0.05$). In this case, 8th classes were the group that made the difference by having more TF values. Similarly, a statistically significant difference was observed in TV measurement according to classes ($p<0.05$). In this case, 8th classes were the group that made the difference by having more TV values. In LV measurement, a statistically significant difference was observed according to classes ($p<0.05$). Here, the 1st classes were the group that made the difference by having a lower LV value. In SV measurement, a statistically significant difference was observed according to classes ($p<0.05$). In this case, the 1st classes were the group that made the difference by having a lower SV value. A statistically significant difference was observed in TE measurement according to classes ($p<0.05$). At these values, the 1st classes were the group that made the difference by having more TE values. A statistically significant difference was observed in LE measurement according to classes ($p<0.05$). In this case, 1st and 5th classes were found to be different from each other.

The lowest LE value was obtained in the 1st classes. On the other hand, no statistically significant difference was observed in the remaining measurements according to the classes (p>0.05).

DISCUSSION

Studies have shown the existence of a relationship between the decrease in lumbar lordosis and the emergence of low back pain (Hasday et al., 1983; Kostuik and Hall, 1983; Frymoyer et al., 1984; Ito, 1991). In the field of orthopedics, there are also cases where interpretations such as decreasing or increasing lordosis are made by evaluating the lumbar lordosis in patients with many low back pain complaints. However, it is known that radiological examination is also important in addition to clinical examinations for the evaluation of the spine (Wiltse and Winter, 1983; Frymoyer et al., 1984).The radiological examination methods for the evaluation of the spine in terms of posture are mostly preferred to be accurate and reproducible. However, even today, lumbar lordosis measurement techniques have not been fully standardized (Polly et al., 1996).We believe that the SM device used in this study can be an alternative to radiological measurement methods because it does not contain x-ray rays that threaten human health, can be used to obtain repetitive results with the device, and is an ergonomic device.

Kasai et al. (1996) in a study conducted on individuals aged 2-18 years, cervical lordosis angles were measured in 20 individuals from all age groups, and the values obtained decreased with age from 2 to 9 years old, and this value remained the same after 10 years of age albeit an increase has been demonstrated. In this study, the inability of the SM to obtain cervical region measurement values in the evaluation of spinal curvature can be considered as a limitation of the study. Because the device can measure from the 7th cervical vertebra.

Mac-Thiong et al. (2004), in his study on spinal curvature and sacro-pelvic alignment in children, gave an extensive literature review on the subject, and the angles of thoracic kyphosis and lumbar lordosis in children aged 3-10 years (mean age: 8.1) were 42.0° and 53.8°, respectively reported 45.8° and 57.7° in the 11-18 age range (mean age: 13.6).Mac-Thiong et al. (2011) evaluated sacropelvic alignment and spinal curvature in children in a similar study. In addition, lumbar lordosis and thoracic kyphosis angles were measured and they reported this value as 42.0° and 53.8° in children aged 3-10 years. They stated that this value is 45.8° and 57.7° in children between the ages of 11-18 and in the developmental age. In this study, it was also stated that thoracic kyphosis and lumbar lordosis increased in an age-dependent manner.

Voutsinas and MacEwen (1986), on the other hand, made angle measurements using the Cobb method over the MR imaging technique on a study group of 620 normal individuals aged 5-20 years. And they reported that found thoracic kyphosis values as 37°±7°, 38°±8° and 39°±8° in individuals aged 5–9, 10–14, and 15–20, respectively. In this study, the thoracic kyphosis value was measured as 41.38 in individuals with a mean age of 7, 41.30 in individuals with a mean age of 11, and 44.33 in individuals with a mean age of 14 years. It was determined that the values we obtained regarding the thoracic kyphosis angles were higher than the previously reported values. It is thought that this difference is due to the age group difference, the number of samples, the method used, and the measurement made at different intervals.

Boseker et al. (2000), on the other hand, they took thoracic kyphosis angle measurement values on 121 individuals between the ages of 5-19 with equal numbers of boys and girls. The mean thoracic kyphosis angle obtained was 33° (17°-51°). In addition, it was reported that the difference between the sexes could not be detected in the study. In this study, the mean values of TE measurement of 1st grade students differ compared to male and female students. This value was found to be higher in male students than in female students and is 52.2.In female students, the measured value was found to be 48.6. A statistically significant difference was observed in TE measurement according to gender (p<0.05).This result we obtained, Boseker et al. (2000), it was reported that while the kyphosis value measured more than 50-60 degrees in the study was considered abnormal for the thoracic spine, this situation was the most common deformity for the spine. Chest enlargement reduces with thoracic kyphosis and also restricts movement in the shoulder region. In many studies, it has been stated that the thoracic kyphosis angles in adults are between 34°-47° (Ecerkale, 2006).

Mac-Thiong et al. (2004), in a different study, took lateral MR images of 180 normal individuals aged 4-18 years and measured the lumbar lordosis and thoracic kyphosis angles on these images. As a result of the evaluation, angle values were reported as 38.3° and 44.2° in children under the age of 10, and as 45.6° and 49.2° in children over the age of 10.In this study, which also evaluated in terms of genders, it was reported that the angles of thoracic kyphosis and lumbar lordosis did not show a significant difference between the genders.

For this study, using only the SM method in spine evaluation and not using the radiographic method can be considered as a limitation of the study. However, this limitation was ignored in our study because children were not exposed to radiation and its validity and reliability were proven in previous studies. It is thought that there is a need for more studies in which SM and X-ray are used together to evaluate the spine. According to the results of the measurements obtained in the posture analyzes made on the spines of the 1st, 5th and 8th grade students studying at Van Vakıfbank Primary and Secondary School in the 2018-2019 academic year, using the Spinal Mouse device it had been determined that deformities were mostly encountered in eighth grade students. It should be known that posture is important for the physical appearance of the body, the continuation of a healthy life and mobility, and it is thought that individuals should be conscious by organizing training programs on this subject under the leadership of studies and researches as a result of the evaluation of this study and the existing literature. It is important to ensure that individuals exhibit a healthy upright posture by paying attention to the exercises in this sense starting from childhood. The importance of putting forward the necessity of including posture-supported education programs in children's play activities and lessons at school, as well as in physical education classes, should be emphasized. Advice should be given to guide children with postural disorders to therapeutic departments, and body posture should be supported with exercises required in physical education classes. It should be emphasized that computer use should be limited to children for limited periods of time. It is known that sitting on school desks, carrying bags and excessive weight of the bag cause permanent spinal curvature. For this reason, necessary information studies should be carried out in schools and both parents and children should be made aware. Since unilateral use of backpacks will adversely affect posture, information studies should be carried out.

In the light of this study, we are of the opinion that there is a need for pilot applications to be supported by new studies in the style of fieldwork in order to control and protect the spine health of children.

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Conflict of Interest

The authors declare that there is no conflict of interest.

Ethical Approval

This study was carried out by Van Yuzuncu Yil University approved dated 26/11/2019 and numbered 2019/11-03by the Social and Human Ethics Committee.

Author Contribution

Material and Method: GÇ, DB; **References:** GÇ, DB; **Writing the publication:** GÇ, DB

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