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Developing a New One-Dimensional Scale to Measure Pain in Children: Pencil Pain Scale

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Abstract

Background: The aim of this study was to develop the Pencil Pain Scale as a new one-dimensional scale for evaluating pain in school-age children (6-12 years old).

Methods: The population of this study is composed of 6-12 year old children who gave blood for examination rather than for an acute or severe cause. The research sample included randomly selected children (N= 464) who applied to the blood collection units of a state hospital between November 2017 - February 2018, on three days of the week (Monday, Wednesday, Friday). A questionnaire that specifies the characteristics of children, the newly developed Pencil Pain Scale, and the two widely used scales (Visual Analogue Scale and the Facial Expressions Rating Scale) were used to collect data. The data obtained were analyzed with percentage distributions, mean, chi-square, t-test, ANOVA, Kruskal Wallis, Mann Whitney U test and correlation. Ethical principles were followed in the study.

Result: According to expert opinions, it was determined that the Pencil Pain Scale had content validity (Content Validity Index= +1.00). It was found that the scale made measurements similar to a previously conducted study and had convergent validity. Also, the scale was found to be sensitive enough to distinguish the differences and to be reliable ($p<.001$). It was also found that the Pencil Pain Scale performs measurements that are in agreement with the Visual Analog Scale and the Facial Expression Rating Scale and has parallel form reliability ($p>.05$). The Pencil Pain Scale was developed in a valid and reliable way.

Conclusion: The Pencil Pain Scale is a valid and reliable scale. In order to make the Pencil Pain Scale a standard scale for measuring children's pain, it needs to be used in different studies and age groups with different scales for different pain types.

Keywords: Pain, Child, Scale development.

Abbreviations

VAS: Visual Analog Scale, FPRS: Wong-Baker Faces Pain Rating Scale, (CVI): Content Validity Index, (CVR) Content validity ratio.

Introduction

Pain is a subjective symptom; thus, it requires getting to know the patient thoroughly and planning pain management as well as using the most appropriate methods, techniques, and measurement tools in pain

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assessment. The most reliable indicator in the assessment of pain is the patient's own expression of pain. Therefore, asking the patient if there is any pain is the easiest way to evaluate the pain. However, the assessment of pain as "there is pain" or "there is no pain" is not sufficient for the optimal control of pain. The use of scales is one of the best methods known to date about pain assessment. Unfortunately, there is no objective standard that can clearly assess pain. The severity and nature of pain reported by the patient with numbers or words are made objective as much as possible with scales, eliminating the different pain assessments between patients, nurses and physicians [1].

Today, many scales are used for pain assessment. Also, in recent years, a number of studies have been conducted to find a scale that will assess pain in the most reliable way possible. Nevertheless, the fact that pain is subjective and individual does not make it possible to talk about the existence of a scale that will solve the problem radically. More importantly, scales that are commonly used in pain assessment also create too much confusion with the advantages and disadvantages of diagnosing pain [1].

Given the management of pain in children, the situation is not very different; it becomes even more difficult. While pain activates the physiological stress response in children, it adversely affects the cardiovascular system and leads to metabolic problems in many systems and some life-threatening outcomes [2]. In addition, it is difficult to assess pain due to the developmental characteristics of children. For these reasons, pain relief in children requires good pain management, assessment, and diagnosis. Studies are being conducted to develop scales that could best evaluate pain in children.

Due to the difficulties in assessing children's developmental characteristics and pain, diversity in the standardized, validated and reliable pain scales is very important. For this reason, the search for tools that best assess the pain of children is continuing. From this point of view, it was thought that a pencil that was converted to a scale could help reach objective values about school-age children's pain perception. Pencil is one of the best known and best used tools for school-age children. These children cognitively know every aspect of a pencil and use it very well with their neuromotor skills. Children write and draw pictures with pencil. It is not only a learning tool for them but also a communication tool and sometimes a game tool. The figures and pictures children draw with a pencil can reflect their inner worlds.

The aim of this study is to develop the new one-dimensional Pencil Pain Scale as a means of assessing pain in school-age children (age group 6-12).

Research Hypotheses

H_0: The Pencil Pain Scale is not a valid and reliable scale.

H_1: The Pencil Pain Scale has content validity.

H_2: The Pencil Pain Scale is a valid and reliable scale.

H_3: In the measurement of pain in children, there is no difference between the mean scores of the Pencil Pain Scale and the mean scores of the Visual Analog Scale and the Facial Expression Evaluation Scale.

Materials and Methods

Participants

This study was carried out between November 2017 and June 2018 in the blood collection unit of Muş State Hospital. The study population consisted of children between 6 and 12 years of age who consulted the blood collection unit of the hospital between November 2017 and February 2018, whose condition was stable and who had their blood taken for examination, not for an acute or severe cause. Children with chronic pain, a chronic illness, long-term hospitalization, children who were unconscious and who could not have verbal communication, children who had mental problems that prevent them from understanding the questions in the scales, children with visual, auditory, neurological and developmental problems, children who had complications after an operation, and children who did not speak Turkish were not included in the study as it was thought that these conditions may affect the measurements and the perception of pain.

The sample was composed of randomly selected children (N = 464) who applied to the blood collection unit three days a week (Monday, Wednesday, Friday). In the unit, blood collection is performed by three nurses.

Data collection tools

To collect data, the Introductory Information Form, which identifies the characteristics of children, the newly developed Pencil Pain Scale, and the commonly known and used scales in evaluating the pain of children which are the Visual Analog Scale (VAS) and the Facial Expression Evaluation Scale (FEES) were used. Also, as the intervention tool, the kaleidoscope toy was used during the stage of making parallel measurements with the equivalent form.

The Introductory Information Form

This form consisted of two questions determining the age and gender of the child. The Pencil Pain Scale was developed for the first time in a single item in order to measure the pain perception of school-age children. It was developed in a way that does not harm children and in line with the developmental characteristics of this age group.

Pencil Pain Scale

The most important feature of school-age children is that they go to school. One of the tools that children use most intensively in school is the pencil. Children write with pencil, draw with pencil, and pencil sometimes becomes a tool to play games. Children are cognitively aware of every aspect of the pencil and use it very well thanks to their neuromotor skills. In addition to being a learning tool, a pencil is also a communication tool for children and they play with it. The figures and pictures children draw with the pencil can reflect their inner worlds. The pencil is one of the best known and best used tools for school-age children (Appendix). For this reason, it was thought that a pencil that was converted to

scale could give objective values about school children's pain perception.

The pencil used as a scale is a handmade pencil whose raw material is wood. The pencil was made by a master who deals with handicraft and it has no harmful features. The pencil is durable, but it is not a standard flat pencil. It was made without spoiling the naturality of the tree branch, and no paint or polish was used. To draw the attention of the children, it is a little bit big, and the top and the base of the pencil were wrapped with an orange rope. The pencil is 17 cm in length; its circumference is 5 cm; and the diameter is 1.59 cm. These dimensions are suitable for a school-age child. At the center of the pencil, a 5 cm-long cavity was formed by carving longitudinally. In order to make it eye-catching, the circumference of the cavity was determined by drawing in orange, and a measuring line of 5cm was manually drawn in the center in millimeter and a numerical value was given from '0' to '5' (no pain.. unbearable pain). The value close to the tip of the pencil is close to "0" and the value close to the bottom of the pencil is "5". The line on the pencil is expected to provide a precise measurement of 50 mm.

Before application, expert opinion was received about the Pencil Pain Scale and a preliminary study was performed with 10 children. Then, the validity and reliability analyses of the scale were completed and the statistical analyses were made.

The Pencil Pain Scale is a valid and reliable instrument, which can make precise measurements. It is practical in terms of application and scoring and sensitive enough to distinguish differences.

VAS

VAS is used to convert subjective data numerically when no objective measurement can be made. There is an atilt triangle with a length of 5cm. The top of the triangle is colorless and it is "0" in the measurement. The color gets darker towards the base of the triangle, and the color in the base is the darkest of that color. There is a connected pointer between the sides of the triangle. At the back of the triangle, there is a precision measurement of 50 mm. The two extremes of the parameter to be evaluated are written on each side of this measurement (no pain…. unbearable Pain), and the patient is asked to determine his/her status on the triangle with the pointer. The scale is reversed and the patient's pain level is determined by a 50 mm measurement. The measurement has no language and is very easy to apply. The triangle can be used vertically and top down. The VAS has proven itself and has been accepted in the literature for a long time. It is reliable and easy to use. It can be used in all age groups from 5-year-olds who know numbers to adults [3-6].

Wong-Baker Faces Pain Rating Scale (FPRS)

This scale which gives numerical pain scores to faces. The lowest score is 1 and the highest score is 5 [7,8]. As the score obtained from the scale increases, pain tolerance decreases, and tolerance increases as the score decreases. While applying the scale, (1) the child is explained that each face belongs to one person and that there is a happy face indicating no pain and some sad faces that feel a little bit or quite painful, (2) Explanation is made by marking each face. For example, the researcher says "This face is very happy because it has no pain" (Score: 0), "It has a little pain" (Score: 1), "It has a little more pain" (Score: 2), "It has more pain" (Score: 3), "It has quite a lot of pain" (Score: 4), and "It has the highest pain you can imagine" (Score: 5). (3) The child is told to choose the face that best expresses his or her feelings [9]. This scale is applied in all age groups from age three to the adults.

Kaleidoscope

The kaleidoscope was used as a means of intervention during the stage of making parallel measurements with the equivalent form. Kaleidoscope is a toy with a variety of shapes and colors observed when viewed with a single eye while the single binocular-shaped cylinder is rotated. It contains various colored beads between broken mirrors adjacent to each other. When rotated at eye level, the beads move in the mirrors and the images are combined. In this way, various attractive designs are observed. When the kaleidoscope is rotated, the designs vary according to the movement of the beads and the same design rarely occurs. Different designs attract the attention of children.

Methodology

The Pencil Pain Scale was developed by assessing its usefulness (economic and practical in terms of preparation, application and scoring), reliability (consistent, stable and sensitive) and validity (degree of serving the purpose, content and convergent validity) [10].

Content Validity: The Pencil Pain Scale was prepared in accordance with the developmental characteristics of school-age children in a single-item and in a way not to harm children. The scale was made by a craftsman without disturbing the naturality of the tree branch. The pencil is durable and has no paint or polish on it. It was made to evaluate pain in a way to attract the attention of the school-age children with a size they could easily use. Opinions of seven field experts were sought to evaluate the suitability of the pencil scale to the characteristics of children, its visuality, and economy, ease of preparation, practicality, usefulness, applicability, scoring, and ability to measure. Content Validity Index (CVI) was used to interpret the opinions. For the expression of opinions, options like "appropriate, should be edited, should be removed" were used for each item of the scale.

Preliminary study: A preliminary study was performed with 10 children. The children who first saw the Pencil Pain Scale started to examine it. The children asked whether they can write with the pencil, how it was made, and what the numbers on it refer to. They tried to write with the pencil. A great majority of the children examined the pencil with interest, while only a small percentage remained indifferent. It was observed that the some children feared the process of taking blood and they felt that the pencil would give them pain like the injector. Throughout the process, a large number of children questioned what the numbers on the pencil

meant because they were school-age children. When they understood that it was a scale and used to show the severity of their pain, they were quite happy. Some children wanted their parents to buy one of these pencils, and some parents stated that the use of the pencil scale reduced the pain and fear their children felt during the process of taking blood. These findings were encouraging for the implementation of the scale. The scale was accepted by the children and their parents.

Reliability: In scale development, information about at least two basic psychometric characteristics is sought in each measurement as in scale adaptation. One of them is reliability [11,12]. The reliability of the scale was evaluated only in terms of sensitivity because it is a perception scale and perception changes based on time and situation. Moreover, its distinctiveness (by comparing the upper 27% and lower 27% parts of the scale / S = 139) was tested.

Similar Scale Reliability*:* In order to understand whether the Pencil Pain Scale makes similar measurements, the mean score of the scale (S = 139) was compared with the mean scores of the VAS (S = 141) and the FEES (S = 143), which are frequently used in evaluating children's pain. The correlation between these scales was tested.

Validity: In scale development, another important primary psychometric feature is validity [11,12]. The validity of the scale was evaluated only in terms of convergence as it was a single item scale. For this purpose, the experimental group (N=41) and the control group (N = 139) were formed. The obtained pain scores were compared with the mean scores of a previously conducted similar study. The experimental group and control group findings [13] of an experimental study which was conducted with the same age group, in the same painful process, and with the same attention distraction method (kaleidoscope) and in which pain was evaluated with FEES were considered.

Evaluating pain according to variables: In order to determine if the scale can evaluate whether the demographic characteristics of children affect their pain, the mean scores of the Pencil Pain Scale (N = 139) was compared within the group according to the demographic characteristics obtained via the introductory information form.

Data collection procedures

After testing the applicability of the scale based on expert opinions, the data were collected between November 2017 and February 2018. A preliminary study was performed on 10 children. Data were then collected. First, children accompanied by their parents (mother and/or father) were informed about the study after they were admitted to the waiting room. They all gave their consent to participate in the study. The data were obtained in the form of question and answer in 10 minutes after the blood collection procedure was completed.

The reliability data of the scale were obtained from the three groups (VAS Group / N = 141, Pencil Group / N = 139, Face Group / N = 143) by rotation on three days a week (Monday, Wednesday, Friday). In the following week, data were collected from the Pencil Group on Monday, from the Face group on Wednesday, and from the VAS Group on Friday. Each week, the data of one group were collected each day by rotation (the VAS Group on Monday, the Pencil Group on Monday, and the Face group on Friday). In the following week, data were collected from the Pencil Group on Monday, from the Face group on Wednesday, and from the VAS Group on Friday. In other words, three rotations were performed.

The validity data of the scale were obtained by applying the intervention (in the fourth week). An experimental (N = 41) and a control group (N = 139) were created to test whether the Pencil Pain Scale measures pain in different groups in a reliable manner. The control group was created by the Pencil group, from which the comparison data were collected in the previous process.

Intervention was performed by distracting the attention of children with the kaleidoscope during blood collection. This study followed the same procedure as the one in Güdücü Tüfekci et al.'s [13] study, which was performed with the children of the same age group and which investigated the effect of attempting to distract attention with kaleidoscope to decrease the pain caused by the same procedure and which evaluated the level of pain with the FEES.

Children in the intervention group were introduced to the kaleidoscope, which would be used to distract their attention during the blood collection procedure, and then they were informed about how to use the kaleidoscope. During blood collection, children used a kaleidoscope and marked the severity of the pain they perceived on the Pencil Pain Scale. The data to evaluate pain according to variables were obtained with the Pencil Pain Scale in the previous process when the reliability data of the scale was obtained (N = 139).

Statistical analysis

- CVI was used in evaluating the field expert opinions.
- Mean, percentage and t test were used in testing the reliability of the scale.
- Mean and t test were used in testing the validity of the scale.
- Chi-square test was used to test group similarities within the scope of the reliability and validity of the scale.
- Mean, t test and ANOVA were used in the comparison of the scale with other scales for reliability
- Percentage, distribution, mean and Mann Whitney U test were used in testing the scale's ability to evaluate pain according to variables.

Ethical aspect of research

The study was approved by the Ethics Committee of Atatürk University, Faculty of Nursing and permission was obtained from the related institution. As answers that provide data in all the studies should be given voluntarily, the voluntary participation of the parents and children was taken into consideration. Also, after the aim of the study and the purposes for which the results will be used were

explained to the parents (informed consent policy), their written consent was obtained. The parents and the children were informed that information about them would not be disclosed to others, and the confidentiality principle was complied with.

Results

This research which developed a new one-dimensional Pencil Pain Scale for evaluating pain in school-age children (6-12 age group), the following findings were obtained.

Content Validity: The Pencil Pain Scale was first evaluated by seven experts who shared their opinions about the suitability of the scale to the characteristics of children, its visuality, ease of preparation, practicality, usefulness, applicability, scoring and ability to measure. The experts were asked to evaluate each item as "appropriate, should be edited, and should be removed" and to write down their suggestions if any. The content validity ratio (CVR) was obtained by subtracting 1 from the ratio of the number of experts who stated that an item is "necessary" to the total number of experts who indicated their opinion of the item [14-16]. $KGO = \frac{NG}{N/2} - 1$.

According to the Lawshe technique [12], as seven experts were asked to express their opinions, the content validity criterion was determined to be at least 0.99 (Table 1) [14,17]. The content validity index of the five parameters (suitability of the scale to the characteristics of children, its ability to measure, its visuality, its usefulness, its applicability) of the scale was determined to be +1.00 (Table 2).

Comparison with a similar study: It was found that the mean score of the Pencil Pain Scale was 1.31 ± 1.21 in the children who had an intervention with a kaleidoscope and it was 2.12 ± 1.63 in the children who had no intervention. The difference between the groups (1.81 ± 0.42) was statistically significant (p <.01, Table 3). These mean scores were found to be similar when compared to the FEES mean scores of a previous study [13] (pain score was significantly lower in children who had intervention than in children who had no intervention/ p <0.01). Thus, it was determined that the Pencil Pain Scale had convergent validity.

Precise measurement: It was found that upper 27% mean scores of the Pencil Pain Scale ($\bar{x}$=4.368) were higher than the lower 27% mean scores ($\bar{x}$=.447). Also, the difference between the groups was found to be significant (t=-41.154, p=0.000<0.001) (Table 4). Thus, it was revealed that the Pencil Pain Scale was sensitive enough to distinguish the differences and could make precise measurement.

Parallel measurement with an equivalent form: The mean age of the children was 9.17 ± 2.05; 20.3% of the children were 12 years old and 53.7% were boys. The experimental and control groups were found to be similar in terms of the characteristics of children (p> 0.05, Table 5).

In order to determine the equivalent form reliability of the Pencil Pain Scale, the correlation coefficient between the VAS and the FEES was examined. No correlation was found. Also, the mean score of the Pencil Pain Scale was compared with the mean scores of the VAS and the FEES in order to determine its equivalent form reliability. The mean score of the Pencil Pain Scale was 2.12 ± 1.63, the mean VAS score was 2.32 ± 1.62, and the mean score of the FEES was 2.38 ±

Number of Experts	Minimum Value	Number of Experts	Minimum Value
5	0.99	13	0.54
6	0.99	14	0.51
7	0.99	15	0.49
8	0.78	20	0.42
9	0.75	25	0.37
10	0.62	30	0.33
11	0.59	35	0.31
12	0.56	40	0.29

Table 1 Minimum values for Content Validity Scales at α=0,05 Level of Significance [17].

Parameters	Appropriate	Should be edited	Should be removed	CVI	Decision
Appropritate to the characteristics of children	7	0	0	+1	Accepted
Measurability	7	0	0	+1	Accepted
Visuality	7	0	0	+1	Accepted
Usability	7	0	0	+1	Accepted
Applicability	7	0	0	+1	Accepted
Content validity scale	0.99				
Content validity index indeksi	+1				
Total number of experts	7				

Table 2: Results of experts' evaluation.

Groups			Pencil Pain Scale	Test ve p
	N	%	$\bar{x}$±SS	
Experimental	41	22.8	1.31±1.21	t_{MU}=2034
Control	139	77.2	2.12±1.63	p= **.004**

Table 3: The comparison of the mean scores of the experimental and control groups (N=180).

Pencil Pain Scale	Group	N	%	x̄±SS	Test ve p
Scores	Top	38	27	4.368±.819	t= 41.154
	Bottom	38	27	0.447±.503	p=**0.000**

Table 4: The comparison of upper 27% and lower 27% mean scores of the Pencil Pain Scale (N=139).

Characteristics			Experimental Group		Control Groups				Test ve p
			PENCIL (N=139)		VAS (N=141)		FEES (N=143)		
	N	%	N	%	N	%	N	%	
Age (9.17±2.05)									
6	55	13.0	21	38.2	17	30.9	17	30.9	
7	58	13.7	18	31.0	21	36.2	19	32.8	χ2=6.027
8	58	13.7	19	32.8	17	29.3	22	37.9	
9	58	13.7	23	39.7	15	25.9	20	34.5	p=0.915
10	65	15.4	19	29.2	25	38.5	21	32.3	
11	43	10.2	10	23.3	17	39.5	16	37.2	
12	86	20.3	29	33.7	29	33.7	28	32.6	
Gender									
Boy	227	53.7	75	33.0	73	32.2	79	34.8	
Girl	196	46.3	64	32.7	68	34.7	64	32.7	χ2=.351
									p=0.839
Total	423	100.0	139	33.0	141	33.3	143	33.7	

Table 5: The comparison of the groups in terms of children characteristics (N=423).

Scales	N	%	Pain Mean Scores x̄±SS	Test ve p
PENCIL	139	32.9	2.12 ± 1.63	t= 1.011
VAS	141	33.3	2.32 ± 1.62	**p= 0.313**
PENCIL	139	32.9	2.12 ± 1.63	t= 1.255
FEES	143	33.8	2.38 ± 1.77	**p= 0.692**
PENCIL	139	32.9	2.12 ± 1.63	F=0.210
VAS	141	33.3	2.32 ± 1.62	
FEES	143	33.8	2.38 ± 1.77	**p=0.412**

Table 6: The comparison of scale mean scores (N=423).

Characteristics	N	%	Pain Mean Scores x̄±SS	Test ve p
Age				
6	21	15.1	2.42 ± 1.77	
7	18	12.9	3.44 ± 1.82	
8	19	13.7	2.73 ± 1.85	F_{KW}= 3.181
9	23	16.5	1.47 ± 1.20	p=0.074
10	19	13.7	1.57 ± 1.34	
11	10	7.2	2.10 ± 1.37	
12	29	20.9	1.55 ± 1.21	
Gender				t= 0.397
Boy	75	54.0	2.17 ± 1.61	
Girl	64	46.0	2.06 ± 1.67	p= 0.692

Table 7: The comparison of Pencil Pain Scale mean scores based on children characteristics (N=139).

1.77. It was found that there was no statistically significant difference between the mean scores of the Pencil Pain Scale and the VAS and the FEES mean scores (p> 0.05). The Pencil Pain Scale was found to have parallel form reliability, and thus it was found to perform measurements consistent with the VAS and the FEES (p> 0.05, Table 6).

The study further revealed that the age and gender of the children did not affect the pain level evaluated by the Pencil Pain Scale (p> 0.05, Table 7).

Discussion

The findings of our study which developed the new one-dimensional Pencil Pain Scale to evaluate pain in school age (6-12 age group) were discussed considering the relevant literature.

In a scale, the indicator of whether the scale is quantitatively and qualitatively sufficient to measure the behavior (feature) that is intended to be measured is the

content validity. One of the logical ways to test content validity is to seek expert opinion [18]. In content validity studies, which are also called logical or rational validity studies [19], a preliminary study must be performed by receiving opinions from sufficient number of experts to determine the ability of the scale items to measure the feature that is intended to be measured [20-27]. If the number of experts in preliminary studies are sufficient (between 5-40), the validity of the scale to be prepared will be high [28,29].

As a result of the evaluation of the coded opinions of the seven experts on the suitability of the scale to children's characteristics, its ability to measure, its visuality, usefulness and applicability, the CVI of the Pencil Pain Scale was determined as +1.00 (Table 1). With this result, the hypothesis that "The Pencil Pain Scale has content validity" was supported. The Lawshe (1975) technique is used to verify the content validity of the scale with numerical values and to evaluate the expert opinions properly. At least five experts are needed to use this technique [14].

Validity is a concept of how well the test measures an individual's desired trait. Validity is the degree to which a measurement tool correctly measures the feature it aims to measure without mixing it with any other feature [24]. Although there are many criteria for testing the validity of a measurement tool, the most commonly used approach is to examine the similarity of the predictive validity of an adapted scale to the measurements obtained from the relevant and reliable scales (with confirmed psychometric properties) used in the same culture [30].

The validity of the Pencil Pain Scale was tested with convergent validity. To this end, the measurements made were compared with the mean scores of a similar study. The mean score of the Pencil Pain Scale was significantly lower in children who had intervention (1.31 ± 1.21) compared to children who had no intervention (2.12 ± 1.63) ($p < 0.01$) (Table 2). The difference between the groups was 1.81. In an experimental study in which children with similar age group and the same painful procedure had the distraction intervention with the same kaleidoscope, the FEES mean score was significantly lower in children who had intervention (3.14 ± 1.41) compared to children who had no intervention (3.80±1.42) ($p < 0.01$). In this study, the difference between the groups was found to be .66 [13] When the Pencil Pain Scale mean scores were compared with the FEES mean scores, similar results were obtained, and it was found that the Pencil Pain Scale had convergent validity. These results showed that the Pencil Pain Scale was able to measure the difference between the groups and the hypothesis that "The Pencil Pain Scale is a valid and reliable scale" was supported.

The research findings are similar to the results of previous research. In a study conducted to reduce the pain associated with blood collection in school-age children, the level of pain assessed by the VAS was 2.17 ± 2.25 [31]. In another study [32] on the effect of the presence of parents during painful procedures and the effect of some factors on the pain tolerance of children aged 6-11, the pain level was determined as 3.50 ± 1.44. In another study [31] conducted to alleviate pain associated with blood collection in children aged 10-12, the level of pain was found as 2.30 ± 0.92.

Reliability is the ability of a measurement instrument to give precise and consistent results. In other words, it is the ability of the measurement instrument to produce replicable results [12,33]. Various methods are used to find the reliability coefficient of a scale. In any scale development study, there is no easy response to the question of which should be used. Reliability test should be performed according to the possible objectivity in the scale to be used and the responses [12]. In this study, the reliability of the scale was measured considering only sensitivity as the scale is a perception scale and the perception of pain changes according to time and situation. The distinction power of the scale was tested. The general pain scores of the upper 27% of the Pencil Pain Scale ($\bar{x}$=4.368) were higher than the general pain scores of the lower 27% ($\bar{x}$=.447). It was revealed that the difference between the upper 27% and lower 27% group scores was significant ($t=-41.154$, $p=.000<.001$) (Table 3). With this result, it was determined that the Pencil Pain Scale was sensitive enough to make precise measurements and to distinguish the differences. The hypothesis that "The Pencil Pain Scale is a valid and reliable scale" was supported, and the hypothesis that "The Pencil Pain Scale is not a valid and reliable scale" was rejected.

One of the methods used to test the reliability of a scale is to divide the upper and lower 27% of the total scale score into groups and to determine the difference between the groups. The difference between the two groups is indicative of distinctiveness. The lack of difference between two groups indicates that the lowest and the highest score range is small. It is assumed that a scale measuring in a narrow range does not distinguish the differences [15,34,35].

It was stated that the pain scales had difficulties in distinguishing emotional states like pain and were criticized for these disadvantages; however, it was also stated that there is a very good correlation between the VAS and the FEES in assessing pain in children, and the emotional aspect is measured through facial expressions [36,37]. In a study, researchers stated that they selected the facial expressions pain scale because there are clear and meaningful facial expressions in the scale. In another study, they preferred a cartoon-like scale [38]. In addition, it is a known fact that in the assessment of pain in children, face scales show a high degree of correlation with other self-report measurement methods [39]. Based on these findings, the Pencil Pain Scale developed in this study was used with the VAS and the FEES to evaluate pain.

In the literature, the positive correlation between two equivalent forms on the same subject is an indicator of consistency in terms of reliability [10]. In order to determine the equivalent form reliability of the Pencil Pain Scale, the correlation between the three scales was examined, and no correlation was found. However, a comparison was made between the scale mean scores. In the study, the mean score of the Pencil Pain Scale was found to be 2.12 ± 1.63, while the mean scores of the VAS and the FEES were found as 2.32 ± 1.62 and 2.38 ± 1.77, respectively. No statistically significant

difference was found between the mean scores of the Pencil Pain Scale and the VAS and the FEES mean scores (p> 0.05, Table 4). These findings indicate that the Pencil Pain Scale measures the pain in children in the same reliable way as the known and commonly used scales. Thus, the hypothesis that "There is no difference between the mean scores of the Pencil Pain Scale and the VAS and the FEES mean scores" was supported.

In the literature, the VAS is accepted as a practical and easy to understand scale for children aged five and older [40,41]. The VAS has been successfully used with school-age children [42]. In one study, a significant relationship was found between the VAS and the facial pain scales stating that there is a sensory component in children [37]. The VAS pain mean scores were reported [45] to be positively correlated with the mean scores of other pain scales such as the Oucher [43,44] Eland Color Scale [45], various facial scales [46] and the Comfort Scale [47] also, Hicks et al. [48] found a positive correlation between the VAS and the FEES pain intensity measurement levels in children between 5 and 12 years of age. Furthermore, the study emphasized the importance of using more than one scale to assess pain in school-age children [31].

In the study, it was found that the age of the children did not affect the level of pain (p> 0.05, Table 5). Although the pain responses of children change with age, it was emphasized that the intensity of pain is not related to age and that each child may react differently to pain due to their individual characteristics, even at the same age [49]. Also, cultural characteristics can lead to a difference in children's perception of pain and their way of expressing it because children and their families may have cultural practices in coping with pain [50]. It has been reported in the literature that pain is experienced by young children as intensely as older children [50,51]. It was further reported that the age of the child affects the pain perception and the response to pain. A child aged 0-1 perceives pain and responds to pain more differently than the child aged 1-3 and the adolescents [49]. Similarly, the pain level of children in the 6-9 age group was found to be significantly higher than those in the 10-12 age group [31]. Another study found an inverse relationship between response to pain and age of children [52]. Young children (4-6 years) reported greater pain in the same type of pain than older children (ages 7 and above). It was stated that as the age of the children increased, the perception of pain decreased and the pain responses were inversely correlated with age. [32,54,54]. It was emphasized that age is important for a child to cope with pain [32,55]. This may be attributed to the increased experience of pain with age.

The study revealed that the gender of children did not affect the level of pain (p> .05, Table 5). Similarly, it was found that gender did not affect the intensity of pain during IV administration [32,56]. In contrast, in other studies, it was found that girls perceived significantly more pain than boys and gender affected the perception of pain [32]. It is stated that gender is important in pain experiences and that girls experienced more pain than boys in some procedure [57,58]. It was reported that this difference between the genders may be caused by the cultural effect and it is generally culturally appreciated to show high tolerance to pain [32].

Generalizability and Limitations of the Study

The results of the study may be generalized to the findings related to the pain resulting from the blood collection procedure in school age (6-12 age group) children.

The study derived from a thesis study, which was completed within a certain period of time. If children whose blood sample was taken only by one nurse had been included in the study, there would have been very few children matching the characteristics of the population. Moreover, as the research is a scale development study, high number of participants is important in terms of validity and reliability. Thus, it may be a limitation that blood collection was performed by three nurses. Another limitation of the study is that in similar scale reliability measurements, the scales were applied to different children with the same characteristics as it was thought that the scales did measurement with the same scoring and the children would be bored. In addition, it was thought that a correlation between the scales could not be determined for this reason. Failure to detect a difference between the mean scores of the scales may compensate for this limitation. In fact, considering the fact that the scales have the same scoring system and children may have a tendency to mark the same values on all scales, it was deemed appropriate to apply the scales to different groups with the same characteristics.

Conclusion

For the school age (6-12 age group) children, the new one-dimensional Pencil Pain Scale was developed in the study as a means of assessing pain. It was found that the new scale had content (The hypothesis that the Pencil Pain Scale is a valid and reliable scale is supported) and convergent validity (The hypothesis that the Pencil Pain Scale is a valid and reliable scale was supported). It was also found that the new scale makes sensitive measurements enough to differentiate differences and it has parallel form reliability (The hypothesis that the Pencil Pain Scale is a valid and reliable scale was supported). The scale further revealed that the level of children's pain was not affected by age and gender.

The Pencil Pain Scale should be used in different studies, with different age groups, different types of pain and different scales in order to be a standard scale in assessing the pain of children.

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Availability of Data and Materials

All relevant data are presented within the manuscript and the dataset used to reach conclusion can be assessable from the corresponding author on request.

Ethics Approval and Consent to Participate

Not applicable.

Consent for Publication

Not applicable.

Competing Interests

The authors declared no competing interests.

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