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Validation and cultural adaptation of the Russian version of the Pedi-IKDC questionnaire

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BACKGROUND: Questionnaires are standard tools used for examination of patients. Obtained data provide information about knee function disturbance and level of the quality of life. Young patients with various knee injuries also needed examination questionnaires. In worldwide practice, the Pediatric International Knee Documentation Committee (Pedi-IKDC) is more often used by doctors. However, if the doctor wants to use foreign questionnaire in his/her practice, the questionnaire should be validated and culturally adaptable.

AIM: This study aimed to enable the validation and cultural adaptation of the Russian version of the Pedi-IKDC questionnaire based on the English version for children and adolescent.

MATERIALS AND METHODS: This questionnaire was translated from English by professional medical translator and by orthopedic surgeon. The Lysholm questionnaire was also used to control the adequacy of Pedi-IKDC results. Statistical analysis was performed to process data.

RESULTS: Cronbach's alpha was 0.902, which means that questions have high level of consistency. The high correlation of results between the Lysholm and Pedi-IKDC questionnaire also proves the adequateness and objectiveness of the results.

CONCLUSIONS: The proposed Russian version of the Pedi-IKDC questionnaire gives effective, objective, and adequate results. It is a good tool for knee assessment in children.

Keywords: knee injuries; anterior cruciate tear; knee instability; meniscal tears; posterior cruciate tear; Pedi-IKDC; evaluation of treatment.

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Валидация и культурная адаптация шкалы Pedi-IKDC

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Обоснование. В качестве стандарта для оценки функционального статуса пациента и результатов лечения используют опросники. Эти данные дают представление о степени нарушения функции коленного сустава и выраженности снижения качества жизни. Пациенты детского возраста с различными повреждениями структур коленного сустава также нуждаются в оценке текущего функционального статуса. В мировой практике с этой целью все чаще применяют шкалу Pedi-IKDC (The Pediatric International Knee Documentation Committee). Однако для того, чтобы использовать зарубежный опросник, врачу другой языковой группы и культуры необходимо выполнить процедуру валидации и культурной адаптации.

Цель — валидация и культурная адаптация шкалы Pedi-IKDC с английского языка на русский для пациентов детской возрастной группы.

Материалы и методы. Для корректного проведения процедуры валидации и культурной адаптации сначала выполнен перевод шкалы Pedi-IKDC с английского языка на русский медицинским переводчиком, практикующим врачом — травматологом-ортопедом со знанием английского. Затем составлена версия опросника для апробации с учетом культурных особенностей языковой группы. Помимо опросника Pedi-IKDC пациентов анкетировали по опроснику Lysholm, данные которого сравнивали с данными Pedi-IKDC. Lysholm наиболее часто используют в практике, его показателям можно доверять. Проводили также статистический анализ данных, апробируемый опросник проверяли на валидность и корреляцию.

Результаты. Согласно статистическому анализу коэффициент α -Кронбаха составил 0,902, что говорит о высокой степени согласованности вопросов внутри теста. Высокий уровень статистической взаимосвязи результатов опросников (корреляции результатов) также подтверждают адекватность и объективность оценок, основанных на опроснике Pedi-IKDC.

Заключение. Предлагаемый вариант переведенного опросника Pedi-IKDC предоставляет надежные, адекватные и объективные данные. Он является отличным инструментом для оценки функционального статуса коленного сустава у детей.

Ключевые слова: повреждение коленного сустава у детей; антеромедиальная нестабильность; повреждение менисков; повреждение передней крестообразной связки; повреждение задней крестообразной связки; Pedi-IKDC; оценка результатов лечения.

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BACKGROUND

In contemporary traumatology and orthopedics, scales (integral point systems) are used as a standard to assess the functional status of patients and their treatment results [1–3].

The data obtained from a systematic survey of a patient using point systems are summarized to a universal indicator that is understandable to orthopedic traumatologists. It provides a concise idea about the degree of knee joint dysfunction and severity of decrease in the quality of life of patients.

The current functional status of pediatric patients with various knee joint injuries also requires assessment [4]. In global practice, the Pedi-IKDC (The Pediatric International Knee Documentation Committee) scale [5–7] is increasingly used for this purpose, since it is adapted and understandable for patients under 18 years of age. In the Russian Federation, versions developed for adult patients are used very often as a questionnaire. Some questions may not be clear to pediatric patients, which can lead to misinterpretation of questions and incorrect final results.

The presence of validated and adapted scales in the arsenal of pediatric trauma orthopedists enables Russian colleagues to interact more effectively when assessing treatment results and to use the same professional language for communication with international colleagues due to the wide occurrence of this assessment system in international literatures [8, 9].

In a study of Charlotte et al. [10], they validated, adapted, and translated the Pedi-IKDC scale into Dutch and revealed which questionnaire is the best for clinical practice. The authors concluded that the Pedi-IKDC questionnaire is more suitable for patients in terms of psychometric parameters than the KOOS-Child.

Dietvorst et al. [11] conducted a systematic review of articles based on patient-reported outcomes (PROMs). PROM enables to determine the extent of patients' satisfaction with treatment results. It was also showed that the Pedi-IKDC and KOOS-Child questionnaires based on PROM data are reliable and sensitive, and these were recommended for the assessment of the functional status of the knee joints of pediatric patients.

The clinical relevance of this review consists of adult versions of questionnaires that are not suitable for children and adolescents.

This study aimed to validate, culturally adapt, and translate the Pedi-IKDC scale from English into Russian for pediatric patients.

MATERIALS AND METHODS

Due to the need to develop assessment standards for pediatric patients, a procedure for the validation and cultural adaptation of the Pedi-IKDC questionnaire was considered.

To date, the translations of the questionnaire have already been completed by an orthopedic traumatologist, a professional medical translator proficient in the English language. As part of the procedure described, a team of specialists developed a variant of the questionnaire (Appendix) for conducting clinical trials. A statistical analysis of the material was performed to study the translated questionnaire for correlation and internal consistency. The stages of validation described above are presented in detail in international sources [12].

Our study included a questionnaire survey on 100 pediatric patients with various knee joint injuries. Fifty-two patients were male, and 48 were female patients. All patients underwent surgical treatment for damage to various knee joint structures (damage to the anterior cruciate ligament, posterior cruciate ligament, and knee menisci) in a clinic of Department No. 9 of the Priorov National Medical Research Center of Traumatology and Orthopedics from August 2020 to January 2021. In addition to the Pedi-IKDC questionnaire, the subjects filled out the frequently used Lysholm questionnaire.

The statistical analysis consisted of three stages. In stage 1, a general analysis was performed, standard baseline indicators were calculated, and their distribution was assessed. Based on the information received, methods and criteria were selected to solve the tasks assigned. In stage 2, the validity of the questionnaire was determined. In stage 3, the objectivity of the results was tested.

RESULTS

In stage 1, the main statistical indicators were calculated [13–15] using the Pedi-IKDC and Lysholm methods (Table 1).

To select the methods for the statistical processing of the results, the type of distribution of indicators was tested according to Pearson's chi-squared test [12]. The significance level did not exceed 0.05, which indicates a normal distribution of the survey results. Calculations were performed using the StatGraphics software package. Figures 1 and 2 shows histograms based on the results above.

Due to the normal distribution of the survey results, parametric statistical methods were used [12–17].

Table 1. Descriptive statistics of the survey results

Statistical indicator	Questionnaire	
	Pedi-IKDC	Lysholm
Mean	55.97	67.89
Dispersion	263.25	274.70
Median	58.15	68.50
Excess	-0.416	0.081
Asymmetry	-0.336	-0.528

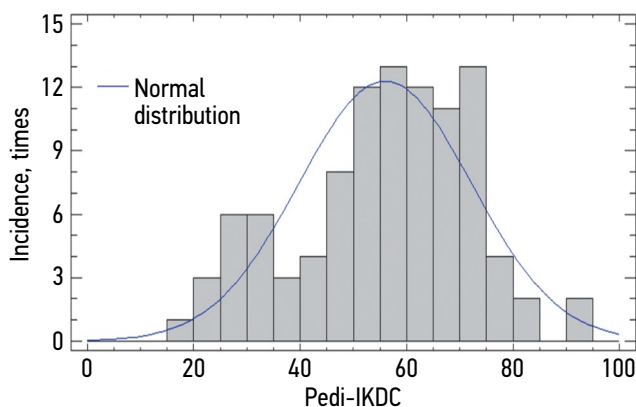


Fig. 1. Histogram of the distribution of patient survey results according to the Pedi-IKDC questionnaire with normal distribution density curve

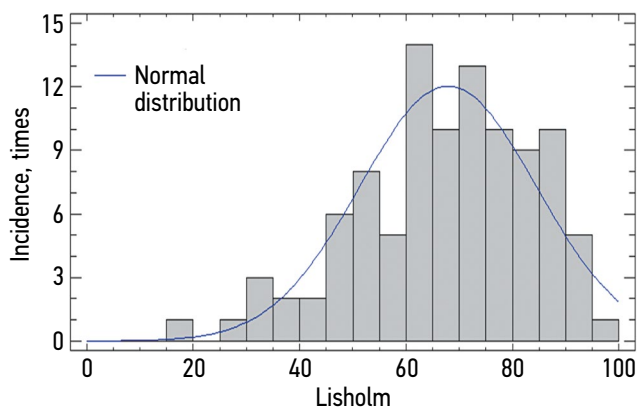


Fig. 2. Histogram of the distribution of patient survey results according to the Lysholm questionnaire with normal distribution density curve

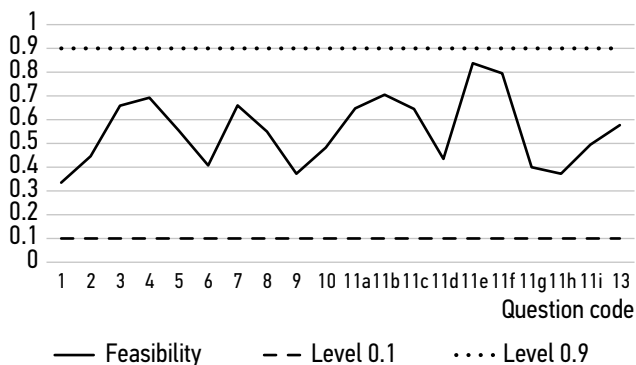


Fig. 3. Testing the feasibility of questions for the Pedi-IKDC questionnaire

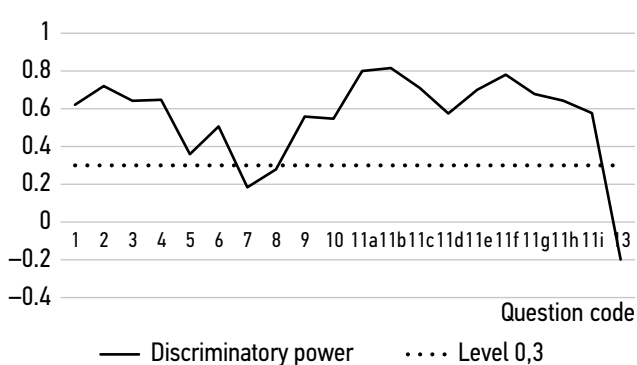


Fig. 4. Discriminatory power values of questions for the Pedi-IKDC questionnaire

Then, the validity of the questionnaire was tested based on three components: feasibility, discriminatory power, and consistency of tasks, which were confirmed using Cronbach's alpha.

Feasibility was considered normal if the condition $0.1 \leq D_j \leq 0.9$ is true. The calculated feasibility of each question for the Pedi-IKDC questionnaire is presented in Fig. 3.

The Figure 3 shows that the feasibility condition was met, so the qualitative compilation of questionnaires was confirmed in terms of feasibility.

Discriminatory power shows the extent of consistency of the survey results on a particular question with the final results obtained from the entire questionnaire.

Table 2. Results of the Cronbach α -test

Questionnaire	M	r	α	Consistency
Pedi-IKDC	20	0.315	0.902	Very high

Table 3. Correlation matrix of survey results by methods

Pearson correlation	Pedi-IKDC	Lysholm
Pedi-IKDC	1.000	0.690
Lysholm	0.690	1.000

The calculated level of discriminatory power of each question in the Pedi-IKDC questionnaire are shown in Fig. 4.

Figure 4 shows that the discriminatory power of the Pedi-IKDC questionnaire for all tasks, except for question 13, is high or moderate. In general, considering the significant number of questions for each questionnaire, their quality in terms of the discriminatory power of the questions can be considered satisfactory.

The Cronbach's alpha coefficient enables the assessment of the internal consistency of the questions. For the Pedi-IKDC scale, it was 0.902. Thus, the questions were consistent despite the unconfirmed discriminatory power of one of the questions (Table 2).

The adequacy and objectivity of the survey results were substantiated using parametric correlation analysis.

The consistency of the assessments in the Pedi-IKDC and Lysholm questionnaires are presented in Table 3.

As shown the Table 3, the correlation is high and suggests a relationship between the survey results. However, to obtain statistically sound conclusions, the correlation coefficients should be tested for significance. The critical value for a sample of 100 patients at a significance level of 0.05 was $t_{cr} = 1.661$, and at a significance level of 0.01, it was $t_{cr} = 2.365$ [18].

Table 4 presents the *t*-test results for the same data categories shown in Table 3.

The high correlation of the results to determine the condition of patients confirms the adequacy and objectivity of the assessments obtained using the Pedi-IKDC questionnaire.

DISCUSSION

The assessment of the functional status of patients very important for conservative and surgical treatments. Pedi-IKDC is an adapted version of the IKDC questionnaire for pediatric patients. The questionnaire has been translated into various languages and is often used in global practice [1, 2, 7, 10, 11]. The Russian-language version of the Pedi-IKDC questionnaire is presented in the Appendix. The data obtained can be interpreted as follows. An excellent, good, satisfactory, and poor result is >90, 80–89, 70–79, and <70, respectively. Statistical analysis was performed to check the correctness of the translation. The level of statistical relationship between the results of the questionnaires (correlation) was also determined. The advantages of the study include the use of the Cronbach's alpha coefficient and the calculation of discriminatory power. High Cronbach's alpha values indicate the absence of contradictions between the questions and are considered a standard when performing questionnaire validation procedures [19]. The question discriminatory power check can be used for both the created questionnaires and the adapted ones. This enables the removal of conflicting questions from the questionnaire and ensures that it is adequate and applied correctly in practice.

Lysholm was used as a "control questionnaire." Its data were compared with the data of the tested Pedi-IKDC. Lysholm was used because it is the most frequently used in our practice, but other questionnaires (KOOS-Child, WOMET, SF-36, etc.) can also be used. It is advisable for future studies on validation and cultural adaptation to select approved questionnaires as controls to have a greater reliability for statistical analysis. Based on the results of our statistical

Table 4. Values of Student's *t*-test necessary to substantiate the significance of the correlation matrix elements in Table 3

Pearson correlation	Pedi-IKDC	Lysholm
Pedi-IKDC	–	9.445
Lysholm	9.445	–

analysis, the Russian version of Pedi-IKDC provides reliable, adequate, and objective data and represents a sensitive tool. This study involved 100 pediatric patients. The association of each test item with the overall score was high. The Cronbach's alpha index was 0.9, which indicates the validity and reliability of the translated version of the questionnaire. The procedure performed was also done in other countries, which is the standard for translation into other languages [10, 20]. Similar procedures were used in the practice of trauma orthopedists in Russia [19–21].

CONCLUSION

The Pedi-IKDC questionnaire validated and adapted here can be used in the practice of trauma orthopedists for children aged 10 to 18 years old. Using statistical methods, the results of the quality assessment of the adapted survey using the Pedi-IKDC method were analyzed. The validity of the questionnaires was also assessed using three components. Regarding the "feasibility of question," all tasks in the questionnaire satisfy the requirements for sufficient feasibility and can be used in practice. In terms of the "discriminatory power of questions," all tasks have high or moderate discriminatory power and make an adequate contribution to the final grade. The general consistency analysis based on Cronbach's alpha test revealed the high overall consistency of questions in each questionnaire. Based on the comparison of assessment results on the patients' condition using the Pedi-IKDC method and Lysholm questionnaire, which has been proven positively in practice, there was a significantly high level of correlation, with a probability of >0.99, which confirms the adequacy and objectivity of the assessments.

APPENDIX

The Pediatric International Knee Documentation Committee (Pedi-IKDC)

General information

1. Full name: _____
2. Date of birth: ___/___/_____
3. Date of completion: ___/___/_____

Injury information

Date of injury: ___/___/_____

MM DD YYYY

We need to know more about your knee injury. Each question focuses on different aspects of the trauma. Please answer each question by ticking only one box.

SYMPTOMS

1. What is the highest level of activity can you perform nowadays without **significant** knee pain?

- ₁ Very strenuous activities like jumping or pivoting to change direction as in basketball or soccer
- ₂ Strenuous activities like weightlifting, skiing, or tennis
- ₃ Moderate activities, such as brisk walking or jogging
- ₄ Low-intensity activities, such as walking at a normal speed
- ₅ I am unable to perform any of the above activities due to severe knee pain

2. How often have you had pain in the injured knee?

Never	0	1	2	3	4	5	6	7	8	9	10	Constant
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

3. How severe is your pain in the knee today?

No pain	0	1	2	3	4	5	6	7	8	9	10	Worst pain
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

4. How **difficult** is it for you to **bend** and move your injured knee?

- ₁ Not difficult
- ₂ Slightly difficult
- ₃ Moderately difficult
- ₄ Very difficult
- ₅ Extremely difficult

5. How **stiff** or **swollen** was your injured knee since your injury?

- ₁ None at all
- ₂ Mildly
- ₃ Moderately
- ₄ Very
- ₅ Extremely

6. What activities can you currently perform without **swelling (edema)** in your knee joint?

- ₁ Very strenuous activities like jumping or pivoting to change direction as in basketball or soccer
- ₂ Strenuous activities like weightlifting, skiing, or tennis
- ₃ Moderate activities, such as brisk walking or jogging
- ₄ Low-intensity activities, such as walking at a normal speed
- ₅ I am unable to perform any of the above activities due to the injured knee swelling even when I am at rest

The Pediatric International Knee Documentation Committee (Pedi-IKDC)

7. Since the injury, have you had episodes of the injured knee **lock or catch** (so that you could not move it at all)? **Yes** ₁ **No** ₂
8. Since the injury, did you feel like the injured knee was **“locked” (stuck)** in one position, **but soon you were able to move it**? **Yes** ₁ **No** ₂
9. What actions can you perform today **without feeling unstable in the knee joint**?
- ₁ Very strenuous activities like jumping or pivoting to change direction as in basketball or soccer
 - ₂ Strenuous activities like weightlifting, skiing, or tennis
 - ₃ Moderate activities, such as brisk walking or jogging
 - ₄ Low-intensity activities, such as walking at a normal speed
 - ₅ I am unable to perform any of the above activities because I feel like I cannot lean on my injured knee

SPORTS ACTIVITIES

10. What exercises are part of your daily activities?
- ₁ Very strenuous activities like jumping or pivoting to change direction as in basketball or soccer
 - ₂ Strenuous activities like weightlifting, skiing, or tennis
 - ₃ Moderate activities, such as brisk walking or jogging
 - ₄ Low-intensity activities, such as walking at a normal speed
 - ₅ I am unable to perform any of the above activities

11. How does your knee affect your ability to:

	None at all	Slight	Moderate	Extreme	Unable to do
a. Go up stairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Go downstairs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Kneel on the front of your knee	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Squat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Sit with your knee bent	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Rise from a chair	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Run straight ahead	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Jump and land on involved leg	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Stop and start quickly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FUNCTION

12. How would you rate the function of your knee prior to the injury?

Inability to perform any of daily activities	0	1	2	3	4	5	6	7	8	9	10	No limitation in daily activities
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

13. How would you rate the current function of your knee?

Inability to perform any of daily activities	0	1	2	3	4	5	6	7	8	9	10	No limitation in daily activities
	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	

14. How did you answer the questions?

- ₁ Independently
- ₂ With the help of parents/adults

ADDITIONAL INFORMATION

Funding. The study had no external funding.

Conflict of interest. The authors declare no conflict of interest.

Ethical considerations. The study was performed in accordance with the requirements of the Declaration of Helsinki of the World Medical Association (as revised in 2013). The study was approved by the ethical committee (02/04/2021 No. 1-2021). The consent of the developers of the questionnaire for translation was obtained.

All patients and volunteers who participated in the clinical study gave written consent to this.

Author contributions. Ya.A. Ivanov created the concept and design of the study, collected and processed the data, and wrote the text. A.G. Yeltsin collected the data, edited the text. D.S. Mininkov collected the data.

All authors made significant contributions to the research and preparation of the article, read and approved the final version before its publication.

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