



Cross-Cultural Adaptation and Validation of the Russian-Language Version of the American Orthopaedic Foot and Ankle Society Ankle-Hindfoot Scale (AOFAS-AHS)

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Abstract

Background. Developed in 1994 by H. Kitaoka et al. the American Orthopaedic Foot and Ankle Society Ankle-Hindfoot scale (AOFAS-AHS) allows to assess pain, function, deformity and alignment of the foot and ankle. There is no Russian-language AOFAS-AHS questionnaire adapted according to current standards in the scientific literature.

The aim of this paper is to perform the cross-cultural adaptation and to assess the validity of the Russian-language version of the AOFAS-AHS scale, including the evaluation of its psychometric properties.

Methods. The original English version of the AOFAS-AHS scale was translated from English into Russian by a native Russian speaker. Then the questionnaire was back-translated into English by another translator whose native language is English. The next stage was the comparison of the original and back-translated versions, followed by the presentation of a pre-final cross-culturally adapted version, which was tested on 10 patients to ensure that the questions were comprehensible. The next step was the approval of the final version and its completion by patients to be operated on the hindfoot or ankle. The printed copy of the final version of the questionnaire was completed by the patients with an interval of 3 days. Total of 44 consecutive patients were enrolled, including 18 women (41%) and 26 men (59%), with a mean age of 61.7 (32-78) years. The psychometric properties of the Russian-language version of the AOFAS-AHS questionnaire (internal consistency, retest reliability, measurement error, responsiveness, and construct validity) were assessed based on the COSMIN (CONsensus-based Standards for the selection of health status Measurement INstruments) principles.

Results. The mean score according to the AOFAS-AHS scale was 49.6 (min 2; max 82) out of a possible 100. The average time to complete the questionnaire was 4.2 minutes. All hypotheses formulated showed correlations of varying moderate to strong degrees. The Cronbach's alpha coefficient was 0.76, which indicates a high level of internal consistency of the elements of the validated questionnaire. A good intra-class consistency of 0.83 was obtained, which shows a high degree of reliability of the questionnaire's reproducibility. The ceiling and floor effects for the primary results of the questionnaires did not exceed 15%. The mean value of the Russian-language version of the AOFAS-AHS increased to 86.6 after surgical treatment. The values of standardized effect size (ES) and standardized response mean (SRM) were 5.56 and 4.83, respectively.

Conclusions. The adapted Russian-language version of the AOFAS-AHS scale showed good psychometric properties and can be recommended for assessment of the physical activity in patients with ankle and hindfoot-related pathology and can also be used for monitoring the changes during the treatment.

Keywords: hindfoot, ankle, AOFAS-AHS, reliability, cross-cultural adaptation, psychometric properties, validity.

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Кросс-культурная адаптация и валидация русскоязычной версии шкалы Американской ассоциации хирургов стопы и голеностопного сустава AOFAS-AHS

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Реферат

Актуальность. Разработанная в 1994 г. Н. Китаока с соавторами шкала Американской ассоциации хирургов стопы и голеностопного сустава AOFAS-AHS позволяет оценить боль, функцию, степень деформации и опороспособность заднего отдела стопы и голеностопного сустава. В научной литературе отсутствуют русскоязычные версии AOFAS-AHS, адаптированные согласно современным методикам.

Целью работы является культурная адаптация и валидация русскоязычной версии шкалы AOFAS-AHS, включая оценку психометрических свойств опросника.

Материал и методы. Оригинальная англоязычная версия шкалы AOFAS-AHS была переведена с английского на русский язык носителем русского языка. Затем был выполнен обратный перевод анкеты на английский язык другим переводчиком, родным языком которого является английский. Затем выполнено сравнение оригинальной и обратно переведенной версий с последующим представлением предфинальной кросс-культурно адаптированной версии, которая была протестирована на 10 пациентах, чтобы убедиться, что все вопросы понятны. Следующим этапом было утверждение финальной версии и ее заполнение пациентами, ожидающими оперативного вмешательства на заднем отделе стопы или голеностопном суставе. Печатный вариант финальной версии опросника заполняли пациентами с промежутком в 3 дня. Для заполнения опросника были отобраны 44 последовательных пациента, из них 18 (41%) женщин и 26 (59%) мужчин, средний возраст которых составил 61,7 (32–78) лет. Оценка психометрических свойств русскоязычной версии опросника AOFAS-AHS (внутренняя согласованность, ретестовая надежность, ошибка измерения, отзывчивость и конструктивная валидность) была выполнена на основании принципов COSMIN (COnsensus-based Standards for the selection of health status Measurement INstruments).

Результаты. Средний балл по шкале AOFAS-AHS составил 49,6 (min 2; max 82) из 100 возможных. Среднее время заполнения анкеты — 4,2 мин. Во всех сформулированных гипотезах была выявлена корреляционная связь умеренной или сильной степени. Коэффициент альфа Кронбаха составил 0,76, что свидетельствует о высоком уровне внутренней согласованности элементов валидируемого опросника. Был получен хороший показатель внутриклассовой согласованности (0,83), что свидетельствует о высокой степени воспроизводимости анкеты. Эффект «потолка» и «пола» для первичных результатов опросников не превышал 15%. Средний балл по русскоязычной версии AOFAS-AHS вырос до 86,6 после оперативного лечения. Значения стандартизированного размера эффекта (ES) и стандартизированного среднего ответа (SRM) составили 5,56 и 4,83 соответственно.

Заключение. Адаптированная русскоязычная версия шкалы AOFAS-AHS обладает хорошими психометрическими свойствами и может быть рекомендована для оценки физической активности пациентов с патологией области голеностопного сустава и заднего отдела стопы, а также использована для оценки динамики изменений в процессе лечения.

Ключевые слова: голеностопный сустав, шкала AOFAS-AHS, кросс-культурная адаптация, психометрические свойства опросника.

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BACKGROUND

Assessment of the functional outcome of patients with ankle joint pathology is an important criterion of treatment efficacy [1]. In recent years, there has been a trend towards the use of patient-reported outcome measure (PROM) questionnaires, which provide a more accurate assessment of functional results [2].

The American Orthopaedic Foot and Ankle Society Ankle-Hindfoot scale (AOFAS-AHS) is one of the most popular scales for assessing ankle joint function [3]. The scale developed in 1994 by H. Kitaoka et al. allows to assess pain, function, deformity and bearing capacity of the lower limb [4].

This questionnaire has proven its validity in the original language [5, 6]. As it is completed by patients on the basis of their own perceptions, the validity of the questionnaire cannot be confirmed when applied in non-English-speaking countries. Therefore, cultural and linguistic adaptation is required for its use in other countries and languages [7]. This questionnaire has already been translated with adaptations into the following languages: Arabic [8, 9], Portuguese [10], Dutch [11], Italian [12], German [13], Persian [14], Turkish [15], and Swedish [16]. In Russia, M.E. Viskarr et al. published a study where the questionnaires for ankle joint assessment were translated into Russian and adapted for use in Russia [17]. However, the authors did not use the recommendations for adapting the questionnaires already published at that time [18]. Thus, nowadays in the Russian Federation there are no specialized Russian-language questionnaires and scales adapted in accordance with the recommended standards to assess the condition of the hindfoot and ankle joint.

Aim of the study is to perform the cross-cultural adaptation and to assess the validity of the Russian-language version of the AOFAS-AHS scale, including the evaluation of its psychometric properties.

METHODS

Methodology of the study

The methodological part of the study included translation of the questionnaire into Russian. In the clinical part of the study, the psychometric properties of the questionnaire were assessed in a group of patients with ankle joint pathology.

Patients

The study was performed in the clinic of the Vreden National Medical Research Center for Traumatology and Orthopedics from November 2021 to August 2022. Forty-four patients with osteoarthritis of the ankle and/or subtalar joints awaiting reconstructive surgery, including 18 women (41%) and 26 men (59%), were enrolled in the study. The mean age of the patients was 61.7 (32-78) years. The nosological structure was as follows: 14 (32%) patients with isolated ankle osteoarthritis, 16 (36%) patients with ankle and subtalar osteoarthritis, 5 (11%) patients with chronic ankle instability, 5 (11%) patients with ankle impingement syndrome, and 4 (9%) patients with dissecting osteochondritis. All patients were interviewed using the Russian translated version of the AOFAS-AHS questionnaire.

Translation and adaptation

Translation and adaptation of the AOFAS-AHS scale was performed in several stages:

Stage I – direct translation from English into Russian by a native Russian speaker;

Stage II – back translation of the questionnaire into English by another translator whose native language is English;

Stage III – comparison of the original and back-translated versions followed by the presentation of a pre-final cross-culturally adapted version, which was tested on 10 patients to ensure that all questions were comprehensive;

Stage IV – approval of the final version of the questionnaire and its completion by patients awaiting hindfoot or ankle surgery.

The AOFAS-AHS questionnaire

The questionnaire consists of nine questions. Four of them assess pain and function, and five assess range of motion, instability, deformity and bearing capacity. To calculate the total score, the points for each response, which are not evenly distributed among the different questions, must be summed. The number of points ranges from 0 to 100, where the maximum number of points corresponds to the best function of the joint.

The EQ-5D-5L questionnaire

This questionnaire was used to test the construct validity based on hypothesis testing, as its Russian version was translated by the questionnaire developers according to a standardized protocol (<https://euroqol.org/support/translation->

process/) that ensures equivalence of the translated version to the original version. The EQ-5D-5L is designed to assess the quality of life and includes questions on mobility, self-care, usual daily activities, pain/discomfort, and anxiety/depression. By answering each of the five questions, the patient can choose one of five response options that most closely matches his or her perception. The obtained values then form the respondent's health status, coded with five consecutive digits, which is then interpreted into a value between 0 and 1 based on the calculator supplied with the questionnaire. In addition, an integral part of the questionnaire is a visual analog scale on which the patient must mark his or her health status on the day of completion of the questionnaire, where 100 is the best possible status. We used the Russian-language version of the EQ-5D-5L questionnaire, taken from the official website www.euroqol.org.

Psychometric assessment

Psychometric properties of the Russian-language version of the AOFAS-AHS questionnaire (internal consistency, retest reliability, measurement error, recall and construct validity) were assessed based on the COSMIN (COnsensus-based Standards for the Selection of Health Status Measurement INstruments) principles [18].

Questionnaire reliability in terms of stability of test results when repeating the test was assessed by calculating the Intraclass Correlation Coefficient (ICC) using a mixed two-factor model [19]. ICC interpretation in the context of consistency was evaluated using the following algorithm: ICC<0.2 – weak consistency, ICC=0.2-0.4 – mediocre; ICC=0.4-0.6 – moderate; ICC=0.6-0.8 – pronounced; ICC>0.8 – almost complete consistency [12].

Internal consistency was assessed using the Cronbach's alpha coefficient calculated for the primary results of the questionnaires. This coefficient evaluates the correlation between all questions in the questionnaire and the correlation between each question and the questionnaire as a whole. The Cronbach's alpha coefficient between 0.7 and 0.9 is considered high, but if the value exceeds 0.9, it may indicate that the questionnaire is redundant and some questions assess the same things [20].

The ceiling and floor effects, i.e., the percentage of maximum and minimum values obtained in the questionnaire, were assessed for the primary and recurrent survey results. If a ceiling or floor effect is present, it is probable that extreme values at the bottom or top of the scale are absent, which may result in a limitation of content validity. As a consequence, this may lead to reduced reliability of the questionnaire, as differences between the lowest or highest values cannot be detected. Values of less than 15% are considered low ceiling and floor effects [19].

Construct validity indicates the extent to which the test results can be considered as a measure of the construct being assessed [18]. In our study, we evaluated the correlation between the Russified version of the AOFAS-AHS and the EQ-5D-5L scale using the hypothesis testing method. Correlation coefficient values greater than 0.60, between 0.40 and 0.59, and less than 0.39 were interpreted as strong, moderate or weak, respectively. In hypothesis testing, we assessed both the correlation of both scales as a whole and the pain and functional subdomains. The share of confirmed hypotheses is calculated as a percentage, and if it exceeds 75%, the construct validity of the questionnaire is considered confirmed [19].

Responsiveness, i.e., the ability of the questionnaire to show changes over time, was assessed using the longitudinal validity assessment method. To interpret changes in scores, measures of treatment effect were assessed using paired t-test, standardized effect size (ES) and standardized response mean (SRM) [21].

Statistical analysis

Statistical analysis was performed using PAST v. 4.13 and IBM SPSS v. 25.0 software. Differences were considered statistically significant at $p < 0.05$. The Shapiro-Wilk test was used to assess the normality of data distribution. Retest reliability was assessed using two-way analysis of variance with a random effects parameter.

RESULTS

Cross-cultural adaptation consisted of developing a different question construction and supplementing the translated text to facilitate its understanding by patients when completing the questionnaire. We

phrased each block of the fillable scale as a patient-facing question (Table 1).

Question 1 was supplemented with a description of the localization of pain for the patient to better understand the location of its origin. Question 2 revealed the concept of "means of additional support" - crutches, cane, walker. Question 3 is one of the most debatable ones, as the most difficult task was to figure out how many meters make up one block ("street block" – a block in the USA, since the author of the

questionnaire H. Kitaoka is from the USA, and in each state a block can be of different length). Therefore, we did an average conversion of the length of one block, which was 100 meters. In question 6, we changed the degrees to percentages of movement amplitude from the level of normal function, as in question 7. The last module "Alignment" literally translates into Russian as "alignment, arrangement on one axis" (see Multitran dictionary). Since the context refers to pathologic changes in the anatomy of

Table 1

Russian-language version of the AOFAS-AHS questionnaire

Pain (40 points)	
1. How would you describe the pain in the ankle and heel?	
None	40
Mild, occasional	30
Moderate, daily	20
Severe, almost always present	0
Function (50 points)	
2. Do you experience limitations of daily activities? Do you need additional support (crutches, cane, walker)?	
No limitations, no support	10
No limitations of daily activities, limitations of sport activities, no support	7
Limited daily and sport activities, cane	4
Severe limitations of daily and sport activities; special footwear for walking, crutches, wheelchair, brace	0
3. What is your maximum walking distance in meters?	
More than 2400 m	5
1600–2400 m	4
400–1200 m	2
Less than 400 m	0
4. Do you have difficulties walking?	
None	5
Some difficulty on uneven terrain, stairs, inclines	3
Severe difficulty on uneven terrain, stairs, inclines	0
5. Do you have abnormal gait?	
None or slight	8
Marked	4
Pronounced	0
6. What is the range of motion in the ankle joint (flexion and extension)?	
Normal or mild restriction (60–100% normal)	8
Moderate restriction (30–59% normal)	4
Severe restriction (less than 25% of normal)	0
7. What is the range of lateral motions in the hindfoot (inward and outward)?	
Normal or mild restriction (75–100% normal)	6
Moderate restriction (25–74% normal)	3
Severe restriction (less than 25% of normal)	0

Russian-language version of the AOFAS-AHS questionnaire

8. Do you experience instability in the ankle joint and hindfoot?	
Stable	8
Unstable	0
Deformity and alignment (10 points)	
9. Do you have deformities in the hindfoot and ankle joint?	
None	10
Slight deformity, plantigrade foot, some degree of ankle-hindfoot malalignment, no symptoms	8
Nonplantigrade foot, severe malalignment, symptoms	0

the joint that result in impaired bearing capacity and normal function, we decided that the most appropriate translation for Russian-speaking patients is "deformity and bearing capacity". In question 9, we changed "correct hindfoot axis location" to "no deformity", "satisfactory axis location" to "slight deformity", and "poor axis location" to "pronounced deformity".

The mean AOFAS-AHS score was 49.6 (min, 2; max, 82) out of a possible 100. All patients were explained in detail how to complete the questionnaire, resulting in a 100% completion rate. The average time to complete the questionnaire was 4.2 min.

Hypothesis testing

All proposed hypotheses showed a moderate to strong degree of correlation (Table 2).

Internal consistency

The value of the Cronbach's alpha coefficient was 0.76, which suggests a high level of internal consistency of the elements of the validated questionnaire. Pronounced correlation was revealed between the results of answers (in points) to some questions of the questionnaire and the results of the whole questionnaire (Table 3).

Reliability

The intraclass consistency value of 0.83 was good, indicating a high degree of reliability of the questionnaire's reproducibility. Ceiling and floor effects for the primary results of the questionnaires did not exceed 15%.

Table 2

Hypothesis testing to determine the construct validity of the translated version of the questionnaire

Questionnaire	Hypothesis
AOFAS-AHS vs VAS EQ-5D-5L	Strong positive correlation
AOFAS-AHS vs health values of EQ-5D-5L	Strong positive correlation
AOFAS-AHS vs mobility subdomain of EQ-5D-5L	Strong negative correlation
AOFAS-AHS vs self-care subdomain of EQ-5D-5L	Strong negative correlation
AOFAS-AHS vs usual daily activities subdomain of EQ-5D-5L	Strong negative correlation
AOFAS-AHS vs pain/discomfort subdomain of EQ-5D-5L	Strong negative correlation
AOFAS-AHS vs anxiety/depression subdomain of EQ-5D-5L	Moderate to strong negative correlation

Construct validity

All hypotheses were confirmed, which proves the construct validity of the Russian-language version of the AOFAS-AHS. The scale correlated with the EQ-5D-5L questionnaire as a whole, as well as the functional and pain subdomain of the latter.

Responsiveness

The mean value of the Russian-language version of the AOFAS-AHS improved to 86.6 after surgical treatment. The values of standardized effect size (ES) and standardized response mean (SRM) were 5.56 and 4.83, respectively.

Table 3

Characteristics of basic values of the Russian-language version of the AOFAS-AHS and their internal consistency

Question	Mean value when excluding the item	Corrected correlation between the item and total	Cronbach's alpha when deleting the item
1	28.45	0.82	0.82
2	44.39	0.67	0.76
3	46.57	0.67	0.77
4	47.27	0.58	0.77
5	46.68	0.53	0.76
6	46.41	0.80	0.74
7	46.86	0.66	0.77
8	45.95	0.63	0.74
9	44.14	0.53	0.75

DISCUSSION

There are no Russian translated and adapted ankle joint assessment questionnaires available in the modern literature. The AOFAS-AHS scale that we selected for translation and adaptation is a patient-completed questionnaire, and the data collected using this scale are more reliable compared with the scales based on physician's assessment [22]. The questionnaire was adapted according to cross-cultural adaptation guidelines to obtain a reliable and valid version of the questionnaire [7].

We obtained a strong correlation in six out of seven hypotheses, which confirms the high construct validity of the Russian-language version of the studied questionnaire, using the data from the EQ-5D-5L scale for comparison. The choice of the EQ-5D-5L questionnaire was due to the fact that the developers offered a translated version of this scale into Russian in accordance with a standardized protocol that ensures equivalence of the translated version to the original one. In the Arabic version, the SF-12 scale was selected for hypothesis testing, and the correlations ranged from weak to strong [9]. The SF-12 scale was also used in the Turkish adapted version [15]. When testing the hypotheses in the Italian version of the questionnaire, the SF-36 scale was used to assess the correlational relationship between

eight subdomains of the previously mentioned questionnaire. The correlation in the hypotheses ranged from 0.52 to 0.82 [12]. The SF-36 scale was also used by the authors to assess the construct validity of the Dutch [11] and Persian [23] versions of the scale, which showed good results. Researchers who evaluated the construct validity of the Danish version of the AOFAS questionnaire used the SEFAS questionnaire to confirm the hypotheses and obtained more than 75% of confirmed hypotheses [24].

The Cronbach's alpha coefficient for the AOFAS-AHS (0.76) showed good internal consistency comparable to versions translated into other languages [8, 12, 14, 15, 23, 24, 25]. In particular, the Cronbach's alpha coefficient was 0.983 for the Arabic version [9], 0.696 for the Persian version [14], and 0.947 for the Dutch version [11]. It should be separately noted that the Cronbach's alpha in the study of the Danish version of the questionnaire was 0.62 [24]. The authors attributed this relatively low value to the small sample size.

Test-retest reliability indicates the consistency of the questionnaire over a certain interval of time. We chose a seven-day interval because, on the one hand, it was short enough to avoid changes associated with disease progression, but at the same time not too short to recall of

previous responses. The seven-day interval was the most commonly used interval in previous studies of cross-cultural adaptation [24].

The ICC value for the Russified version of the AOFAS-AHS (0.83) was considered to be well reproducible, which also corresponded to the results of previous validation studies ranging from 0.72 to 0.95 [8, 12, 14, 15, 23, 24, 25].

Limitations of the study

Our study had a number of limitations. First, the patients in our study sample do not reflect the entire population of Russia. Given that there is a large number of ethnic groups in our country who speak national languages, our proposed translation would be incomprehensible for them, and a questionnaire completed by such patients would be uninformative for routine data collection. However, since the literacy rate in Russia is 99%, we are confident that the questionnaire will be comprehensible to the vast majority of patients.

The second limitation of this study was the patient selection. We included only patients with severe ankle osteoarthritis who were admitted for surgical treatment. This probably explains the low AOFAS-AHS score in our study.

CONCLUSIONS

The adapted Russian-language version of the AOFAS-AHS scale showed good psychometric properties and can be recommended for assessment of the physical activity in patients with ankle and hindfoot-related pathology and can also be used for monitoring the changes during the treatment.

DISCLAIMERS

Author contribution

Fomichev V.A. — data collection, writing the article.

Sorokin E.P. — data collection, drafting the article.

Konovalchuk N.S. — data collection, statistical analysis of results.

Pashkova E.A. — data collection and processing, drafting the article.

Sereda A.P. — study concept and design, drafting the article.

All authors have read and approved the final version of the manuscript of the article. All authors agree to bear responsibility for all aspects of the study to ensure proper consideration and resolution of all possible issues related to the

correctness and reliability of any part of the work.

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