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The "Ankle Instability Instrument": Cross-cultural adaptation and validation in French

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ABSTRACT

Background: Functional ankle instability affects 20–40% of individuals who have already suffered from a sprain. Such dysfunctions are difficult to diagnose. Therefore, the information provided by self-administered questionnaires is essential. Thus, the Ankle Instability Instrument (AII) was developed and initially validated in English. Our goal is to create a French version of the instrument, named AII-F, by scrupulously respecting the cultural adaptation phases and to make sure the new instrument has good psychometric properties.

Methods: International recommendations have been rigorously followed for the cultural adaptation and the French-translation phase. Six steps are recommended: I) two initial translations from English to French; II) synthesis of the two versions; III) back-translations from French to English; IV) comparisons between the back-translations and the original questionnaire by the expert committee; V) pretest; and VI) approval of the final French version of the AII. In order to validate this French-translation, 91 subjects suffering from ankle instability matched to 91 healthy subjects were asked to complete the AII-F. The Short Form Health Survey (SF-36) was used as a comparative questionnaire as well as the French Cumberland Ankle Instability Tool (CAIT-F). The psychometric properties of the questionnaire were evaluated by determining the test-retest reliability after a 10–14-day interval, the internal consistency, construct validity, and the floor/ceiling effects.

Results: The French-translation did not pose a problem and could be validated by the expert committee. The AII-F showed a very good test-retest reliability for the total score, with an Intra Class Coefficient of 0.983. The internal coherence is high with an alpha coefficient of Cronbach of 0.861. The association of the AII-F with the CAIT-F was high, for the summary of the physical component of the SF-36, meaning a great convergent validity. The other subscales of the SF-36 (mental health) were weakly correlated with the AII-F, reflecting good divergent validity. An optimal cut-off score was obtained to dissociate pathological patients from healthy subjects: when the subject responded to "yes" 5 times or more, he is considered, with a very high degree of confidence, to be pathological.

Conclusion: The AII-F is reliable and valid for evaluating and measuring functional ankle instability.

1. Introduction

In sports medicine, ankle sprains are very frequent, accounting for more than 25% of sport-related injuries [1]. In 80% of cases, it is the external collateral ligament that is affected [2]. A recent meta-analysis states that women tend to present this type of pathology more frequently than men. It also specifies that all sports present their own degree of risk, but the highest risk seems to be with indoor sports [3]. A higher body mass index (BMI) would also represent an increased risk to sprains [4]. Most athletes tend to overlook these sprains, which they consider "minor" incidents. However, the recurrence of this injury is common and can therefore lead to chronic ankle instability. It is characterized by

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residual symptoms such as pain, falls, recurrent injuries, a decline in physical activity [5,6] and often the sensation of instability [7]. Ankle functional instability can both be described as a sensation of "giving way" or instability (due to proprioceptive, postural, neuromuscular deficits [4,8]) but there can also be mechanical instabilities which are the result of various muscular abnormalities (ligament laxity and morphological irregularities) [9]. If this instability is not handled correctly from a clinical point of view, it can lead to end-stage arthritis. With regards to the evaluation of ankle instability, it seems that it is more difficult for clinicians to identify functional instabilities than mechanical instabilities [10]. Indeed, to evaluate functional instabilities, clinical tests must be performed, but these resources are often unavailable or expensive. The use of questionnaires therefore seems to be an efficient tool to evaluate these functional instabilities. Among these questionnaires, besides the Cumberland Ankle Instability Tool (CAIT) [11] which evaluates the severity of instability by giving it a score, few questionnaires are available, let alone translated into French [12]. Another questionnaire, the Ankle Instability Instrument (AII) [13] could be a tool to be considered by the practitioner in the management of ankle instabilities, in order to identify the functional aspects. Originally developed in English, our goal was to translate it, while culturally adapting it, and finally by validating the psychometric properties of the newly French-translated AII.

2. Methods

Two steps were followed through the present paper.

2.1. Translation procedure

The aim of the translation was to provide a precise and culturally adapted French version of the Ankle Instability Instrument (AII) questionnaire. This translation was based on a standardized method, following Beaton's international cross-cultural adaptation recommendations for questionnaires measuring health status: «Guidelines for the Process of Cross-Cultural Adaptation of Self-Report Measures» [14]. This procedure consisted of six steps:

- The initial translation: the English questionnaire was translated into French by two bilingual native French-speaking translators (a linguistic expert, a medical expert).
- The synthesis of the translations: the two translators met to exchange on the possible difficulties encountered during their respective translation. They also discussed the most appropriate language style.
- Retro-translation: The joint translation was sent to two English-speaking translators: a clinical expert and a linguist expert. These native English-speaking translators, retro-translated the joint French version into English. They then met to synthesize their translations into one common retro-translated version.
- The Expert Committee: This was comprised of a medical specialist, a linguist and the four translators. The advantage of such a committee is that it ensures intercultural and optimal equivalence in four areas of the translated questionnaire compared to the original one: Semantic Equivalence, Experimental Equivalence, Idiopathic Equivalence and Conceptual Equivalence. The committee adjusted the synthesis of the French translations into a pre-final version.
- Pre-final version test: The pre-final version was tested on 5 pathological patients and on 5 healthy patients chosen randomly.
- Final approval of the expert committee: the AII-F was closed.

2.2. Validation process

This step was necessary for the translation of the questionnaire and its use to be reliable. To do this, a questionnaire study is conducted.

2.3. Sampling methods

A sample-size calculation was done beforehand in order to estimate the ideal number of subjects to include in the study for it to be representative of the population and to provide sufficient statistical power to our results. The statistical formula is applied: $n = \left[Q_0\left(1 - {}^{\alpha}/_{2}\right)\right]^2 \frac{\pi(1-\pi)}{\Delta^2}$, where $\left[Q_0\left(1 - {}^{\alpha}/_{2}\right)\right]^2$ is equal to 0.96 for a proportion, α is the first species risk (0,05), π is the prevalence of chronic ankle instability established (0,234) and Δ is the precision chosen, namely 0.05. A value of 140 subjects is then obtained. This number represents the minimum number of subjects that should be included in the study.

2.4. Ethics considerations

The subjects who took part in the study were informed of the objectives pursued and gave their oral consent to participate. Calls for volunteers have been made in clinical routine (via rheumatologists, physical medicine and rehabilitation doctors and physiotherapists) as well as via social networks and intranets. After consulting the institution's Ethics Committee, an ethics approval was not required as per applicable institutional and national guidelines and the informed consent of the participants was implied through survey completion. On the other hand, an informational note on the use and processing of data was attached. Data anonymization was not necessary since this did not require the subjects to fill in their name or date of birth. The data have not been communicated to a third party. In accordance with the provisions of the General Data Protection Regulation (UE 2016/679), participants can exercise their rights regarding personal data (access, rectification, erasure, restriction on processing, data portability, consent withdrawal).

2.5. Participants

We recruited two distinct populations. The first was "healthy", with no history of ankle injury. The second presented a sensation of instability/"passing through"/"giving way" of the ankle with at least one prior of a sprain in this joint. In order to have the best homogeneity possible between the two groups, and to avoid bias, we matched pathological and healthy individuals in terms of age and gender. The inclusion criteria were as follows:

- Aged 18 or more,
- Speak French fluently,
- Being willing to participate in the study,
- Being able to consent,
- Be informed of the interests of the study,
- Subjects with no history of trauma or episodes of recurrent instability in the ankle (criteria only for the healthy population),
- Subjects with at least one prior ankle injury and recurrent instability to the ankle (criteria only for the pathological population).

The exclusion criteria exclusion criteria were:

- Subjects who suffered from a sprained ankle less than 3 months prior to the questionnaire. Indeed, it avoids the maximum residual symptoms that may persist after a sprain.

- Subjects with a neurological disease or deformities resulting in poor ankle stability. Subjects with neurological involvement (stroke, spinal cord injury, Parkinson's disease, etc.) may have worse motor control of their ankles and thus a predisposition for sprain. Patients with anklejoint deformities their foot in a position susceptible to induce a sprain.

2.6. The course of the validation study

Firstly, the French version of the questionnaire "Ankle Instability Instrument" (AII-F) was sent to the study participants, who filled it out a first time, by mail, in person. Two other questionnaires were also used: Short Form Health Survey 36 (SF-36) [15] and Cumberland Ankle Instability Tool (CAIT-F) [12].

Two weeks after submitting these questionnaires, we asked the study participants to refill the AII-F to test the psychometric properties of this French version. The duration of the interval between the test period and the retest was established so that the injury "ankle instability" did not evolve positively or negatively. Since this is usually a chronic problem, there is very little risk of changes within two weeks. It is also important that the participants who completed the questionnaire do not remember the answers they wrote on the first handover. An interval of two weeks seemed correct.

Patients with ankle instability completed the questionnaire according to their pathological ankle. If, by chance, both ankles were affected, they were asked to complete the questionnaire for the most affected ankle. As for the healthy patients, they answered the questionnaire according to their dominant ankle.

2.7. Statistical analyses

All statistical analyses were computed using SPSS version 25 (IBM, USA). First, the distribution, normal or otherwise, of the collected variables was verified. They were subjected to the Shapiro–Wilk normality test, the histogram analysis, the QQ plot diagram and the difference between the mean and the median. The mean and standard deviation were then used to present the normally distributed variables while the median and quantiles (percentile 25 and percentile 75) are characteristic of the asymmetric variables. The qualitative variables are presented as an absolute or relative frequency. For group comparison, the Student's T was applied if the variables were normally distributed or by the Mann–Whitney test when variables were skewed. The Chi^2 test was used for qualitative variables. Next, we measured the correlation between 2 quantitative variables using the Pearson (normal distribution) or Spearman (anomalous distribution) coefficients. Finally, these results were classified as "statistically significant" if the p-values were smaller than the significance threshold of 5% ($p < 0.05$).

Then, psychometric performance was evaluated using 6 properties:

1) **The discriminative ability** of the AII-F questionnaire was tested by comparing the scores (total score and individual items scores) among the two groups. Intergroup differences in regards to the clinical characteristics were tested using Student's t-test when comparing two groups.
2) **Test-retest reliability** to test whether the tool being used is stable and reproducible over time. We hypothesize that if no change in health status occurred between the two completions of the questionnaire, the AII-F score should not or hardly change. Thus, as advocated by the international recommendation [16], AII-F was completed a second time, 10–14 days after the first completed questionnaire. As previously stated, this time interval was chosen firstly because chronic instability should not evolve over this period of time, and secondly, this time interval is sufficient for subjects to not remember their previous answers. From the test and the re-test questionnaires, the data analysis yielded an intra-class correlation coefficient (ICC) and its 95% confidence interval (CI) (two-way analysis, absolute agreement). The closer it is to 1, the greater the fidelity. Conventionally [17], it is:
3) Very good if $ICC \geq 0.91$
4) Good if $0.9 \leq ICC \leq 0.71$
5) Moderate if $0.7 \leq ICC \leq 0.51$
6) Poor if $0.5 \leq ICC \leq 0.31$
7) Very bad if $ICC \leq 0.3$
8) **Internal consistency**: The evaluation of this internal consistency was performed using Cronbach's alpha coefficient. The value of alpha varies between 0 and 1, with the internal consistency increasing as alpha approaches 1. A good level of internal consistency is established when the alpha value ranges from 0.70 to 0.95 [18]. We also used correlations (and 95%CI) between the total score and each individual item. To be considered relevant (i.e., strong correlation), the correlation coefficient between each item and the total AII-F score must be greater than 0.6 [19]. However, it must not be too close to 1, otherwise it means that several items correspond to the same idea and are therefore "duplicated" [13].
9) **Construct validity** is a psychometric property that consists of two components: convergent validity and divergent validity. Their measurement is made possible by evaluating the association, using the correlation coefficient, between the AII-F result and subscales of the SF-36. Hypotheses were formulated concerning the two types of validity:
   a. Convergent validity: There is a strong correlation between the score of the CAIT-F questionnaire and subscales of the SF-36 regarding the evaluation of similar concepts (i.e., "physical functioning," "role limitation due to physical problems," "bodily pain," and "general health"). The total AII-F score should be strongly correlated with the CAIT-F [12] score, because both questionnaires assess the same pathology.
   b. Divergent validity: There is a weak correlation between the score of the CAIT-F questionnaire and subscales of the SF-36 regarding the evaluation of different concepts (i.e., "mental health," "role limitation due to emotional problem," "social functioning," and "vitality"). This requirement was considered to be fulfilled when at least 75% of the hypotheses were confirmed.
10) **Floor and ceiling effects**. They are present if more than 15% of the population obtain a maximum score (ceiling effect) or a minimum score (floor effect). When either of these effects are present, subjects with a minimum (or maximum) score cannot be distinguished from each other, decreasing the discriminative power of the questionnaire.
11) **Cut-off limit** for helping diagnosis. A Receiver Operating Characteristic (ROC) analysis was performed to calculate the perfect discriminant score for individuals suffering from the pathology and those not suffering from it. This gives our sample the optimal threshold value that offers us the best sensitivity/specificity ratio [20]. This analysis will allow us to conclude on the diagnostic performance of our questionnaire.

3. Results

3.1. French-translation and cross-cultural adaptation

Following the procedure rigorously, the AII questionnaire was translated into French without any major difficulties. Most of the

time, the experts committee was confronted with a choice of words either more generic or more medical. The pre-final version was tested on 10 subjects: 5 pathological subjects and 5 asymptomatic subjects. They were subsequently integrated into the validation step. They did not reveal any problems in understanding the questionnaire or have any particular difficulties completing the questionnaire. The pre-final version became the definitive final version, the AII-F, validated by all the expert committee (see Supplementary materials).

3.2. Validation step via psychometric properties

3.2.1. General characteristics

The total sample for the validation of the AII-F questionnaire included 182 subjects. 91 pathological individuals were matched for age and gender (a margin of 2 years was tolerated) to 91 healthy people. In each population, the same proportion of men (34%) and women (66%) are respected. The average total age is 26.73 years old. Other clinical characteristics of subjects by group are shown in Table 1.

In this table, it is noted that there is a significant difference in body mass index (and weight) between the two samples (the pathological group being higher). Regarding the scores obtained in AII-F, CAIT-F and the physical component of the SF-36, a significant difference between the two groups was observable, which is in line with our expectations.

3.2.2. Discriminative power

Table 2 shows the p-values obtained when comparing the score for each of the items between the healthy sample and the pathological sample. There is a significant difference in score between the two groups for each item. The AII-F thus has the ability to dissociate pathological subjects from healthy subjects in light of the results of Tables 1 and 2.

3.2.3. Test-retest reliability

Table 3 showed that the total score of the AII-F had a great test-retest reliability, with an ICC of 0.983 (95% CI 0.977–0.987). As for the items taken separately, we note that only the "4a" has moderate reliability. Since all of the other items have an ICC above 0.867, we can say that their reliability is good (item 3, item 4, item 7 and item 9) or very good (item 1, item 2, item 5, item 6, item 8, item 2a and item 3a). This means that the questionnaire is reproducible; if the state of health remained unchanged, the results in the AII-F remained similar in the majority of cases.

3.2.4. Internal consistency

There is a good level of confidence for the internal consistency, as indicated by Cronbach's alpha of the AII-F questionnaire as it rose to 0.861. When deleting one item at a time, reliability remained unchanged (see Table 4). The correlation between the total score of the AII-F questionnaire and each item was also assessed. The results indicated that all individual items were positively and significantly correlated with the AII-F total score, with Spearman coefficient correlations (RS) ranging from 0.67 (for item 4a) to 0.826 (item 2a) (Table 4).

3.2.5. Construct validity

Construct validity was assessed using SF-36 and CAIT-F. The results of these two questionnaires were compared with that of the AII-F. A correlation was made between the AII-F and these two other tools. The physical component summary (PCS) of the SF-36, the subscales evaluating the physical component (FP, RP, BP and GH) of the SF-36, the total score of the CAIT-F as well as all of its components have been used for convergent validity. The divergent validity was analyzed using the mental component (MCS) of the SF-36 and the "mental" sub-scales of the SF-36 (MH, RE, SF and VI). The results obtained are shown in Table 5.

The results obtained in the table above show a strong correlation (>0.6) between the different components of the CAIT-F (and the total score) with the AII-F. Moreover, this correlation is statistically significant. There was also a good correlation between the component and the "physical" subscales of the SF-36 and the AII-F. "GH" is very weakly correlated (<0.3) with AII-F whereas the association between the others (PCS, FP, RP and BP) and AII-F is statistically significant, although moderate ($0.3 < \times < 0.6$).

As expected, the "mental" component and subscales of the SF-36 are all weakly correlated with the AII-F.

3.2.6. Floor and ceiling effects

In the total population, 19.8% scored 0/9 in AII-F. Thus, there is a floor effect as more than 15% of the population obtained a minimum score on the questionnaire. This can be explained by the fact that 36 healthy subjects obtained the minimum score for AII-F. However, there is no ceiling effect as only 6.5% of the population (13% of the pathological sample) had a score of 9/9.

3.2.7. Diagnostic performance: ROC analysis

The ROC analysis allowed us to determine that the threshold value of ≥5 points (=5 "Yes" checked) is the one that offers the best discrimination between individuals with functional instability (score≥5) and unaffected individuals (score≤4). The cut-off score has indeed a very high sensitivity (100%) coupled to a high specificity (100%). This is justified by an area under the curve that equals 1.

Table 1
Overall characteristics of the whole sample and by group.

	Whole sample (n = 182) Median (P25-P5)	Healthy group (n = 91) Median (P25-P5)	Pathological group (n = 91) Median (P25-P5)	P-value*
Gender (%)				
Male	34	34	34	
Female	66	66	66	
Age (years)	23 (21–27)	22 (21–26)	23 (21–28)	0.49
BMI (kg/m^2)	22.1 (20.31–24.66)	21.22 (19.92–23.5)	23.15 (21.34–25.35)	<0.001
AII-F score	4.5 (1–7)	1 (0–2)	7 (6–8)	<0.001
CAIT-F score	23 (14–30)	30 (28–30)	14 (10–20)	<0.001
SF-36 score				
Physical component	56.163 (51.84–60.19)	59.15 (55.88–61.83)	52.92 (47.09–57.46)	<0.001
Mental component	44.55 (34.86–51.33)	45.34 (36.57–52.83)	42.55 (32.14–51.09)	0.46

* Healthy versus pathological using test U of Mann Whitney.

Table 2
Proportion of response to one item per group as well as the value of p-value.

Items	Proportion of total sample	Proportion of healthy subject	Proportion of pathological subject	P-value
Item 1	66,5%	33%	100%	<0,001
Item 2	47%	1%	93%	<0,001
Item 2a				
Nothing	52,7%	98,9%	6,6%	<0,001
Slight	6,6%	1,1%	12,1%	<0,001
Moderate	17,6%	0%	35,2%	<0,001
Severe	23,1%	0%	46,2%	<0,001
Item 3	36,5%	0%	73%	<0,001
Item 3a				
Noting	63,7%	100%	27,5%	<0,001
1–3 days	3,3%	0%	6,6%	<0,001
4–7 days	10,4%	0%	20,9%	<0,001
1–2 weeks	5,5%	0%	11%	<0,001
2–3 weeks	7,1%	0%	14,3%	<0,001
>3 weeks	9,9%	0%	19,8%	<0,001
Item 4	54%	18%	90%	<0,001
Item 4a				
Rien	46,2%	82,4%	9,9%	<0,001
<1 month	19,2%	3,3%	35,2%	<0,001
1–6 months	15,9%	6,6%	25,3%	<0,001
6–12 months	3,8%	1,1%	6,6%	<0,001
1–2 years	3,3%	0%	6,6%	<0,001
>2 years	11,5%	6,6%	16,5%	<0,001
Item 5	33%	2%	64%	<0,001
Item 6	62%	26%	97%	<0,001
Item 7	60%	27%	93%	<0,001
Item 8	20%	1%	38%	<0,001
Item 9	31%	1%	62%	<0,001

4. Discussion

The translation of the AII questionnaire into French, a language spoken by 300 million people, was carried out rigorously, and according to a strict procedure, following the international recommendations. The psychometric performances of the new questionnaire, the AII-F were therefore tested on a sample of 182 subjects. Our sample is predominantly female, which is consistent with other studies [21,22] When discussing topics on age and gender, we avoid selection bias. However, we found that people with a higher body mass index would be more at risk of developing an ankle sprain, which is confirmed by some studies [5,21].

With regard to the psychometric properties as such, we can already claim a good discriminative capacity of our AII-F. The pathological group scored significantly higher on the AII-F than the healthy group. Then, the AII-F was filled out twice 10–14 days apart by the pathological group and the healthy group. Thus, an ICC of the total AII-F score of 0.983 was obtained. This value indicates a very good test-retest reliability of the AII-F. At unchanged health status, the AII-F score also remains unchanged. Moreover, this result is close to that obtained in the Persian version (0.93) [23] and in the original validation article AII (0,95) [13]. Internal consistency was evaluated and had an alpha of 0.861, indicating good internal consistency. Since the value is not too close to 1, we can conclude that the items are not too redundant and therefore do not have a "double-use" effect. This analysis is consistent with that made in the Persian version (0,87) [23] and in the initial version where the Cronbach's alpha coefficient is 0.89 [13]. Regarding the convergent and divergent validity, we can conclude that 75% of the observations made confirm our initial hypotheses. The construct validity of the AII-F questionnaire is thus positive. A good level of reliability can therefore be granted to translation (AII-F) compared to other generic and specific questionnaires that already exist.

Of the 91 pathological individuals, only 12 had a total score of 9/9, which equates to 13% of this sample. There is no ceiling effect. On the other hand, of the 91 healthy subjects, 36, or 19.8% of the total population (39.13% of the corresponding group), had the minimum score of 0/9. There is a floor effect. This one testifies to a correct recruitment of the healthy population. These effects were not analyzed in the original English version and in the Persian version no floor and ceiling effects were visible. The ROC analysis validated the 5 "Yes" threshold to determine the presence of ankle instability, in our sample testing the questionnaire in French Other studies that have used AII for their experimentation have already pointed out that with a score greater than or equal to 5, they consider patients to be pathological [24,25]. For a diagnostic purpose, this threshold value is therefore quite relevant.

Our study also has other strengths. The different stages of translation and validation of the AII-F have been carried out in strict compliance with international recommendations. A French version (AII-F) was thus obtained. No version of the AII had been translated into French to date. It seems that the proportion of French-speaking people at an international level or in Belgium is large enough to justify a French translation of the AII [26]. Knowing that chronic instability represents between 20% and 40% of

Table 3
Test-retest reliability for the whole sample.

Items	ICC	95% CI
Item 1	0,914	0,887–0,935
Item 2	1	–
Item 2a	0,98	0,973–0,985
Item 3	0,906	0,876–0,929
Item 3a	0,917	0,891–0,931
Item 4	0,867	0,825–0,9
Item 4a	0,696	0,612–0,763
Item 5	0,914	0,886–0,935
Item 6	0,919	0,893–0,939
Item 7	0,896	0,863–0,921
Item 8	0,911	0,883–0,933
Item 9	0,887	0,852–0,915
Total Score AII-F	0,983	0,977–0,987

Table 4
Cronbach alpha coefficient in case of item deletion and Spearman correlation coefficient between each item and the total score, for the entire sample.

Items	Coefficient alpha de Cronbach in case of suppression of this item	Spearman coefficient correlation (Rs) with the total score of the AII-F
Item 1	0.851	0.751**
Item 2	0.842	0.832**
Item 2a	0.824	0.826**
Item 3	0.845	0.732**
Item 3a	0.856	0.726**
Item 4	0.845	0.777**
Item 4a	0.877	0.670**
Item 5	0.854	0.707**
Item 6	0.848	0.801**
Item 7	0.849	0.767**
Item 8	0.858	0.618**
Item 9	0.853	0.712**

** P-value < 0.001.

Table 5
Convergent or divergent validity.

Convergent validity	Spearman correlation	P-value
PCS SF-36	0,482	<0,001
FP SF-36	0,468	<0,001
RP SF-36	0,421	<0,001
BP SF-36	0,517	<0,001
GH-SF-36	0,289	<0,001
CAIT-F	0,875	<0,001
CAIT-F (1)	0,666	<0,001
CAIT-F (2)	0,787	<0,001
CAIT-F (3)	0,775	<0,001
CAIT-F (4)	0,674	<0,001
CAIT-F (5)	0,708	<0,001
CAIT-F (6)	0,743	<0,001
CAIT-F (7)	0,711	<0,001
CAIT-F (8)	0,723	<0,001
CAIT-F (9)	0,689	<0,001
Divergent validity	**Spearman correlation**	**P-value**
MCS SF-36	0,088	0,236
MH SF-36	0,207	0,005
RE SF-36	0,136	0,68
SF SF-36	0,241	0,001
VI SF-36	0,760	0,310

subjects who have had a sprained ankle, we could thus spread the use of a new evaluation tool of functional instability in the Belgian Francophone population. Our statistical analyses, which have been confronted with those observed in the initial validation article of the AII [13] and the Persian version [23] were strongly similar. This demonstrates the good validity and reliability of the AII-F. In addition, the use of the AII has been endorsed by the International Ankle Consortium [27].

For the sample of individuals, each group was matched in age and gender to ensure homogeneity of the population. All individuals were volunteers and were recruited through health professionals in clinical settings or via social networks or intranets platforms. They come from different social backgrounds. Thus, there was no selection bias for these characteristics. 182 people were finally included in the study. This number, higher than that obtained in the initial version, is largely sufficient for a questionnaire validation study (i.e., at least 100 individuals) and ensures optimal statistical power (according to our calculations a priori, according to the pathology). Finally, the AII-F consists of 9 questions. The estimated time required to complete it is 2–10 min maximum. The rapidity to complete this questionnaire and its ease of use are therefore worthwhile for the practitioner using the questionnaire for a diagnosis.

However, our study has a number of limitations that must be kept in mind. The individuals who took part in the study were informed of the objectives. Therefore, they may have been influenced in their responses: pathological patients aiming for a high score; healthy patients, a lower score. An information bias could also be present in the AII-F. Indeed, this tool requires remembering events that are quite old and that the patient might not remember anymore. However, this recall bias is minimized by the clarity and accuracy of the questions asked. It also seems necessary to point out that we have opted for a convenience sampling method, given our limited resources. In fact, the participants in the study were selected based on their availability and proximity. One can therefore question the generalization of the results. Nevertheless, the representativeness of our sample can be given considerable confidence: the inclusion and non-inclusion criteria were very precise, the sample of healthy subjects was matched to the pathological sample and good statistical power was obtained. Finally, sensitivity to change has not been measured. This criterion assesses the ability of the questionnaire to identify clinical changes over time. Thus, it allows the evaluator to become aware of changes (improvement or deterioration) regarding functional instability during/after rehabilitation or treatment, and to see if these changes are clinically important. This could be an important point for future work.

5. Conclusion

Given its adequate psychometric performance, the AII-F can be considered to be discriminant, reliable and valid for the evaluation of the presence or not of ankle instability. Nowadays, this questionnaire can be relevantly used for patients in the French-speaking community.

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Conflict of interest

None - All the authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.fas.2020.02.006.

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