

Cross Cultural Adaptation and Multi Centric Validation of The Italian Version of The Tegner Activity Scale

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SUMMARY

Background. This study aims to adapt the Tegner Activity Scale (TAS) to Italian language and establish its reliability and validity in patients after anterior cruciate ligament reconstruction.

It was hypothesized the Italian version of the TAS have acceptable psychometric properties for use with the Italian population.

Methods. This is an observational multicenter study. The Tegner Activity Scale was translated and culturally adapted according to the Beaton guidelines. A web-based survey was conducted to evaluate the construct validity: 62 patients were included in the study. Spearman's rank correlation coefficient (r) between the TAS and the Short Form 36 (SF-36) subscales and the International Knee Documentation Committee (IKDC) was used to evaluate construct validity. The patients completed the TAS again one week after their first submission, and the intraclass correlation coefficient was used to calculate the test-retest reliability.

Results. The correlation coefficient showed moderate correlation with the SF-36 Physical Function domain ($r = 0.41$; $p = 0.001$) and weak correlation with the IKDC ($r = 0.3$; $p = 0.02$). Correlations with the other SF-36 subscales were very weak and not statistically significant. Test-retest reliability (0.68, 95%CI 0.43-0.83) ranged from good to excellent.

Conclusions. The Italian version of the Tegner Activity Scale is a valid instrument to assess a patient's level of sporting activity after anterior cruciate ligament reconstruction. Cultural adaptation of this scale is fundamental to make this instrument comparable throughout scientific literature.

KEY WORDS

Anterior cruciate ligament reconstruction; ACL injury; functional score; knee function; rehabilitation; reliability; return to sport; patient-centered care; PROMs.

INTRODUCTION

The Tegner Activity Scale (TAS) was developed by Tegner in 1985 (1). Thanks to its simplicity, it is one of the most used scales for scoring activity levels after knee surgery, especially anterior cruciate ligament reconstruction (ACL-R) (2-4). The TAS validity has been proven by its strong correlation with other Patient-Reported Outcome Measures (PROMs) like Lysholm scale (5, 6), International Knee Documentation Committee (IKDC) (6, 7), Physical Activity Scale (8), and Marx Activity Rating Scale (9).

Good test-retest reliability for the TAS was found not only in patients who had been treated for ACL-R (ICC of 0.82) (10) but also for meniscal injuries (ICC of 0.82) (11), and acute patellar dislocation (ICC of 0.92) with no ceiling and floor effects being reported (6).

Despite its widespread use in scientific literature, an Italian version of the TAS is not available. Cultural adaptation of this scale is fundamental to make this instrument comparable throughout scientific literature and especially useful for Italian clinicians who have to decide between surgery and conservative treatment, particularly with recreational athletes.

Countries have different sports traditions, and the same sport can reach different levels of media attention, competition, and diffusion. So, the TAS, by not mentioning certain sports that could be very common in a country, should be adapted to include them in the related questionnaire.

The TAS has already been translated in Chinese (12), Dutch (10), German (13), Persian (14), although to our best knowledge, an Italian version has never been validated.

The aim of this study was to translate and cross-culturally adapt the TAS for use with an Italian population and to evaluate its reliability and validity in individuals after ACL-R. The hypothesis of the present study was that the Italian version of the TAS would have acceptable psychometric properties for use with the Italian population.

MATERIALS AND METHODS

Translation procedure

Permission to translate and validate the questionnaire was achieved by the original author before starting the study.

The procedure of cross-cultural adaptation followed the international guidelines published by Beaton (15) for a self-administered questionnaire.

The research group was composed of 5 physical therapists and 5 orthopedic surgeons.

Two independent individuals unrelated to the research group translated the questionnaire from English to Italian and then synthesized them into a first draft of the scale.

Two independent English native speaker professional translators, who were not familiar with the questionnaire at that moment, translated the draft back into English.

Inconsistencies between the original English version and the backward translations were resolved in the second draft of the questionnaire.

The final Italian version, the I-TAS (**table I**) was pre-tested on 16 patients, who had been treated with ACL reconstruction: each participant was asked to give feedback to the corresponding author about the comprehensibility and acceptability of the questionnaires.

Patients

Between April 2019 and April 2020, 157 patients were invited to participate in this study. Inclusion criteria were patients aged between 16 and 65, who underwent ACL-R at least one year before the moment they answered the questionnaire. Patients were recruited from 9 Italian orthopedic or rehabilitation centers where they underwent surgery or rehabilitation. Subjects were contacted by phone to present the research to them and explain all the information needed. All of them gave their informed consent to participate. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration. According to Italian law, ethical approval for this study was not required because it involved only routine clinical follow-up.

Patients were sent an e-mail with the I-TAS and 2 complementary questionnaires used for reference: the validated Italian version of the IKDC (16), and Short Form 36-Item Health Survey (SF-36) (17). Participants were invited to fill in the 3 questionnaires online. One week after receiving the first assessment, the corresponding author sent a second e-mail with the I-TAS only, for reliability analysis.

At the beginning of the second e-mail, patients were asked if their status had changed since the first assessment: possible answers were “Yes, it’s better”, “Yes, it’s worse” and “No”. This question was necessary to ensure that only patients with no change in their knee functions within the time interval considered were included in the test-retest analysis. Patients returning the second e-mail after more than 2 months were also excluded for the test-retest analysis.

Instruments

The TAS is a 1-item instrument that evaluates sport levels and occupational activities (1). It ranges from 0 to 10 where 0 stands for sick leave or disability pension and 10 represents the highest level of competition.

The IKDC is a valid tool to assess knee function: it has already been translated and cross-culturally adapted to Italian speaking-countries, showing good validity and reliability (16).

Table I. I-TAS: the Italian version of the Tegner Activity Scale.

Per favore indichi il livello d'attività massimo che riesce a praticare attualmente		
Punteggio	Intensità	Sport
10	Sport Agonistici	Calcio (categorie nazionale e internazionale) Rugby (categorie nazionale e internazionale)
9	Sport Agonistici	Calcio (categorie minori) Rugby (categorie minori) Sport di combattimento Ginnastica
8	Sport Agonistici	Pallavolo Calcio a 5 Atletica (corsa ostacoli, siepi, salto in lungo, salto in alto) Sci da discesa
7	Sport Agonistici	Tennis Atletica (corsa su pista e su strada) Corsa campestre* Motocross, motociclismo Pallamano Pallacanestro
	Sport Amatoriali	Calcio Pallavolo Calcio a 5 Atletica (corsa ostacoli, siepi, salto in lungo, salto in alto) Corsa campestre*
6	Sport Amatoriali	Tennis e Volano Pallamano Pallacanestro Sci da discesa Jogging, almeno 5 volte alla settimana
5	Sport Agonistici	Ciclismo Sci di fondo
	Sport Amatoriali	Jogging su terreno irregolare almeno 2 volte a settimana
	Attività lavorativa	Lavori pesanti (es. muratore, boscaiolo)
4	Sport Amatoriali	Ciclismo Sci di fondo Jogging su terreno regolare almeno 2 volte a settimana
3	Attività lavorativa	Lavori moderatamente pesanti (es. camionista, lavori domestici pesanti)
	Sport Agonistici e Amatoriali	Nuoto
	Attività lavorativa	Lavori leggeri (infermiere)
2	Attività ricreativa	Camminata nel bosco
	Attività lavorativa	Lavori leggeri (commessa, insegnante)
	Attività ricreativa	Camminata su terreno irregolare (sterrato)
1	Attività lavorativa	Lavoro sedentario (segretaria)
	Attività ricreativa	Camminata su terreno regolare
0	Congedo per malattia lavorativa o pensione di invalidità a causa dei problemi al ginocchio	

*Corsa campestre is considered both in agonistic and non agonistic group.

It consists of 3 domains: symptoms, sports and daily activities and current knee functional status. Items required different answers (one yes or no question, Likert scales) and have different weights: the final score is expressed as a percentage. The SF-36 consists of 36 questions on the general health status of patients: it's a worldwide instrument and the Italian version has already been validated (17).

It consists of 8 health domains: physical function (PF), role physical (RP), bodily pain (BP), general health (GH), vitality (VT), social function (SF), role emotional (RE), and mental health (MH) whose score can vary from 0 (lowest health status) to 100 (highest health status) and are then aggregated and weighted into a two summary score *i.e.* the physical and the mental component.

Statistical analysis

Descriptive statistics were used to report patients' demographics in the form of means, standard deviation (SD) and range. The Kolmogorov–Smirnov test was used to assess the assumption of normality. Conventionally, at least 50 patients are the minimum sample size required to compare properties as validity in PROMs (18).

A P-value of less than 0.05 was considered statistically significant.

ICC was calculated for test-retest reliability (2-way random-effects model, single measurements and absolute agreement): reproducibility was considered to be “excellent” ($r > 0.75$), “good” ($0.75 < r < 0.40$), or “poor” ($r < 0.40$) (19). The 95% confidence interval (CI) for the ICC, was also calculated.

Construct validity was assessed by calculation of the association between the I-TAS and the Italian versions of the IKDC and different SF-36 subscales. Scale scores were treated as ordinal variables, thus Spearman's rank correlation coefficient was used. Levels of correlation were defined as follows: 0.00 to 0.19 – very weak; 0.20 to 0.39 – weak; 0.40 to 0.59 – moderate; 0.60 to 0.79 – strong; 0.80 to 1.00 – very strong (20). It was hypothesized a priori that:

1. according to literature, the correlation between the I-TAS and the Italian IKDC was > 0.40 (10, 12);
2. the correlation between I-TAS and Physical functioning subscale of the SF-36 was > 0.40 (10);
3. the correlations between the I-TAS and the SF-36 subscale of Physical Functioning, and I-TAS and IKDC were higher than those between the I-TAS and the other SF-36 subscales RP, BP, GH, VT, SF, RE, MH.

Construct validity of the I-TAS questionnaire was defined as good if $\geq 75\%$ of the hypotheses were confirmed (21).

All data was analyzed using IBM SPSS Statistics software.

RESULTS

Translation process

During the translation process, hockey was substituted with rugby and wrestling was substituted with combat sport at question 9. Volleyball substituted bandy and futsal substituted squash at question 8.

Patient characteristics

Of the 157 patients available, 33 were not able to participate due to the impossibility of being contacted. Of the remaining 124 patients:

- 4 did not send all the completed questionnaires.
- 58 did not answer.
- 62 patients completed the questionnaires.

Demographic cohort data is listed in **table II**.

Of the 62 completed questionnaires, 31 patients returned a valid I-TAS for re-test.

Absolute values of all scales are listed in **table III**.

Correlations between the I-TAS and the other scales are listed in **table IV**. Spearman's rank correlation between the I-TAS and Physical Function subscale was moderate (0.41; $p < 0.05$). A weak significant correlation was found between I-TAS and IKDC (0.3; $p = 0.03$). The ICC correlation was good 0.68 (95%CI 0.43-0.83).

Table II. Patient demographics.

Variables	Validation	Reliability
Patients	62	31
Gender M	50	27
Mean Age (years) \pm SD	33 \pm 11	30 \pm 1
Range	17-57	17-53
Mean Follow-up \pm SD	2 \pm 1.3 years	18 \pm 12 days
Range	1-7 years	7 -52 days
Time Injury to LCA-R (months)	17 \pm 38	13 \pm 25
Range (months)	0-232.57	2.11-129.46

SD: standard deviation.

Table III. Absolute values of all scores.

Scale	Mean (SD)	Maximum score
IKDC	80 ± 15	100
SF-36 Physical Function	94 ± 9	100
SF-36 Bodily Pain	88 ± 16	100
SF-36 Vitality	71 ± 17	100
SF-36 Role Emotional	87 ± 30	100
SF-36 Role Physical	92 ± 23	100
SF-36 Social Function	86 ± 15	100
SF-36 Mental Health	79 ± 14	100
SF-36 General Health	59 ± 13	100

SD: standard deviation; IKDC: International Knee Documentation Committee; SF-36 Medical Outcome Study Short-Form 36 Health Survey.

Table IV. Validity as measured by correlation between the I-TAS and the IKDC and different SF-36 subscales.

Scale	Correlation with TAS	P-value
IKDC	0.3	0.02
SF-36 Physical Function	0.41	0.001
SF-36 Bodily Pain	0.25	0.05
SF-36 Vitality	0.08	0.55
SF-36 Role Emotional	-0.03	0.85
SF-36 Role Physical	0.06	0.64
SF-36 Social Function	0.001	0.99
SF-36 Mental Health	0.04	0.78
SF-36 General Health	0.02	0.87

SD: standard deviation; IKDC: International Knee Documentation Committee; SF-36 Medical Outcome Study Short-Form 36 Health Survey.

DISCUSSION

The most important finding of the present study was that the Italian version of the TAS was valid and reliable, and can be used in the Italian population to evaluate the level of sports condition after ACL-R.

The translation and adaptation of the TAS for an Italian context required some modifications because some sports on the original scale are not common in Italy.

The construct validity of the questionnaire was determined by comparing the I-TAS with selected outcome measures (the subscales of the SF-36 and the IKDC) which were already validated in Italian. A significant but low correlation was found between I-TAS and IKDC, meaning all the other hypothesis were confirmed. Despite the low correlation, the Bodily Pain subscale, which is part of the physical component of the SF-36, was also close to a statistically significant ($p = 0.05$) correlation with I-TAS even if Role Physical was not.

Spearman's rank correlation coefficient of 0.41 between the I-TAS and the Physical Functioning domain of the SF-36 in our study was similar to that of Eshuis *et al.* (10) and other types of research using different patient-Reported Outcome Measures (PROMs):

- range from 0.24 (6) to 0.35 (5) for the Lysholm scale;
- range from 0.22 (7) to 0.54 (6) for the International Knee Documentation Committee (IKDC);
- 0.4 for the Physical Activity Scale (8);
- 0.66 for the Marx Activity Rating Scale (9).

The correlation between I-TAS and IKDC in our study was lower than other research projects (10, 12) but similar to the investigation by Briggs *et al.* (7).

The test-retest reliability of 0.68 (95%CI 0.43-0.83) indicated good to excellent reliability: the estimate precision seems lower than other studies (7, 10-12) and this is probably due to the fact the ICC calculation has been affected by the presence of outliers considering the small sample size of the reliability study.

The strength of this study is that the current sample is highly representative of the general Italian population as subjects have been recruited from centers from all over the country. The clinical relevance of this study is that the proposed Italian version of the TAS is reliable and valid when compared to the English version. The use of the cross-culturally adapted Italian TAS may be considered as a means of evaluating clinical condition after LCA-R in clinical practice and research in the Italian population.

CONCLUSIONS

The Italian version of the Tegner Activity Scale proved to be equivalent to the original version in terms of its evaluative capacity, making it a valid instrument in the assessment of the level of sports activity among patients after knee surgery.

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None.

DATA AVAILABILITY

Data are available under reasonable request to the corresponding author.

REFERENCES

1. Tegner Y, Lysholm J. Rating systems in the evaluation of knee ligament injuries. *Clin Orthop Relat Res.* 1985;(198):43-9. Available at: <https://pubmed.ncbi.nlm.nih.gov/4028566/>.
2. Ibrahim SA, Al-Kussary IM, Al-Misfer AR, Al-Mutairi HQ, Ghafar SA, El Noor TA. Clinical evaluation of arthroscopically assisted anterior cruciate ligament reconstruction: patellar tendon versus gracilis and semitendinosus autograft. *Arthroscopy.* 2005;21(4):412-7. doi: 10.1016/j.arthro.2004.12.002.
3. Jerre R, Ejerhed L, Wallmon A, Kartus J, Brandsson S, Karlsson J. Functional outcome of anterior cruciate ligament reconstruction in recreational and competitive athletes. *Scand J Med Sci Sports.* 2001;11(6):342-6. doi: 10.1034/j.1600-0838.2001.110605.x.
4. Lee DY, Karim SA, Chang HC. Return to sports after anterior cruciate ligament reconstruction - a review of patients with minimum 5-year follow-up. *Ann Acad Med Singap.* 2008;37(4):273-8. Available at: <http://www.annals.edu.sg/pdf/37VolNo4Apr2008/V37N4p273.pdf>.
5. Kocher MS, Steadman JR, Briggs KK, Sterett WI, Hawkins RJ. Reliability, validity, and responsiveness of the Lysholm knee scale for various chondral disorders of the knee. *J Bone Joint Surg Am.* 2004;86(6):1139-45. doi: 10.2106/00004623-200406000-00004.
6. Paxton EW, Fithian DC, Stone ML, Silva P. The reliability and validity of knee-specific and general health instruments in assessing acute patellar dislocation outcomes. *Am J Sports Med.* 2003;31(4):487-92. doi: 10.1177/03635465030310040201.
7. Briggs KK, Kocher MS, Rodkey WG, Steadman JR. Reliability, validity, and responsiveness of the Lysholm knee score and Tegner activity scale for patients with meniscal injury of the knee. *J Bone Joint Surg Am.* 2006;88(4):698-705. doi: 10.2106/JBJS.E.00339.
8. Thomeé P, Währborg P, Börjesson M, Thomeé R, Eriksson BI, Karlsson J. Self-efficacy, symptoms and physical activity in patients with an anterior cruciate ligament injury: a prospective study. *Scand J Med Sci Sports.* 2007;17(3):238-45. doi: 10.1111/j.1600-0838.2006.00557.x.
9. Marx RG, Stump TJ, Jones EC, Wickiewicz TL, Warren RF. Development and evaluation of an activity rating scale for disorders of the knee. *Am J Sports Med.* 2001;29(2):213-8. doi: 10.1177/03635465010290021601.
10. Eshuis R, Lentjes GW, Tegner Y, Wolterbeek N, Veen MR. Dutch Translation and Cross-cultural Adaptation of the Lysholm Score and Tegner Activity Scale for Patients With Anterior Cruciate Ligament Injuries. *J Orthop Sports Phys Ther.* 2016;46(11):976-83. doi: 10.2519/jospt.2016.6566.

CONTRIBUTIONS

NR: conceptualization, drafting, statistical analysis performing. VA, RA: conceptualization, patients contact, drafting. PG: design. PA, VE: statistical analysis revision, tables creations. FM, RA, GS, BF: patients data gathering, drafting, critical revision. All the authors gave their formal approval to the final draft before submission.

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CONFLICT OF INTERESTS

The authors declare that they have not conflict of interests.

11. Briggs KK, Lysholm J, Tegner Y, Rodkey WG, Kocher MS, Steadman JR. The reliability, validity, and responsiveness of the Lysholm score and Tegner activity scale for anterior cruciate ligament injuries of the knee: 25 years later. *Am J Sports Med.* 2009;37(5):890-7. doi: 10.1177/0363546508330143.
12. Huang H, Zhang D, Jiang Y, et al. Translation, Validation and Cross-Cultural Adaptation of a Simplified-Chinese Version of the Tegner Activity Score in Chinese Patients with Anterior Cruciate Ligament Injury. *PLoS One.* 2016;11(5):e0155463. doi: 10.1371/journal.pone.0155463.
13. Swanenburg J, Koch PP, Meier N, Wirth B. Function and activity in patients with knee arthroplasty: validity and reliability of a German version of the Lysholm Score and the Tegner Activity Scale. *Swiss Med Wkly.* 2014;144:w13976. doi: 10.4414/smw.2014.13976.
14. Negahban H, Mostafae N, Sohani SM, et al. A. Reliability and validity of the Tegner and Marx activity rating scales in Iranian patients with anterior cruciate ligament injury. *Disabil Rehabil.* 2011;33(23-24):2305-10. doi: 10.3109/09638288.2011.570409.
15. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine (Phila Pa 1976).* 2000;25(24):3186-91. doi: 10.1097/00007632-200012150-00014.
16. Padua R, Bondi R, Ceccarelli E, et al. Italian version of the International Knee Documentation Committee Subjective Knee Form: cross-cultural adaptation and validation. *Arthroscopy.* 2004;20(8):819-23. doi: 10.1016/j.arthro.2004.06.011.
17. Apolone G, Mosconi P. The Italian SF-36 Health Survey: translation, validation and norming. *J Clin Epidemiol.* 1998;51(11):1025-36. doi: 10.1016/s0895-4356(98)00094-8.
18. Kearney RS, Achten J, Lamb SE, Parsons N, Costa ML. The Achilles tendon total rupture score: a study of responsiveness, internal consistency and convergent validity on patients with acute Achilles tendon ruptures. *Health Qual Life Outcomes.* 2012;10:24. doi: 10.1186/1477-7525-10-24.
19. Fleiss JL, ShROUT PE. The effects of measurement errors on some multivariate procedures. *Am J Public Health.* 1977;67(12):1188-91. doi: 10.2105/ajph.67.12.1188.
20. Mukaka MM. Statistics corner: A guide to appropriate use of correlation coefficient in medical research. *Malawi Med J.* 2012;24(3):69-71. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC23638278/>.
21. Terwee CB, Bot SD, de Boer MR, et al. Quality criteria were proposed for measurement properties of health status questionnaires. *J Clin Epidemiol.* 2007;60(1):34-42. doi: 10.1016/j.jclinepi.2006.03.012.