Translation, Adaptation and Psychometric Properties of the Arabic Version of The Numerical Rating Scale when Used with Children and Adolescents

J. Finianos, MSci,[1,2,3] E. Sánchez-Rodríguez, PhD[1,2,3] P.J. Ferrando, PhD,[1] J. Miró, PhD[1,2,3]

[1] Universitat Rovira i Virgili, Research Center for Behavior Assessment (CRAMC), Department of Psychology, Catalonia, Spain.

[2] Institut d'Investigació Sanitària Pere Virgili; Universitat Rovira i Virgili, Catalonia, Spain

[3] Unit for the Study and Treatment of Pain – ALGOS, Chair in Pediatric Pain

Corresponding author: Jordi Miró; e-mail: jordi.miro@urv.cat. Address**:** Departament de Psicologia, Universitat Rovira i Virgili; Carretera de Valls s/n; 43007 Tarragona; Spain. Telephone: (+34) 977 55 81 79; Fax: (+34) 977 55 80 88

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ORCID IDENTIFIERS
JF: 0000-0002-3634-1929
ES-R: 0000-0001-8377-1799
PJF: 0000-0002-3133-5466
JM: 0000-0002-1998-6653

Abstract

Objective: The 0-10 Numerical Rating Scale (NRS-11) is widely used with Arabic-speaking pediatric populations. However, there is no data about its validity or reliability. Thus, the aims of this research were to translate the NRS-11 into Arabic and study its dimensionality and construct (convergent and discriminant) validity, and reliability. ***Methods:*** A group of 190 Lebanese students between 8-18 years old participated. Participants were interviewed online and asked to imagine themselves in a hypothetical painful situation and rate the expected pain intensity using the NRS-11-Arabic and an Arabic version of the Visual Analogue Scale (VAS-Arabic). They were also requested to respond to the pediatric Arabic version of the Pain Catastrophizing Scale (PCS-Arabic). Data collection lasted for a month. ***Results***: Data showed that the NRS-11-Arabic and the VAS-Arabic scores measure the same common construct. In addition, they showed strong statistically significant correlations between NRS-11 and VAS (ranging from 0.83 for the whole sample and 0.83 and 0.84 for the 8–12-year-olds and the 13–18-year-olds, which support its construct validity). These correlations were higher than those between the NRS-11-Arabic and the PCS-Arabic, which support the discriminant validity of NRS-11-Arabic scores. Test-retest reliability was 0.86 for the whole sample, and 0.89 and 0.82 for the 8–12-year-olds and the 13–18-year-olds, respectively, which shows the reliability of the NRS-11-Arabic scores. ***Conclusions***: The data provide preliminary evidence of the unidimensionality, validity and reliability of the NRS-11-Arabic scores, thus supporting its use in clinical and research activities involving Arabic-speaking pediatric samples.

Keywords: Pain assessment; Pain intensity; NRS-11; Young People; Translation; Arabic; Validity; Reliability

Introduction

Chronic pain (i.e., a pain condition that recurs or persists for more than three months) [1] is a significant problem among children and adolescents with prevalence rates ranging between 11 and 38% [2].

Chronic pain in children and adolescents is undertreated [3,4], and this is particularly the case in low-income countries [5,6]. In order to improve the management of chronic pain in young people, it is important to have psychometrically sound measurement instruments.

Although it is not the only factor involved, pain intensity is commonly used as the main domain in the study and treatment of chronic pain [7]. There are several self-report pain intensity questionnaires for assessing pain in children and adolescents [8], each with its own strengths and weaknesses. The 0-10 Numerical Rating Scale (NRS-11) is one of the most used pain intensity questionnaires with young people (as it has proved to provide valid and reliable pain intensity scores in studies with samples suffering from different conditions and with different languages) [9].

The NRS-11 is used with Arabic-speaking pediatric pain samples [10], although to date no studies have been made on the psychometric properties of the NRS-11 reports when used in Arabic-speaking children and adolescents. Although it is very simple and easy to use, it should not be assumed that the results found in Arabic-speaking samples of children and adolescents are the same as those found in studies with samples of young people from different cultures with other languages, or as those found in studies with Arabic-speaking adults. The psychometric properties of translated instruments should always be evaluated and tested [11]. Thus, research needs to be done on the psychometric properties of the NRS-11 when used with the Arab pediatric population. If the scores are found to be valid and reliable, then it could be used to help tens of millions of young people who speak the

language worldwide (there are 466 million people who speak Arabic in the world) [12], particularly those who only speak Arabic despite living in countries with other languages. For example, in 2019, 6,370,000 Arab-speaking individuals were reported to be living in Europe and 2.1 million individuals of Arabian ancestry in the United States of America [13]. It would also help children who have Arabic as their first language and live in Arab countries, and the most vulnerable individuals among them, such as refugee children. For example, 42% of the people displaced in 2020 are children below 18 years of age [14] and more than 30% of the global refugee population are Arabs [15].

Therefore, the purpose of this study was to evaluate some of the psychometric properties of the Arabic version of the 0-10 Numerical Rating Scale (NRS-11-Arabic) when used to assess pain intensity in children and adolescents. Specifically, we wanted to examine (1) the dimensionality and construct (convergent and discriminant) validity, and (2) the reliability of the NRS-11-Arabic scores.

Materials and methods

Participants

The sample size needed in the analyses was calculated using G*Power version 3.1.9.6. Assuming a medium effect size (r= 0.3), an alpha of 0.05 and a power of 0.8, the study needed a minimum of 82 participants.

In order to avoid potential problems due to attrition, we invited a sample of 190 children and adolescents. They were recruited after distributing flyers in a school in Zgharta (Lebanon). To participate, students had to be aged between 8 and 18 years old, and be able to read, write, and speak Arabic. Potential participants were excluded if they had cognitive disabilities that interfered with participation, did not give their assent to participate or did not provide an informed consent form signed by their parents.

Measures

Sociodemographic Information. Participants were asked to provide information about their gender, age, and school grade.

Pain. Participants were asked to report their pain intensity using the Arabic versions of the 0-10 Numerical Rating Scale (NRS-11-Arabic) and the Visual Analog Scale (VAS-Arabic), as described in the Procedure section. The NRS-11 asks respondents to rate their pain intensity with a number, between 0 and 10, where 0 means "No pain" and 10 "Very much pain". Pain intensity reports provided with this scale have been found to be valid in children as young as 6 years old [9,16–18]. The VAS consists of a 10-cm line, with anchors at both ends representing "No pain" (the left anchor) and "Very much pain" (the right anchor). With the VAS, responders are requested to mark their pain intensity on the line. Pain intensity is computed as the distance between the "No pain" anchor and the mark made by the responder. Research has also shown that pain intensity reports reported with the VAS provide valid information when used with children and adolescents [19–22].

Pain catastrophizing. We used an Arabic translation of the Pain Catastrophizing Scale-Child (PCS-C) [23] to measure catastrophic thinking about pain. The PCS-C is a 13-item questionnaire which requires respondents to indicate the extent to which they have catastrophic beliefs when in pain on a scale from 0 ("not at all") to 4 ("extremely"). Scores range from 0 to 52, and the higher the score the more the respondent catastrophizes about pain. The PCS-C assesses three pain catastrophizing domains: Rumination (e.g., "I cannot keep it out of my mind"), Magnification (e.g., "I am afraid that pain will get worse"), and Helplessness (e.g., "There is nothing I can do to reduce pain"). The PCS-C scores have been shown to have sound psychometric properties in different languages and in different samples of children and adolescents [24–26]. In this study, we used only the total score of

the questionnaire, not the information from the subscales. The reliability estimate of the scores of the Arabic version of the PCS-C was assessed using Cronbach's alpha, which mainly reflects the amount of internal consistency among the items (i.e., the extent to which the items relate highly and positively between them). The estimate ($\alpha = 0.91$) is very high and shows that the scores are accurate enough for individual measurement purposes.

Procedure

Translation of the questionnaires

A back-translation procedure was used to translate the instructions and items of the questionnaires used in this study (i.e., the NRS-11, the VAS, and the PCS-C) into Arabic [27,28]. First, three bilingual healthcare professionals separately translated the instructions from English into Arabic (i.e., forward translation). Then they met and agreed on one form (i.e., reconciliation of the translation). Subsequently, the translated versions were back translated from Arabic into English by a certified translator who was ignorant of the original instruments (i.e., back translation). The back-translated instructions of the NRS-11 and VAS were evaluated by two independent researchers with wide experience in the study and treatment of individuals with chronic pain. No changes in the instructions were deemed necessary. The English back-translated version of the PCS-C was sent to the instrument's author to check whether the back-translation was appropriate (i.e., harmonization). Some minor changes were made in the Arabic instructions following the author's recommendations to solve slight discrepancies between the back-translated English version and the original. Finally, the Arabic translations of these questionnaires were pilot-tested with a sample of 10 students to check for understandability and cultural relevance of the translated versions (i.e., cognitive debriefing). The Arabic translations of these questionnaires are available upon request from the corresponding author.

Procedure

We contacted the North College School (Zgharta, Lebanon) to recruit participants for this study. The school helped us to get in touch with the parents of their 8–18-year-old students. The parents that showed an interest were asked for permission for their child's participation. Only two of the parents approached declined. The study was conducted during April of 2021. Due to the COVID-19 lockdown, it was not possible to conduct the study face to face, and the procedure was fully conducted online, using *Microsoft Teams* (the platform that the school used for online teaching during the COVID-19 pandemic).

Parents who agreed to proceed with the study were called to an online meeting with their child. At the beginning of the first online meeting, the researcher met the participant and her or his parent (mother or father), introduced herself and described the study procedure to both the parent and the participant. If the participant was ≤ 12 years old, the parent was invited to stay in the video meeting but asked to remain silent and intervene only if there was a technical difficulty that the child could not easily solve by her or himself (e.g., a disconnection, a common problem in Lebanon at the time this study was conducted). However, no parents actually had to intervene, as we did not encounter any technical difficulties that interfered with the implementation of the study.

After obtaining consent from the parent and the participant, the researcher asked the participants to report the following demographic information: gender and age. Then, they were sent a link to the online survey, and asked to respond to the questions on pain intensity, in the presence of the researcher.

The online survey had five different pages: (1) the instructions to participate and the informed consent (only by clicking "YES" in response to a question about consent could they move forward to the next pages of the survey); (2) the demographic questions; (3) the

NRS-11-Arabic; (4) the VAS-Arabic; and (5) the PCS-C-Arabic. When the last page was filled in and submitted, a thank you note appeared on the participant's screen and a report with all the answers given was sent by email to the researcher, under a randomly assigned code for each participant that was secured on a two-password protected laptop.

To respond to the questions about pain intensity, the researcher followed a procedure successfully used with similar objectives [11] and asked the participants to imagine themselves in a potentially painful situation. We used two different scenarios and we chose one or the other depending on the age of the participant. The 8–12-year-olds were asked to imagine that they fell over and scraped their knees, whereas the 13–18-year-olds were asked to imagine that they burned their hand. Then, the researcher read the instructions for the NRS-11-Arabic and asked the participant to report the pain intensity on the online survey. Next, the researcher read the instructions for the VAS-Arabic and again asked the participant to report the pain intensity on the online survey. Previous studies comparing pain intensity scales [8,29] found that the order in which the scales were presented had no influence on the responses, so we chose not to randomize the presentation of the NRS-11-Arabic and VAS-Arabic in this study. Finally, participants were asked to respond to the PCS-C-Arabic.

At the end of this meeting, a second one was scheduled for three weeks later. In this second meeting, participants were only requested to report their pain intensity with the NRS-11-Arabic and VAS-Arabic, following the same procedure as in the first meeting.

This study was approved by the Ethics Committee of Universitat Rovira i Virgili (CEIPSA-2020-TD-0002).

Data Analysis

First, we computed descriptive statistics of the demographic variables (percentages, means and standard deviations) to describe the study sample and of the psychometric measures used in the study. All the measures showed unimodal, and fairly symmetrical distributions (i.e., the skewness coefficients were well below 1 in all cases). Furthermore, the number of response categories was 11 or more for all the measures. These conditions support that Product-Moment (Pearson) correlations would be appropriate to measure the association among the variables, and that the linear model based on these correlations would be an appropriate choice for the analyses implemented in this research [30].

Given the distributional results above, we next performed a combined analysis to assess the reliability, convergent validity and unidimensionality of the NRS-11-Arabic scores. To study reliability, we computed the Pearson correlation coefficient between ratings on the NRS-11-Arabic at time 1 and time 2. There were 3 weeks between both time measurements. To study the convergent validity of the NRS-11-Arabic scores, we first computed the Pearson correlation coefficient between the ratings on the NRS-11-Arabic and the VAS-Arabic. Then, to further assess that both sets of scores were measuring the same single construct of pain intensity, we implemented a modified factor analytic (FA) approach, because a standard FA solution requires at least three indicators if it is to be identified and at least four if it is to be tested. With only two indicators, as is the case in this study, the only reasonable approach is to fit the FA solution as an error-in-variables model with known reliabilities for both indicators [31,32]. That is, if the two FA loadings in the solution are set to fixed values by using the reliability estimates (the test-retest scores in this study) as if they were known parameters, then, the disattenuated correlation between the true scores in both measures can be estimated. If the disattenuated correlation is fixed to

unity, we obtain one degree of freedom to test the hypothesis that both the NRS-11-Arabic and the VAS-Arabic scores measure the same single construct.

Finally, to evaluate the discriminant validity of the scores of the NRS-11-Arabic, we conducted a Steiger's z test [33], which compared the magnitude of the correlation between the ratings on the NRS-11-Arabic and the VAS-Arabic with the magnitude of the correlation between the NRS-11-Arabic and the PCS-C-Arabic. Since we used two different scenarios, which depended on the age of the participants, we also divided the group in two – the 8–12-year-olds and the 13–18-year-olds – to study the planned associations. We also looked into the associations of the group as a whole.

We hypothesized that the NRS-11-Arabic is a unidimensional questionnaire that measures the same dimension as the Visual Analogue Scale, another questionnaire known to measure pain intensity. This hypothesis will be assessed by first computing the product-moment correlation between both sets of scores (i.e., convergent validity evidence) [34] and then testing that the corresponding disattenuated correlation is 1 (i.e., when measurement error is removed, both sets of scores measure exactly the same dimension) by using a factor-analytic approach. We further hypothesized that the magnitude of the association between the scores of the NRS-11-Arabic and the scores of the Arabic version of the VAS (VAS-Arabic) would be significantly greater than the association between the scores of the NRS-11-Arabic and the scores of the Arabic version of the Pain Catastrophizing Scale-Child version (PCS-C-Arabic), a questionnaire measuring a construct that is theoretically different to pain intensity (i.e., discriminant validity). Finally, we hypothesized a strong and statistically significant correlation between the scores of the NRS-11-Arabic at two different times (i.e., test-retest reliability estimate).

All analyses were conducted using the Statistical Package for Social Sciences for Windows version 27.0 [35] and LISREL 8.80 [36].

Results

Participants

In total, 190 schoolchildren were enrolled and 182 (96%) of these provided complete data. A little bit more than half of the participants were males (54%), with an average age of 12.70 years old (SD= 2.29). Just a small group of participants (6.3%) reported pain at the time of the interview, most of which was located in the head (75%). Table 1 provides additional descriptive information about the sample of participants.

[Insert Table 1 about here]

Dimensionality, Validity, and Reliability Assessments

The off-diagonal elements in the matrices in Table 2 shows the product-moment correlations between the different scores used to study the validity and dimensionality characteristics of the NRS-11-Arabic scores. The elements on the main diagonal show the corresponding reliability estimates. For the NRS-11-Arabic and VAS-Arabic scores, the reliability estimates are the test-retest estimates.

Reliability

One hundred and eighty-two children and adolescents (96%) responded to both measurements. There were no statistically significant differences regarding sex and age between those who did and did not complete the second measurement. As shown in Table 2, the test-retest reliability estimates for the NRS-11-Arabic scores ranged between .82 (13-18 years old) and .89 (8-12 years old), thus showing a good reliability. In all cases they were statistically significant. These estimates suggest that the scores will be accurate enough to be used in all types of application, including individual assessment.

Validity and Unidimensionality

Convergent Validity was supported by the strong correlations between the scores on the NRS-11-Arabic and the scores on the VAS-Arabic in both age groups and in the whole sample (see Figure 1 and Table 2).

Evidence was then obtained of the *unidimensionality* of the NRS-11-Arabic scores by fitting the error-in-variables model described above. The disattenuated correlation estimates and the corresponding approximate 90% confidence intervals between the NRS-11-Arabic and the VAS-Arabic scores were: 0.996 (0.748; 1.00) in the 8–12-year-olds; 0.999 (0.752; 1.00) in the 13–18-year-olds, and 0.993 (0.813; 1.00) in the whole group. For all the three groups, the upper end of the confidence interval contains the unit correlation as an admissible value. Setting the disattenuated value to unity provided the following chi-squared goodness-of-fit results with one degree of freedom: $\chi^2 = 0.001$, p=0.98 (8-12 group); $\chi^2 = 0.267$, p=0.60 (13-18 group); and $\chi^2 = 0.004$, p=0.95 (whole group). As expected, the fit in the three cases was very good, thus providing evidence that the NRS-11-Arabic and the VAS-Arabic scores measure the same common construct.

[Insert Figure 1 and Table 2 about here]

Discriminant Validity was supported because the magnitude of the correlation between the NRS-11-Arabic and the VAS-Arabic was significantly greater than the correlation between the NRS-11-Arabic and the PCS-C-Arabic for the whole sample (z= 8.23, p <0.001) and for the 8–12-year-olds (z=8.29, p<0.001) and the 13–18-year-olds (z=8.67, p <0.001).

Discussion

Our aim was to study some psychometric properties of the Arabic version of the 0-10 Numerical Rating Scale (NRS-11-Arabic). As we hypothesized, we found that NRS-11-

Arabic provided scores that measured a single dimension with strong reliability and validity. Thus, the NRS-11-Arabic proved to be a suitable self-report questionnaire to inform about pain intensity in this sample of young people between 8 and 18 years old. Moreover, the NRS-11-Arabic was easy to understand (i.e., none of the participants requested additional explanations) and use. Importantly, these findings are in line with data supporting the validity and reliability of the NRS-11 scores when it is used with pediatric populations [16,37–40], including studies using electronic versions of the scale [41].

Some limitations should be taken into account when interpreting the study's findings. First, participants were a convenience sample of schoolchildren from one school in the north of Lebanon that may or may not be representative of the Arabic-speaking population. Thus, additional research with other samples from other Arabic-speaking countries is needed to determine which of the study findings are valid. Nevertheless, the findings are in line with studies using the NRS-11 in many different languages (e.g., Catalan, English, French, German, Spanish) and with clinical and student samples from different countries [8,42–46]. Second, to report the expected level of pain intensity, the procedure required participants to imagine situations that they might or might not have experienced or which had happened a long time ago (i.e., Imagine that you burned your hand). This could have influenced the results. Therefore, studies with samples of children with acute and chronic pain are also needed. However, this procedure has been successfully used in previous studies [37,48] with similar results. Third, we did not randomize the presentation of the pain intensity scales used in this study (i.e., NRS-11-Arabic and VAS-Arabic). Therefore, it is unclear whether there were order effects on the ratings reported by the schoolchildren. However, previous studies have found that the order in which the scales are presented makes no difference [16,48]. Finally, there are other psychometric properties

of interest that were not examined in this study (e.g., feasibility, sensitivity to change over time). Therefore, additional studies should be made to evaluate other characteristics. In addition, future research should also compare the NRS-11-Arabic with other widely used self-report questionnaires (e.g., Faces Pain Scale-Revised) [11,21,49,50], and study if there are any preferences related to variables like age or gender. Moreover, future studies should examine whether paper-and-pencil forms of the NRS-11-Arabic provide pain intensity reports that are equivalent to verbally or electronically administered forms of the questionnaire.

Despite these limitations, the findings suggest that the Arabic version of the NRS-11 provides valid and reliable scores for assessing pain intensity in young people. If these findings are found to be valid in future studies, it would support the use of the NRS-11-Arabic, thus facilitating transcultural studies about the expression of pain intensity which in turn might improve the assessment and management of pain in children worldwide.

Transparency:

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Author Contributions:

- JF: Data collection, Data curation; Methodology; Software; Writing- Original draft preparation.
- ES-R: Data analysis; Writing - review & editing
- PJF: Data analysis; Writing - review & editing
- JM: Conceptualization; Methodology; Supervision; Writing - review & editing; Funding acquisition

All authors discussed the results and commented on the manuscript.

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Figure Legend

Figure 1. Correlations between NRS-11-Arabic and VAS-Arabic scores in the whole sample