Further validation and psychometric properties of the Spanish adaptation of the Genetic Counselling Outcome Scale

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Running Head: Further validation and psychometric properties of the Spanish GCOS.

ABSTRACT

Evaluation of clinical genetic services is challenging due to the nature of their interventions. The Genetic Counselling Outcome Scale (GCOS-24), a patient-reported outcome measure, was developed to measure empowerment, an important patient-reported outcome from genetic counselling. Previously, we translated and adapted GCOS-24 for use in Spain, but neither test-retest reliability nor structural and construct validity were assessed at that time. In the present study, we set out to test the reliability and validity of the Spanish adaptation of the GCOS-24 against already-validated Spanish language measures of satisfaction with life, anxiety, and health locus of control. 880 patients/families who attended the genetics clinic were invited to participate in a online survey. 201 participants (23%) completed the four questionnaires at the first timepoint, and 59 of these (29%) completed GCOS-24 again the second timepoint, 2-4 weeks later. Test-retest realibility was confirmed, with no significant differences between responses to GCOS-24 at the first and second timepoints and good internal consistency. Convergent validity was confirmed between GCOS-24 and measures of satisfaction with life and anxiety but not with measures of health locus of control. For the structural and construct validation an exploratory factor analysis was performed. The resulting factorial structure of GCOS-24 consists of 6 factors that accumulate 68% of the variance shared by the 21 items that remained in the model. We applied the factor structure of the three validated measures to the available data and analysed the correlation between factors of GCOS-24 and the other scales. The results showed significant and consistent correlation with factors of the satisfaction with life and anxiety scales but no significant correlation with internal health locus of control. The use of the Spanish adaptation of GCOS-24 in other genetic clinics in Spain will help to validate it further. This study contributes to the international

validation of GCOS-24 to evaluate the quality of genetic counselling in Europe.

Keywords: Empowerment, genetic counseling, evaluation, validation, patient-reported outcome measure, clinical genetics services.

What is known about this topic

The Genetic Counselling Outcome Scale (GCOS-24), a patient-reported outcome measure, has been developed to measure empowerment as the outcome goal of the genetic counselling process. However, the use of GCOS-24 is limited to English-speaking countries and it requires cross-cultural adaptation and psychometric validation to be used in other countries. So far, GCOS-24 has been adapted to the Danish, Spanish, Brazilian Portuguese and Dutch languages, but only in the latter has the adaptation been validated.

What this paper adds to the topic

The validation of the previously adapted Spanish version of GCOS-24 will allow it to be used in other clinical genetics services in Spain, and also in Latin-American countries, provided that further adaptation to the use of the Spanish language in the specific country is carried out. This work contributes to the international validation of GCOS-24 to evaluate the quality of genetic counselling in Europe and other countries.

INTRODUCTION

Genetic counselling is one of several interventions offered at clinical genetics services. Evaluation of these services is problematic, as outcome measures such as morbidity or mortality do not apply and the interventions offered do not directly result in health improvement. Genetic counselling has been defined as a process of communication that can help patients, their partners, and other family members understand and adapt to the medical, psychological, familial, and reproductive implications of having a genetic condition in the family (Resta et al., 2006). This is usually achieved by the acquisition of knowledge, psychosocial support, anticipatory guidance, and facilitation of decision making (Bernhardt, Biesecker, & Mastromarino, 2000). Although there is evidence that genetic counselling is perceived as beneficial to the patient (Madlensky et al., 2017), it is still regarded by many as a "soft" intervention and thus difficult to evaluate.

One way to measure the potential benefits of genetic counselling for patients is using patient-reported outcome measures (PROMs). These are short self-report questionnaires that capture aspects of the patient's health status or Health-Related Quality of Life; their key element is that the information comes directly from the patient, without interpretation of the patient's reponse by a clinician or anyone else (McAllister, Wood, Dunn, Shiloh & Todd, 2011).

The Genetic Counseling Outcome Scale (GCOS-24) was developed to assess patient-reported outcomes of genetic counselling interventions (namely, benefits). The GCOS-24 captures a construct labelled empowerment, defined as "a set of beliefs that enable a person from a family affected by a genetic condition to feel that they have some control over and hope for the future" (McAllister, Dunn, & Todd, 2011, p.125). Based on its similarity to the Perceived Personal Control (PPC) measure,

empowerment comprises five dimensions: Cognitive, Decisional and behavioural control, Hope, and Emotional regulation (McAllister & Dearing, 2015).

GCOS-24 has been used in a quality improvement initiative by a clinical genetics team in the UK (Costal Tirado et al., 2017), and to evaluate genetic counselling in a psychiatric genetic counselling clinic in Canada (Inglis, Koehn, McGillivray, Stewart, & Austin, 2015) and in a cancer genetics clinic in Singapore (Yuen et al., 2020). However, use of GCOS-24 is limited to English-speaking countries; it requires cross-cultural adaptation and psychometric validation to be used in other countries (McAllister, Moldovan, Paneque, & Skirton, 2016). Towards this end, the GCOS-24 has been translated and adapted for use in Denmark (Diness et al., 2017), the Netherlands (Voorwinden et al., 2019), and Brazil (Segundo-Ribeiro et al., 2020). But only in the Dutch adaptation were the psychometric properties evaluated as part of the validation process.

In a previous study, we translated and adapted the GCOS-24 for use in Spain; the Spanish version of the GCOS-24 demonstrated both good internal consistency and sensitivity to change over time (Munoz-Cabello et al., 2018). However, neither test-retest reliability, nor structural and construct validity were assessed at that time. In the present study, we set out to validate the Spanish adaptation of GCOS-24 against already-validated Spanish language measures of satisfaction with life, anxiety, and health locus of control, expecting the Spanish version of the GCOS-24 to be significantly correlated with these measures. Specifically, the hypotheses to be tested are: 1) Empowerment will have a significant positive correlation with satisfaction with life and Internal health locus of control; 2) Empowerment will have a significant negative correlation with anxiety; 3) Empowerment will have no significant correlation with Chance-External or Powerful Others-External health locus of control, as it was

shown in the original work by McAllister et al. (McAllister, Wood, Dunn, Shiloh & Todd, 2011).

METHODS

PARTICIPANTS

Eight hundred and eighty patients/families who attended the Institute of Medical and Molecular Genetics (INGEMM) at Hospital Universitario La Paz, Madrid, for a clinical genetics consultation between April 2017 and July 2018 were invited to participate.

For the factorial analysis a minimum sample of seven times the number of items (7x24=168) was estimated (Mokkink et al., 2010; Terwee et al., 2012), and for test-retest reliability a sample size of at least 50 patients (Terwee et al., 2007).

STUDY DESIGN AND PROCEDURE

Initial contact with patients and their families was made by post, by means of an introductory letter addressed to the patient and/or legal guardian (in case of underaged or intellectually disabled persons), inviting participation in the study and enclosing a project information sheet. A contact address and telephone number were provided to which prospective participants could direct any questions that might arise regarding participation in the study.

In order to facilitate completion of the questionnaires, monitoring, and data collection for subsequent analysis, the survey was designed using the REDCap platform. REDCap is a secure web application for creating and managing online surveys and databases, used primarily in biomedical research. As it is a platform contracted by the hospital's Research Institute (IDIPaz), the server is located in the hospital itself, which prevents access to data by third parties and guarantees data confidentiality.

To access the survey, participants were asked to follow an online link and insert a numerical identification code included in the information sheet into their browser, read

the terms and conditions, agree to participate in the study, and agree to the processing and protection of their data, as well as to provide basic demographic data. The GCOS-24 and the rest of the questionnaires were then made available. The estimated time needed to complete the four questionnaires in this first phase of the study (T1) was 20 minutes. Participants were able to stop the survey, save their answers, and continue at another time if they so desired.

Subsequently, for assessment of test-retest reliability of GCOS-24, between two and four weeks after completing the questionnaires for the first time, without any personal contact or clinical intervention, participants were asked to retake the GCOS-24 questionnaire only (T2). A reminder was sent, either by regular post or by e-mail, as indicated by the participants at the end of the first survey. The estimated time needed to complete this questionnaire alone was 5 minutes.

To allow follow-up on the response, avoid duplication, and permit correlation between the GCOS-24 questionnaire completed in the second phase of the study (T2) and that completed in T1, each participant was assigned a numerical identification code, included in the information sheet. However, data analysis was performed completely anonymously.

The study was approved by the Research Ethics Committee of Hospital Universitario La Paz prior to its commencement.

MEASURING INSTRUMENTS

Genetic Counselling Outcome Scale

The Genetic Counselling Outcome Scale (GCOS), developed by McAllister et al. (McAllister, Wood, Dunn, Shiloh & Todd, 2011), measures the degree of empowerment, which is defined as the set of beliefs that enable a person affected by a genetic disease or disorder to cope and maintain hope. It consists of 24 items with

7 possible answers for each of them, ranging from 1=strongly disagree to 7=strongly agree. Scores were reversed for certain items (4, 5, 10, 11, 12, 13, 17, 18, 21 and 22; and 6 in the case of the Spanish adaptation) to calculate the total score, ensuring that higher total GCOS-24 scores indicate higher levels of empowerment. In a previous project, we translated and adapted the GCOS questionnaire for use in Spain with adequate measures of internal consistency (Cronbach α=0.84) and effect size (Cohen d=0.70) (Munoz-Cabello et al., 2018).

Satisfaction With Life Scale

The Satisfaction With Life Scale (SWLS), developed by Diener et al. (Diener, Emmons, Larsen, & Griffin, 1985) considers only one factor (satisfaction) and consists of 5 items scored on a 6-point scale ranging from 1=strongly disagree to 6=strongly agree. This scale has been translated, adapted and validated for use in Spain, and demonstrated adequate psychometric properties (Vazquez, Duque, & Hervas, 2013).

State-Trait Anxiety Inventory

The State-Trait Anxiety Inventory (STAI), developed by Spielberger et al. (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983), measures independent concepts of anxiety. **State Anxiety (S/A)** refers to a **transitory emotional state** characterized by subjective feelings of tension that can vary in intensity over time. **Trait Anxiety (T/A)** refers to a **relatively stable disposition to respond to stress with anxiety** and to perceive situations as threatening, raising State anxiety. This scale consists of 40 items scored on a 4-point scale from 0=never to 3=very much. It considers four independent dimensions/subscales/factors: 1) State Anxiety (S/A) Affirmative (includes items 3, 4, 6, 7, 9, 12, 13, 14, 17, 18); 2) State Anxiety (S/A) Negative (includes items 1, 2, 5, 8, 10, 11, 15, 16, 19, 20); 3) Trait Anxiety (T/A) Affirmative

(includes items 22, 23, 24, 25, 28, 29, 30, 31, 32, 34, 35, 37, 38, 40); and 4) Trait Anxiety (T/A) Negative (includes items 21, 26, 27, 30, 33, 36, 39).

This scale has been translated, adapted and validated for use in Spain, and has also shown adequate psychometric properties (Spielberger CD, Gorsuch RL, 1997; Urraca Martínez, 1981).

Multidimensional Health Locus of Control Scale

The Multidimensional Health Locus of Control (MHLC) scales, developed by Wallston et al.(Wallston, Wallston, & DeVellis, 1978) measures personal beliefs about behaviours that influence or determine health status. It consists of 18 items scored on a 6-point scale from 1=completely agree to 6=completely disagree. It considers three independent dimensions/subscales/factors: 1) **Internal Health Locus of Control (HLC)** (belief that the state of health depends on the person's own behaviour) (ILHC); 2) **Powerful Others External HLC** (the state of health would be influenced by the action of relevant agents/persons) (PHLC); and 3) **Chance External HLC** (the state of health is the result of chance or luck) (CHLC). The first factor includes items 1, 6, 8, 12, 13, 17. The second includes items 3, 5, 7, 10, 14, 18. The third includes items 2, 4, 9, 11, 15, 16.

This scales have been translated, adapted and validated for use in Spain, showing adequate psychometric properties (Tomas-Sabado & Montes-Hidalgo, 2016)

STATISTICAL ANALYSIS

TEST-RETEST RELIABILITY EVALUATION

The sign test for two related samples and the marginal homogeneity test for two related samples were used for test-retest reliability evaluation. The **sign test** calculates the differences between two variables for all cases and classifies the differences as positive, negative, or equal. If the two variables have a similar distribution, the number

of positive and negative differences does not differ significantly. Although it is desirable for the variables to be measured on an interval scale, it can be used if they are at least ordinal, as is the case here. The **marginal homogeneity test** is an extension of McNemar's test from the binary response to the multinomial response. It uses the chi-square distribution to contrast changes in response, and is useful for detecting such changes in before-after designs. In both tests the null hypothesis is that there are no statistically significant differences, at the set significance level, between the before and after response distributions. Internal consistency was assessed using Cronbach´s alpha.

CONVERGENT VALIDITY

Convergent validity was measured with Pearson correlation coefficients between the total scores of GCOS-24 at T1 and each of the three other scales (with their corresponding subscales), having previously reversed the score of negatively worded items with an implicit negative or “disempowering” meaning. Tests measuring the same or similar constructs are expected to be highly correlated.

STRUCTURAL VALIDATION

CONSTRUCT DEVELOPMENT

An exploratory factor analysis was performed, using the **common factor analysis** technique, to which a **promax oblique rotation** is added. This technique seeks the best projection of the common or shared variance of the variables, as opposed to principal components analysis, which seeks the best projection of the total variance (that of each variable and that shared with the rest of the variables). Promax rotation allows construction of factors that are not necessarily independent, a requirement in situations where factors to be identified are associated with characteristics that are not independent either.

Since factor analysis of common factors is a technique that isolates only the variability of the relationships between variables, the initial communality of each item will no longer be 1, but an estimate of the variance it has in common with the rest of the items. To carry out this initial estimation, we chose to use the **principal axis factoring** method, which is considered more appropriate when normality in the item distributions cannot be guaranteed.

Since in this model we start from an initial estimate of the communalities, which only represents the part of variability that each variable shares with the other variables, we proceed as follows:

1) An initial factor analysis is carried out in which all items of the questionnaire are included and as many factors are extracted as there are eigenvalues greater than or equal to one, carrying out the corresponding rotations.
2) All variables or items that present (with all factors extracted) an absolute factor loading lower than 0.3 are eliminated from the analysis (Bandalos & Finney, 2010).
3) The process is repeated successively until all the variables in the model pass the previous filter, considering in the last step all factors extracted (no longer only those with eigenvalues greater than or equal to 1).

CONSISTENCY OF THE SUBSCALES (FACTORS OBTAINED)

To evaluate the internal consistency of each of the factors obtained, the Cronbach α statistic was used. The most commonly used criterion is to consider values of this statistic between 0.70 and 0.90 as indicative of good internal consistency for the appropriate factor.

COMPARISON WITH OTHER MEASURING INSTRUMENTS

To compare the adapted GCOS-24 scale with the already validated measuring instruments (SWLS, STAI, and MHLC scales), the following process was used:

1) Each of the three questionnaires to be used as comparators have known theoretical factors (and their constituent items), as they have been duly validated. For each questionnaire and for each theoretical factor in it, a principal component analysis was carried out on the sample data, in which a single factor was extracted using only those items associated in the literature with the aforementioned theoretical factor. The factor extracted is the equivalent to the theoretical factor obtained on the sample and the one used in the comparison process.
2) The previous step, once completed, is followed by analysis of the relationships between the factor structure of the questionnaire we intend to validate and those obtained for each of the comparator questionnaires by the previous method. We expect GCOS-24 to be positively correlated with the validated scales that measure satisfaction, positive feelings and belief that personal behaviour determines the state of health, and to be negatively correlated with anxiety and negative feelings.

Statistical analyses were carried out in SPSS 25.0 software.

RESULTS

PARTICIPANTS

Of the 880 patients contacted and invited to participate, 201 (23%) completed all questionnaires in the first phase (T1). Of these 201, 59 (29%) completed the GCOS-24 questionnaire in the second phase (T2). Demographic characteristics of participants are shown in Table 1.

TEST-RETEST RELIABILITY EVALUATION

In the sign test, for an alpha significance level of 0.05, the equality of behaviour in the distribution of before (T1) and after (T2) responses was rejected only for item 6 (“I can´t see that good things have come from having this condition in my family”). In the test of marginal homogeneity, with the same level of significance, equality of behaviour was not rejected for any of the questionnaire items (Supporting Information 1). The intra-class correlation was good (r=0.867).

CONVERGENT VALIDITY

The GCOS-24 total score at T1 showed a statistically significant positive linear correlation with SWL total score and a statistically significant negative linear correlation with STAI S/A and STAI T/A total scores. It did not show statistically significant evidence of a linear relationship with Internal, Chance-External and Powerful Others-External HLC total scores (Table 2).

STRUCTURAL VALIDATION

FACTOR ANALYSIS OF THE ADAPTATION OF THE GCOS SCALE: DEVELOPMENT OF THE CONSTRUCT

Prior to factor analysis, the suitability of the data for factor analysis was checked using the Kaiser-Meyer-Olkin test (0.814) and the Bartlett’s test of sphericity ($p < 0.01$).

On a first analysis, item 10 (“I don't know what could be gained from each of the options available to me”) exhibited factor loadings with absolute values <0.3 with all factors extracted and, therefore, was eliminated from analysis. In successive steps, according to the same criterion, the following variables were removed from the model:

7. ”I can control how this condition affects my family”.
5. “I don't know where to go to get the medical help I / my family need(s)”.

The resulting factor pattern model after this process consists of 6 factors that accumulate 68% of the variance shared by the 21 questionnaire items that remained

in the model (Supporting information 2). We named them “Hope”, “Referral clarity”, “Cognitive control”, “Emotional regulation”, “Family impact” and “Decisional and behavioural control”.

CONSISTENCY OF THE SUBSCALES (FACTORS OBTAINED)

Internal consistency was low for subscale “Referral clarity” (Cronbach's α = 0.288) but satisfactory for the other five subscales. Supporting information 3 shows the values of Cronbach's α for each of them.

EMPOWERMENT MEASURED AS THE FACTOR OF FACTORS

An alternative to the additive method in the construction of empowerment is to understand it as the common part of the factors previously obtained. Since the factor analysis used in the construction incorporates an oblique rotation, the factors determined are not uncorrelated and therefore can be used as the basis for a new factor analysis. The suitability of the data for factor analysis was checked using the Kaiser-Meyer-Olkin test (0.623) and the Bartlett’s test of sphericity ($p < .001$).

Supporting information 4 shows the matrix of the factor pattern with the factor loads corresponding to each of the six factors previously obtained.

COMPARISON BETWEEN SCALES: CORRELATION BETWEEN FACTORS OF THE GCOS-24 SCALE AND THOSE OF THE OTHER SCALES

The relationship between the factors of the adapted GCOS-24 scale and those resulting from applying the validated constructs of the Satisfaction With Life, State-Trait Anxiety, and Multidimensional Health Locus of Control scales was also analyzed. The results are shown in table 4.

GCOS-24 and the Satisfaction With Life Scale (SWL)

Hope, Cognitive control, Emotional regulation, Family impact and Decisional and behavioural control factors demonstrate a positive correlation with the SWL Scale. The Referral clarity factor does not show a statistically significant correlation.

These results show that administration of both scales to the same group of individuals consistently discriminates responses related to factors that increase the degree of empowerment and satisfaction with life. These findings confirm convergent validity of GCOS-24 with the SWL Scale.

GCOS-24 and the State-Trait Anxiety Scale (STAI)

Hope, Cognitive control, Emotional regulation, Family impact and Decisional and behavioural control factors demonstrate a positive correlation with S/A negative and T/A negative factors, and a negative correlation with S/A affirmative and T/A affirmative factors. The Referral clarity factor does not show a statistically significant correlation with any of the four factors of the scale.

These results show that administration of both scales to the same group of individuals consistently discriminates between responses related to factors that increase the degree of empowerment and those that reduce the level of anxiety. These findings confirm convergent validity of GCOS-24 with the STAI Scale.

GCOS-24 and the Multidimensional Health Locus of Control Scale (MHLC)

The Hope factor demonstrates a negative correlation with Internal HLC. Referral clarity demonstrates a negative correlation with Powerful Others-External HLC.

COMPARISON BETWEEN EMPOWERMENT AS A FACTOR OF THE GCOS(E) SCALE AND FACTORS OF THE OTHER SCALES

Total GCOS-24 scores (empowerment) demonstrate a positive correlation with the only factor of the SWL Scale and with the S/A negative and T/A negative factors of the STAI Scale. Total GCOS-24 scores demonstrate a negative correlation with the S/A

affirmative and T/A affirmative factors of the STAI scale, and shows no statistically significant correlation with any of the three factors of the MHLC Scale.

DISCUSSION

The Genetic Counseling Outcome Scale (GCOS-24) is a PROM that measures empowerment, a construct that comprises five dimensions (Cognitive, Decisional and behavioural control, Hope and Emotional regulation), which summarises the patient benefits from using clinical genetics services (McAllister, Wood, Dunn, Shiloh & Todd, 2011; McAllister, Dunn, & Todd, 2011; McAllister & Dearing, 2015). Genetic counselling, as one of the interventions offered at clinical genetic services, has been shown to increase the degree of empowerment and therefore demonstrates a measurable beneficial effect for patients. GCOS-24 was developed in the United Kingdom; its application in other languages and cultures requires prior adaptation and validation (McAllister et al., 2016). In a previous study we translated and adapted GCOS-24 for use in Spain. The Spanish version of the GCOS-24 showed both good internal consistency and sensitivity to change over time. However, in order to be able to use this scale in other clinical genetic services in Spain, it was necessary to assess test-retest reliability and validity, both structural and internal.

Strenghts of the study

In this study we confirmed the reliability of the Spanish adaptation of GCOS-24. With the exception of item 6 in the sign test, the test-retest reliability evaluation showed no statistically significant differences between the responses of individuals to the test (T1) and retest (T2) for any of the other items of the GCOS-24 questionnaire, and the intra-class correlation was good.

Convergent validity was confirmed for the SWL and STAI scales. The GCOS-24 total score showed a positive correlation with the SWL total score and a negative correlation

with the STAI S/A and STAI T/A total scores, but it showed no correlation with the Internal HLC total score.

Factor analysis of the Spanish adaptation of GCOS-24 obtained a six-factor model with 21 items in total. A recent Dutch study in its adaptation and validation of GCOS-24 to this language obtained a six-factor model with 18 items in total (Voorwinden et al., 2019). Five of these six factors fully coincide in both studies, reinforcing their suitability for the GCOS. The sixth factor differs completely: four of the five items included in our "Decisional and behavioural control" factor (items 24, 13, 17, 22 and 15) are excluded in the Dutch model, and two of the three items of their "Uncertainty about the treatment" factor (items 17, 5 and 10) are excluded in ours. A possible explanation is that the criteria used to determine which variables (items) remain in the model were not the same in the two studies. However, factor analysis for GCOS-24 remains somewhat inconsistent across studies and languages (McAllister et al, 2011; Costal Tirado et al, 2015, Voorwinden at al, 2019). Furthermore, it was previously demonstrated that all GCOS-24 factors exist under the higher order factor, empowerment, and the scale developers have recommended that the scale be treated as a one-dimensional scale capturing empowerment (McAllister et al, 2011).

As expected, the GCOS-24 factors showed significant correlation with factors of the SWL and the STAI scales. Cognitive control, Hope, Decisional and behavioral control, Emotional regulation and Family impact factors showed a positive correlation with the SWL scale factor and with STAI scale S/A and T/A negative factors. Referral clarity did not show a statistically significant correlation with any of the factors of these two scales. Total GCOS-24 score (empowerment) showed a positive correlation with SWL and with STAI scale S/A and T/A negative factors, and a negative correlation with STAI scale S/A and T/A affirmative factors.

Empowerment, as captured by the English language GCOS-24, was shown to have a significant positive correlation with Internal HLC but not with Chance-External or Powerful Others-External HLC (McAllister, Wood, Dunn, Shiloh & Todd, 2011). In this study the total GCOS-24 score showed no evidence of a linear relationship with Internal or External HLC total scores.

The results of this study, nevertheless, show that empowerment achieved by genetic counselling for patients with genetic disorders correlates positively with life satisfaction and negatively with anxiety.

Study Limitations

The low response rate could be considered a limitation of this study. Of the 880 patients contacted and invited to participate, only 201 of them (23%) completed all questionnaires in the first phase (T1), and of these 201, 59 (29%) completed the GCOS-24 questionnaire in the second phase (T2). Although the final number of participants has allowed for statistical analysis, it is likely that the low response rate may have resulted in a self-selection of individuals willing to participate in the study. However, there were no statistically significant differences in the distribution of the demographic characteristics (sex, patient/guardian, age) between respondents and non-respondents. It is also possible that the time of the year when the survey was distributed (end of November, near the Christmas season) may have influenced the response rate.

As mentioned above, total GCOS-24 scores showed no evidence of a linear relationship with Internal HLC total scores. The validation of the Spanish adaptation of the MHLC scale was carried out with a sample of first-year nursing students, likely to be more aware of the factors determining health and disease, which may influence responses amongst lay people differently than the English language MHLC scales,

such as the participants in the current study (Tomas-Sabado & Montes-Hidalgo, 2016). The GCOS-24 factor analysis obtained a six-factor model with 21 items in total. Given the somewhat different psychometric properties between the Dutch and Spanish adaptations we would not advocate the use of a 21-item Spanish version of the GCOS-24 at present as only the use of the full version will allow comparability between centers and countries.

A short (6-item) version of the GCOS-24 has been developed recently using a different methodology (Grant, Pampaka, Payne, Clarke, & McAllister, 2019). The Genomic Outcome Scale (GOS) retains the ability to capture the empowerment construct. It includes the following items from the original GCOS-24: item 20 (Hope dimension), 16 (Cognitive control), 4 (Emotional regulation), 18 (Family impact), 24 and 17 (Decisional and behavioural control). Items 17 and 18 have been reworded to avoid confusion over double negatives. The number of possible answers has been reduced to five, removing the “Slightly agree” and “Slightly disagree” options. This short version will reduce completion time and facilitate its use in clinical genetics services. The adaptation of GOS to languages in which the full version of GCOS-24 has already been adapted and validated should be straight forward.

Practice implications

The present study has confirmed the test-retest reliability and the structural and construct validity of the Spanish adaptation of GCOS-24 with other validated outcome measures. It may now be used in other genetic clinics in Spain, which will help to validate it further. The Spanish version of GCOS-24 may be useful to demonstrate measurable patient benefits from genetic counselling and to highlight the contribution that genetic counsellors make to delivering positive patient outcomes in clinical genetics services.

Given differences in the pragmatic use of the Spanish language between Spain and Latin-American countries, and also between different Latin-American countries, we recommend further adaptation to the Spanish Language as used in the specific country or Spanish-speaking population group. Spanish, Catalan and Galician are different languages that derive from Latin. Therefore, a whole new adaptation of GCOS-24 to Catalan and Galician languages would be needed. This study contributes to the international validation of GCOS-24 to evaluate the quality of genetic counselling in Europe and other countries.

Author Contributions

Roser Lleuger Pujol, Eduardo Ortega Castelló, Lorenzo Fernández Franco, Manuel Eliecer Espinel Vallejo, Patricia Muñoz Cabello, Fernando Santos Simarro, Marion McAllister and Sixto García-Miñaúr all made substantial contributions to this study as outlined by the International Committee of Medical Journal Editors (ICMJE). Every author made substantial contributions to the conception or design of the work, contributed to drafting and revising the work critically for important intellectual content, provided final approval of the version to be published, and agrees to be accountable for all aspects of the work.

Roser Lleuger Pujol and Eduardo Ortega Castelló confirm that they had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. All of the authors gave final approval of this version to be published and agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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Compliance with Ethical Standards

Conflicts of Interest: Roser Lleuger Pujol, Eduardo Ortega Castelló, Lorenzo Fernández Franco, Manuel Eliecer Espinel Vallejo, Patricia Muñoz Cabello, Fernando Santos Simarro, Marion McAllister and Sixto García-Miñaúr declare that they have no conflicts of interest.

Human Studies and Informed Consent: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Informed consent was obtained from all individuals participants included in the study.

Animal Studies: No animal studies were carried out by the authors for this article.

Data Availability Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

REFERENCES

Bandalos, D. L. & Finney, S. J. (2010). Factor Analysis: Exploratory and Confirmatory. In *The Reviewer's Guide to Quantitative Methods in the Social Sciences.*

Bernhardt, B. A., Biesecker, B. B., & Mastromarino, C. L. (2000). Goals, benefits, and outcomes of genetic counseling: client and genetic counselor assessment. *American Journal of Medical Genetics*, *94*(3), 189–197. https://doi.org/10.1002/1096-8628(20000918)94:3<189::aid-ajmg3>3.0.co;2-e

Diener, E., Emmons, R. A., Larsen, R. J., & Griffin, S. (1985). The Satisfaction With Life Scale. *Journal of Personality Assessment*, *49*(1), 71–75.

https://doi.org/10.1207/s15327752jpa4901_13

Diness, B. R., Overbeck, G., Hjortshoj, T. D., Hammer, T. B., Timshel, S., Sorensen, E., & McAllister, M. (2017). Translation and Adaptation of the Genetic Counselling Outcome Scale (GCOS-24) for Use in Denmark. *Journal of Genetic Counseling*, *26*(5), 1080–1089. https://doi.org/10.1007/s10897-017-0086-7

Grant, P. E., Pampaka, M., Payne, K., Clarke, A., & McAllister, M. (2019). Developing a short-form of the Genetic Counselling Outcome Scale: The Genomics Outcome Scale. *European Journal of Medical Genetics*, *62*(5), 324–334. https://doi.org/10.1016/j.ejmg.2018.11.015

Inglis, A., Koehn, D., McGillivray, B., Stewart, S. E., & Austin, J. (2015). Evaluating a unique, specialist psychiatric genetic counseling clinic: uptake and impact. *Clinical Genetics*, *87*(3), 218–224. https://doi.org/10.1111/cge.12415

Madlensky, L., Trepanier, A. M., Cragun, D., Lerner, B., Shannon, K. M., & Zierhut, H. (2017). A Rapid Systematic Review of Outcomes Studies in Genetic Counseling. *Journal of Genetic Counseling*, *26*(3), 361–378. https://doi.org/10.1007/s10897-017-0067-x

McAllister, M, & Dearing, A. (2015). Patient reported outcomes and patient empowerment in clinical genetics services. *Clinical Genetics*, *88*(2), 114–121. https://doi.org/10.1111/cge.12520

McAllister, M, Wood, A. M., Dunn, G., Shiloh, S., & Todd, C. (2011). The Genetic Counseling Outcome Scale: a new patient-reported outcome measure for clinical genetics services. *Clinical Genetics*, *79*(5), 413–424. https://doi.org/10.1111/j.1399-0004.2011.01636.x

McAllister, Marion, Dunn, G., & Todd, C. (2011). Empowerment: Qualitative underpinning of a new clinical genetics-specific patient-reported outcome.

European Journal of Human Genetics, *19*(2), 125–130. https://doi.org/10.1038/ejhg.2010.160

McAllister, Marion, Moldovan, R., Paneque, M., & Skirton, H. (2016, April). The need to develop an evidence base for genetic counselling in Europe. *European Journal of Human Genetics : EJHG*, Vol. 24, pp. 504–505. https://doi.org/10.1038/ejhg.2015.134

Mokkink, L. B., Terwee, C. B., Knol, D. L., Stratford, P. W., Alonso, J., Patrick, D. L., … de Vet, H. C. (2010). The COSMIN checklist for evaluating the methodological quality of studies on measurement properties: a clarification of its content. *BMC Medical Research Methodology*, *10*, 22. https://doi.org/10.1186/1471-2288-10-22

Munoz-Cabello, P., Garcia-Minaur, S., Espinel-Vallejo, M. E., Fernandez-Franco, L., Stephens, A., Santos-Simarro, F., … McAllister, M. (2018). Translation and Cross-Cultural Adaptation with Preliminary Validation of GCOS-24 for Use in Spain. *Journal of Genetic Counseling*, *27*(3), 732–743. https://doi.org/10.1007/s10897-017-0154-z

Resta, R., Biesecker, B. B., Bennett, R. L., Blum, S., Hahn, S. E., Strecker, M. N., & Williams, J. L. (2006). A new definition of Genetic Counseling: National Society of Genetic Counselors' Task Force report. *Journal of Genetic Counseling*, *15*(2), 77–83. https://doi.org/10.1007/s10897-005-9014-3

Segundo-Ribeiro, M., Bacalá, B. T., Alvarenga, W. de A., Nascimento, L. C., McAllister, M., & Flória-Santos, M. (2020). Adaptation and preliminary validation of the genetic counseling outcome scale (GCOS-24) in a Brazilian genetic counseling setting. *European Journal of Medical Genetics*, *63*(11), 104018. https://doi.org/10.1016/j.ejmg.2020.104018

Spielberger CD, Gorsuch RL, L. R. (1997). *STAI Cuestionario de Ansiedad Estado Rasgo. Manual.* (4th ed.). Madrid: TEA EDiciones.

Terwee, C. B., Bot, S. D. M., de Boer, M. R., van der Windt, D. A. W. M., Knol, D. L., Dekker, J., … de Vet, H. C. W. (2007). Quality criteria were proposed for measurement properties of health status questionnaires. *Journal of Clinical Epidemiology*, *60*(1), 34–42. https://doi.org/10.1016/j.jclinepi.2006.03.012

Terwee, C. B., Mokkink, L. B., Knol, D. L., Ostelo, R. W. J. G., Bouter, L. M., & de Vet, H. C. W. (2012). Rating the methodological quality in systematic reviews of studies on measurement properties: a scoring system for the COSMIN checklist. *Quality of Life Research : An International Journal of Quality of Life Aspects of Treatment, Care and Rehabilitation*, *21*(4), 651–657. https://doi.org/10.1007/s11136-011-9960-1

Tomas-Sabado, J., & Montes-Hidalgo, J. (2016). [Spanish version of the Multidimensional health locus of control scale innursing students]. *Enfermeria clinica*, *26*(3), 181–187. https://doi.org/10.1016/j.enfcli.2015.12.005

Urraca Martínez, S. (1981). *Actitudes ante la muerte (preocupación, ansiedad, temor) y religiosidad. Tesis doctoral.* Madrid, 1981: Facultad de Psicología, Universidad Complutense.

Vazquez, C., Duque, A., & Hervas, G. (2013). Satisfaction with life scale in a representative sample of Spanish adults: validation and normative data. *The Spanish Journal of Psychology*, *16*, E82. https://doi.org/10.1017/sjp.2013.82

Voorwinden, J. S., Plantinga, M., Krijnen, W., Ausems, M., Knoers, N., Velthuizen, M., … Ranchor, A. V. (2019). A validated PROM in genetic counselling: the psychometric properties of the Dutch version of the Genetic Counselling Outcome Scale. *European Journal of Human Genetics : EJHG*, *27*(5), 681–690.

https://doi.org/10.1038/s41431-018-0318-9

Wallston, K. A., Wallston, B. S., & DeVellis, R. (1978). Development of the Multidimensional Health Locus of Control (MHLC) Scales. *Health Education Monographs*, *6*(2), 160–170. https://doi.org/10.1177/109019817800600107

Yuen, J., Lee, S. Y., Courtney, E., Lim, J., Soh, H., Li, S. T., … Ngeow, J. (2020). Evaluating empowerment in genetic counseling using patient-reported outcomes. *Clinical Genetics*, *97*(2), 246–256. https://doi.org/10.1111/cge.13646