Factorial structure and short version of the Modified Fresno Test to assess the use of evidence-based practice in physiotherapists.

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Abstract
Background: The Modified Fresno Test is an adapted version for physiotherapists. So far, none of the versions of the Fresno Test were subjected to analysis of the factorial structure. Objective of the study was describe the exploratory and confirmatory factorial structure of the Modified Fresno Test adapted to the Portuguese-Brazilian and analyze the statistic feasibility for the elaboration of a short version.

Methods: The questionnaire was applied in 57 physiotherapists, being 36 professionals (13 of these also professors) and 21 students of the last semester of the physiotherapy course. Exploratory Factor Analysis was performed by the method of principal components. The confirmatory factor analysis was performed by the method of maximum likelihood. The score of the answers in the test and retest was evaluated, totaling 228 observations. Reliability was assessed by means of internal consistency, using Cronbach’s alpha coefficient. Results: The internal consistency indicated value of 0.81 for the questions of the instrument. The Kaiser-Meyer-Olkin test presented acceptable values (KMO=0.80). The Bartlett’s sphericity test indicated that the correlations were sufficient for the analysis. The analysis revealed the presence of 3 factors (eigenvalues > 1), which explains 60.9% of total variance of the instrument. In the confirmatory factor analysis, the second model which tested a three-factor structure provided a better fit to the data. Conclusion: The analysis showed good factorial validity and adequate internal consistency for the use of the instrument consisting of 13 questions and 3 factors. This model proved to be better than the original model. The short version consisting of 9 questions may be an appropriate alternative for use in the population of interest.

1. Background
The Evidence-Based Physiotherapy (EBP) consists of using the best available evidences to guide therapeutic decisions.\textsuperscript{1−3} The decision making process must consider judiciously three requirements\textsuperscript{4−7}, clinical research of high quality, professional knowledge and the patient’s preferences. The physiotherapists should follow five steps to effectively translate the evidence into practice:\textsuperscript{2−3−6−8} 1) convert the need for information in clinical question (s); 2) find the best evidence to answer issues (s); 3) critically assess the validity of the evidence located; 4) fit the evidence into practice considering the professional knowledge and the patient’s preferences; and 5) to evaluate the effectiveness in the
execution of the 4 previous stages. The adoption of evidence in practice has been increasingly used by physiotherapists.\textsuperscript{9−10} And generally, the assessment of its effectiveness is conducted by means of self-reported instruments.\textsuperscript{11}

The Modified Fresno Test\textsuperscript{12} the adapted version of the Fresno test,\textsuperscript{13} developed to evaluate the use of the EBP by physiotherapists. It has been recognized as a reliable instrument for assessing all five steps of EBP objectively.\textsuperscript{14−15} It was adapted for other languages\textsuperscript{8−16−17} and different health professionals.\textsuperscript{12−18−19} In general the Fresno test presents satisfactory measurement properties, however, the responsiveness and construct validity were tested unsatisfactorily.\textsuperscript{8−16}

The construct validity or items is the capacity that the instrument must measure what it is proposing and can be tested by means of factorial analysis.\textsuperscript{21} In addition to the assessment of the construct validity, the factorial analysis can determine properly the factorial structure of the items contained in an instrument, and the contribution and relationship among them.\textsuperscript{22−23} Also, it allows to consider the reduction in the number of items of instrument.\textsuperscript{24−25} Furthermore, the analysis of the factorial structure of the Modified Fresno Test can provide evidence about the power of each construct of the instrument, which was not performed in the original version of the instrument.\textsuperscript{12} These analyzes will contribute to the definition of the best model for a short version of the instrument. The objective of the study is describing the exploratory and confirmatory factorial structure of the Modified Fresno Test adapted to the Portuguese-Brazilian and analyze the statistic feasibility for the elaboration of a short version of the instrument.

2. Methods

Study Design

This is a cross-sectional study carried out with 57 physiotherapists being that 36 were professionals (13 of these professors as well) with an average time of formation/performance of 6.6 years (SD-3.8) and 21 students (all last semester of the course). The inclusion criteria were: (1) professors involved with the teaching of Physiotherapy and linked to institutions of Higher Education; (2) students enrolled from the seventh period of the course; (3) therapists not linked to institutions of higher
education and with up to 5 years of professional experience, regardless of familiarity with the topic.

Instrument

The Modified Fresno Test for physiotherapists is a self-explanatory instrument that presents an initial text with instructions for completing and two clinical scenarios. In this study was used the Brazilian-Portuguese version of instrument.

The participant must choose one of the scenarios so that, from it, he or she can answer the 13 open-ended questions, being that the answers of questions 9 and 10 require mathematical calculations. The total score of the instrument is calculated by means of the partial score for each question whose scoring criteria vary from item "a" to the item "d". The response of each item in question is scored in five categories of classification, namely: (1) non-evident; (2) limited; (3) minimum; (4) strong and (5) excellent. The sum of scores of each criterion results in a score per question that varies between 0 and 24 points. The total test score is the sum of points of all questions, which varies between 0 to 224 points.

Procedures

Each participant received the questionnaire in two moments (test and retest), with an interval of 7 days, allowing the evaluators to score 114 questionnaires. Instructions on the use of the instrument, and informed consent form were sent to the participants. After choosing one of the clinical scenarios, the participants should answer the entire test at once with a maximum time of 60 (sixty) minutes. To answer the questionnaire, it was necessary to use a notebook and a calculator. But were not allowed additional features such as internet sites, books, etc. All participants answered the questionnaire individually. Of the total sample, 37 answered the questionnaire in the printed version and 20 on the digital version. The samplings were carried out in three institutions of Higher Education, in the period from April to September 2013. The sample size was estimated as proposed by the guidelines for reliability tests.

Data Analysis

The analysis of the responses and sum of scores of the Modified Fresno Test were performed by two
independents evaluators with experience in EBP who received a single training, divided into 3 stages of one hour each. The first time was devoted to the guidance on the criteria to score the questions contained in the instrument, the second time for conducting a pilot test, where each evaluator scored 1 test of the sample, and the third time for analysis and discussion of the results of the score in the pilot test.

Statistical analysis

The construct validity, Exploratory Factor Analysis (EFA) was performed by the method of principal components followed by Confirmatory Factor Analysis (CFA). The score of the 114 questionnaires in the test and retest was used to analysis, totaling 228 observations. To investigate the factorability of the instrument the Kaiser-Meyer-Olkin test - KMO and the test of sphericity of Bartlet were used.\(^{26-27}\)

The KMO index, or adequacy index indicates whether the application of factorial analysis is appropriate for the data set.\(^{28}\) the values between 0.5 and 1.0 indicate that the factorial analysis is appropriate.\(^{25-26-29}\) The test of sphericity of Bartlet evaluates the null hypothesis of the correlation matrix being a matrix-identity.\(^{27}\) It also evaluates the general significance of all correlations in a matrix of data.\(^{24}\) Values with significance levels \(p < 0.05\) indicate that the matrix is favorable.\(^{30}\) To determine the number of components to be removed, the criterion of Kaiser-Guttman was used (Eigenvalue > 1).\(^{31}\) The procedure of rotation was orthogonal Varimax type,\(^{24}\) as well as the graphic of sedimentation of "scree plot". The factor loadings were considered significant when values were greater than 0.30.\(^{32}\) The commonalities were also examined in order to assess the variation of each item.\(^{30}\) The items that did not have a minimum commonality of 0.4 with the extracted factors, should be considered invalid.\(^{25}\)

Subsequently, it was calculated the CFA to investigate adequacy of EFA model proposed in this study, with the original model defined by Tilson (2010). The model 1 assessed the structure of only a factor of the Modified Fresno Test. (Fig. 1). The model 2 tested the hypothesis that the instrument is composed by three factors loaded the 4 items in one latent variable, 6 items for a second variable
and 3 items of the instrument for a third latent variable. For the analysis, the maximum likelihood method was used\textsuperscript{33–34}. For adjustment of models the following indexes were used: Index of chi-square (c2), which are estimated values with significance levels (p < 0.05), Goodness of Fit Index (GFI), Comparative Fit Index (CFI), the Normed Fit Index (NFI) and the Non-Normed Fit Index (NNFI). Values above 0.90 for these indices indicate a proper fit of the model\textsuperscript{35–36}. The Root Mean Square Error of Approximation (RMSEA) considers the error of approximation in the population in a covariance matrix. Values equal to or lower than 0.08 represent a reasonable error\textsuperscript{37}. It was also analyzed the Expected Cross-Validation Index (ECVI), which indicates the best adjustment of models and it is appropriate to compare non-grouped models\textsuperscript{37}. There are no reference values that allow to classify the adjustment of the model, being preferable that it is as low as possible\textsuperscript{33–36}.

The reliability was evaluated through the analysis of internal consistency, using Cronbach's alpha coefficient for all items of the instrument and for the corrected item-total correlations\textsuperscript{38}. A value of $\alpha \geq 0.7$ was defined as "acceptable" and an $\alpha \geq 0.80$ as "good". A value of 0.2 was considered for the corrected item-total correlations.\textsuperscript{39} For the data statistical analysis the software Statistical Package for Social Sciences (SPSS version 22) and the software Analysis of Moment Structures (AMOS - Version 25) were used.

3. Results

Descriptive analysis and Reliability

The internal consistency obtained with Cronbach's alpha indicated value of 0.81 for the 13 items. The coefficient $\alpha$ calculated for the corrected item-total showed values higher than 0.20 except for item 9. The items 2, 8, 9, 10, 11 and 12 showed $\alpha$ coefficient lower than 0.50 (Table 1). The mean of scores for individual items ranged from 12.59 (item 1) to 0.57 (item 11).
Table 1
Adapted Fresno test mean scores (M) and standard deviation (SD) for individual items, corrected item-total correlation and internal consistency (Cronbach's alpha) if the item is deleted

| Item                                                | M   | S.D. | Corrected item-total correlation | Cronbach's alpha if item is deleted |
|------------------------------------------------------|-----|------|----------------------------------|-------------------------------------|
| Q1 – Formulate a clinical question                   | 12.59 | 7.16 | .53                              | .79                                 |
| Q2 – Information Sources                             | 10.60 | 5.98 | .42                              | .80                                 |
| Q3 – Study design                                    | 10.99 | 7.77 | .62                              | .78                                 |
| Q4 – Search (search strategy)                        | 11.40 | 6.40 | .62                              | .78                                 |
| Q5 – Relevance                                       | 7.84  | 5.55 | .62                              | .79                                 |
| Q6 – Internal Validity                               | 10.01 | 7.78 | .52                              | .80                                 |
| Q7 – Magnitude and significance                      | 8.06  | 7.03 | .63                              | .78                                 |
| Q8 – Questioning the patient / family                | 6.17  | 4.59 | .43                              | .80                                 |
| Q9 – Sensitivity, positive predictive value and positive likelihood | 1.84  | 3.60 | .10                              | .82                                 |
| Q10 – Absolute risk reduction, relative risk, NNT, and p-value | 1.73  | 3.90 | .23                              | .81                                 |
| Q11 – Confidence Interval                            | .57   | 1.40 | .41                              | .81                                 |
| Q12 – Best study design (diagnosis)                  | 1.74  | 1.99 | .46                              | .81                                 |
| Q13 – Best study design (prognosis)                  | 1.94  | 2.00 | .54                              | .81                                 |

Exploratory Factor Analysis

The Kaiser-Meyer-Olkin test verified the suitability of the sample for analysis with acceptable values (KMO = 0.80). The Bartlett's sphericity test [Chi-square (78) = 1149.615, p < 0.001], indicated that the correlations among the items of the instrument are sufficient for the completion of the analysis. The criterion of extraction of factors with eigenvalues, showed the presence of three (3) factors with eigenvalues > 1 related to the 13 items of the instrument, which explains 60.94% of total variance of the participants' responses (Table 2). These values were satisfactory, as they should explain at least 50% of the total variance of the instrument. The graph of scree plot sedimentation below presents the distribution of the eigenvalues and the three components that are positioned before the inflection point (Fig. 2).
Table 2
Total variance explained by 3 (three) components

| Factor | Initial Eigenvalues | Extraction Sums of Squared Loadings | Rotation Sums of Squared Loadings |
|--------|---------------------|-------------------------------------|----------------------------------|
|        | Total               | % of Variance | Cumulative % | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1      | 4.57                | 35.22         | 35.22        | 4.57  | 35.22         | 35.22        | 3.37  | 25.98         | 25.98        |
| 2      | 1.99                | 15.36         | 50.58        | 1.99  | 15.36         | 50.58        | 2.59  | 19.92         | 45.90        |
| 3      | 1.34                | 10.36         | 60.94        | 1.34  | 10.36         | 60.94        | 1.95  | 15.03         | 60.94        |

Factor 1 grouped the items 3, 5, 6, 7, 12 and 13 that compose the Modified Fresno Test. These items had significant loadings with values of $\alpha$ between .50 and .80. Factor 2 grouped the items 1, 2, 4 and 8 with values of factorial load between .60 and .70 and factor 3 grouped the items 9, 10 and 11, with values between .50 and .90. Items 3, 4, 5, and 7 were grouped into more than one factor and kept in a certain factor according to their highest factor load. Item 4 was kept in factor 2. Items 3, 4, 5 and 7 were kept in factor 1. Table 3 shows the grouping in each factor of the items of Modified Fresno Test by following the steps in the adoption of EBP. The commonalities per item of the instrument can also be observed in Table 3.
Table 3
Principal axis factoring analysis factor loading and communalities ($h^2$) of the 13 Adapted Fresno test items following varimax rotation

| Step/Action | Question - Q | Factor 1 | Factor 2 | Factor 3 | Communalities ($h^2$) |
|-------------|--------------|----------|----------|----------|-----------------------|
| Step 1: Elaboration of the matter | Q1 - Formulate a clinical question | .73 | | | .57 |
| Step 2: Search the best available evidence | Q2 - Information Sources | | .71 | | .52 |
| | Q4 - Search (search strategy) | | .62 | | .57 |
| Step 3a: Critical evaluation (qualitative) evidence | Q3 - Study design | .66 | | | .59 |
| | Q5 - Relevance | .52 | | | .54 |
| | Q6 - Internal Validity | .71 | | | .54 |
| | Q7 - Magnitude and significance | .60 | | | .55 |
| | Q12 - Best study design (diagnosis) | .83 | | | .69 |
| | Q13 - Best study design (prognosis) | .88 | | | .77 |
| Step 3b: Critical evaluation (quantitative) evidence | Q9 - Sensitivity, positive predictive value and positive likelihood | | .90 | | .83 |
| | Q10 - Absolute risk reduction, relative risk, NNT, and p-value | | .91 | | .84 |
| | Q11 - Confidence Interval | | .51 | | .42 |
| Step 4: Implementation of evidence in clinical practice | Q8 - Questioning the patient / family | .69 | | | .49 |

Confirmatory Factor Analysis

The model 1, which tested the structure of a factor of the Modified Fresno Test did not provide an adequate adjustment (Table 4). None of the indices approached an acceptable level ($\geq 0.90$). The model 2 which tested a three-factor structure provided a better fit to the data. Although the chi-square test was significant, the difference of the chi-square test between the model 1 and 2, was statistically different ($\chi^2 = 237.56, df = 62; p < 0.001$). Therefore, there was a better adjustment of the model 2 in comparison with the model 1. However, the indices of adjustment of the model 2 also did not reach the acceptable level. Thus, the model 2, although better than the model 1 also did not provide a proper fit to the data.
Table 4
Fit indices for the three PSWQ factor models tested according to confirmatory factor analysis. CFI = Comparative Fit Index; GFI = Goodness of Fit Index; RMSEA = Root Mean Square Error of Approximation; SRMR = Standardized Root Mean Residual (SRMR); AIC = Akaike’s Information Criterion; ECVI = Expected Cross-Validation Index; NFI = Normed Fit Index; and NNFI = Non-Normed Fit Index.

| Models | $\chi^2$ | df  | GFI | CFI | RMSEA | SRMR | AIC    | ECVI | NFI | NNFI |
|--------|--------|-----|-----|-----|-------|------|--------|------|-----|------|
| Model 1| 492.14 | 65  | .75 | .61 | .17   | .12  | 544.14 | 2.40 | .58 | .50  |
| Model 2| 254.58 | 62  | .85 | .82 | .11   | .10  | 312.58 | 1.38 | .78 | .73  |

4. Elaboration Of The Short Version Of The Modified Fresno Test

From the results of this study the Modified Fresno Test short version was drawn. The short version of the instrument consisted of the exclusion of 4 items, based on the arguments set out by the authors of this study. The arguments for the exclusion of items were the values obtained by the Cronbach's alpha coefficient for reliability and the values of the factorial structure. To contribute to the decision-making process, a group of experts was constituted (n = 16) composed by postgraduate students and professionals with training and knowledge about evidence-based practice. Previously, it was sent to the members of the group of experts the article of Brazilian-Portuguese version of Modified Fresno Test for Physiotherapists. Then, it was held two face-to-face meetings (3 hours) to discuss the items of the instrument and the test results of measurement properties. From the debate, the conclusions allowed to consider the exclusion of items 2, 9, 10 and 11. Thus, the short version contains 9 items and contemplates the items 1, 3, 4, 5, 6, 7, 8, 12 and 13. (Appendix 1 and 2). After the exclusion of these four items, the internal consistency indicated value ($\alpha = 0.82$) for all the items of the instrument.

5. Discussion

The Exploratory Factorial Analysis demonstrated suitability of the Modified Fresno Test. It showed good internal consistency, with the values of $\alpha$ satisfactory for all the extracted factors. This property of measurement has sustained the reliability of the instrument in its most varied versions. The three extracted factors with eigenvalues > 1, shows a small total variance of participants' responses and provides greater reliability of the instrument. Items 9 and 10 showed the highest loadings among the 13 items analyzed, which demonstrates the important items for the construct of instrument. However, they showed low values by the Cronbach's alpha reliability. They are items that require a high knowledge of the participants on statistics. The confirmatory factor analysis tested the proposed
model with 3 factors (model 2) in comparison to the original version of the instrument. 9 indices were analyzed for adjustments using the method of maximum likelihood. The indices that represent the proportional improvement in the adjustment of models (CFI, NFI and NNFI), showed a better adjustment of the model 2. However, the analysis showed that none of the tested models showed appropriate adjustments.

The internal consistency by Cronbach's alpha coefficient showed satisfactory reliability for all items of the instrument. These values agree with reliability values presented in original Fresno Test studies developed by Ramos et al (2003), Argimon-Pall’as et al. (2010), Tilson (2010) and Silva et al (2015). These studies claim that the test must be reliable to different languages and professionals. In the analysis by item of the instrument, 2 items (9 and 10) values were not acceptable. Items 9 and 10 assess the participants' knowledge in performing statistical calculations instead of interpreting the statistical results for clinical decision making. This makes these items unable to respond what they propose. Item 11 evaluates the interpretation of the confidence interval for statistical significance and presented low reliability, in addition to minimum value for commonality. The results demonstrated that these items do not contribute significantly to the overall reliability of the instrument. The experts' opinion group pointed a need for an approach of items 9 and 10 related to the interpretation of the results and not to perform statistical calculations. Also, they evidence that the statistical concepts required in these items are already covered in other items of the instrument, as for example, the item 7. The low reliability of these items justifies its high omission of responses, reported by Silva et al (2015) and may be related to the difficulty understanding the questions. The difficulty dealing with statistics is one of the main obstacles, among other pointed to the adoption of EBP in several studies on the theme.

From the results obtained in the exploratory and confirmatory factor analyzes, the making-decision was taken to introduce a short version of the Modified Fresno Test which consisted of the exclusion of 4 items of the instrument. The version proposed also enables the instrument to evaluate all stages of adoption of EBP objectively. The version consisted of 9 items presented better reliability in relation to
the version composed by 13 items. This short version may be an appropriate alternative to be used in
the population of interest. The sample used in this study may characterize a limitation. Just as in
other studies of adaptation, a convenience sample was used instead of determining a sample size to
achieve statistically significant results. It is worth noting that more research should be conducted in
order to confirm the structure of the instrument. In this sense, it is suggested to conduct studies that
compare the models presented here with other alternative models. Still, it would be important to
attest to the ability of the instrument to discriminate among theoretically different groups. These
analyzes can further enhance the instrument.

6. Conclusion
The Modified Fresno Test in Brazilian-Portuguese version demonstrated satisfactory factorial validity
and good internal consistency. The results of the confirmatory factor analysis showed that the rates of
adjustment of the model 2 composed of three factors, proved to be more suitable than the model 1.
These results are enabled to assert that the short version presented to the instrument can be a very
suitable alternative to be used in the population of interest.

Abbreviations
EBP - Evidence-Based Physiotherapy
EFA - Exploratory Factor Analysis
CFA - Confirmatory Factor Analysis
KMO - Kaiser-Meyer-Olkin test
GFI - Goodness of Fit Index
CFI - Comparative Fit Index
NFI - Normed Fit Index
NNFI - Non-Normed Fit Index
RMSEA - Root Mean Square Error of Approximation
ECVI - Expected Cross-Validation Index
SPSS - Statistical Package for Social Sciences
AMOS - Analysis of Moment Structures
Declarations
Ethics approval and consent to participate: The study was submitted to and approved by the Research Ethical Committee Protocol of Universidade Cidade de São Paulo - UNICID No 13696713/2012.

Consent for publication: Not applicable

Availability of data and material: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

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References
1. Herbert R, Jamtvedt G, Mead J, Hagen KB. Practical Evidence-Based Physiotherapy. 2nd ed. London: Churchill Livingstone; 2011.

2. Elkins MR, Moseley AM, Pinto RZ. Usage evaluation of the Physiotherapy Evidence Database (PEDro) among Brazilian physical therapists. Brazilian journal of physical therapy. 2015;19(4):320-8. Epub 2015/09/01.PubMed

3. Silva TM, Costa LCM, Costa LOP. Evidence-Based Practice: a survey regarding behavior, knowledge, skills, resources, opinions and perceived barriers of Brazilian physical therapists from São Paulo state. Brazilian journal of physical therapy. 2015;19(4):294-303. Epub 2015/09/01.PubMed

4. Saragiotto BT, Costa LC, Oliveira RF, Lopes AD, Moseley AM, Costa LO. Description of research design of articles published in four Brazilian physical therapy journals. Braz J Phys Ther. 2014;18(1):56-62. Epub 2014/03/29.

5. Albarqouni L, Hoffmann T, Glasziou P. Evidence-based practice educational
intervention studies: a systematic review of what is taught and how it is measured. 
BMC medical education. 2018;18(1):177-. Epub 2018/08/01. PubMed

6. Alshehri MA, Alalawi A, Alhasan H, Stokes E. Physiotherapists’ behaviour, attitudes, 
awareness, knowledge and barriers in relation to evidence-based practice 
implementation in Saudi Arabia: a cross-sectional study. Int J Evid Based Healthc. 
2017;15(3):127-41. Epub 2017/04/12.

7. Scurlock-Evans L, Upton P, Upton D. Evidence-Based Practice in physiotherapy: a 
systematic review of barriers, enablers and interventions. Physiotherapy, 100.3 
(2014): 208-219. Epub 2014/12/03.

8. Silva AM, Costa LC, Comper ML, Padula RS. Cross-cultural adaptation and 
reproducibility of the Brazilian-Portuguese version of the modified FRESNO Test to 
evaluate the competence in evidence based practice by physical therapists. Braz J 
Phys Ther. 2016;20(1):26-47. Epub 2016/01/21.

9. Lewis LK, Williams MT, Olds TS. Development and psychometric testing of an 
instrument to evaluate cognitive skills of evidence based practice in student health 
professionals. BMC Med Educ. 2011;11:77. Epub 2011/10/05.

10. Lizarondo L, Grimmer K, Kumar S. The Adapted Fresno test for speech pathologists, 
social workers, and dieticians/nutritionists: validation and reliability testing. J 
Multidiscip Healthc. 2014;7:129-35. Epub 2014/03/07.

11. Boström AM, Sommerfeld DK, Stenhols AW, Kiessling A. Capability beliefs on, and use 
of evidence-based practice among four health professional and student groups in 
geriatric care: A cross sectional study. PLoS One. 2018;13(2): e0192017. Published 
2018 Feb 14. doi: 10.1371/journal.pone.0192017.

12. Tilson JK. Validation of the modified Fresno test: assessing physical therapists’ 
evidence based practice knowledge and skills. BMC Med Educ. 2010;10:38. Epub
13. Ramos KD, Schafer S, Tracz SM. Validation of the Fresno test of competence in evidence based medicine. BMJ. 2003;326(7384):319-21. Epub 2003/02/08.

14. Shaneyfelt T, Baum KD, Bell D, Feldstein D, Houston TK, Kaatz S, et al. Instruments for evaluating education in evidence-based practice: a systematic review. JAMA. 2006;296(9):1116-27. Epub 2006/09/07.

15. McCluskey A, Bishop B. The Adapted Fresno Test of competence in evidence-based practice. J Contin Educ Health Prof. 2009;29(2):119-26. Epub 2009/06/17.

16. Dizon JM, Grimmer-Somers K, Kumar S. Effectiveness of the tailored EBP training program for Filipino physiotherapists: a randomised controlled trial. BMC Med Educ. 2011; 11:14. Published 2011 Apr 13. doi:10.1186/1472-6920-11-14.

17. Argimon-Pallas JM, Flores-Mateo G, Jimenez-Villa J, Pujol-Ribera E. Psychometric properties of a test in evidence based practice: the Spanish version of the Fresno test. BMC Med Educ. 2010;10:45. Epub 2010/06/18.

18. Laibhen-Parkes N, Kimble LP, Melnyk BM, Sudia T, Codone S. An Adaptation of the Original Fresno Test to Measure Evidence-Based Practice Competence in Pediatric Bedside Nurses. Worldviews Evid Based Nurs. 2018;15(3):230-40. Epub 2018/05/08.

19. Rothberg B, Feinstein RE, Guiton G. Validation of the colorado psychiatry evidence-based medicine test. J Grad Med Educ. 2013;5(3):412-6. Epub 2014/01/10.

20. Coppenrath V, Filosa LA, Akselrod E, Carey KM. Adaptation and Validation of the Fresno Test of Competence in Evidence-Based Medicine in Doctor of Pharmacy Students. Am J Pharm Educ. 2017;81(6):106. Epub 2017/10/04.

21. Roque H, Veloso A, Ferreira PL. Portuguese version of the EUROPEP questionnaire: contributions to the psychometric validation. Rev Saude Publica. 2016;50(0):61. Epub 2016/10/06.
22. Aires MT, Auquier P, Robitail S, Werneck GL, Simeoni M-C. Cross-cultural adaptation and psychometric properties of the Brazilian-Portuguese version of the VSP-A (Vécu et Santé Perçue de l'Adolescent), a health-related quality of life (HRQoL) instrument for adolescents, in a healthy Brazilian population. BMC pediatrics. 2011;11:8-. Epub 2011/01/27. PubMed

23. Williams B, Brown T, Onsman A. Exploratory factor analysis: A five-step guide for novices 2010. 1-13 p.

24. Damásio BF. Uso da análise fatorial exploratória em psicologia. Avaliação Psicológica. 2012;11:213-28.

25. Costello AB, Osborne J. Best Practices in Exploratory Factor Analysis: Four Recommendations for Getting the Most From Your Analysis 2005. 1-9 p.

26. Thompson B. Thompson, B. (2004). Exploratory and confirmatory factor analysis: Understanding concepts and applications. Washington, DC: American Psychological Association. (International Standard Book Number: 1-59147-093-5)2004.

27. D. Dziuban C, C. Shirkey E. When Is a Correlation Matrix Appropriate for Factor Analysis? Some Decision Rules 1974. 358-61 p.

28. Lorenzo-Seva U, Timmerman ME, Kiers HAL. The Hull Method for Selecting the Number of Common Factors. Multivariate Behavioral Research. 2011;46(2):340-64.

29. Field A. Discovering Statistics Using SPSS. 5nd ed.2017.

30. Tabachnick BG, Fidell LS. Using Multivariate Statistics. Pearson ed.2013.

31. Patil VH, Singh SN, Mishra S, Todd Donavan D. Efficient theory development and factor retention criteria: Abandon the ‘eigenvalue greater than one’ criterion. Journal of Business Research. 2008;61(2):162-70.

32. Hair J, Anderson RE, Black WC, Tatham RL WB. Multivariate Data Analysis.7nd ed..
2010, editor.

33. Byrne BM. Structural equation modeling with AMOS: Basic concepts, applications, and programming: Routledge; 2016.

34. Schweizer K. Some guidelines concerning the modeling of traits and abilities in test construction. European Journal of Psychological Assessment. 2010;26(1):1-2.

35. Bentler PM. Comparative fit indexes in structural models. Psychological bulletin. 1990;107(2):238.

36. Marôco J. Análise Estatística com o SPSS Statistics 5th ed. 2011.

37. Brown MW, & Cudeck, R. Alternative ways of assessing model fit. In: Bollen KA, Long JS., editors. Testing structural equation models.1993.

38. Nunnally JC, & Bernstein, I. H. Psychometric theory 3rd ed.1994.

39. Kline P. A Handbook of Test Construction (Psychology Revivals). 2015.

Figures
Two models for the confirmatory factorial analysis. Model 1 = A general factor. Model 2 = Three factors.
Figure 2

The sedimentation plot (scree plot)

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

Appendix_2_Modified_Fresno_Test_Short_version.doc
Appendix_1_Modified_Fresno_Test_Short_version_portuguese.doc
Declaration_of_Transparency.doc
Checklist - STROBE.docx