Validity of a protocol for remote static posture assessment (ARPE)

Validação do protocolo de Avaliação Remota da Postura Estática (ARPE)

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Abstract

Introduction: Remote postural assessment, necessary during the pandemic, required strategies to replace its in-person counterpart. **Objective:** Analyze the content validity of a protocol for Remote Static Posture Assessment (ARPE) that includes three items, postural checklist, rater's manual and ratee's manual. **Methods:** Six experts in postural assessment were invited to validate the content of the three items of the ARPE protocol and 10 laypersons evaluated the ratee's Manual. The validity questionnaire encompassed the protocol in general and each individual item, containing an area for suggestions from experts and laypersons. The responses of these raters were used to calculate the Content Validity Indexes (CVI). **Results:** Two rounds of evaluations were carried out with the experts and one with the laypersons. In the first round with the experts, the CVI ranged from 98.6 to 83%. Three aspects (description of head positioning, description of scapula and waist positioning in the frontal plane) required adjustments. In the first round with the laypersons and second round with the experts, the CVI was 100%. **Conclusion:** The 100% agreement between experts and laypersons regarding the content of the ARPE protocol confirms its content validity.

Keywords: Posture. Telerehabilitation. Validation study.

Resumo

Introdução: *A avaliação da postura por atendimento remoto, necessária durante o cenário pandêmico, exigiu estratégias para substituir a avaliação postural presencial.* ***Objetivo:*** *Realizar a validação de conteúdo de um protocolo de Avaliação Remota da Postura Estática (ARPE) que contempla três itens: checklist postural, manual do avaliador e manual do avaliado.* ***Métodos:*** *Seis especialistas em avaliação postural foram convidados para a validação de conteúdo dos três itens do protocolo ARPE e 10 leigos avaliaram o manual do avaliado. O questionário de validação englobava o protocolo em geral e cada item isolado, contendo espaço para sugestões dos especialistas e leigos. As respostas desses avaliadores foram utilizadas no cálculo dos índices de validade de conteúdo (IVCs).* ***Resultados:*** *Foram realizadas duas rodadas de avaliações com especialistas e uma com leigos. Na primeira rodada com os especialistas, os IVCs variaram de 98,6 a 83%.Três aspectos (descrição do posicionamento da cabeça, do posicionamento das escápulas e da "cintura" no plano frontal de costas) necessitaram de ajustes. Na primeira rodada com os leigos, os IVCs foram de 100%. Na segunda rodada com os especialistas, os IVCs foram de 100%.* ***Conclusão:*** *A concordância de 100% entre os especialistas e leigos sobre o conteúdo do protocolo ARPE confirma sua validade de conteúdo.*

Palavras-chave: *Postura. Teleatendimento. Estudo de validação.*

Introduction

Different methods have been used to assess body posture in different settings, such as schools, clinics and gyms.[1] Classic body assessment, in the orthostatic position, is based on the qualitative visual assessment of body asymmetries in the sagittal and frontal planes.[1,2] This is usually performed in person or by analyzing photographs, also obtained in person.[1,2] However, in situations where this is not possible, methodological procedures must be adapted to the virtual environment in order to obtain a photographic record of posture.

With the new global scenario caused by the COVID-19 pandemic, remote care is a strategic alternative to overcome physical and geographic barriers.[3,4] In this respect, there was a greater need to develop technological protocols and tools to qualify remote care.[3,5] The rigor of these protocols and tools is directly associated with measurement properties, such as validity.[1,2,6,7] Among the different validity types, content validity should be the primary focus in creating a new instrument,[6] since it provides evidence on the extent to which the elements of an assessment instrument are representative of the target construct for a certain assessment proposal.[7]

In the context of postural assessment, given that photography provides a two-dimensional and static description of body posture,[8] which can be obtained by virtual (remote) care, research is needed to establish the validity of remote postural assessment. As such, the aim of the present study was to develop and validate the content of the Remote Static Posture Assessment (ARPE) protocol, which includes three items: the postural checklist, rater's manual and ratee's manual. Once the content validity of the ARPE protocol is confirmed, it is believed that it will be a useful tool in providing information on the static posture of people when in-person assessment is not feasible.

Methods

This is a study on the development and validity of the ARPE protocol, which was approved by the Research Ethics Committee of the Federal University of Rio Grande do Sul, where it was conducted (CAAE: 54077321.1.0000.5347).

Development of the ARPE protocol involved two steps: (1) a review study,[9] aimed at identifying, examining and describing the instruments, methods and variables used to assess static body posture via telerehabilitation, whose measurement properties have been described; this review served as the foundation for the proposed protocol; (2) The personal experience of researchers with postural assessment and exchanging experiences with their peers regarding remote care and the development of new postural assessment instruments.

The ARPE protocol initially consisted of a postural checklist to guide care, with a description of posture parameters in the frontal and sagittal planes; a rater's manual, with detailed guidelines on how to obtain information via remote care; and a ratee's manual, with instructions for the person to be assessed.

The postural checklist (Appendix 1) contains a header for personal identification data and instructions on using the checklist, where to insert the photograph of the

assessed person and a brief description of the following terms: alignment, misalignment and alteration. The use of a postural checklist presumes the fulfillment of some basic procedures, which are presented in two manuals: rater's manual and ratee's manual.

The rater's manual (Appendix 2) contains guidelines for the assessor regarding contact with the ratee; materials, procedures and software needed to capture the image; instructions that should be given to the ratee; procedures used in treating images to insert the virtual plumb line; and how to use the Postural Checklist.

The ratee's manual (Appendix 3), which contains instructions for the person who will be assessed, aims at helping prepare and organize the environment; indicates the materials needed for the assessment; and instructs them on the proper clothing to wear at the assessment.

Expert assessment

Six experts, selected by convenience, were invited to validate content (two master's holders and two with PhDs), using the "snowball" methodology.[10] All the experts have more than five years' experience in postural assessment and experience in remote care, two with experience in studies that assess the measurement properties of postural assessment instruments. The experts were emailed the invitation, informed consent form, ARPE protocol (postural checklist, assessor manual and assessee manual) and a specific questionnaire for content validity.

The validity questionnaire contains 37 questions on the ARPE protocol (Chart 1), including six general questions (1-3,20,32,33), 16 on the postural checklist (4-19), 11 on the rater's manual (21-31) and four on the ratee's manual (32-37). For each of these questions, the experts answered: 1 = not relevant; 2 = somewhat relevant, needs substantial revision; 3 = relevant, but needs minor revision; 4 = very relevant. There was a space after each item for the experts to explain their scores. At the end of the content validity questionnaire there was a blank space where the experts could spontaneously assess the ARPE protocol, providing criticisms and/or observations.[11]

After returning from the first assessment round, if necessary, the ARPE protocol would be reformulated based on the experts' suggestions and submitted to a second round. This process would be repeated until there was agreement among the experts. [6,7,11]

Layperson assessment

For content validity of the ratee's manual, 10 laypersons of both sexes, aged 18 years or older, with no professional experience in postural assessment, were invited to take part in the study. This sample size is in line with content validity guidelines.[6,7,11] The sample was recruited on social media, using the "snowball" methodology.[10] The researchers emailed an invitation, informed consent form, the ratee's manual and a content validity questionnaire to the interested laypersons.

The questionnaire contained six questions on ease of understanding and the quality of information on prior preparation for postural assessment (questions 32 to 37 of Chart 1). For each question, the laypersons could answer: 1 = not relevant; 2 = somewhat relevant, needs substantial revision; 3 = relevant, but needs minor revision; or 4 = very relevant to the items of the proposed manual. For all the questions, if attributed scores of 1, 2 or 3, the laypersons gave their reasons for this assessment. At the end of the questionnaire, there was a space for them to spontaneously assess the ratee's manual, providing criticisms or observations.[11] After returning to the first assessment round, if necessary, the ratee's manual would be reformulated, based on the laypersons` suggestions, and resent for a second assessment round. This process would be repeated after validation by the experts

Data analysis

The content validity of the ARPE protocol was determined based on the agreement between experts and laypersons, as demonstrated by the content validity index (CVI) used to measure the content validity of each question and of the ARPE protocol as a whole. The following indices were used: Item-level content validity index (I-CVI): calculated by the number of scores 3 and 4 obtained in each question of the content validity questionnaire; Scale-level content validity index/universal agreement calculation method (S-CVI/UA): defined as the number of questions on the content validity questionnaire that received a score of 3 and 4 by all the experts;Scale-level content validity index/averaging calculation method (S-CVI/Ave): the average number of answers to individual questions on the content validity questionnaire, obtained by adding the I-CVI and dividing by the number of questions on the content validity questionnaire.[12,13]

Chart 1 - Content validity questionnaire for the Remote Static Posture Assessment (ARPE) protocol

	Questions
1.	What is your opinion regarding the ease of understanding the postural checklist?
2.	In general, what is your opinion regarding the postural checklist images?
3.	What is your opinion regarding the objective of assessing static body posture through photographs and using the postural checklist as reference?
4.	What is your opinion regarding the descriptions of the "global examination" in the frontal plane?
5.	What is your opinion regarding the descriptions of "head" positioning in the frontal plane?
6.	What is your opinion regarding descriptions of "shoulder" positioning in the frontal plane of the back?
7.	What is your opinion regarding descriptions of the "waist" in the frontal plane?
8.	What is your opinion regarding thedescriptions of "knee" positioning in the frontal plane?
9.	What is your opinion regarding the descriptions of "shoulder blade" positioning in the frontal plane of the back?
10.	What is your opinion regarding the descriptions of the "waist" in the frontal plane of the back?
11.	What is your opinion regarding the descriptions of "knee" positioning in the frontal plane of the back?
12.	What is your opinion regarding the descriptions of "feet" positioning in the frontal plane of the back?
13.	What is your opinion regarding the descriptions of the "global examination"in the sagittal plane?
14.	What is your opinion regarding the descriptions of "head" positioning in the sagittal plane?
15.	What is your opinion regarding the descriptions of the "dorsal spine" in the sagittal plane?
16.	What is your opinion regarding the descriptions of the "lumbar spine" in the sagittal plane?
17.	What is your opinion regarding the descriptions of "pelvic tilt" in the sagittal plane?
18.	What is your opinion regarding the descriptions of "pelvic version" in the sagittal plane?
19.	What is your opinion regarding the descriptions of "knee" positioning in the sagittal plane?
20.	In general, what is your opinion regarding the ease of understanding of the rater's manual?
21.	What is your opinion regarding the descriptions of the "materials" that the rater will use?
22.	What is your opinion regarding the "before assessment" instructions?
23.	What is your opinion regarding the "at the moment of assessment" instructions?
24.	What is your opinion regarding the "assessment location" instructions?
25.	What is your opinion regarding the "ratee clothing" instructions?
26.	What is your opinion regarding the "checking with the ratee" instructions?
27.	What is your opinion regarding the "personal identification data requested at the start of the assessment"?
28.	What is your opinion regarding "positioning of the ratee during video recording"?
29.	What is your opinion regarding the item "after assessment, to save the video"?
30.	What is your opinion regarding the "image capture" item?
31.	What is your opinion regarding the item "inserting the virtual plumb line"?
32.	In general, what is your opinion regarding the ease of understanding of the ratee's manual?
33.	In general, what is your opinion regarding ease of access to the ratee's manual by email or WhatsApp?
34.	What is your opinion regarding the descriptions of the "materials" that will be used?
35.	What is your opinion regarding the descriptions of the "location" to perform postural assessment?
36.	What is your opinion regarding the descriptions of the "clothing" to wear for the video?
37.	What is your opinion regarding the descriptions of the "positioning of the ratee"?

The ARPE protocol was deemed to be valid with agreement of at least 80% between experts and laypersons.[11,12]

Results

Two assessment rounds were conducted by the experts and only one by the laypersons, since in the first layperson round the CVI was 100%, CVI-UA = 6/6*100% = 100%, S-CVI/AVE = 100%*6 = 600/6 = 100%, as shown in Table 1.

In the first assessment round by the experts, the CVI was satisfactory. In the S-CVI-UA subitem, the experts classified 92% of the questions as 3 or 4. The S-CVI/AVE, which shows the average percentage of experts that attributed a score of 3 or 4 per question, obtained 83% in three questions that were scored 1 or 2 (description of head, shoulder blades and waist positioning in the frontal plane of the back). The other questions obtained 100% (Table 2). Although questions 5, 9 and 10 reached the expected minimum agreement of 80%,[14,15] a second assessment round of the ARPE protocol was conducted, incorporating the experts' suggestions.

Table 1 - Content validity index of the first Ratee's Manual assessment round of the laypersons (L)

No.	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	A3 or 4	I-CVI
32	√	√	√	√	√	√	√	√	√	√	10	100
33	√	√	√	√	√	√	√	√	√	√	10	100
34	√	√	√	√	√	√	√	√	√	√	10	100
35	√	√	√	√	√	√	√	√	√	√	10	100
36	√	√	√	√	√	√	√	√	√	√	10	100
37	√	√	√	√	√	√	√	√	√	√	10	100
A3 or 4	6	6	6	6	6	6	6	6	6	6	-	-

Note: No. = number of questions from the content validity questionnaire; A = answer; I-CVI = *item-level content validity index* (%); √ = item assessed as 3 or 4 on ratee's manual validity questionnaire by the laypersons.

With respect to the postural checklist, the following expert suggestions were incorporated: including in the header a space for date of birth, a description of where to use the term inconclusive and that the segments assessed in more than one plane should have similar results; including the description of where the plumb line should originate in the global assessments; substituting the image in the model profile photo; including a detailed description of the points the plumb line should pass through in the "global examination", in the frontal and sagittal planes; including a detailed description of foot assessment; replacing the term "symmetrical" with "balanced" in the assessment of the dorsal and lumbar spine; highlighting the expressions "excessively, reduced, and smooth" to help decision making; including the term "posteriorized" and its definition in the assessment of the global sagittal examination; and using the reference sites instead of anatomical structures, replacing "tuberosity of the lateral condyle of the femur" "with center of the knee".

For the rater's manual, the following expert suggestions were incorporated: including instructions for ratees who wear glasses every day that these can be worn during the assessment, and including voice commands to guide the ratee. For the ratee's manual, the following expert suggestions were incorporated into the ARPE protocol: photo option only for a door or smooth wall; instruction on the use of a bra-like women's top and hair pinned back on the top of the head; including a video tutorial;[16] and option of using a tablet for assessment. After the second assessment round of the ARPE protocol, which considered all the suggestions given, there was 100% agreement among the experts, with the S-CVI/Ave and S-CVI/UA indices also equal to 100% (Table 3).

Table 2 - Content validity index of the first round of Remote Static Posture Assessment (ARPE) by the experts (S)

No.	S1	S2	S3	S4	S5	S6	A3 or 4	I-CVI
1	√	√	√	√	√	√	6	100
2	√	√	√	√	√	√	6	100
3	√	√	√	√	√	√	6	100
4	√	√	√	√	√	√	6	100
5	√	√	X	√	√	√	5	83
6	√	√	√	√	√	√	6	100
7	√	√	√	√	√	√	6	100
8	√	√	√	√	√	√	6	100
9	√	√	√	X	√	√	5	83
10	√	√	√	X	√	√	5	83
11	√	√	√	√	√	√	6	100
12	√	√	√	√	√	√	6	100
13	√	√	√	√	√	√	6	100
14	√	√	√	√	√	√	6	100
15	√	√	√	√	√	√	6	100
16	√	√	√	√	√	√	6	100
17	√	√	√	√	√	√	6	100
18	√	√	√	√	√	√	6	100
19	√	√	√	√	√	√	6	100
20	√	√	√	√	√	√	6	100
21	√	√	√	√	√	√	6	100
22	√	√	√	√	√	√	6	100
23	√	√	√	√	√	√	6	100
24	√	√	√	√	√	√	6	100
25	√	√	√	√	√	√	6	100
26	√	√	√	√	√	√	6	100
27	√	√	√	√	√	√	6	100
28	√	√	√	√	√	√	6	100
29	√	√	√	√	√	√	6	100
30	√	√	√	√	√	√	6	100
31	√	√	√	√	√	√	6	100
32	√	√	√	√	√	√	6	100
33	√	√	√	√	√	√	6	100
34	√	√	√	√	√	√	6	100
35	√	√	√	√	√	√	6	100
36	√	√	√	√	√	√	6	100
37	√	√	√	√	√	√	6	100
A3 or 4	37	37	36	35	37	37	-	-

Note: No. = number of questions on the validity questionnaire; A = answer; I-CVI = *item-level content validity index* (%); √ = item assessed as 3 or 4 on the ratee's manual validity questionnaire by the experts; X = item assessed as 1 or 2 by the experts on the ratee's manual validation questionnaire.

Table 3 - Content validity index of the second Remote Static Posture Assessment (ARPE) round with the experts (S)

No.	S1	S2	S3	S4	S5	S6	A3 or 4	I-CVI
5	√	√	√	√	√	√	6	100
9	√	√	√	√	√	√	6	100
10	√	√	√	√	√	√	6	100
A3 or 4	3	3	3	3	3	3	-	-

Note: No. = number of questions on the validity questionnaire; A = answer; I-CVI = *item-level content validity index* (%); √ = item assessed as 3 or 4 on the validity questionnaire of the ratee's manual by the experts.

Discussion

A recent review study[9] demonstrated a gap in reliable instruments that assess static posture remotely, indicating the need to use information technology to evaluate posture from a distance. With a view to bridging this gap, the present study evaluated the content validity of the ARPE protocol, obtaining validity indices of 100% at the end of the process.

When developing a new instrument, content validation is a very important process[6,7,11,17] and it should be the first step to establish whether an instrument really evaluates what it proposes.[5] As such, its requires a rigorous process, since the steps and information obtained are essential in determining the quality of the new instrument.[6,7,11,18,19] Although the authors also underscore the importance of content validity in developing new instruments,[11,20] few studies describe the properties of the measurements assessed,[9] which is the difference in the present investigation, since it presents the measurement property of the ARPE protocol.

When content validity is analyzed by a committee of experts, it provides information on the representativeness and clarity of each item, with suggestions to improve the assessment instrument.[6,7,11,18,19] In this study, a committee of six experts assessed the ARPE protocol and ten laypersons the Ratee's Manual. The authors disagreed on the number of experts needed to evaluate content validity, ranging from three to ten,[6,7,11] demonstrating that the higher the number of experts, the more difficult it is to reach an agreement.

Some studies emphasize the importance of clinical proficiency in selecting experts.[11,14,17] The experts in this study had more than five years of clinical practice in postural assessment and experience in remote care, and two were experienced researchers in development studies and assessment of instrument measurement properties for postural assessment.

It is important to note that experts should not only assess an instrument as a whole, determining its scope, but also analyze the items individually to evaluate its clarity and relevance.[3] In the present study, the content validity questionnaire contained 37 questions on the ARPE protocol, including six general questions and the others on each item of the postural checklist, and rater's and ratee's manuals. In addition, each of these questions had a space where the experts and laypersons could freely assess all the items, providing criticisms or suggestions.

Content validity of the ratee's manual by experts is considered by Lynn[11] as the "validity awarded by a layperson's acceptance that an instrument seems to be solid or relevant". Rubio et al.[6] underscore that this assessment is for the public to whom the issue is most significant, and whom the measure being developed represents. Thus, the assessment of laypersons ensures the correction of unclear instructions or those that raise questions.[21] In the present study, this step was conducted after expert validation of the protocol, because it is believed that the people that use the manual should express their opinion about its ease, clarity and coherence as a whole and the items individually.

For quantative analysis of assessor agreement (experts and laypersons), that is, in order to obtain the measurement properties, it is recommended that content validity indices be used.[7,12] These indices are therefore essential factors in the instrument development process. Determining the CVI of each item and the overall CVI is especially important when the instrument is used to measure health outcomes or to guide clinical

decisions.[6,7,11-13] In the present study, CVI was used to measure assessor (experts and laypersons) agreement.

Also with a focus on the methodological rigor of the content validity process, two important aspects of the present study are emphasized. First, in the content validity questionnaire, a four-point classification scale revealed that it is preferable to both scales (odd-numbered or classification), which do not have the option for the assessor to be unsure or neutral.[11] Second, 80% agreement was established as the minimum to consider the ARPE protocol valid. This criterion was used in the analysis of both experts and laypersons.[12,14] After completing all the content validity procedures, 100% agreement was achieved for both experts and laypersons, demonstrating the content validity of the ARPE protocol.

A number of limitations of content validity studies should be noted, such as the subjective feedback of experts,[21,22] which subjects the study to a biased interpretation and assessment from the experts themselves. Another potential limitation is that content validity does not necessarily identify the content that can be omitted in the initial preparation of the instrument.[7]

The present study, however, overcomes these limitations by applying methodological rigor in all steps of the content validity process and using experts with broad knowledge in the clinical or research field, who provided suggestions for each item of the ARPE protocol. It is important to note that all the suggestions were incorporated, thereby increasing confidence in the ARPE protocol.

Several types of devices can be used to implement the ARPE protocol, such as cell phones, laptops, tablets or cameras connected to PCs. Camera resolution and internet quality at the time of assessment will influence the video being recorded and, in turn, the image used in postural assessment. In addition, camera positioning at assessment may also influence the results. To minimize this problem, the following is suggested for the rater's and ratee's manuals: (a) that the distance between the camera and the ratee be around 2 meters; (b) that the entire body of the ratee appear in the camera's viewfinder; and (c) that the ratee be positioned in an area with natural or front light to avoid shadows. It is known that sending a video tutorial before assessment helps the patient and decreases difficulties related to poor image quality.[3,8] In the present study, based on one expert's suggestion, a link to the assessment presentation video was included in the ratee's manual.[16]

The main contribution of the ARPE is to bridge the gap in remote posture assessment instruments. ARPE is primarily an easy-to-use, practical, low-cost instrument. It contains two manuals to guide the rater and ratee, and an explanatory video on how assessment should be conducted. ARPE assesses the frontal (dorsal and ventral) and sagittal planes, and allows individual assessment of these planes should the rater be interested. The ARPE postural checklist contains the following: a space for the rater to insert a photograph of the ratee; descriptive items of the alignments and misalignments of each body segment; the option of marking inconclusive in the assessment of each body segment; and a space for observations that the rater deems relevant. The checklist is a way of minimizing the subjectivity inherent in postural assessment, but it is essential that both the ratee and rater follow closely all the manual instructions.

Conclusion

The ARPE protocol was developed to meet the need for a protocol able to evaluate static posture remotely, allowing the assessment and follow-up of posture from a distance. The results confirm that the ARPE protocol exhibits content validity, with 100% agreement in both expert and layperson assessment.

It is important to note that the ARPE protocol was created based on clinical practice and planning for two planes (frontal and sagittal), but not necessarily used together. However, to correctly apply the ARPE protocol, it is essential that the rater and ratee follow certain practices contained in the protocol manuals.

Authors` contributions

BMP, MGS and CTC were responsible for the study design and methodology; BMP for validation processes and writing the first draft; IP and CTC for technological resources; BMP and PF for data curation, which were analyzed by BMP, MGS and IP. BMP, MGS and CTC wrote, revised and edited the article. The project was managed by BMP and supervised by CTC. All the authors approved the final version.

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