

ORIGINAL RESEARCH

Measurement properties of the Human Activity Profile questionnaire in hospitalized patients



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Abstract

Objective: To test the measurement properties (reproducibility, internal consistency, ceiling and floor effects, and construct validity) of the Human Activity Profile (HAP) questionnaire in hospitalized patients.

Methods: This measurement properties study recruited one-hundred patients hospitalized for less than 48 h for clinical or surgical reasons. The HAP was administered at baseline and after 48 h in a test–retest design). The International Physical Activity Questionnaire (IPAQ-6) was also administered at baseline, aiming to assess the construct validity. We tested the following measurement properties: reproducibility (reliability assessed by type 2,1 intraclass correlation coefficient (ICC_{2,1})); agreement by the standard error of measurement (SEM) and by the minimum detectable change with 90% confidence (MDC₉₀), internal consistency by Cronbach's alpha, construct validity using a chi-square test, and ceiling and floor effects by calculating the proportion of patients who achieved the minimum or maximum scores.

Results: Reliability was excellent with an ICC of 0.99 (95% CI = 0.98–0.99). SEM was 1.44 points (1.5% of the total score), the MDC₉₀ was 3.34 points (3.5% of the total score) and the Cronbach's alpha was 0.93 (alpha if item deleted ranging from 0.94 to 0.94). An association was observed between patients classified by HAP and by IPAQ-6 ($\chi^2 = 3.38$; $p = 0.18$). Ceiling or floor effects were not observed.

Conclusion: The HAP shows adequate measurement properties for the assessment of the physical activity/inactivity level in hospitalized patients.

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Introduction

Physical activity level is an important predictor of hospital admission, complications, and mortality in patients with chronic diseases, such as chronic obstructive pulmonary disease¹ and heart failure,² and acute diseases, such as spinal cord injury³ and acute myocardial infarction.⁴ Inactive patients are more likely, in daily life, to develop complications after surgeries^{5,6} and hospital readmission.^{7,8} This susceptibility to worse outcomes is probably associated with more comorbidities and a lower recovery capacity.⁹ On the other hand, patients with a high physical activity level in daily life are more likely to recover early in the postoperative period,¹⁰ accelerating their hospital discharge and reducing their functional impairment, immobilization, mortality rate, and healthcare costs.^{11,12} Therefore, assessing the level of physical activity before hospital admission is important to detect inactivity in the daily life of hospitalized patients aiming to develop strategies for early rehabilitation, such as muscle strengthening and improved fitness, which can reduce the risk of poor outcomes.

There are many methods to assess physical activity level in daily life, such as questionnaires, accelerometers and pedometers.¹³ A good measurement tool should take into account the frequency, intensity, and duration of physical activity.¹⁴ Other aspects to consider when choosing a measurement tool to be used in clinical studies would involve the costs, the sample size, the time and number of assessors available for data collection.¹⁴ Questionnaires have been increasingly used in healthcare research and in clinical practice due to their low cost and ease of administration.¹⁵ In a hospitalized population, questionnaires are especially useful because they can assess the level of physical activity in daily life before hospital stay.¹³ On the other hand, although the accelerometers and pedometers are more precise measurement tools, they can only be useful to measure physical activity level when the patients are available for data collection, e.g., during hospital stay or before admission to hospital).¹³

The accuracy of information obtained by a questionnaire depends on three aspects: (1) whether the patient understands the questions properly,¹⁶ (2) ease of the scoring system, and (3) measurement properties' estimates on the target population.¹⁷ We are unaware of any questionnaires aimed at assessing physical activity levels in the daily life of hospitalized patients in general that have had their measurement properties tested. The only exception is a previous study that tested the measurements properties of the Human Activity Profile (HAP) questionnaire in hospitalized patients after allogeneic hematopoietic stem cell transplantation.¹⁸ The authors showed good results, indicating that it can be an appropriate questionnaire for hospitalized patients in general.

The International Physical Activity Questionnaire (IPAQ-6) is one of the most widely used questionnaires in health care practice to assess level of physical activity. The IPAQ-6 considers the intensity of physical activity in a patient's routine, at work, at home, and means of transportation.¹⁹ The weaknesses of this questionnaire are that it considers only the last days of activities, it does not have an objective score, and it is too extensive.²⁰ A questionnaire that evaluates the

physical activity levels in daily life and that has been increasingly used worldwide is the HAP.^{21,22} This questionnaire has been used in both healthy and symptomatic population as it assesses physical activities ranging from very easy to very strenuous.²¹ The HAP estimates the energy expended in daily activities and physical fitness.^{21,22} The questions involve self-care activities, work, social activities and exercise, and activities that require the use of muscle groups of the hands, legs, and trunk and the use of wheelchairs.²³ A systematic review showed that the HAP's measurement properties are consistent, but limited in multiple languages and populations with different chronic conditions.²³ Furthermore, this systematic review also suggested that some measurement properties, such as the minimum detectable difference of the HAP, still need to be better investigated, possibly due to the small samples enrolled in the previous studies.²³ Although the HAP has already been translated and cross-culturally adapted to Portuguese, its measurement properties have not been tested in the Brazilian population.²¹

Therefore, the objective of this study was to test the reproducibility (reliability and agreement), internal consistency, construct validity, and ceiling and floor effects of the Human Activity Profile questionnaire administered to hospitalized patients.

Methods

Participants

The study included one-hundred consecutive patients admitted to a university hospital for less than 48 h for clinical or surgical reasons (during the preoperative period). The inclusion criteria were patients over 18 years old, able to read and understand the questionnaires, expected to remain hospitalized for at least three days, able to perform activities of daily living (with or without assistance) and not bedridden.

According to the COSMIN guidelines to conduct reproducibility, construct validity, and ceiling and floor effect analyses, a sample of 100 patients is required.^{24,25} Therefore, a sample size of 100 patients^{24,25} was chosen. This study was approved by the Ethics Committee of Hospital das Clínicas (CAAE: 06324412.9.0000.0068), São Paulo, SP, Brazil, and all participants signed an informed consent form prior to data collection.

Procedure

All participants answered the HAP and IPAQ-6 questionnaires to provide the baseline data. After 48 h, all patients answered the HAP again. This time interval was chosen to prevent changes in clinical status between the test and retest as the need for referral to intensive care unit or change in level of consciousness would make the administration of the questionnaire impossible.

Instruments

Human Activity Profile (HAP): The HAP was cross-culturally adapted to Brazilian Portuguese by Souza et al.²¹ The items

of this instrument do not focus on a specific time point, and the patient is asked to indicate whether they are “still doing this activity”, have “stopped doing this activity,” or “never did this activity.” The total score constantly increases by adding the activities that the patients are able to perform, and it ranges from 0 to 94.²² The adjusted score was used, given by the more intense activity that the patient still engages in, subtracted from the number of activities he/she stopped performing. Activities that have never been performed by the patients were not considered in the total score.²¹ The classification of the physical activity level was classified as low (inactive) if the total score is less than or equal to 53 points, moderate (moderately active) if the total score is between 54 and 73 points, and high (active) for a total score of 74 points or more.²³

The International Physical Activity Questionnaire (IPAQ-6): The IPAQ-6 is a questionnaire developed by the World Health Organization (WHO) and has been cross-culturally adapted to Brazilian-Portuguese.²⁶ The intensity of physical activity is classified as low (inactive) if it requires less than 3.0 METs, moderate (moderate active) if it requires between 3.0 and 6.0 METs, and high (active) if it requires 6.0 METs or more.²⁷ This instrument was chosen because it is the most widely used questionnaire in clinical practice and research in this area and because the final classification is similar to the classification given by the HAP.

Measured properties of the HAP

We measured the following measurement properties:

Reproducibility: measures the degree to which repeated measurements in stable people (test–retest) provide similar answers. Reproducibility is an umbrella term that involves the reliability, agreement, and internal consistency of the instrument.²⁴

- **Reliability** measures the relative error of the instrument measurement, i.e., the ratio between the variance of the patients' scores.^{28,29}
- **Agreement** measures how well patients can be distinguished from one another considering the absolute error of measurement of the instrument.^{29,30}
- **Internal consistency** measures the inter-relationship between the items in a questionnaire and their homogeneity.^{29,30}

Construct validity: measures the association between the scores obtained from a specific questionnaire and another similar instrument so that the assumed hypotheses regarding the magnitude and direction of the association are consistent, as established by the guidelines.^{24,29} The construct validity of the HAP was tested with the IPAQ-6 questionnaire, as both instruments classify the physical activity level of the patients as inactive, moderately active, or active. In this study, our hypothesis for construct validity was that there would be a moderate and positive association between the activity level classifications indicated by the HAP and the IPAQ-6.^{24,25}

Ceiling and floor effects: measure the proportion of patients who achieved the maximum or the minimum HAP score. Ceiling and floor effects were considered present if

15% or more of respondents achieved a maximum or minimum score.^{29,30} A score of ten points or less was considered a minimum score because the first ten questions refer to extremely basic activities. On the other hand, a score of 90 points or more was considered a maximum score because the last four questions refer to extremely strenuous activity and do not reflect the everyday activities of most of the population.

Statistical analysis

Initially, a *t*-test was performed to compare the groups hospitalized for clinical or surgical conditions, and Pearson's correlation test was used to test the relationship between the IPAQ-6 and HPA scores. To evaluate each measure property, the following tests were used:

- 1) Reliability was tested by a type 2,1 intraclass correlation coefficient (ICC_{2,1}) and its 95% confidence intervals. Reliability was considered low if ICC < 0.40; moderate if 0.40 < ICC < 0.75; substantial if 0.75 < ICC < 0.90; and excellent if ICC > 0.90.²⁸
- 2) Agreement between scores from test and retest for each patient was evaluated by the standard error of measurement (SEM = Standard Deviation of difference between test and retest divided by $\sqrt{2}$), and the minimum detectable change with 90% confidence (MDC90 = (pre-test score – post-test score) / $\sqrt{2} \times \text{SEM}$).^{24,25} The SEM is considered very good if <5% of the total score, good if $\geq 5\%$ and <10%, doubtful if $\geq 10\%$ and <20%, and negative if >20%.³⁰
- 3) The internal consistency was assessed by Cronbach's alpha. To be able to perform the analysis, the items marked as “never did this activity” in the HAP were categorized as 0 (zero), items marked as “stopped doing this activity” were categorized as –1 (minus one) and items marked as “still doing this activity” were categorized as 1 (one). In addition, we calculated Cronbach's alpha if item deleted. This analysis was performed to test the internal consistency of the instrument by removing one item at a time from the questionnaire. Values are considered appropriate when they vary between 0.70 and 0.95.³¹
- 4) The construct validity was tested by chi-square tests.

The level of significance for all the tests was set at 5%. The Statistics Package for the Social Science (SPSS) version 19 for Windows was used in the analysis.

Results

The majority of patients included in this study were admitted for treatment of infections or to await abdominal or thoracic surgery. Their age ranged from 18 to 81 years (15% elderly). Forty-one percent of our sample was composed of women. Body mass index ranged from 16.3 to 38.5 kg/m². The reasons for admission to hospital were 54% clinical and 46% surgical (Table 1). Comparing the subgroups of patients admitted for clinical and surgical reasons, we observed that both had similar physical activity levels for all assessments (Table 2).

Table 1 Characteristics of the hospitalized patients ($n = 100$).

Variables	Values
Sex	
<i>Male</i>	58
Age (years)	41 ± 15
Weight (kg)	67.28 ± 18.06
BMI (kg/m²)	27.34 ± 6.18
Reasons for hospital admission	
<i>Clinical conditions</i>	54
Respiratory decompensation	16 (30%)
Infectious	38 (70%)
<i>Surgical conditions</i>	46
Orthopedic	6 (13%)
Thoracic	8 (17%)
Abdominal	30 (70%)

Continuous variables are presented as mean ± standard deviation and the reasons for hospital admission as the absolute number and percentage of total in each subgroup.

The physical activity level was graded and assessed by both questionnaires: HAP (Pearson's correlation = -0.70 ; $p < 0.001$) and IPAQ-6 (Chi-square = 19.482; $p < 0.001$).

All measurement properties showed adequate levels of reproducibility (reliability, agreement, and internal consistency). The reliability was excellent, with an ICC > 0.90 . The agreement was very good, with a SEM $< 5\%$ of the total score. The internal consistency was considered appropriate (Cronbach's alpha > 0.70). The physical activity level classification by the HAP and IPAQ-6 were not significantly different, which confirms the construct validity (Table 3).

No ceiling or floor effects were observed. The lowest score achieved by patients was 45 points (1% of patients) and the highest was 91 points (4% of patients).

Discussion

Our results show that the HAP questionnaire has adequate measurement properties when administered to hospitalized

patients to assess physical activity level. Although this is the first study to evaluate all of these measurement properties in hospitalized patients, the results reproduce previous findings in patients with chronic conditions.²³

Our study was conducted in 100 patients, a sample considered optimal to test measurement properties.²⁵ We included a heterogeneous sample that realistically represents hospitalized patients. Our sample was composed of young adults and elderly patients, normal weight and overweight patients, and patients with different reasons for admission to hospital, which enhances the external validity of our findings. A suitable questionnaire to measure the physical activity level of patients in this general condition must be able to match all types of functional impairment and, according to previous studies and the present study, the HAP appears to meet that criterion satisfactorily,^{22,24,31} as it has been demonstrated to have adequate measurement properties.

The HAP questionnaire is not specific to any particular population or clinical condition and can be calculated by the maximum activity carried out or adjusted to the activities that are no longer done. The maximum activity score represents the activities the individual is "still doing", therefore a calculation is not required. The adjusted score is calculated by subtracting the maximum activity score from the number of items that the individual has "stopped doing", prior to the last one that he/she is "still doing." Therefore, the adjusted score provides a more stable estimate of the average daily activities representing the physical activity levels of a given day.²¹⁻²³

Obviously, the use of an instrument that objectively assesses the level of physical activity such as a pedometer or an accelerometer seems to be more attractive than applying a questionnaire. However, in clinical practice, these devices are more costly, and subjects undergoing assessment may forget to use them during the required period or not use them at all, making their use difficult outside an academic environment as it may cause biased measures.

Our study showed substantial levels of reproducibility of the HAP administered to hospitalized patients. The reliability of the HAP was assessed in a test-retest design and was classified as excellent. Our results were similar to those

Table 2 Physical activity level assessed by two instruments in the total group and in subgroups divided according to the reasons of hospital admission.

Physical activity level	All patients ($n = 100$)	Clinical conditions ($n = 54$)	Surgical conditions ($n = 46$)	p
<i>HAP adjusted scoring</i>				
HAP test	68.34 ± 12.83	67.23 ± 13.53	69.52 ± 12.08	0.40
HAP retest	68.45 ± 12.54	67.37 ± 13.24	69.60 ± 11.76	0.38
<i>HAP classification</i>				
Inactive	15	9	6	0.82
Moderately active	55	27	28	0.37
Active	30	18	12	0.57
<i>IPAQ classification</i>				
Inactive	19	12	7	0.43
Moderately active	42	21	22	0.49
Active	38	21	17	0.99

Continuous variables are presented as mean ± standard deviation and categorical variables as absolute numbers. The subgroups divided according to reason for hospital admission were compared using t test, with the significant level set at 5%.

Table 3 Measurement properties of the human activity profile questionnaire administered to hospitalized patients ($n = 100$).

	Reliability ICC _{2,1} (CI _{95%})	Agreement SEM/MDC ₉₀	Internal consistency Cronbach's alpha (Variation for each detected item)	Construct validity Chi-square with classification by IPAQ-6
HAP	0.987 (0.981 and 0.991)	1.44/3.34	0.937 (0.935–0.938)	3.39 ($p = 0.18$)

ICC_{2,1}: Intraclass correlation coefficient type 2,1; SEM: standard error of measurement; MDC₉₀: minimum detected change with 90% of confidence; IPAQ: International Physical Activity Questionnaire. The significance level was set at 5%.

of previous studies that also have used the HAP adjusted scoring, where the reliability ranged from substantial to excellent (ICC 0.76–0.97).²³ However, these previous studies have tested the reliability in a small number of subjects (20–28 subjects).²³ The agreement of the instrument indicated in our study by the SEM was less than 2%, which can be classified as excellent,²⁵ showing a low variability of response between the answers given by patients on the test and retest. The SEM provides an error measurement value, which allows us to know the amount of real change. This type of measurement of reproducibility is more applicable in clinical practice compared to the ICC, for example. The SEM also allows the calculation of the minimum detectable change (MDC), which is an estimate of the minimum change in score greater than the instrument error. Based on our results, the difference between two HAP scores needs to be greater than 3.34 points to be considered real change. Therefore, in practice, our results show that changes in physical activity level detected by the HAP are real and not due to problems in the questionnaire's structure.

The HAP questionnaire administered to hospitalized patients also demonstrated adequate internal consistency in our study, i.e., questionnaire items were homogeneous and therefore each group of items that was designed to measure a certain domain actually measured it.¹⁹ On the other hand, Cronbach's alpha above 0.90 can indicate excessive redundancy of the questionnaire,³¹ suggesting the need for a shortened version of the HAP. Nevertheless, Souza et al.²¹ found a Cronbach's alpha of 0.91 when the HAP was administered to community-dwelling elderly. The authors believe that this result indicates stability of the calibration of the questionnaire items.

Regarding construct validity, the HAP was shown to be appropriate for assessing physical activity level if used as a tool for classification. Classification as inactive, moderately active, or active according to the HAP were similar to those provided by the IPAQ-6, which is the most commonly used instrument to assess and classify physical activity levels in healthy and sick people.³² We believe that our study provides a novel result in the literature, because to our knowledge, it was the first one to evaluate all of the major measurement properties, such as reliability, internal consistency, ceiling and floor effects, and construct validity in a hospitalized population.

Regarding floor and ceiling effects, because the activities assessed by the HAP range from very easy (sitting and standing) to very strenuous (running 5 km in 30 min or less), the results were as expected. Therefore, the structure of

the questionnaire appears to be adequate even for general populations related to age and clinical condition, such as hospitalized patients. This observation was confirmed because a variation of only 3.4 points in the adjusted score was necessary for an impact on clinical practice, with a 90% certainty that this change did not occur because of an instrument measurement error.

Knowledge of appropriate measurement properties of a questionnaire helps health professionals choose the best instrument for each situation in clinical practice. Previous studies showed good association between the HAP score and physical performance, muscle strength, and endurance tests in hospitalized patients.^{18,33,34} Therefore, a low score may indicate the need for improvement in the patient's physical condition prior to surgery or during intra-hospital rehabilitation in order to minimize or prevent complications and morbidities related to hospital admission.^{5–8}

Study limitations

The main limitation of this study may have been some recall bias by the patients when they answered the questionnaire for the second time after 48 h. However, we chose a time interval between test and re-test that had no impact on any clinical change that could interfere with patient responses, as recommended by the guidelines. In addition, we assessed only the measurement properties of the HAP. Future studies should assess other aspects such as proper understanding of the issues by patients and understanding of the questionnaire scoring system by health professionals.

Conclusions

The HAP questionnaire has adequate measurement properties and can be used to assess the physical activity and inactivity of hospitalized patients during clinical routine and in research protocols; however, its questions have a degree of redundancy and the development of a shortened version could be very useful.

Conflicts of interest

The authors declare no conflicts of interest.

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