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# Development and content validation of the FisiCan-CP: a physiotherapy screening tool for patients with advanced cancer receiving palliative care in resource-limited communities

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## ABSTRACT

**Introduction:** Physiotherapy plays a vital role in palliative care for patients with advanced cancer. However, access to physiotherapy is often limited in resource-limited communities. To address this gap, a screening tool tailored to clinical needs and contextual constraints is needed.

**Objective:** To develop and validate the content of the FisiCan-CP, a physiotherapy screening tool for patients with advanced cancer receiving palliative care in resource-limited communities.

**Methods:** A methodological study was conducted in two phases: (1) development of the instrument based on clinical data, targeted literature review, and expert brainstorming; and (2) content validation by Delphi method.

**Results:** Eleven preliminary items were generated and submitted to expert evaluation. In the first Delphi round, 10 items reached the consensus threshold, resulting in the exclusion of the delirium item, the merging of two functionality-related items, and the addition of fall risk. In the second round, all remaining items achieved high agreement (Content Validity Index >0.90). The final FisiCan-CP consists of 10 items: functional limitation, immobility syndrome, frailty, moderate/severe pain, asthenia/fatigue, lymphedema, vascular changes, pressure injuries, dyspnea, and fall risk.

**Conclusion:** The FisiCan-CP demonstrated strong content validity and provides an initial, conceptually grounded tool to support physiotherapy referral in palliative care.

## ARTICLE HISTORY

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## KEYWORDS

Palliative care; physiotherapy; screening; advanced cancer; resource-limited settings

## 1. Introduction

Physiotherapy is increasingly recognized as a key component of palliative care for patients with advanced cancer, helping to manage symptoms such as pain, dyspnea, fatigue, and immobility, while supporting autonomy and functional independence [1]. For dyspnea, physiotherapy may help through positioning, breathing techniques, airway clearance, and energy-conservation strategies, which can reduce the sensation of breathlessness and improve functional tolerance [2]. Evidence indicates that physiotherapy interventions can improve quality of life, reduce caregiver burden, and help maintain daily living activities, especially as disease progresses and symptom burden intensifies, benefits that are particularly relevant in advanced disease, where symptom burden and functional decline are highly prevalent [1,3,4]. Despite this growing recognition, timely referral to physiotherapy is not routinely achieved in many palliative care settings.

However, in resource-limited and socioeconomically disadvantaged communities, barriers such as limited availability of rehabilitation services, inadequate healthcare infrastructure, and social inequities further hinder access to physiotherapy [5,6]. These challenges are especially evident in densely populated urban settlements like Brazilian favelas, where palliative care teams often work in constrained environments with limited rehabilitation capacity. These contextual constraints frequently force healthcare teams to prioritize patients based on clinical urgency rather than standardized criteria, which can increase disparities and compromise the continuity of supportive care [7,8].

In this context, factors such as educational attainment, occupation, lack of insurance coverage, and advanced age strongly influence access to rehabilitation services. Consequently, patients living in socially vulnerable settings are more likely to experience unmet rehabilitation needs [6]. In resource-

limited healthcare systems, the absence of structured referral criteria may further delay access to physiotherapy and worsen clinical outcomes [7]. Screening strategies that are simple, culturally appropriate, and based on typical clinical presentations may therefore support more equitable referral pathways in these settings.

Despite this, existing assessment tools commonly used in palliative care, such as the Karnofsky Performance Status (KPS) [9] and the Palliative Performance Scale (PPS) [10], provide valuable insights into functional decline but were not specifically designed to identify physiotherapy needs or guide referral decisions. Additionally, these tools do not fully address common physiotherapeutic targets, including fatigue, pain affecting mobility, dyspnea, lymphedema, and fall risk [2,11]. The lack of validated instruments specifically for physiotherapy screening contributes to delays in referral, inconsistent prioritization, and missed opportunities for symptom management and rehabilitation in patients with advanced cancer [3,12].

Moreover, most available tools do not adequately address contextual, cultural, and socioeconomic factors that influence access to care. Recent evidence indicates that even among instruments used in advanced cancer populations, very few have been validated, and almost none have been adapted for socially vulnerable groups, including individuals experiencing socioeconomic deprivation, low educational attainment, and barriers to accessing continuous healthcare [13].

Given these gaps, developing a physiotherapy-specific screening tool that reflects clinical priorities and contextual limitations may support decision-making, optimize referral processes, and promote more equitable access to rehabilitation [7,13]. Such a tool may be especially relevant in palliative care services operating in resource-constrained environments, where professionals must balance high patient demand with limited therapeutic capacity. Therefore, the aim of this study was to develop and validate the content of the FisiCan-CP, a physiotherapy screening tool for patients with advanced cancer receiving palliative care, particularly in resource-limited communities.

## 2. Methods

### 2.1. Study design

This methodological study was conducted in two phases: (1) development of the screening instrument, based on clinical data from patients with advanced cancer, a targeted literature review, and expert brainstorming; and (2) content validation (Figure 1). Ethical approval was obtained from the

Research Ethics Committee of the National Cancer Institute, Rio de Janeiro, Brazil (protocol number 69123823.6.0000.5274).

### 2.2. Phase 1: Instrument development

#### 2.2.1. Cross-sectional analysis

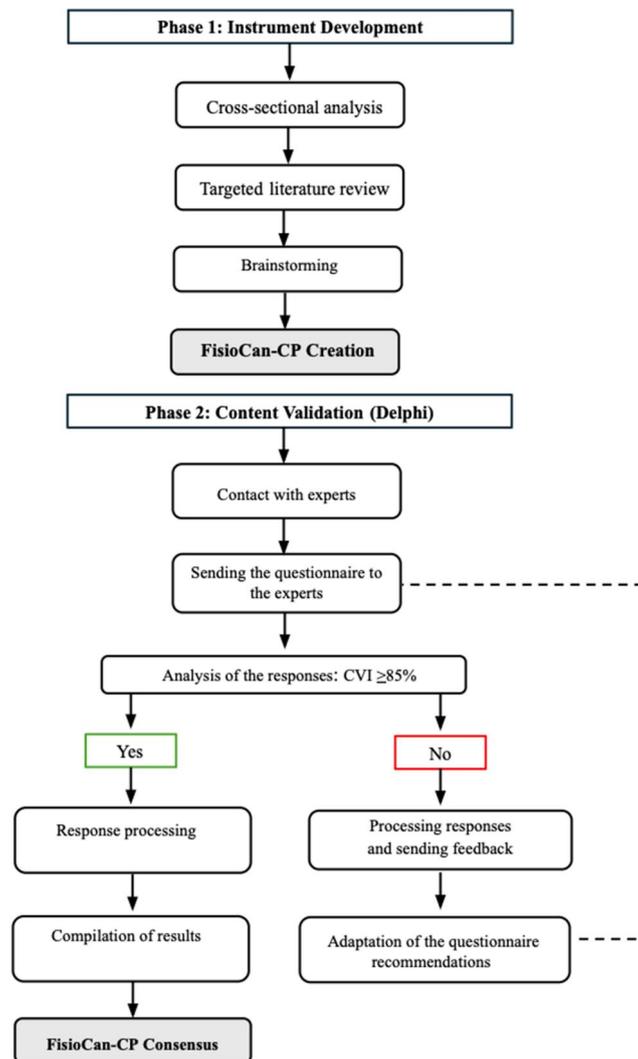
A retrospective cross-sectional analysis was conducted using clinical records of patients with advanced cancer living in the Rocinha and Vidigal favelas in Rio de Janeiro, Brazil. These patients live in resource-limited communities and therefore receive follow-up from healthcare professionals and local volunteers who are part of the Compassionate Community, a community-based palliative care initiative established within the favelas. Compassionate Communities function as complementary, rather than substitutive, initiatives to the public healthcare system, providing care focused on promoting human dignity through relief of pain and other distressing symptoms, supporting autonomy and functional capacity, and enabling dignified end-of-life care that addresses physical, psychological, social, and spiritual suffering [14,15].

Patients were eligible if they were 18 years or older, had advanced cancer regardless of tumor site, and received physiotherapy during community-based palliative care (Compassionate Community) follow-up between July 2021 and August 2023. Advanced cancer was defined as malignant disease in incurable or end-stage phases, characterized by high symptom burden and reduced functional capacity [16]. Cases were excluded if clinical records were incomplete or missing.

Sociodemographic, clinical (including common physiotherapy-related symptoms), and functional characteristics were extracted. Functional status was assessed using the KPS, a widely used scale in oncology and palliative care to quantify functional impairment and disease impact, with lower scores indicating greater impairment [9]. Data were analyzed using Stata 15.0, and frequencies and percentages were reported. These data were used to identify the most frequent physiotherapy-related clinical presentations in this population and to support the selection of preliminary domains for the FisiCan-CP.

#### 2.2.2. Targeted literature review

In parallel, a targeted literature review was conducted to identify common physiotherapy needs in patients with advanced cancer receiving palliative care and to support the selection of clinically relevant domains for the initial version of the FisiCan-CP. Searches were performed in PubMed, LILACS, and the Cochrane Library in July 2023, covering the



**Figure 1.** Stages of development and content validation of the FisiCan-CP.

Note: CVI = Content Validity Index; FisiCan-CP = Physiotherapy Screening Instrument for Patients with Advanced Cancer receiving Palliative Care

previous 10 years to capture contemporary palliative care practices and physiotherapy interventions. The search combined controlled vocabulary (MeSH/DeCS) and free-text terms related to ‘physiotherapy’, ‘advanced cancer’, and ‘palliative care’.

Studies were eligible if they included adults with advanced or incurable cancer, reported physiotherapy interventions, functional assessment, or symptom management, and were published in English or Portuguese. Opinion papers and studies lacking full text or a physiotherapy focus were excluded. Two reviewers independently screened titles and abstracts, resolving disagreements by consensus.

Data extracted included target symptoms, clinical conditions, and physiotherapy outcomes. These findings were used to compare the most frequently reported physiotherapy needs in the literature with those identified in the clinical analysis, supporting the convergence of evidence used to draft the preliminary domains of the instrument.

In addition, technical guidelines issued by the Regional Council of Physiotherapy and Occupational Therapy of the 2nd Region [17] were reviewed to

ensure that the selected domains and items align with current clinical and professional recommendations.

### 2.2.3. Brainstorming process

Based on clinical data and literature findings, two physiotherapists with experience in oncology and palliative care drafted a preliminary pool of domains for the development of the screening instrument.

A brainstorming session was conducted with a selected panel of four specialists (two physiotherapists, one nurse, and one nutritionist). The panel was intentionally multidisciplinary to incorporate complementary clinical perspectives relevant to palliative care, while maintaining physiotherapy as the core discipline guiding item development. A small group format is recommended for early instrument development due to feasibility and the potential for in-depth discussion [18,19]. Disagreements regarding item inclusion, wording, or relevance were resolved through group discussion [20].

Text readability was assessed using the ALT software, and items classified as medium or low readability were revised to ensure clarity and

comprehensibility [21]. This brainstorming process produced the first draft of the FísioCan-CP, which was then submitted for Delphi validation.

### 2.3. Phase 2: Content validation (Delphi)

The Delphi technique [20] was used to evaluate the clarity, relevance, and importance of each item in the FísioCan-CP instrument. Literature recommendations for expert panel size in health-related Delphi studies generally range from 10 to 18 participants, which is considered sufficient to ensure reliability while maintaining feasibility [20,22]. Experts from diverse professional backgrounds (physiotherapy, medicine, nursing, nutrition, and occupational therapy) were eligible if they held advanced academic qualifications, had at least five years of clinical experience in oncology and/or palliative care, and demonstrated participation in scientific or clinical activities related to the field. All invited experts provided informed consent and completed an online questionnaire with sociodemographic and professional data.

Once the panel was established, the Delphi process proceeded through iterative rounds to refine item content and achieve consensus. In the first round, experts rated each item on a 5-point Likert scale and provided qualitative suggestions. Items with a Content Validity Index (CVI) below 0.85 were revised or excluded. The CVI was calculated as the proportion of experts rating each item as 4 or 5. A second round was conducted with the revised items. Consensus was defined as a CVI of 0.85 or higher for clarity, relevance, and importance, resulting in the final validated FísioCan-CP.

## 3. Results

### 3.1. Instrument development

A total of 37 patients with advanced cancer receiving palliative care were included in the cross-sectional analysis. Most lived in Rocinha (70.3%), were female (73.0%), and were aged 60 years or older (59.5%). Additionally, 78.4% reported having a caregiver and 83.8% had access to the public health-care system (Supplementary Table 1).

The most frequent clinical complaint among patients receiving physiotherapy was pain (48.7%), followed by functional limitation (24.3%) and asthenia/fatigue (24.3%). Gastrointestinal symptoms and psychological symptoms were identified in 21.6% and 18.9% of patients, respectively, and 27.0% presented other complaints. Functional status was markedly impaired, with 35.1% of patients having a KPS less than 50% (Table 1).

Consistent with the clinical findings, the targeted literature review showed that functional limitation, fatigue, frailty, dyspnea, and fall risk are frequently addressed in rehabilitation studies involving patients with cancer, providing empirical support for the corresponding domains selected for the FísioCan-CP (Table 2).

Integrating findings from the clinical analysis, literature, and the CREFITO-2 technical guideline enabled the identification of an initial pool of seven physiotherapy-related domains (Table 3). These domains were then expanded into 11 preliminary items to form the initial version of the FísioCan-CP, marking the completion of the instrument development phase.

The preliminary version of the FísioCan-CP, consisting of 11 items, was evaluated by 15 specialists (Supplementary Table 2) using the Delphi technique. In the first round, most items met the predetermined consensus threshold with a CVI  $\geq$  0.85; however, the item related to delirium did not reach this level of agreement, obtaining a CVI of 0.77 (Table 4). Based on expert feedback, this item was excluded, and wording and structural adjustments were made to improve clarity. Additionally, fall risk was identified as a relevant domain not previously included and was added as a new item in the revised version of the FísioCan-CP.

In the second and final Delphi round, the revised version of the instrument was reassessed, and all remaining items achieved CVI values above the established threshold, indicating strong agreement on clarity, relevance, and importance (Table 4). No further exclusions or additions were recommended by the expert panel. As a result, the final version of the FísioCan-CP included 10 validated items: functional limitation, immobility syndrome, frailty, moderate or severe pain, asthenia or fatigue, lymphedema, vascular changes, pressure injuries, dyspnea, and fall risk (Table 5), concluding the content validation phase.

**Table 1.** Clinical complaints and functional status of patients receiving physiotherapy in community-based palliative care ( $n = 37$ ).

Clinical complaints	n (%)
Pain	18 (48.7)
Functional limitation	9 (24.3)
Asthenia / fatigue	9 (24.3)
Gastrointestinal symptoms	8 (21.6)
Lymphedema	7 (18.9)
Psychological symptoms	7 (18.9)
Other complaints <sup>1</sup>	10 (27.0)
Functional status	n (%)
<b>KPS</b>	
< 50%	13 (35.1)
$\geq$ 50%	24 (64.9)

Note: KPS = Karnofsky Performance Status.

<sup>1</sup>Other complaints included: arthrosis, right upper limb joint blockage, dyspnea, hemiparesis, aphasia, and tetraplegia.

**Table 2.** Evidence from literature supporting domains of physiotherapy needed in patients with advanced cancer.

Study	Main findings	Supported physiotherapy domains
[23]	Supervised aerobic and resistance exercise improved mobility, strength, and physical functioning in cancer survivors	Functional limitation
[24]	An exercise program for patients with cancer receiving palliative care demonstrated feasibility and reduced fatigue, with functional improvement.	Asthenia/fatigue; functional limitation
[25]	A home-based supervised exercise program for patients with head and neck cancer improved physical function and QoL.	Functional limitation; fatigue
[26]	Rehabilitation in patients with cancer receiving palliative care reduced fatigue and improved physical function and QoL.	Asthenia/fatigue; functional limitation
[27]	Interdisciplinary palliative rehabilitation improved functional status and QoL in patients with cancer.	Functional limitation; frailty
[28]	Non-pharmacological interventions for dyspnea were effective in patients with advanced cancer	Dyspnea
[29]	Home-based rehabilitation was feasible and led to functional gains and improved mobility in patients with cancer.	Functional limitation; fall risk

Note: QoL = quality of life.

**Table 3.** Domains pool for the composition of the preliminary version of the screening tool.

Domains	Source		
	Patient profile	Scientific literature	CREFITO-2 document
Functional limitation	X	X	X
Asthenia/fatigue	X	X	X
Pain	X	X	X
Lymphedema	X	X	
Dyspnea	X	X	X
Delirium			X
Pressure injury			X

Note: CREFITO-2 = *Conselho Regional de Fisioterapia e Terapia Ocupacional da 2ª Região*.

**Table 4.** Content validity Index of the assertions of the physiotherapy screening instrument for patients with advanced cancer receiving palliative care (FisioCan-CP).

Screening tool	CVI		
	Round 1		Round 2
	Clarity	Relevance	Importance
<b>Introduction</b>			
Part 1	100%	100%	100%
Part 2	100%	100%	100%
Part 3	92%	100%	100%
<b>Item</b>			
Functional limitation	92%	100%	100%
Immobility syndrome	100%	100%	100%
Functional incapacity <sup>a</sup>	85%	100%	–
Frailty	92%	100%	100%
Pain	85%	92%	100%
Asthenia, Fatigue, or Weakness	85%	100%	100%
Lymphedema	100%	100%	100%
Vascular changes	85%	92%	92%
Pressure Injury	100%	92%	92%
Delirium <sup>b</sup>	77%	77%	–
Dyspnea	92%	92%	100%
Fall <sup>c</sup>	–	–	100%

Note: CVI = content validity index.

<sup>a</sup>item merged with functional limitation after the first round.

<sup>b</sup>item removed after the first round.

<sup>c</sup>item inserted after the first round.

## 4. Discussion

This study developed and established the content validity of the FisioCan-CP, a physiotherapy screening tool for patients with advanced cancer receiving palliative care in communities with limited access to rehabilitation. The integration of real-world clinical

data, literature evidence, regulatory guidelines, and expert consensus through the Delphi method produced a set of ten items deemed clear, relevant, and important by specialists. This work offers a methodological contribution by creating a preliminary instrument aligned with physiotherapy needs commonly seen in underserved settings, where referral processes may be inconsistent and access to rehabilitation is limited [5,7,8].

Taken together, the final set of items, functional limitation, immobility syndrome, frailty, moderate or severe pain, asthenia or fatigue, lymphedema, vascular changes, pressure injuries, dyspnea, and fall risk, reflects clinical presentations frequently observed in patients with advanced cancer and described in the palliative rehabilitation literature [1–3]. These symptoms and conditions are highly prevalent in advanced cancer, often compromise autonomy and mobility, and are commonly addressed by physiotherapists across care settings [11].

Within this framework, existing tools widely used in palliative care, such as the KPS and PPS, support functional assessment and prognostic stratification [9,10], but offer limited guidance for physiotherapy-specific decision-making. Rather than competing with these instruments, the FisioCan-CP is designed to complement them by focusing on domains directly related to physiotherapy needs, such as fall risk and lymphedema, which are underrepresented in current palliative assessment tools [11,12]. By concentrating on conditions that are both prevalent and potentially responsive to physiotherapy, the tool aims to support more structured and equitable referral processes.

From a clinical perspective, potential clinical implications should be interpreted with caution. Screening tools may support earlier identification of rehabilitation needs, promote standardized prioritization, and optimize resource allocation in palliative care [7,30]. Structured triage systems have been associated with reduced referral delays and improved consistency in physiotherapy pathways [12,13]. However, although

**Table 5.** Final version of the physiotherapy screening instrument for patients with advanced cancer receiving palliative care (FisioCan-CP).

Physiotherapy screening instrument for patients with advanced cancer receiving palliative care (FisioCan-CP)		
Date: / /	Patient name:	
Physiotherapy should be provided early and preventively for patients with advanced cancer receiving palliative care. It should not be limited to the presence of physical problems, such as decreased functional status and worsening symptoms. In other words, patients with any type of cancer require physiotherapy.		
In this context, in resource-constrained settings, patient referrals must be proportionate to service capacity (i.e. the number of available physiotherapists) and patient needs. Accordingly, this screening tool can then be used by other healthcare professionals to ensure timely referrals for physiotherapy.		
<b>Referral criteria for physiotherapy are the identification of one or more of the clinical conditions listed below.</b>		
<b>Mark an X next to each clinical situation listed, indicating its presence in the patient being evaluated.</b>		
	<b>Yes</b>	<b>No</b>
1. Functional limitation	[ ]	[ ]
2. Immobility syndrome	[ ]	[ ]
3. Frailty	[ ]	[ ]
4. Moderate or severe pain that limits mobility and functional status	[ ]	[ ]
5. Asthenia and fatigue	[ ]	[ ]
6. Lymphedema (grade 0, I, II, III, or IV) in the lower limbs, upper limbs, genital region, etc.	[ ]	[ ]
7. Vascular changes	[ ]	[ ]
8. Pressure injuries (stages I–IV) that compromise functional status and quality of life	[ ]	[ ]
9. Acute or chronic dyspnea	[ ]	[ ]
10. Fall or recent history of falls	[ ]	[ ]
Stamp:	Professional signature:	
<i>Front of the instrument</i>		
<b>Details of clinical situations</b>		
<b>1. Functional limitation</b>	<b>2. Immobility syndrome</b>	
Limitation related to one or more of the following conditions	Impairment of the musculoskeletal system (muscles, bones, joints, tendons, and ligaments) related to one or more of the following conditions:	
- Need for assistance with activities (community, social, and domestic);	- Functional limitation that impairs transfers, postures, and movement in bed;	
- Need for assistance with self-care activities (bathing, combing hair, eating, etc.);	- Remaining seated or lying down for at least 50% of the day;	
- Fracture or history of falls;	- Prolonged hospital stay (>15 days);	
- PPS <60%.	- Mental confusion and/or cognitive changes that compromise functional status.	
<b>3. Frailty</b>	<b>4. Moderate or severe pain that limits mobility and functional status</b>	
Disorders in the physical, cognitive, sensory, or nutritional domains due to aging or disease, related to one or more of the following conditions:	Pain assessed with ESAS from 4 to 10 that causes limitation of mobility and functional status, related to one or more of the following conditions:	
- Unintentional and refractory weight loss;	- Pain refractory to medication;	
- Decreased strength in the lower limbs, upper limbs, or overall strength;	- Pain due to bone metastasis;	
- Slow gait in the last 3 months;	- Pain due to pressure ulcer in early stages (1 or 2).	
- Balance disorders;		
- Sarcopenia (loss of muscle mass).		
<b>5. Asthenia and fatigue</b>	<b>6. Lymphedema in the lower limbs, upper limbs, genital region, etc</b>	
A subjective, multicausal phenomenon related to one or more of the following conditions:	Accumulation of lymph in the tissues, causing chronic edema, related to one or more of the following conditions:	
- Persistent fatigue that does not improve with rest;	- Due to cancer treatment or tumor compression;	
- Generalized weakness;	- Removal of lymph nodes;	
- Lack of energy for even minimal activities;	- Requirement for compression therapy.	
- Inability to perform activities of daily living.		
<b>7. Vascular changes</b>	<b>8. Pressure injuries (stages I–IV) that compromise functional status and quality of life</b>	
Caused by poor circulation or venous obstruction, related to one or more of the following conditions:	Located in the heel, ankle, hip, and coccyx regions, related to one or more of the following conditions:	
- Initial venous ulcers;	- Balance disorders;	
- Chemotherapy-induced peripheral neuropathy;	- Prolonged hospitalization (>15 days);	
- Amputation and/or phantom limb syndrome;	- Dependent on position changes;	
- Thrombosis, with medical clearance and already taking medication.	- Bedridden	
<b>9. Acute or chronic dyspnea</b>	<b>10. Fall or recent history of falls</b>	
A sensation of "shortness of breath" related to one or more of the following conditions:	Related to one or more of the following conditions:	
- Restriction of work, social, and family activities;	- Frail elderly person;	
- Negative impact on quality of life and will to live;	- Low physical fitness;	
- Shortness of breath with minimal exertion.	- Changes in balance and gait;	
Note: PPS = Palliative Performance Score; ESAS = Edmonton Symptom Assessment Scale.		
<i>Back of the instrument.</i>		

the FísioCan-CP represents an initial conceptual contribution to support physiotherapy referral, its ability to produce similar effects remains unknown, as this study did not evaluate its implementation in routine practice or outcomes such as acceptability, feasibility, or workflow impact. Therefore, further research is needed before considering clinical adoption.

Considering these uncertainties, it is important to highlight the methodological strengths of this study, which provide a solid foundation for subsequent validation phases. Triangulating clinical data, targeted literature, and regulatory guidance ensured that item development was grounded in real-world rehabilitation needs and aligned with professional standards. The use of the Delphi technique enabled systematic, consensus-based expert evaluation of clarity, relevance, and importance, ensuring conceptual coherence before psychometric testing.

Despite these strengths, several limitations warrant consideration. Only content validity was assessed; therefore, additional psychometric properties, including reliability, construct validity, criterion validity, responsiveness, and diagnostic accuracy, remain to be evaluated. Furthermore, the clinical data used to inform item development originated from a single geographic region, and the Delphi panel consisted predominantly of Brazilian experts, which may limit generalizability of the findings. Moreover, the cross-sectional analysis included only individuals who accessed physiotherapy services, potentially underrepresenting unmet rehabilitation needs among those who were not referred. Finally, the instrument was not tested in real-world clinical settings, leaving its feasibility, usability, and acceptability unknown.

Looking ahead, future research should focus on comprehensive psychometric evaluation, including assessment's reliability (test-retest and inter-rater), construct and criterion validity, responsiveness, and diagnostic accuracy. Implementation studies in diverse palliative care contexts will also be essential to assess feasibility and acceptability and to explore potential effects on workflow and patient-centered outcomes. Such investigations will help determine whether the FísioCan-CP can contribute to more consistent and timely rehabilitation referral, particularly in settings with limited rehabilitation capacity.

In conclusion, this study developed and established the content validity of the FísioCan-CP, resulting in a ten-item screening instrument aligned with physiotherapy needs commonly observed in patients with advanced cancer in underserved communities. By integrating clinical evidence, literature findings, regulatory guidance, and expert consensus, the tool provides a conceptually robust foundation for physiotherapy referral and prioritization in

palliative care. Although further validation and implementation studies are needed, this work represents a significant initial step toward more structured and equitable approaches to rehabilitation access in resource-limited settings.

### Author contributions

CRedit: **Cintia Maia Prates**: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Validation, Visualization, Writing – original draft; **Liana Amorim Corrêa Trotte**: Data curation, Formal analysis, Validation, Visualization, Writing – review & editing; **Janaína Santos Nascimento**: Data curation, Formal analysis, Methodology, Validation, Visualization, Writing – review & editing; **Maria Gefé da Rosa Mesquita**: Conceptualization, Investigation, Methodology, Supervision, Validation, Visualization, Writing – review & editing; **Alexandre Ernesto Silva**: Conceptualization, Data curation, Investigation, Methodology, Supervision, Visualization, Writing – review & editing; **Anke Bergmann**: Investigation, Methodology, Supervision, Visualization, Writing – review & editing; **Luciana da Silva Couto**: Data curation, Investigation, Project administration, Validation, Visualization, Writing – review & editing; **Livia Costa de Oliveira**: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Supervision, Validation, Writing – original draft.

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