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Physiotherapy clinical practice in cystic fibrosis after the introduction of highly effective CFTR modulators: a mixed-methods study

Prática assistencial da fisioterapia na fibrose cística após a introdução dos moduladores de CFTR de alta eficiência: estudo de métodos mistos

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Abstract

Introduction: Advances in the diagnosis and treatment of cystic fibrosis (CF) have resulted in a significant increase in survival and quality of life, as well as the incorporation of highly effective CFTR modulators into the Brazilian Unified Health System (SUS), which has impacted physiotherapy care. **Aim:** To identify aspects of the physiotherapist's clinical practice, considering the introduction of highly effective CFTR modulators, as well as the difficulties and barriers in managing individuals with CF**.** **Methods:** A cross-sectional observational study was conducted with physiotherapists working in Cystic Fibrosis Reference Centers (CFRC) and in private services. A questionnaire containing 19 questions was administered via Google Forms to collect information on physiotherapy care, including routines, use of technologies, and challenges faced. Descriptive and frequency statistics were used for data analysis, and the data were stored in an Excel spreadsheet. **Results:** Fifty physiotherapists responded to the questionnaire. Most participants had more than five years of experience in CF (80%), and the hybrid model of care was predominant (34%). The prescription of physical exercise, recommendation of noninvasive ventilation, and use of standardized assessments are part of physiotherapy care. Even after the introduction of modulators, continuity of physiotherapy (42%) and encouragement of regular physical activity (80%) remain routine practices among professionals. However, physiotherapists face challenges such as treatment adherence after the introduction of highly effective CFTR modulators (52%) and standardization in disease management (13%). **Conclusion:** The findings suggest that physiotherapeutic management of CF in the context of highly effective CFTR modulators requires individualized, integrated, and evidence-based care, considering the healthcare challenges still present in the country.

Keywords: Cystic Fibrosis; Physiotherapy; Public Health; Highly Effective CFTR Modulators.

Resumo

Introdução: Os avanços no diagnóstico e tratamento da fibrose cística (FC) resultaram no aumento significativo da sobrevida e qualidade de vida, assim como a incorporação dos moduladores da CFTR de alta eficiência no Sistema Único de Saúde no Brasil, o que impactou no atendimento fisioterapêutico. **Objetivo:** Identificar prática assistencial do fisioterapeuta, considerando a introdução dos moduladores da CFTR de alta eficiência, além de suas dificuldades e barreiras no manejo de pessoas com FC. **Métodos:** Conduziu-se um estudo observacional transversal com fisioterapeutas atuantes em centros de referência para tratamento da FC (CRFC) e em serviços particulares. Aplicou-se um questionário via Google Forms com 19 perguntas para coletar informações sobre a assistência fisioterapêutica, incluindo rotinas, uso de tecnologias e desafios enfrentados. Para análise dos dados foi utilizada estatística descritiva e de frequências, e os dados foram armazenados em uma planilha do Excel. **Resultados:** Cinquenta fisioterapeutas responderam ao questionário. A maioria dos participantes possui mais de cinco anos de experiência com a FC (80%), e a modalidade de atendimento híbrido é predominante (34%). A prescrição de exercícios físicos, indicação de ventilação não invasiva e utilização de avaliações padronizadas fazem parte da assistência fisioterapêutica e, mesmo após a introdução dos moduladores, a continuidade da fisioterapia (42%) e o estímulo à prática de atividade física regular (80%) são rotinas dos profissionais. No entanto, os fisioterapeutas enfrentam desafios, como a adesão ao tratamento após a introdução dos moduladores da CFTR de alta eficiência (52%) e padronização no manejo da doença (13%). **Conclusão:** Os achados sugerem que o manejo fisioterapêutico da FC no contexto dos moduladores da CFTR de alta eficiência demanda cuidado individualizado, integrado e baseado em evidências, frente aos desafios assistenciais ainda presentes no país.

Palavras-chave: Fibrose Cística; Fisioterapia; Saúde Pública; Moduladores da CFTR de Alta Eficiência.

INTRODUCTION

In recent decades, numerous advances in the diagnosis and treatment of cystic fibrosis (CF) have dramatically changed the landscape of this health condition, leading to a significant increase in survival rates and improved quality of life[1,2]. Currently, Brazil has a comprehensive program for neonatal screening of the disease and referral centers distributed across most states to provide follow-up care for these individuals[3]. To date, the Brazilian Cystic Fibrosis Study Group (GBEFC) has registered 37 reference centers for CF treatment (CRFC)[4]. In 2021, the Brazilian Cystic Fibrosis Registry (REBRAFC) recorded 6,427 diagnosed individuals, 68.74% of whom were under 16 years of age[5].

For decades, CF was limited to the pediatric age group, but with the advancement of treatments — which are now more comprehensive and effective — more adults are being diagnosed with this condition today[6]. Recent advances, such as the use of highly effective CFTR (Cystic Fibrosis Transmembrane Conductance Regulator) modulators, have transformed treatment, thus improving respiratory function and reducing exacerbations in patients eligible for these therapies[3,6,7].

Nevertheless, access to diagnostic and therapeutic methods varies widely across regions of Brazil, despite the presence of CRFCs in most of them[8]. The CRFC is the facility that enables access to experienced professionals in the field and to specialized services[3], whose approach follows the international model, which requires a multidisciplinary care approach[3].

The team should include pediatricians (when treating children and adolescents), pulmonologists, gastroenterologists, nutritionists, nurses, psychologists, pharmacists, social workers, and physical therapists[8]. Among these professionals, consultation with a physical therapist is recommended from the time of diagnosis, since respiratory complications are one of the leading causes of death in this health condition[8-11]. Therefore, physical therapy focuses on respiratory and motor functions by designing individualized strategies that consider each patient's lifestyle, preferences, age group, and disease stage[11,12].

In general, physical therapy has been responsible for implementing interventions aimed at clearing the airways, maintaining lung function, and preserving the physical and functional capacity of CF patients[12]. Physical therapists also play a key role in managing the clinical condition, promoting physical activity, and providing guidance to family members and caregivers regarding therapeutic strategies, aiming to encourage treatment adherence[3,8].

Even in asymptomatic individuals, physical therapy has been associated with reduced progression of lung disease, as well as the prevention of exacerbations and respiratory complications[13]. Since the 1920s, international guidelines have guided the physical therapy management of this health condition[9,14,15]. The first Brazilian Recommendation in this field was published in 2019[11], a guide that presents various aspects of interventions beyond airway clearance, which had been the main focus of therapy for many years.

In the current context, following the incorporation of highly effective CFTR modulators into Brazil's Unified Health System (SUS), physiotherapy services for CF have also been affected. This is because eligible patients experienced a reduction in hypersecretory symptoms and respiratory exacerbations, which altered adherence to therapy and required its readjustment[2,16].

Despite the benefits of using these modulators and the improvement in symptoms, physical therapists and the entire multidisciplinary team are concerned that CF patients will discontinue their treatments[3,17]. Therefore, this study aims to identify physical therapists' clinical practices following the introduction of highly effective CFTR modulators, as well as the difficulties and barriers they face in managing CF.

METHODS

This is a mixed-methods (qualitative and quantitative) study based on a cross-sectional design, conducted using a structured questionnaire applied to physical therapists who provide care to CF patients in Brazil. The study included physical therapists who were directly involved in the care of these patients and were affiliated with CF centers or in private practice in Brazil before the introduction of modulators. Professionals who did not answer the questionnaire adequately were excluded; however, no such cases occurred.

The sample was therefore a non-probability, convenience sample, consisting of professionals who met the eligibility criteria and agreed to participate in the study during the data collection period. No prior sample size calculation was performed, given the exploratory nature of the study and the strategy of extending invitations to professionals affiliated with the CRFCs and listed in the GBEFC registry.

The structured questionnaire was developed by the researchers using Google Forms and was sent to each professional, along with a text message via WhatsApp, inviting them to provide the information and giving their consent to participate. This instrument was presented at the 9th Brazilian Interdisciplinary Congress on Cystic Fibrosis, held in Salvador, Bahia, Brazil, in May 2025.

The instrument consisted of 19 questions, including closed-ended and open-ended questions (Chart 1). Quantitative responses were analyzed using descriptive statistics and frequency distributions. The open-ended questions were subjected to categorical content analysis, organized into thematic categories for data systematization and interpretation, thus characterizing the qualitative component of the mixed-methods design.

Chart 1. A structured instrument for investigating physical therapy practices in cystic fibrosis in the post-CFTR modulator context.

Nº	Question
	Professional profile
1	Length of experience caring for people with cystic fibrosis
2	Contact email
3	City and state where you practice
4	Do you work at a reference center?
5	If so, which reference center?
	Type and Volume of Services Provided
6	Does the service offer in-person and/or telemedicine physical therapy? (Check more than one option, if applicable)
7	If in-person, how many patients receive physical therapy?
8	If via telemedicine, how many patients receive physical therapy?
	Post-CFTR Modulator Management Strategies
9	What are the main challenges following the introduction of modulators? Please describe.
10	Are you responsible for collecting secretions for routine diagnostic culture (RDC)?
11	Do you perform field tests on a systematic basis?
12	If so, which test do you use, and how often?
13	How are the routine procedures and guidelines for physical therapy to remove secretions being implemented for patients using modulators?
	Exercise Prescription and Noninvasive Ventilation
14	Do you prescribe exercise?
15	Do you prescribe noninvasive ventilation (NIV)?
16	If so, what criteria do you use to prescribe NIV?
17	If so, how many patients use NIV?
18	What is the main reason for using NIV?
	Institutional suggestions
19	Do you have any suggestions or questions regarding how the GBEFC can assist in the management of patients with cystic fibrosis?

Legend: CFTR: Cystic Fibrosis Transmembrane Conductance Regulator; RDC: Routine Diagnostic Culture; GBEFC: Brazilian Cystic Fibrosis Study Group; NIV: Noninvasive Ventilation.

Source: A tool developed by the authors, consisting of a structured questionnaire created using Google Forms and applied online to physical therapists participating in the study.

Responses were collected between May and June 2025, and the study was previously approved by the Ethics Committee under CAAE 80800217.4.0000.5361.

No specific Informed Consent Form (ICF) was used for this study, as it was part of a larger umbrella project. Nevertheless, all participants were informed about the research in advance and provided their consent by voluntarily submitting their responses.

RESULTS

A total of 37 CRFCs were contacted, three of which did not respond to the questionnaire, and two reported not having a physical therapist on staff. Thus, 50 physical therapists who provide care to CF patients participated in the study. Thirty-six of them work at CF centers (bearing in mind that some centers have more than one physical therapist on staff), and 14 work in private practices in Brazil.

Most of the participating physical therapists (80%) have more than five years of experience in the field. Those who work at CRFCs are distributed across all regions of Brazil, with the highest concentration in the Southeast (55%), particularly in the state of São Paulo (30%). Figure 1 shows the percentage of responses by state.

Regarding the type of physical therapy provided, most professionals (34%) provide in-person follow-up combined with guidance. Care provided exclusively in person accounts for 28% of the sample, while a combination of in-person care, guidance, and telemedicine is adopted by 20% of professionals. Meanwhile, the combination of in-person care and telemedicine accounts for 10% of cases, and 8% of professionals rely solely on guidance. Table 1 shows the responses on the number of CF patients treated in person and via telemedicine.

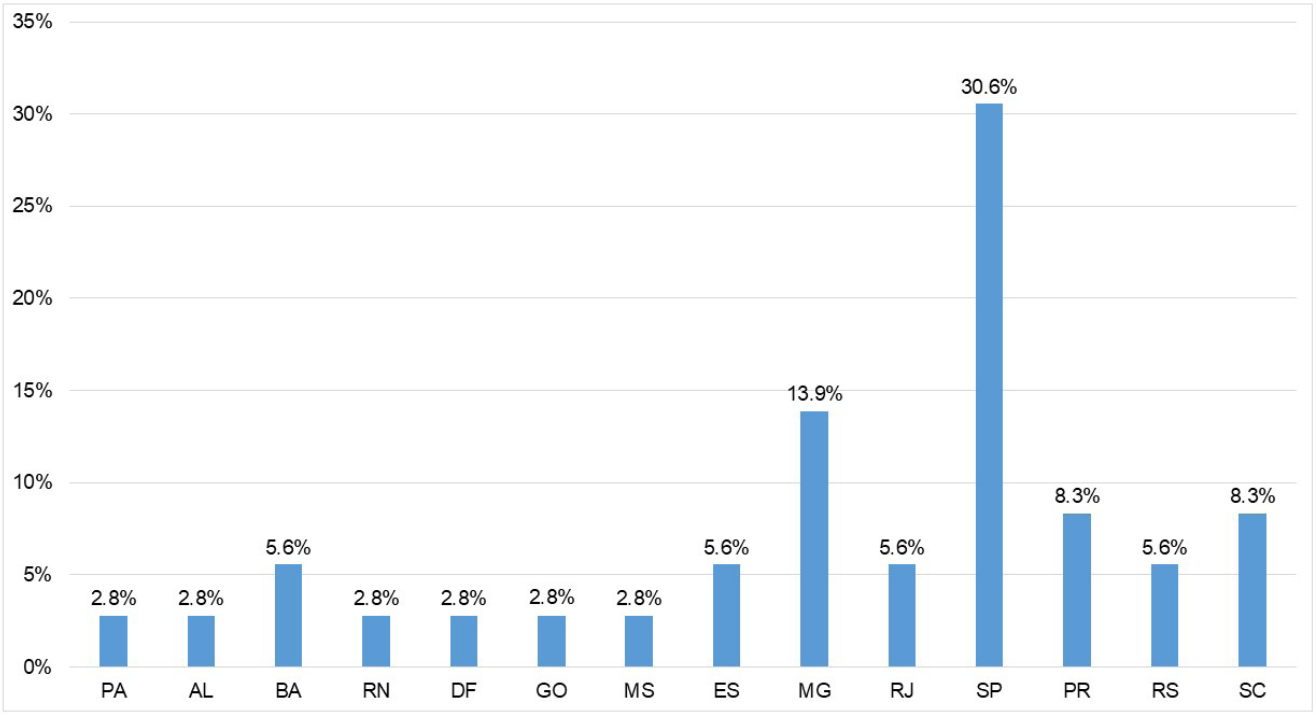

Figure 1. Distribution of physical therapists working at Cystic Fibrosis Reference Centers by Brazilian state.

Legend: Data shown as percentages and by region from North to South. PA: Pará; AL: Alagoas; BA: Bahia; RN: Rio Grande do Norte; DF: Distrito Federal; GO: Goiás; MS: Mato Grosso do Sul; ES: Espirito Santo; MG: Minas Gerais; RJ: Rio de Janeiro; SP: São Paulo; PR: Paraná; RS: Rio Grande do Sul; SC: Santa Catarina.

Source: Information gathered from a structured questionnaire applied online to physical therapists participating in the study.

Table 1. Profile of physical therapists' responses regarding the number of people with cystic fibrosis treated at referral centers, by type of care.

People with cystic fibrosis who are receiving care	Distribution of physical therapists' responses on the number of people with cystic fibrosis treated at the referral center where they work (n = 50)	
	In-person service n (%)	Telemedicine n (%)
1–80	26 (52.0)	25 (50.0)
81–150	11 (22.0)	5 (10.0)
>150	5 (10.0)	0
Volume varies according to care demand	4 (8.0)	15 (30.0)
No answer	4 (8.0)	5 (10.0)

Legend: Data regarding physical therapists' responses on the number of people with cystic fibrosis treated at the facility where they work, stratified by type of care (in-person and telemedicine). The results are presented as absolute numbers and percentages (n %), based on the 50 professionals who participated in the study. The responses refer to the number of patients treated at the facility (referral center), with each physical therapist answering for both modes independently, given that centers may offer in-person care, telemedicine, both, or neither. Absolute numbers and percentages should be interpreted vertically by column.

Source: Data extracted from a structured questionnaire administered online to physical therapists participating in the study.

As for the characteristics of physical therapy care for CF patients using highly effective CFTR modulators, most professionals reported continuing this treatment (42%), followed by a greater emphasis on prescribing physical exercise (26%). In addition, the frequency/intensity of sessions involving airway clearance techniques has gradually decreased (12%). Table 2 outlines the challenges reported by physical therapists following the introduction of high-efficacy CFTR modulators.

Secretion collection for routine diagnostic culture (RDC) has been performed by 38% of the sample, and systematic field testing has been conducted by most professionals (56%). Figure 2 shows the standardized assessments used by physical therapists.

Of all participating physical therapists, 80% prescribe physical exercise, and the majority (52%) reported recommending NIV, based on criteria such as the presence

Table 2. Challenges and needs reported by physical therapists following the introduction of highly effective CFTR modulators.

Answers	N	%
Adherence to physical therapy	32	52.46
Transition to new therapeutic goals	8	13.11
No response	7	11.48
Service structure	6	9.84
Other clinical and technical challenges	4	6.56
New physical therapy guidelines	1	1.64
Raising awareness of the need for continuity in pulmonary rehabilitation	1	1.64
Expectations regarding outcomes, adherence to inhalation therapy, and continued regular physical activity	1	1.64
Hospitalizations due to exacerbations have decreased significantly	1	1.64

Legend: Data shown as percentages and absolute numbers, in descending order. %: percentage; N: absolute number.
Source: Information gathered from a structured questionnaire applied online to physical therapists participating in the study.

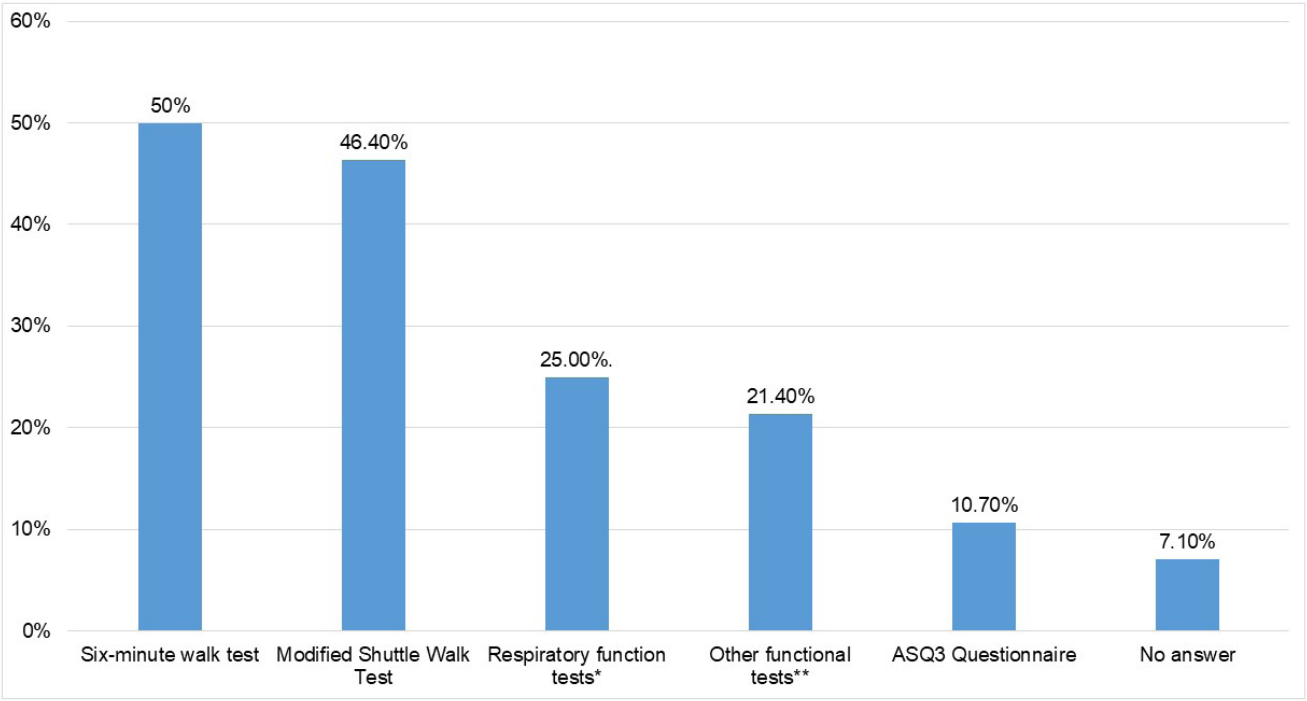

Figure 2. Standardized assessments used by physical therapists.
Legend: Data shown as percentages. %: percentage; ASQ3 Questionnaire: Ages and Stages Questionnaire, Third Edition. *spirometry, manometry, peak expiratory flow. **incremental test, endurance test, muscle strength test, and sit-to-stand test.
Source: Information gathered from a structured questionnaire applied online to physical therapists participating in the study.

of nocturnal hypercapnia and/or hypoxemia (53.8%) and severely impaired lung function (19.2%). Other criteria cited were severe or recurrent exacerbations (15.3%), clinical symptoms of ventilatory failure (15.3%), difficulty clearing secretions (3.8%), respiratory distress (3.8%), and 7.6% were unable to specify. The use of NIV was highlighted during sleep (73%) and/or as support during physical therapy interventions (50%).

In addition, 7.6% of the professionals reported that the children with CF under their care use the resource on an ongoing basis, while 7.6% did not answer this question. Regarding the number of patients using NIV, most professionals (58%) reported caring for between one and four children, while 11% reported caring for between five and ten children. Thirty-one percent of the sample either did not answer the question or reported not knowing.

Finally, 46% of the participating physical therapists offered no suggestions regarding the GBEFC's management of the studies. However, 36% requested clinical practice guidelines for the new scenario following the introduction of highly effective CFTR modulators, in addition to specific comments related to the indication for NIV, clinical scales, telemedicine protocols, and encouragement of multicenter scientific research.

DISCUSSION

This study aimed to assess physiotherapists' clinical practice following the introduction of highly effective CFTR modulators, as well as the difficulties and barriers encountered in the management of cystic fibrosis (CF). The results indicate that the professionals providing care to this population have expertise in the field and are committed to adhering to scientific guidelines in managing the disease. Despite significant participation by physical therapists affiliated with CF centers, the fact that five did not respond — representing 13.5% of all CF centers — raises questions about the current structure of physical therapy care for CF, whether this percentage stems from the absence of these professionals at the CF centers or from a failure to respond.

Physical therapy, like other fields, faces new challenges due to changes in the clinical profile of CF patients following the introduction of highly effective CFTR modulators. Although the benefits of these interventions are widely recognized, there are gaps in care, such as staff overload at CF centers, the lack of transition programs to adult care, and difficulties related to treatment adherence, which have persisted since the pre-modulator era[3,18].

Moreover, the distribution of CRFCs across Brazil was found to be uneven. Some Brazilian regions have a higher concentration of services, such as the Southeast, while in others, specialized care is almost nonexistent. This finding had already been reported in a previous study[3], which highlighted the variable incidence of the disease and the heterogeneity of CF in Brazil, as well as the challenges related to access to effective treatment across all regions.

This pattern in the distribution of care is also reflected in the flow of in-person visits, which tends to be moderate in most services and may depend on each service's available infrastructure, the number of active professionals, and internal organization. This trend may explain the prevalence of the hybrid care model observed, which reflects an adaptation of physical therapy services to the current needs of CF patients and their families.

The hybrid model broadens access to a community of specialized professionals, simplifies logistics, and incorporates technological possibilities, which mitigates some of the challenges faced by a country marked by geographic and social inequalities[3]. According to Ortiz Ortigosa et al.[19], while no significant improvements were observed in some clinical variables, the adherence and satisfaction reported by patients and professionals in telemonitoring highlight the potential of this approach as a complementary form of care. However, telecare is still used on an ad hoc or complementary basis, without clear standardization across services.

During the COVID-19 pandemic, COFFITO temporarily authorized telemedicine (COFFITO Resolution No. 516). In 2025, the regulation became permanent with COFFITO Resolution No. 619. Nevertheless, this approach must be combined with in-person consultations, as clinical evaluation involving a physical examination is crucial for safe and individualized clinical management. Despite these advances, the effectiveness and consolidation of these approaches still depend on further research and the development of specific guidelines[20].

The introduction of highly effective CFTR modulators has led to a significant shift in the focus of physical therapy practice. While nearly half of the professionals still include bronchial clearance interventions as part of the treatment plan, others have begun to prioritize prescribing regular physical exercise. A reduction in the intensity or frequency of sessions using clearance techniques has been reported, both at the therapist's initiative and due to a lack of patient adherence.

These findings are consistent with the positive clinical impact of highly effective CFTR modulators described in the international literature, which points to a reduction in respiratory exacerbations, less mucus buildup, and improvements in lung function, exercise tolerance, and nutritional status[6,7], as well as a decrease in hospitalizations and an improvement in quality of life[2].

This scenario reflects the primary concern of physical therapists at this time, which appears to be maintaining the care of CF patients in light of the clinical changes brought about by new treatments. However, evidence points to the need to adapt physical therapy practices.

In our study, this becomes clear when the main difficulty reported by physical therapists following the introduction of highly effective CFTR modulators is adherence to physical therapy, as reported by more than half of the participants. In this context, the professional's decision to continue, reduce, or suspend physical therapy should consider the clinical presentation, the degree of pulmonary impairment, the functional deficit assessed by exercise capacity, as well as the presence of clinical signs of pulmonary exacerbation and pathogen colonization[1,18,21].

It is not yet clear what the impact of these therapeutic changes will be, including in light of possible reductions or suspensions of physical therapy. In this scenario, the therapeutic goals for CF must be reviewed and, when necessary, reinforced, while monitoring changes in care[9,18,21].

The literature provides no evidence to support discontinuing physical therapy for CF patients, even after the introduction of highly effective CFTR modulators[9,18,21], despite eligible patients showing reduced airway secretions and improved respiratory symptoms[2]. Thus, an individualized approach to optimizing therapies can alleviate the burden of care while maintaining the best health outcomes. This strategy should be developed in partnership with the multidisciplinary team, considering the patient's individuality and preferences. The consensus is that proactivity, management of airway clearance, and attention to the symptoms of each person with CF are essential[21].

Therefore, we highlight the importance of the role of physical therapists on CRFC teams, which extends beyond the simple application of techniques to encompass continuous assessment and individualized treatment planning. In certain situations, it may be appropriate to consider approaches for maintaining respiratory health, including physical exercise as a complementary intervention to airway clearance techniques, especially in individuals with stable respiratory conditions[22,23]. However, it is worth noting that there is no evidence to support the use of exercise as a substitute for conventional techniques for removing secretions from the airways[22].

In this vein, this study found that a significant number of physical therapists incorporate exercise prescriptions into their care routines. This trend is consistent with current recommendations for the physical therapy management of CF[24,25]. However, the proportion of professionals who do not yet prescribe exercises indicates that there is significant room for advancing this practice as part of treatment.

The systematic use of field tests by most physical therapists also highlights the importance of standardized physical and functional assessment, as recommended[24]. However, there are still settings where these tests are not administered regularly, indicating the need to standardize care. Similarly, the collection of RDC data by physical therapists remains controversial and inconsistent, reflecting institutional barriers, differences in local protocols, and the division of responsibilities among care teams[26].

Furthermore, the indication for NIV was based on well-established criteria, which highlights the technical expertise of the professionals and their practice in line with international recommendations[14,27,28]. Most professionals recognize the role of NIV as a therapeutic resource, especially in cases of more severe respiratory compromise. However, the proportion of professionals who do not prescribe NIV suggests variations in professional training, institutional protocols, and access to equipment.

These findings not only reflect a practice centered on individualized clinical assessment but also point to the need for greater clarity and consistency in the criteria for its use. In addition, approximately 20% of healthcare professionals did not report the number of patients using NIV, which represents a limitation in the analysis of the actual use of this technology and indicates a potential weakness in the systematic monitoring of NIV in healthcare settings, as well as possible difficulties in monitoring or recording its use in a standardized manner.

The data collected also indicate that the main reasons for using NIV are “during sleep” and “as an aid during physical therapy,” which is consistent with findings in the literature indicating that NIV is a useful complement to other airway clearance techniques. In addition, NIV has shown beneficial results in hypercapnic patients with severe disease, especially for nighttime use[28]. A more structured and systematic approach is needed for implementing NIV in the care of CF patients in Brazil.

The mild impairment of lung function in the patients, followed by the responding physical therapists, may account for the percentage of recommendations for NIV, since it is a resource often used to assist in the performance of respiratory physical therapy techniques in individuals with severe lung impairment[28,29]. Studies show that individuals with mild lung disease tend to use only physical exercises as part of their routine therapy, while those with more severe conditions are more likely to use NIV[23,30,31].

Finally, when asked about potential requests to the GBEFC, the participating physical therapists highlighted the importance of producing technical and scientific support materials, especially regarding NIV, the development of clinical scales, and telemedicine protocols. However, most importantly, physical therapy guidelines adapted to the new profile of CF patients using highly effective CFTR modulators, which motivates and guides future actions for managing the condition. The encouragement of multicenter research also underscores the need to consolidate robust evidence to support physical therapy practices in the Brazilian context.

This study has some limitations, such as the self-reported nature of the responses and potentially biased participant selection. Furthermore, not all CRFCs responded to the questionnaire. Nevertheless, our findings provide a current overview of physical therapy practice for CF in Brazil, at a time of significant therapeutic changes following the implementation of highly effective CFTR modulators by the SUS. The results may support professional training, clinical care routines, and further research, which will contribute to the continuous improvement of care for CF patients.

CONCLUSION

This study described aspects of physical therapists’ clinical practice in the management of CF in Brazil following the introduction of highly effective CFTR modulators. Our findings suggest that the participating professionals have experience in this field and seek to align their approaches with international scientific recommendations for managing this condition, although they still face challenges, such as patient adherence to treatment following the introduction of highly effective CFTR modulators and disparities in the distribution and quality of care services for this disease in the country. The predominance of a hybrid care model may reflect adaptation to current demands.

Nevertheless, professionals recognize the importance of continuing physical therapy even after the introduction of highly effective CFTR modulators and point out some gaps in the use of technologies — such as NIV — and in the RDC procedure, which suggests a need for standardization of care protocols at CFRCs.

Finally, this information provides an overview of physical therapy for CF in Brazil and points to possible paths for future research and improvements in care routines, emphasizing the importance of collaboration among professionals to address the challenges and barriers in managing this health condition in the country.

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CONFLICT OF INTEREST

None to declare.

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RESEARCH DATA AVAILABILITY

Research data are available only upon request.

ARTIFICIAL INTELLIGENCE USE STATEMENT

We hereby declare that no artificial intelligence (AI) tools were used at any stage of the design, development, analysis, or writing of this manuscript.

AUTHOR CONTRIBUTIONS

Research; Methodology; Project Management; Writing, Review, and Editing: Maria Ângela Gonçalves de Oliveira Ribeiro, Bruna Ziegler, Camila Isabel Santos Schivinski, Evanirso da Silva Aquino, and Márcio Vinícius Fagundes Donadio. Data Curation; Formal Analysis; Visualization; Original Drafting: Luize Souto Ceolin and Jorge Eduardo Cortz Sernaglia. Study design: Ana Carolina da Silva Almeida, Bruno Fernandes Costa Ferreira, Celize Cruz Bresciani, Edilene do Socorro Nascimento Falcão Sarges, Fernanda Maria Vendrúsculo, Letícia Pereira do Amaral Cidade Silva, Nelbe Nesi Santana, Paloma Lopez Francisco Parazzi, Renata Maba Gonçalves Wamosy, Sheyla Haun.

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