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ORIGINAL ARTICLE

Physiotherapy practice for hospitalized patients with COVID-19

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ABSTRACT

Objective: To identify the indications for physiotherapy and to evaluate physiotherapy practices in patients with COVID-19 admitted to the ICU (on mechanical ventilation) or to the ward (spontaneously breathing). **Methods:** An online, 50-item survey was completed by physiotherapists who had been treating hospitalized patients with COVID-19 in Brazil. **Results:** Of the 644 physiotherapists who initiated the survey, 488 (76%) completed it. The main reasons for indications for physiotherapy in both settings reported as "very frequently" and "frequently" both in the ICU and the ward by most respondents were oxygenation improvement (> 95%) and prevention of general complications (> 83%). Physical deconditioning was considered an infrequent indication. When compared with mobilization strategies, the use of respiratory interventions showed great variability in both work settings, and techniques considered effective were underutilized. The most frequently used respiratory techniques in the ICU were positioning (86%), alveolar recruitment (73%), and hard/brief expiratory rib cage compression (46%), whereas those in the ward were active prone positioning (90%), breathing exercises (88%), and directed/assisted cough (75%). The mobilization interventions reported by more than 75% of the respondents were sitting on the edge of the bed, active and resistive range of motion exercises, standing, ambulation, and stepping in place. **Conclusions:** The least common reason for indications for physiotherapy was avoidance of deconditioning, whereas oxygenation improvement was the most frequent one. Great variability in respiratory interventions was observed when compared with mobilization therapies, and there is a clear need to standardize respiratory physiotherapy treatment for hospitalized patients with COVID-19.

Keywords: COVID-19; Physical therapy modalities; Hospitalization; Critical illness; Surveys and questionnaires.

INTRODUCTION

Since the COVID-19 outbreak in December of 2019, SARS-CoV-2 has infected more than 450 million people and been responsible for more than 6 million global deaths. Brazil is among the ten most affected countries in terms of mortality, together with the United States of America and the United Kingdom.[1]

Before vaccination, approximately 20% of infected patients required hospitalization, and 5% developed critical illness requiring intensive care support.[2] Physiotherapists have a fundamental role in treating hospitalized patients by using respiratory support and early mobilization, decreasing the length of hospital stay, improving functional capacity, and decreasing the number of readmissions and deaths during the first year after hospital discharge.[3,4] In Brazil, before COVID-19, physiotherapists were already considered essential members of the intensive care team, and the pandemic has strengthened their role.

As in Australia, Canada, Italy, and the United Kingdom, physiotherapists in Brazil are responsible for both respiratory and mobilization therapies.[5-8] They are also accountable for mechanical ventilation management along with the medical team.[9] The main goals of respiratory therapy include promoting adequate gas exchange, clearance of airway secretions, reduction of work of breathing, and prevention of respiratory complications.[10] Respiratory physiotherapy interventions are usually

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divided into two classes: assistance with airway clearance and promotion of lung expansion. However, some interventions work for both, such as techniques that increase inspiratory volumes, transpulmonary pressures, and collateral ventilation. Mobilization, a key component of inpatient rehabilitation, comprises physical activity sufficient to produce acute physiological effects that increase ventilation, circulation, muscle metabolism, and alertness to avoid physical deconditioning and other effects of prolonged immobility.[10]

Although the role of physiotherapy is well established in many countries, there is no consensus on the effectiveness of many physiotherapy interventions.[11-13] In 2020, some documents with detailed recommendations for physiotherapy treatment of hospitalized patients with COVID-19 were published to guide physiotherapists at the frontline.[6,7,14-16] However, due to the urgent need for support and the lack of scientific information on physiotherapy in COVID-19, owing to the disease's novelty, these guidelines were mainly based on specialists' consensus.

This survey was conducted to identify the indications for physiotherapy and to evaluate physiotherapy practices in patients with COVID-19 admitted to the ICU (on mechanical ventilation) or to the ward (spontaneously breathing).

METHODS

This was a cross-sectional online questionnaire survey. The study was approved by the Research Ethics Committee of Federal University of São Paulo (Protocol n. 44771021.2.0000.5505) and was reported following the Consensus-Based Checklist for Reporting of Survey Studies.[17] The survey was carried out between June and October of 2021.

Physiotherapists who treated hospitalized patients with COVID-19 in Brazil for at least two months were eligible to complete the survey. In Brazil, there is no sampling frame of physiotherapists who worked at referral hospitals for treating patients with COVID-19. According to the Brazilian federal government, we had a mean number of 40,000 ICU beds during the first 15 months of the COVID-19 pandemic. The number of physiotherapists working with patients with COVID-19 could have been estimated on the basis of the number of ICU beds but would probably have been inaccurate. Physiotherapy services differ tremendously among hospitals and regions in Brazil regarding duration of shifts, number of physiotherapists per ICU bed, and others. Therefore, it was not possible to conduct a sample size calculation. Instead, a recruitment strategy based on the snowball effect and the support of professional network groups to spread the survey were employed.

Invitations to participate in the survey were sent to potential participants by social media and e-mails, and these potential participants were encouraged to forward the link of the survey to other colleagues. The *Associação Brasileira de Fisioterapia Cardiorrespiratória e Fisioterapia em Terapia Intensiva* (ASSOBRAFIR, Brazilian Association of Cardiorespiratory Physiotherapy and Intensive Care Physiotherapy) and the *Conselhos Regionais de Fisioterapia e Terapia Ocupacional* (CREFITO, Regional Councils of Physiotherapy and Occupational Therapy) in four states and in one region of Brazil (São Paulo, Minas Gerais, Pernambuco, Rondônia, and northern region) supported the study by sending the survey to their associates.

A committee of experts developed the survey after several meetings. The group consisted of 6 experienced physiotherapists who are professors at federal universities from five different Brazilian states. The survey was designed within a secure, web-based software platform—REDCap[18]—hosted at the *Universidade Federal do Ceará*. The first version of the instrument was previously tested for content validity, clarity, relevance, and completeness by 15 physiotherapists with different experience levels and from different regions of Brazil. Thereafter, the committee discussed their suggestions, and minor modifications were made to the final version of the instrument.

The survey consisted of 50 questions regarding professional information, characteristics of the respondent's hospital of employment, reasons for indications for physiotherapy, and respiratory/mobilization interventions. When answering questions regarding the application of the techniques, participants were requested to consider that the patients had favorable clinical conditions for their use. More information regarding the survey is presented in the supplementary material.

The questions regarding indications for physiotherapy and the interventions used were closed-ended and scored on a five-point Likert scale; response options were "very frequently", "frequently", "occasionally", "rarely", or "never." Questions that inquired about using a specific instrument, such as mechanical in-exsufflation (MI-E), also had a "not available" option. Responses marked as "rarely" or "never" opened another question asking why that specific instrument or technique was "rarely" or "never" used.

The estimated time to complete the survey varied between 10-12 min for physiotherapists working in ICUs or wards and 20-25 min for those who worked at both settings. Respondents who worked in both settings and completed the survey in less than 10 minutes were excluded from the analysis. A copy of the survey is available in the supplementary material.

Data were summarized using descriptive statistics reported as median (IQR) or absolute and relative frequencies for categorical data.

RESULTS

After removing 60 duplicates, the number of physiotherapists who consented to participate and initiated the questionnaire was 643, of whom 488

completed the survey, yielding a completion rate of 76%. However, 3 respondents were excluded because they completed the survey in less than 10 min.

Characteristics of the respondents (N = 485) and the primary hospital of employment are shown in Table 1. The median age of the physiotherapists was 33 years, and the median length of professional experience was 9 years. The most common characteristics of the participants were having a specialization degree (80%), working at hospitals for > 5 years (52%), and working at both wards and ICUs (47%). Most worked at a public hospital (66%) that was not connected to a university (61%) and had some training on COVID-19 (88%). Their median experience treating patients with COVID-19 was 15 months, and the median number of patients seen per shift of 6 h in the ICU was 10.

Table 1. Characteristics of the respondents (N = 485).[a]

Variable	Result
Age, years	33 [28-40]
Male gender	126 (26)
Brazilian regions	
Southeast	298 (61)
Northeast	102 (21)
South	54 (11)
Central-West	21 (4)
North	10 (2)
Years since graduation	9 [4-15]
Qualifications	
Specialization degree[b]	390 (80)
Stricto sensu graduate degree	96 (20)
Certified specialist	61 (13)
Hospitalist experience, months	
< 3	7 (1)
3-11	56 (12)
12-60	169 (35)
> 61	253 (52)
Work setting	
Ward	47 (10)
ICU	213 (44)
Both	225 (47)
Type of hospital	
Public	320 (66)
Private	124 (26)
Other	41 (9)
University hospital	
Yes	188 (39)
Patients seen in the ICU per a six-hour shift	10 [7-10]
Hospitalist experience with COVID-19, months	15 [12-16]
Training in COVID-19	
Yes	425 (88)
Type of training in COVID-19	
Virtual	380 (78)
Virtual (10 h at least)	224 (46)
Reading articles	391 (81)

[a]Values expressed as n (%) or median [IQR]. [b]Specialization degrees must have a minimum workload of 360 h.

Perceived reasons for indications for physiotherapy in the ICU and the ward

The frequency of perceived reasons for indications for physiotherapy is shown in Figure 1. Mechanical ventilation management, oxygenation improvement, mechanical ventilation weaning, airway clearance, lung expansion, and prevention of pulmonary and general complications were reported a frequent indication for physiotherapy by the majority (> 80%) of the respondents working in the ICU. Avoidance of physical deconditioning, which included recovering or preserving aerobic capacity and muscle strength, was reported as a frequent indication for physiotherapy by less than 65% of the physiotherapists.

Oxygenation improvement, reduction of work of breathing, and prevention of pulmonary and general complications were considered frequent indications for physiotherapy by more than 80% of the respondents working in the ward. However, avoidance of physical deconditioning was considered a frequent indication by less than 58% of the respondents, whereas airway clearance was reported as "rarely' or "never" by 46% of the respondents.

Physiotherapy practice in the ICU

Figure 2 illustrates the frequencies of reported respiratory and mobilization interventions for patients with COVID-19 on mechanical ventilation. The most frequently reported airway clearance technique was positioning (82%), followed by hard/brief expiratory rib cage compression (46%). The least frequently reported techniques were chest percussion (1%), PEEP-zero end-expiratory pressure (PEEP-ZEEP) maneuver (13%), and manual hyperinflation (18%). For lung expansion, the most frequently cited interventions were positioning (89%) and alveolar recruitment maneuver (73%), whereas manual hyperinflation was the least cited one (15%).

Regarding mobilization, active and resistive range of motion exercises, sitting on the edge of the bed, standing, ambulation, and stepping in place were reported as "very frequently" and "frequently" by more than 70% of the respondents. The least frequently cited ones were neuromuscular electrical stimulation (NMES), squats, and climbing steps. However, among the 54% of the respondents who "never" cited NMES, 39% reported that the device was unavailable at their institutions, the same occurring with cycle ergometers, in 20% and 14%, respectively (Figure 2).

Figure 3 shows the reasons for selecting "never" or "rarely" regarding the use the survey's least frequently reported respiratory interventions. Clearly, the main reason for not using manual hyperinflation for neither airway clearance nor lung expansion was biosecurity due to the risk of aerosol production. Almost 70%, 35%, and 34% of the physiotherapists, respectively, did not know how to apply expiratory

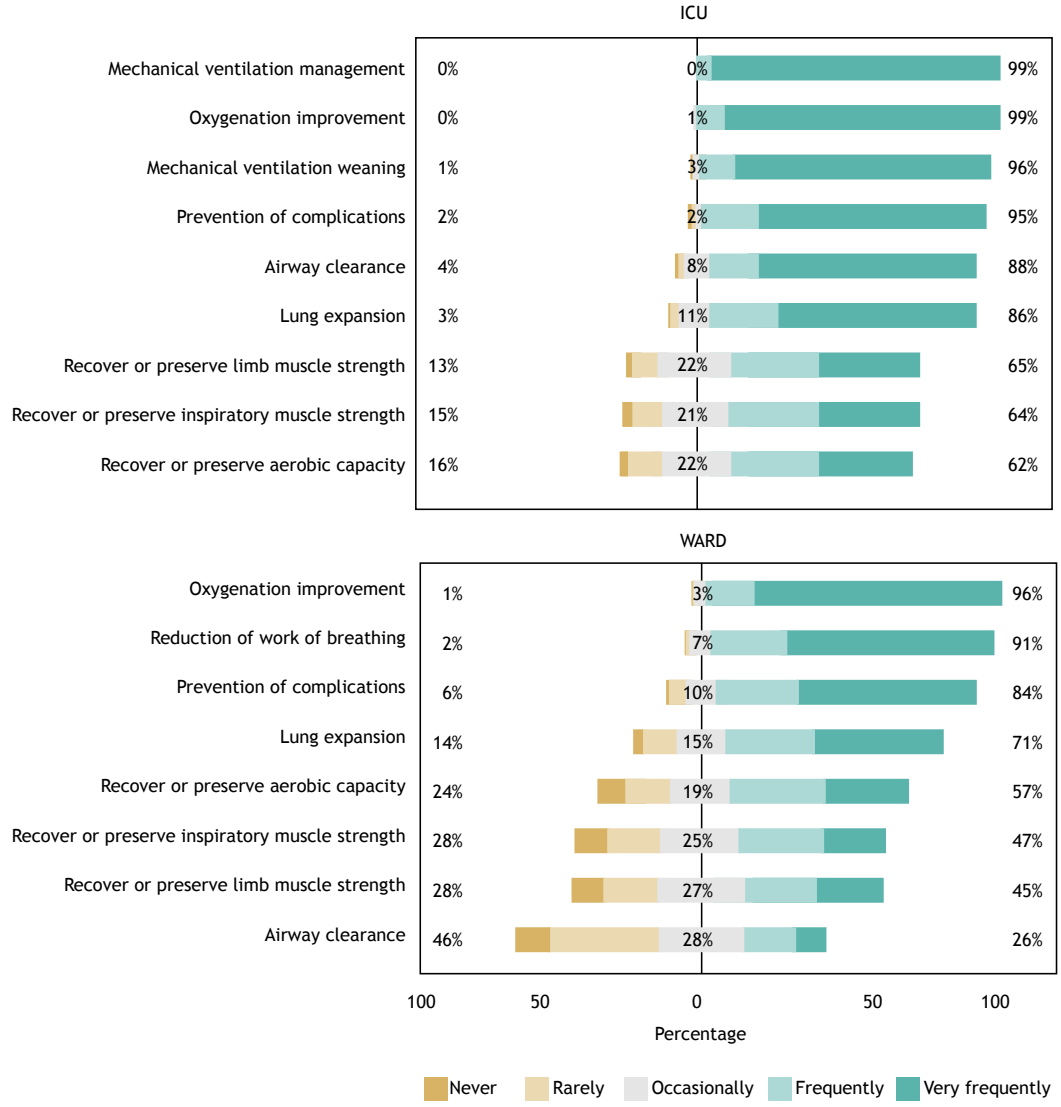

Figure 1. Frequencies of perceived reasons for indications for physiotherapy for patients with COVID-19 admitted to the ICU and the ward.

flow bias, ventilator hyperinflation, and the PEEP-ZEEP maneuver. Chest percussion, vibration, and manual chest compression-decompression (MCCD) maneuver were reported as "never" or "rarely" used mainly due to the belief that these techniques have no scientific evidence supporting their efficacy and that there are others that are more effective. Detailed reasons for selecting "never" or "rarely" regarding the use of each of the surveyed respiratory interventions are shown in Tables S1 and S2.

Ninety percent of the respondents who reported "never" or "rarely" using passive range of motion exercises believed that other techniques were more effective. The most common reasons for not using squats or climbing steps were the poor functional status of most patients with COVID-19 and the critical clinical condition of most patients (Table S3).

Physiotherapy practice in the ward

Figure 4 illustrates the frequencies of respiratory and mobilization interventions for patients with COVID-19 breathing spontaneously. The most frequently cited airway clearance techniques were positioning, in 78%; directed/assisted cough, in 75%; active cycle of breathing technique (ACBT), in 64%; and forced expiratory technique (FET), in 59%. The least frequently reported ones were percussion (1%), autogenic drainage (20%), and vibration (35%). For lung expansion, the most frequently cited interventions were active prone positioning (90%) and deep breathing exercises (88%). Only squat, climbing steps, and NMES were less commonly reported for avoidance of deconditioning. NMES and cycle ergometer were "never" used by 41% of 68% of the respondents and

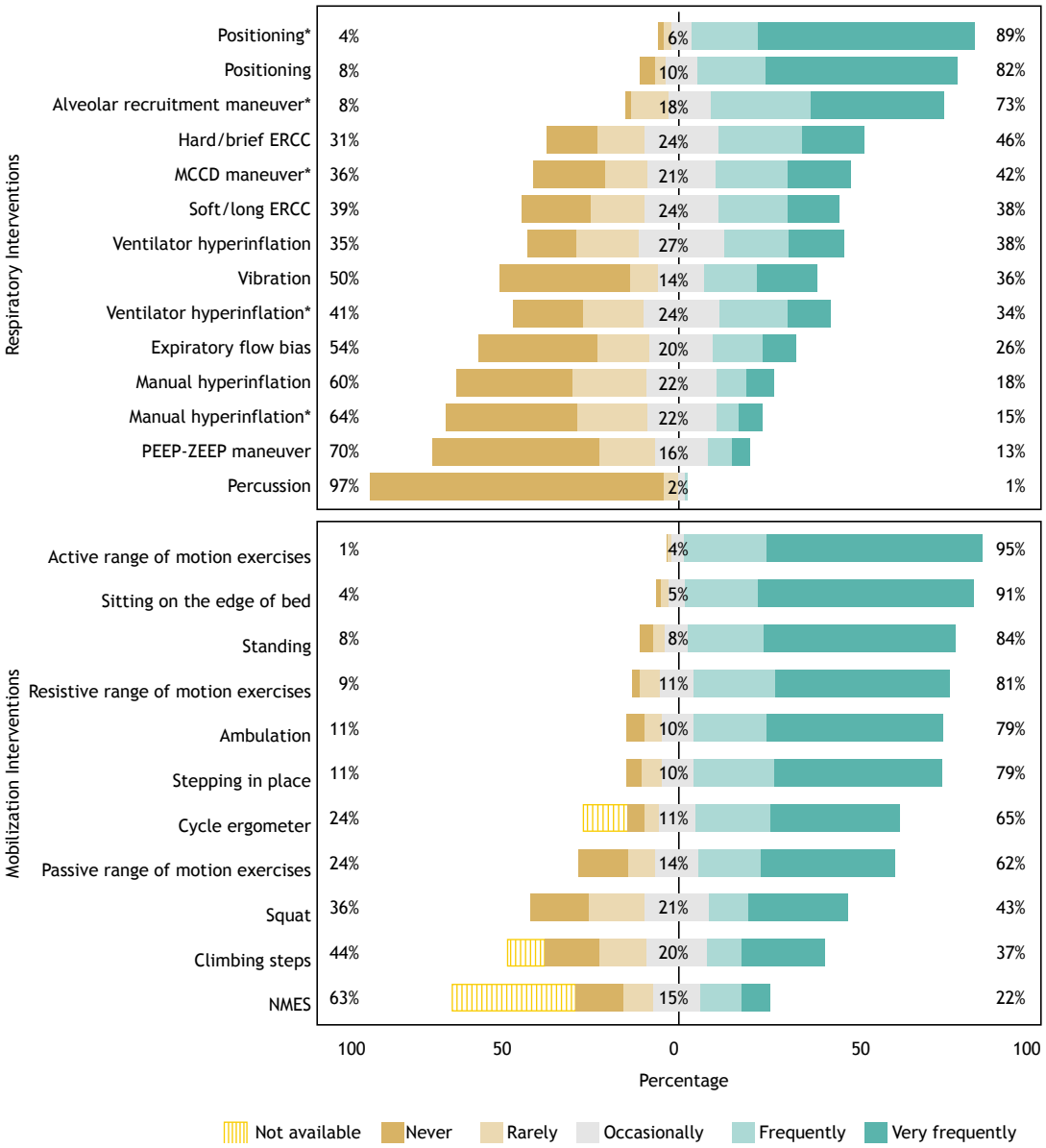

Figure 2. Frequencies of reported respiratory and mobilization interventions for mechanically ventilated patients. Respiratory interventions include techniques for lung expansion and airway clearance. ERCC: expiratory rib cage compression; MCCD: manual chest compression-decompression; ZEEP: zero end-expiratory pressure; and NMES: neuromuscular electrical stimulation. *Techniques used for lung expansion.

by 15% of 24%, respectively, because the devices were unavailable at their institutions.

The instrumental interventions less commonly used were MI-E (86%), incentive spirometry (77%), and oscillatory positive expiratory pressure (PEP) devices (70%; Figure S1). However, a significant proportion of physiotherapists informed that MI-E (48%) and oscillatory PEP devices (31%) were unavailable at their institutions.

Figure 5 shows the reasons for selecting "never" or "rarely" regarding the use of the survey's least frequently cited respiratory interventions. The most frequently declared reason for not using percussion and incentive spirometry was that the techniques have no scientific support; with regard to vibration, autogenic drainage, oscillatory PEP, intermittent positive pressure breathing, and MCCD, the main reason was that there are other more effective techniques; and PEP masks were never/rarely used because they were not part of their institution's protocol. Oscillatory PEP and intermittent positive pressure breathing were also less frequently applied because of biosecurity reasons. A common reason for not using MI-E was that the technique was not part of their institution's

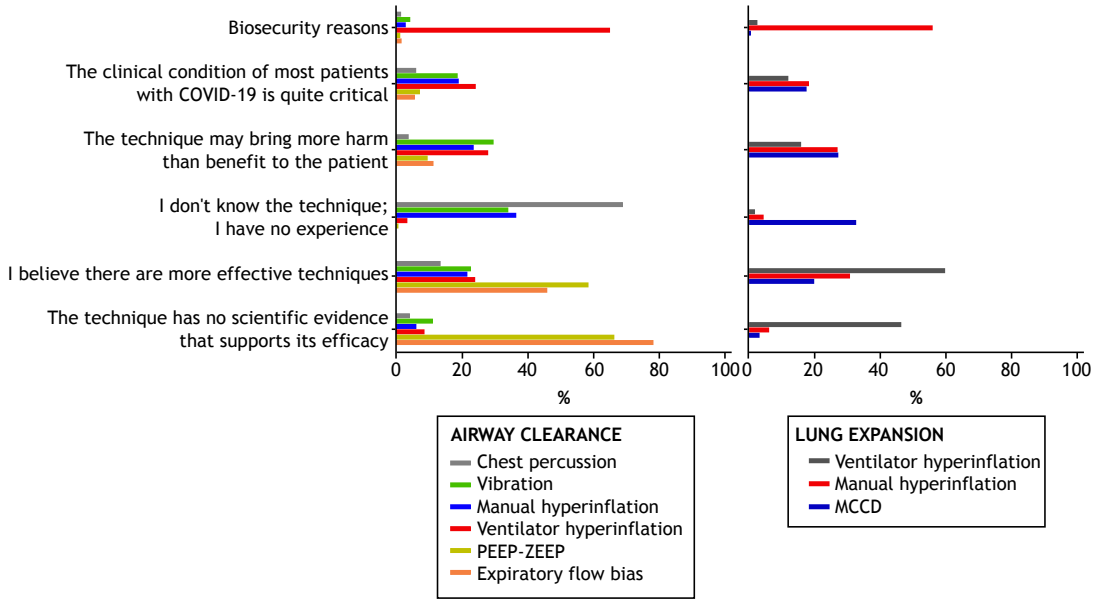

Figure 3. Reported reasons for selecting "never" or "rarely" regarding the use of the survey's least frequently cited respiratory chest physiotherapy techniques for mechanically ventilated patients. Interventions to assist airway clearance are displayed on the left and those to promote lung expansion are displayed on the right. ZEEP: zero end-expiratory pressure, and MCCD: manual chest compression-decompression.

protocol, but also the fact that they did not know how to use it.

The most frequently reported reason for not using squats or climbing steps was the poor functional status of most patients with COVID-19. Detailed reasons for selecting "never" or "rarely" regarding the use of each of the surveyed respiratory and mobilization interventions are shown in Tables S4 to S6.

DISCUSSION

This is the first study to describe self-reported answers about indications for physiotherapy and physiotherapy practice in hospitalized patients with COVID-19. The least frequent reason for indications for physiotherapy in patients on mechanical ventilation was avoidance of physical deconditioning, which included recovering or preserving aerobic capacity and muscle strength. In spontaneously breathing patients, avoidance of deconditioning was also less frequently reported along with airway clearance. Moreover, the present study revealed great variability in respiratory interventions compared with mobilization practices for both mechanically ventilated and spontaneously breathing patients, and there was an underutilization of techniques that are considered effective.

The low number of referrals for mobilization therapy might have at least two explanations: the critical condition of patients with COVID-19 and the high demand for respiratory treatment combined with limited staff. Due to the increased number of hospitalizations during the pandemic, patients with COVID-19 referred to physiotherapy usually had severe or critical illness, limiting mobilization interventions. An observational study conducted in the United Kingdom reported that the mean time to first mobilize ICU patients with COVID-19 was 14 days owing to the severity of illness,[5] whereas the time to first mobilize ICU patients without COVID-19 was 8 days in a previous study by the same group.[19] The high demand for respiratory treatment combined with limited staff is supported by the finding that the respondents treated a median of 10 patients in a 6-h shift. This means that considering that it takes at least 1 h to solve bureaucratic assignments, such as registering physiotherapy sessions in the patients' records, they had 30 min per patient, which is quite tricky to deliver complete treatment and use personal protective equipment (PPE) appropriately, as recommended. This is in accordance with the study by Li et al.,[20] who reported that physiotherapy sessions, including respiratory management and mobility exercises, for patients with COVID-19 lasted 30-40 min, without including PPE donning and doffing time. In addition, to reinforce this point of view, it has been shown that more than one person is needed to mobilize a critically ill patient on mechanical ventilation safely.[21]

Although airway clearance was considered a frequent indication for physiotherapy in mechanically ventilated, only 26% of the respondents reported it as a frequent indication for physiotherapy in patients breathing spontaneously in the ward. This result agrees with studies that have reported that retained airway secretions was expected to occur in only 28-33% of patients with severe COVID-19 admitted to the ward.[22,23]

The indications for physiotherapy most frequently reported by the respondents working in the

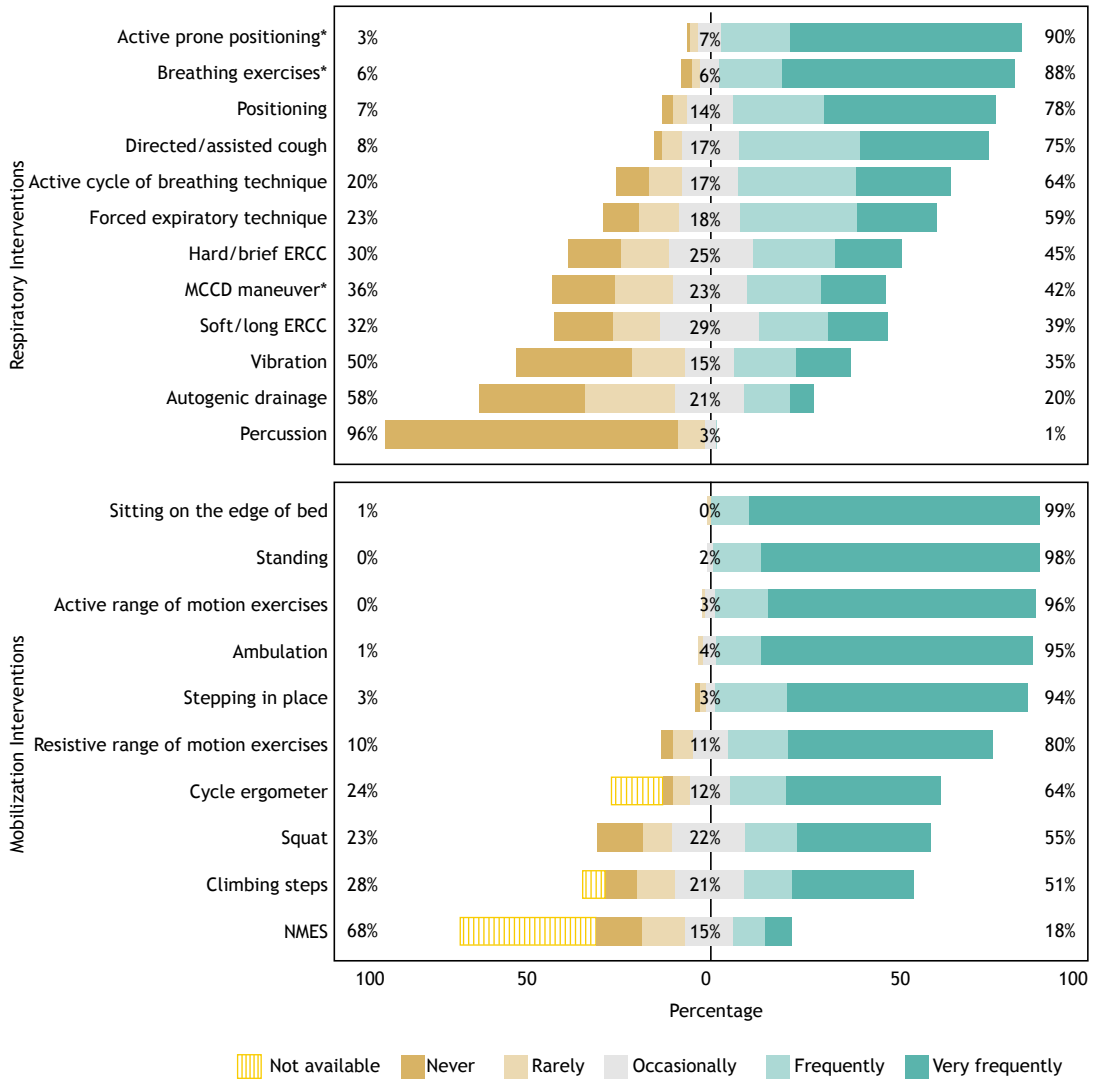

Figure 4. Frequencies of reported respiratory and mobilization interventions for spontaneously breathing patients in the ward. Respiratory interventions include techniques for lung expansion and airway clearance. ERCC: expiratory rib cage compression; MCCD: manual chest compression-decompression; ZEEP: zero end-expiratory pressure; and NMES: neuromuscular electric stimulation. *Techniques used for lung expansion.

ICU—mechanical ventilation management and oxygenation improvement—and by those working in the ward—also oxygenation improvement and reduction of work of breathing—reinforce the severity of respiratory illness of hospitalized patients with COVID-19.

Noticeably, the reported use of respiratory interventions was more erratic than that of mobilization interventions both in the ICU and the ward. This might be explained by the lack of consensus worldwide about the most effective respiratory interventions for mechanically ventilated and spontaneously breathing patients.[11-13] In addition, COVID-19, as a new disease, might have brought more uncertainty to physiotherapists during their practice.

In our study, manual techniques were less frequently applied for both mechanically ventilated and spontaneously breathing patients. Indeed, percussion and vibration were rejected by 96% and 50% of the respondents, respectively, mainly because they believed that there was no scientific evidence supporting their efficacy. Hard/brief expiratory rib cage compression and MCCD were the most commonly manual techniques applied, but only by 45% and 42% of the respondents, respectively. Because physiotherapists were instructed always to consider the benefits of hands-on treatment versus the risks of virus transmission and PPE was scarce,[14] the decision not to use manual interventions might have been strengthened.

In the case of mechanically ventilated patients, manual hyperinflation, a procedure that is widely contraindicated in the guidelines because of aerosol production, was applied by only 15-18% of the

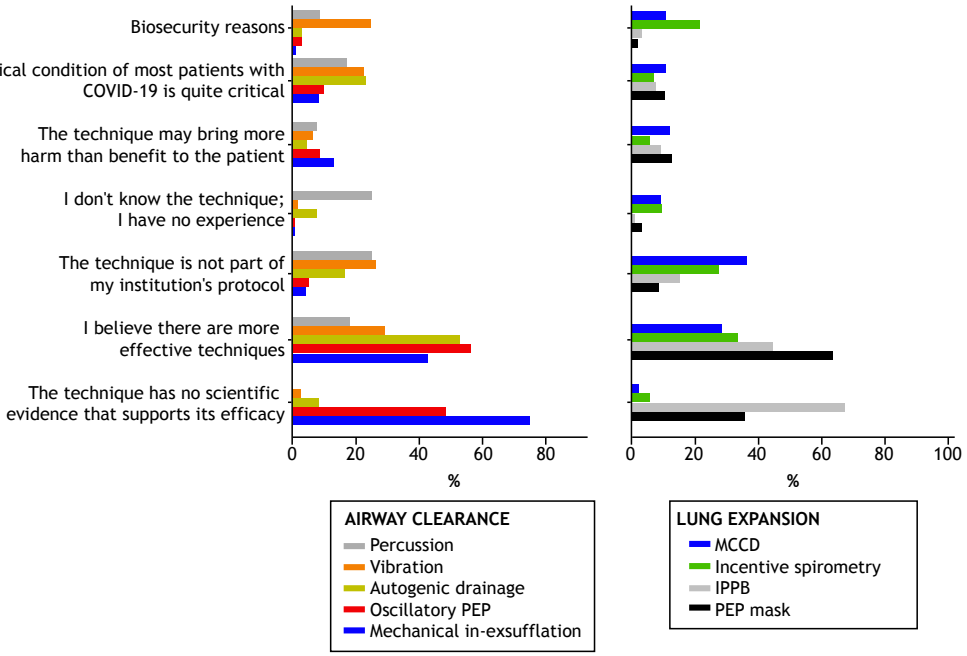

Figure 5. Reported reasons for selecting "never" or "rarely" regarding the use of the survey's least frequently cited chest physiotherapy techniques for spontaneously breathing patients. Interventions to assist airway clearance are displayed on the left and those to promote lung expansion are displayed on the right. PEP: positive expiratory pressure; MCCD: manual chest compression-decompression; and IPPB: intermittent positive pressure breathing.

respondents.[7] PEEP-ZEEP maneuver, ventilator hyperinflation, and especially expiratory flow bias were infrequently applied, because the respondents did not know or have experience applying these techniques. Since the use of expiratory flow bias has a clear rationale[24,25] and ventilator hyperinflation is as effective as manual hyperinflation—with advantages and no risk of aerosol dispersion[7,26]—these results portray the delay between the production of knowledge and its incorporation into clinical practice. The second main reason for not applying PEEP-ZEEP and ventilator hyperinflation was that the respondents believed that these techniques could bring more harm than benefits to the patient. Some professionals were likely to be wary of applying high distension pressures and ZEEP in the context of COVID-19 due to the risk of augmenting lung injury.[27,28] Indeed, it is worth mentioning that the PEEP-ZEEP maneuver and the use of expiratory flow bias require more studies to support their application.[29,30]

Techniques that use airflow modulation to assist secretion removal are considered effective for patients with mucus hypersecretion and are usually preferred by them.[31,32] Of those techniques, ACBT was recommended by most guidelines for hospitalized patients with COVID-19.[7,14,16,33] According to our survey, ACBT, FET, and autogenic drainage were used by 64%, 59%, and 28% of the respondents, respectively. The main reason for not using ACBT, FET, and especially autogenic drainage was that the respondents believed that there were other more effective techniques. These results suggested that the respondents might not be well instructed in those techniques. A more plausible reason for not using airflow modulation techniques would be the critical condition of patients with COVID-19. All techniques actively performed by the patient may increase the work of breathing, which is not recommended to patients with moderate/severe illness, especially those with low respiratory reserve.[6]

Indeed, the poor functional status of patients with COVID-19 was the most frequently reported reason for not using squats and climbing steps during mobilization therapy. These exercises are highly energy demanding for most patients with COVID-19, and the guidelines recommend that exercise intensity be set from light to moderate depending on the patient's clinical condition. For instance, Righetti et al.[9] recommended using a score < 3 on the modified Borg rating of perceived exertion scale for patients with mild COVID-19 in the acute phase, whereas Zhao et al.[34] suggested a score ≤ 3 for mild disease and < 3 for moderate disease.

Concerning instrumental interventions, incentive spirometry and oscillatory PEP were extremely underutilized at the institutions where they were available. Incentive spirometry, which is not recommended by two guidelines,[6,7] was rejected by almost 70% of the respondents, because they believe that no scientific evidence supported its use. Oscillatory PEP was included in the list of potentially aerosol-generating procedures, which probably explains the poor adherence to this technique.[7]

Surprisingly, most respondents had a specialization degree in physiotherapy related to hospital practice, but this did not prevent the underutilization of effective techniques. In order to have such a degree, participants must have a minimum of 360 h of training. However, no further information was collected to determine the quality of the programs; for example, whether a specialization program was accredited by the Brazilian Ministry of Education.

This study has some limitations. First, a convenience sample was used, which may not accurately represent physiotherapists in Brazil. However, the sample in this study included respondents from all Brazilian regions, although in different proportions. Second, because the respondents were instructed to answer the questions considering that the patients' safety criteria for use of the techniques were met, the percentages of reported interventions might differ from physiotherapy practice in the actual scenario. Therefore, the results of this study reflect preferences, perceptions of, and limitations to practice of the physiotherapists involved in treating patients with COVID-19.

This survey of self-reported physiotherapy practice revealed that the least common reason for the indication for physiotherapy was avoidance of deconditioning, whereas oxygenation improvement was the most frequent one for both mechanically ventilated and spontaneously breathing patients with COVID-19. It also revealed great variability in respiratory interventions in comparison with mobilization therapies. Moreover, it brought to light some gaps regarding physiotherapists' understanding of respiratory interventions, as well as the clear need to standardize the respiratory physiotherapy treatment for this population of patients.

Future research should first establish which physiotherapy interventions and outcomes should be investigated. Thereafter, these interventions should be evaluated through high-quality studies to clarify the best evidence-based physiotherapy treatment for critically ill patients with COVID-19.

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CONFLICTS OF INTEREST

None declared.

AUTHOR CONTRIBUTIONS

LMSD, FSG, CLF, and MSV: study design and drafting of the manuscript. LMSD and ACOO: data collection. CLF, FMP, RA, MA, and MSV: guarantors of data integrity. LMSD, FSG, CLF, and MSV: data analysis. All authors reviewed and approved the final manuscript.

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