

### **PhD Study Summary**

**Thesis Study Title:** An online survey investigating strength assessment and strength training in pulmonary rehabilitation services in England

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### **Introduction**

Pulmonary Rehabilitation (PR) is the gold standard non-pharmacological intervention offered to individuals with chronic obstructive pulmonary disease (COPD) (1). It is a structured programme comprised of two key components, exercise and education, with exercise training widely regarded as the cornerstone of PR (2). People with COPD commonly present with peripheral muscle weakness, particularly of the quadriceps, which is considered an important systematic marker of the condition (3, 4). Strength Training (ST) is an effective intervention for improving muscle strength in COPD (5-10), and consequently published PR guidelines recommend its inclusion, with an emphasis on it being individually prescribed and progressive (2, 11-14). However, there is wide variation in how ST is prescribed and delivered within research studies (2, 15-18), as well as markedly limited guidance provided in PR guidelines. This is similar with regards to strength assessment (SA). Assessing muscle strength has multiple benefits, including identification of muscle weakness, prescription of individualised training intensity/loads, and evaluation of intervention effectiveness (3, 19-22). Consequently, UK PR guidelines recommend its inclusion (4, 13, 14), but again guidance is limited and vague. There are many methods for assessing muscle strength, but not all are appropriate or feasible in clinical practice (19). Therefore, when considering how to assess muscle strength in PR, and how to prescribe and deliver ST, it is essential to consider relevant factors which influence feasibility in clinical practice.

Overall, literature supports and recommends the inclusion of ST and SA in PR programmes, but there is a noticeable absence of guidance for implementation, delivery, and prescription in UK PR. Therefore, it begs the question of how PR services are fulfilling such recommendations. Over the years, several surveys have investigated PR provision within the UK (23-29). Specifically, NACAP audits have been published (27-29), reporting some data on the provision of SA and ST, but detail is lacking. Additional and more specific information is needed to gain further insight and understanding of how SA and ST are used in PR programmes. Therefore, this study aimed to provide a clearer and more detailed picture of provision. It set out to investigate ST and SA in PR services in England, and improve understanding of its use, with a particular focus on influential factors within clinical practice, including practitioner training, attitudes, and perceived barriers.

### **Research Questions**

1. Do PR services assess patient muscle strength? If so, how is it assessed?
2. Do PR services include strength training in their exercise programme? If so, how is it prescribed?
3. Do PR practitioners have training for assessing muscle strength and delivering strength training?
4. What are the attitudes and opinions of PR practitioners towards strength assessment and strength training in PR?
5. What barriers do practitioners face in PR concerning strength assessment and strength training?

## Method

A cross-sectional questionnaire-based online survey design was used. In total, 219 healthcare professionals participated and were included in the analysis. A total of 74 PR services in England were represented by at least one participant in this study, with a median number of 2 participants recruited per PR service ( $IQR=3$ ). Eligible participants were healthcare professionals who had a job role either running, managing, or assisting in PR programmes located in England. Specifically, they worked in PR conducting standard face-to-face exercise programmes before the Covid-19 pandemic. The sampling method was purposive, with participants primarily recruited via NHS Trusts and non-NHS organisations. Participant recruitment took place between 25<sup>th</sup> October 2021 and 6<sup>th</sup> May 2022. Ethical approval was granted by the Health Research Authority on 7th Oct 2021 (REC REF: 21/HRA/4032; IRAS ID: 302999) and by the University of Essex on 16th Oct 2021 (REF: ETH2122-0177). Descriptive statistics were used to describe the sample characteristics and answer all research questions. Such data was reported using frequency distributions ( $n$  and %), and measures of central tendencies.

## Results

The majority of participants were female ( $n=180$ , 82.2%), the average age was 42.8 years ( $SD=10.19$ ), and the predominant job role was a physiotherapist ( $n=135$ , 61.6%). Participants had an average duration of 6.7 years ( $IQR=8.7$ ) working in their job role and 7.8 years ( $IQR=8.6$ ) working in PR overall. A summary of the key findings in relation to each research question is outlined in Table 1.

**Table 1.** Key Findings

Research Question	Key Findings
<b>Research Question 1: Do PR services assess patient muscle strength? If so, how is it assessed?</b>	<ul style="list-style-type: none"> <li>47% (<math>n=103</math>) of participants reported their PR service assessed patient muscle strength, equating to 56.8% of PR services represented in this study. Whereas 49.3% (<math>n=108</math>) reported their PR service did not. The remaining 3.7% (<math>n=8</math>) were unsure.</li> <li>SA methods varied. The most reported assessment was a sit to stand (S2S) test variation (<math>n=32</math>, 34%), which was predominately used as an outcome measure of strength. Followed by a one-repetition maximum (1-RM) test (<math>n=29</math>, 28.2%) or a multiple-repetition maximum (m-RM) test (<math>n=26</math>, 25.2%), primarily used for exercise prescription purposes and the assessment of bicep muscle strength. Other strength assessments reported to be used included dynamometer (<math>n=17</math>, 16.5%) and strain gauge (<math>n=6</math>, 5.8%).</li> </ul>
<b>Research Question 2: Do PR services include strength training in their exercise programme? If so, how is it prescribed?</b>	<ul style="list-style-type: none"> <li>93.6% of participants reported the inclusion of ST in PR exercise programmes.</li> <li>PR exercise programmes consisted predominantly of ST exercises, equating to nearly two thirds (61.5%) of an exercise session.</li> <li>The most used resistance equipment was free weights (<math>n=209</math>, 96.8%), with nearly all these participants selecting dumbbells (<math>n=208</math>, 99.5%) and nearly half selecting ankle weights (<math>n=98</math>, 46.9%). Resistance bands were selected by over a third of participants (<math>n=79</math>, 36.3%). Weighted machines or multiple gym apparatus was the least used (<math>n=43</math>, 19.9%).</li> <li>ST prescription varied overall (e.g., intensity, load/resistance, volume, rest period, progression), with no dominant strategy identified. Nevertheless, it can be reported that a common method utilised is a breathlessness scale (e.g., Borg scales), with 81.7% (<math>n=165</math>) reporting use for prescribing exercise intensity and 59.1% (<math>n=120</math>) reporting use for prescribing ST load/resistance. The use of a</li> </ul>

	formal strength assessment (e.g., 1-RM or M-RM) was less common, with only 16.3% ( $n=33$ ) using it to prescribe exercise intensity and 27.6% ( $n=56$ ) using it to prescribe ST load/resistance.
<b>Research Question 3: Do PR practitioners have training for assessing muscle strength and delivering strength training?</b>	<ul style="list-style-type: none"> <li>• A substantial proportion of participants did not have training related to the assessment of muscle strength (37.4%, <math>n=82</math>) and the delivery of ST (45.2%, <math>n=99</math>)</li> <li>• Staff training was predominately received while working in PR, with a primary method of training being 'learning on the job'.</li> <li>• On average, participants 'agree' themselves and their colleagues would benefit from training/additional training in the assessment of muscle strength and delivery of ST.</li> </ul>
<b>Research Question 4: What are the attitudes and opinions of PR practitioners towards strength assessment and strength training in PR?</b>	<ul style="list-style-type: none"> <li>• Overall, participants have positive attitudes and opinions towards SA and ST in PR</li> <li>• On average, participants 'agree' that assessing patient muscle strength is important, safe, a useful outcome in PR, and should be standardised across all PR services. Additionally, on average, participants 'somewhat agree' that assessing patient muscle strength is easy.</li> <li>• On average, participants 'strongly agree' that ST is important and beneficial for patients. Furthermore, on average, participants 'agree' that ST is safe for patients, easy to deliver in PR, should be individually prescribed, and should be standardised across all PR services.</li> </ul>
<b>Research Question 5: What barriers do practitioners face in PR concerning strength assessment and strength training?</b>	<ul style="list-style-type: none"> <li>• On average, participants 'somewhat agree' that limited time, inadequate equipment, and patient physical limitations are barriers to the assessment of patient muscle strength in PR. Other potential barriers, with mixed agreement results, included high staff workloads, limited funding, low staff numbers, and a lack of training for both the practitioner and their colleagues.</li> <li>• On average, participants 'somewhat agree' that patient physical limitations are barriers to ST. Other potential barriers, with mixed agreement results, include inadequate exercise equipment and not enough equipment.</li> </ul>

## Conclusion

This study provides insight into the use of SA and ST in PR services in England, and importantly the influential factors and related barriers faced by practitioners within clinical practice. ST is included in the majority of PR programmes, whereas SA is relatively low. However, no clear or consistent approach is observed, with the suitability of some assessment and prescription methods being uncertain and questionable (e.g., the use of a Borg breathlessness scale to prescribe ST intensity/load and a S2S test or bicep SA to measure muscle strength). Key factors identified as barriers are service-related factors, such as time and equipment, as well as staff training, and patient physical limitations. PR is already a successful intervention but there is room for improvement and refinement, particularly regarding SA and ST. There is a need for clearer guidance on the use in PR, with consideration for variability, feasibility, and barriers within clinical practice. If not, practices and methods will continue to vary, with questionable relevance and effectiveness. Future research should investigate best practice within the parameters of real-world clinical settings and the resources they have available to them. Additional considerations include ensuring staff have relevant and high-quality training, with further research focusing on the effectiveness of staff training, especially understanding and application, and identifying the specific aspects of training that require attention.

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