Title: An exploratory mixed methods study of respiratory physiotherapy for patients with Lower Respiratory Tract Infections.

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ABSTRACT

Objectives: To assess the outcomes of respiratory physiotherapy (RP) for patients with Lower Respiratory Tract Infections (LRTI).

Design: Parallel group mixed-methods study.

Setting: Patients were recruited from a general hospital. RP took place at a community setting.

Participants: Fifty-four patients aged ≥18yrs and diagnosed with a LRTI completed the study. Twenty-seven were allocated to the control group (CG -10 male; 53.3±17.4yrs) and twenty-seven to the experimental group (EG -10 male; 58.6±17.2yrs).

Intervention: The CG received conventional medical treatment and the EG conventional medical treatment plus RP during 3 weeks.

Outcome measures: The 6-minute walk test (6MWT), modified Borg Scale (MBS), modified Medical Research Council questionnaire (mMRC), Breathlessness, cough, and sputum scale (BCSS) were collected pre/post-intervention from both groups. Telephone follow-up surveys were also collected three months after hospital visit. Interviews were conducted immediately after the intervention in the EG.

Results: The 6MWT in the EG improved above the MID (p=0.001) and significantly more than the CG (EG: ∆76m (63.2), 95%CI 51 to 101; CG; ∆27m (56), 95%CI 4.9 to 49.2; Mean diff. between groups: 49m 95%CI 16.4 to 81.6; n^2=0.15). No differences between groups were observed in the MBS, mMRC and BCSS. The EG reported high levels of satisfaction with the intervention (27/27; 100%) and with the physiotherapist (20/27; 74%). The intervention impacted on patients' symptoms (19/27; 70%) and on their self-management skills to control/prevent future LRTI (19/27; 70%). The EG presented significantly less hospital visits (p=0.04).

Conclusions: RP seems to be effective in the management of patients with LRTI.

Clinical Trial Registration Number: NCT02053870

Keywords: Respiratory Tract Infections; Physical Therapy; Personal Satisfaction; Self Care

INTRODUCTION

Lower respiratory tract infections (LRTI) are among the most common infectious diseases worldwide[1], affecting 429 million people annually[2]. This persistent and prevalent health problem is accompanied by several respiratory symptoms, such as dyspnoea, cough and sputum[3], and significantly compromises patients' functioning and quality-of-life[4]. As a result, LRTI are considered a global health problem, responsible for approximately 3.08 working days lost due to disability per patient/per incident, and 23.88€ to 116.47€ spent in each hospital visit[5, 6].

Pulmonary rehabilitation programmes, including respiratory physiotherapy (RP), are recognised as effective for chronic respiratory diseases, improving patients' independence and function[7], as well as their individual strategies to cope with the disease[8]. These improvements result in fewer days of hospitalisation and decreased healthcare use[9]. Regarding acute respiratory diseases, the implementation of RP is controversial. The British Thoracic guidelines suggests that spontaneous breathing patients with dyspnoea, cough and sputum benefit from physiotherapy[10]. However, a recent systematic review in inpatients with pneumonia reported that RP does not improve patients' status and thus should not be implemented[11]. Nevertheless, this review addressed inpatients only, and thus the content and structure of the intervention (e.g., techniques, duration and frequency) may not serve the needs of community patients. Moreover, most patients with LRTI are treated in an outpatient basis[12] hence, studies focused in their management are needed.

Preliminary studies conducted in outpatients with LRTI have identified improvements in lung and overall function after RP[13]. Nevertheless, only quantitative measures were used and patients' perspectives about the outcomes achieved, implications for their future and healthcare use after the intervention were not evaluated. It is known that quantitative outcomes have poor correlation with patient's satisfaction and healthcare needs[14] and therefore, are insufficient to comprehensively understand the length to which an intervention impacts on patients' life.

The lack of this integrated knowledge limits the conclusions about the effectiveness of RP as a contributor for addressing LRTI. This study aimed to comprehensively assess the short- (exercise tolerance dyspnoea, cough, sputum and patients' perspectives) and mid-term (health services use) outcomes of a RP intervention for patients with LRTI living in the community.

METHOD

Design

A parallel group mixed-methods study, part of a larger randomized control trial (NCT02053870), was undertaken with a sample of patients with LRTI living in the community. The study received full approval from the Institutional Ethics Committee (2010-4-14).

Participants

Consecutive patients were recruited from the emergency department of a general Hospital. Patients were eligible if: i) aged ≥18 years old and ii) diagnosed with LRTI by a physician, according to current guidelines[3].

Exclusion criteria were: i) hospital admission (after the physician examination); ii) discrepancies in the speech and/or disorientation at the initial examination; iii) bedridden or dependence on a wheelchair; iv) score >2 in the CURB criteria[15]; and v) presence of comorbidities that could interfere with the tests performed (e.g., past history of pulmonary lobectomy and current history of neoplasia, tuberculosis or other infectious disease).

Patients were randomly assigned to RP (experimental group - EG) or conventional medical treatment (control group - CG). A simple randomization process was performed in Matlab 2009 (The MathWorks, Inc, Natick, MA, USA). The allocation sequence was kept in sealed opaque envelopes by a researcher, not involved in data collection, and provided to the consultants at the emergency department.

Physicians informed eligible patients about the study and asked about their willingness to participate. Interested patients were contacted via telephone by a researcher to schedule an appointment where more detailed information was provided and written informed consent was obtained.

Sample Size Calculations

A sample size estimation with 85% power at 5% significant level determined that a clinically significant difference in six-minute walk test - 6MWT (30.5 m)[16], would be detected with a minimum of 18 subjects (SD 46m) in each group. In respiratory interventions, dropout rates are around 43-50%[17], thus 62 participants were recruited.

Intervention

The intervention consisted of conventional medical treatment (i.e., antibiotherapy, bronchodilators and rest)[3] for the CG and conventional medical treatment plus RP for the EG. The RP intervention was carried out three times per week for 3 weeks (9 sessions)[3]. Each session lasted on average 60±15 minutes and was composed by three main components: i) breathing techniques; ii) exercise training and iii) education. Sessions were held in a well-equipped room in a community setting by one physiotherapist with experience in respiratory interventions. A detailed description of the protocol can be found in the supplementary material.

Outcome measures

Socio-demographics (gender, age and educational level), general clinical data, smoking habits and lung function, assessed with a portable spirometer (MicroLab 3500, CareFusion, Kent, UK)[18], were collected up to 48h after hospital visit. Information on dyspnoea, sputum and exercise tolerance were collected at baseline and repeated in both groups three weeks after. Data were collected by a trained researcher blinded to patients' group allocation and independent from the RP intervention.

Exercise tolerance was chosen as the primary outcome measure and was assessed with the 6MWT, following international guidelines[19]. In our sample, 6MWT presented a standard error of the mean (SE_{mean}) of 14.8 meters.

Dyspnoea was assessed with the modified Borg Scale (SE_{median}=0.2)[20] and activities limitation resulting from dyspnoea with the modified Medical Research Council questionnaire (SE_{median}=0.1)[21].

Self-reported sputum was evaluated using a 5 level qualitative scale which is a domain of the Breathlessness, cough and sputum scale (SE_{median}=0.1)[22]: (i) no sputum production; (ii) mild sputum production; (iii) moderate sputum production; (iv) severe sputum production and (v) unquantifiable.

Semi-structured face-to-face interviews were conducted with the EG to explore the impact of the RP intervention on their recovery and overall health status. The interview was guided by open-ended questions formulated based on the literature[23, 24]. Specifically, patients were asked: *Can you give us your opinion about the RP intervention?*; *Can you expand on the impacts that the intervention had on you? How do you think we could improve the intervention?*. The interviews were conducted up to 48h after the last RP session, in a community setting, by two trained researchers (one physiotherapist and one physiotherapy student), not involved in the study and with no relationship with the patients. All interviews were digitally audio-recorded for further transcription and analysis. Data collection ended when saturation was achieved.

Telephone surveys were performed to all patients, by one independent researcher with no previous participation in the study, 3-months after the first hospital visit. The survey followed a structured questionnaire to gather information consistently across patients about health services used due to worsening of respiratory symptoms (LRTI recurrence), duration of the symptoms, need for hospitalisation and length of hospitalisation.

Data analysis

Quantitative data

Descriptive statistics were carried out to describe the socio-demographic and general clinical data of the sample as well as the follow-up telephone surveys. Independent t-tests, Mann Whitney U-tests and Chi-square tests were used to compare baseline measurements and telephone surveys between groups. Two-way analysis of variance with repeated measurements was used for continuous measures. For ordinal data, the differences between pre and post assessments were pooled and then Mann Whitney U-tests were used to compare groups. Improvements in the 6MWT were compared with the minimally important difference (MID i.e., 30,5 meters)[16] using the one sample t test. Statistical analysis was completed with the estimation of effect sizes, via Partial eta-squared for ANOVA analysis, rank-biserial correlation for Mann Whitney U-tests and Cohens' d for one sample t tests. Analyses were performed using IBM SPSS Statistics version 20.0 (IBM Corporation, Armonk, NY, USA). The level of significance was set at 0.05

Qualitative data

Interviews were independently analysed and coded by the two researchers who conducted the interviews, following thematic analysis procedures[25]. Five steps were followed: i) the transcripts of the interviews were read until researchers were familiar with the content; ii) codes were attached to the words of text that represented themes; iii) the information relevant to each theme was displayed; iv) the information was reduced to its essential concepts and relationships and v) the core meaning of the data was identified and explained. The final themes were agreed in a consensus meeting. Consensus was

obtained based on the richness and importance of the theme, rather than on its prevalence alone. If a consensus could not be reached, a third independent researcher was consulted. To assure credibility of qualitative data the peer debriefing technique was performed[26]. Patients' identification was coded and fictitious names were used to preserve anonymity. The qualitative analysis followed the COREQ checklist, detailed in the supplementary material.

RESULTS

Participants

Figure 1 shows the CONSORT flow diagram for the trial. Of the 64 patients screened, 2 were excluded because they did not meet the inclusion criteria. Therefore, 62 patients were allocated to the intervention (n=31) or control (n=31) group. Fifty-four patients completed the intervention and post-test assessments. There were no significant differences between completers and dropouts with regard to age, gender or diagnosis ($p>0.05$).

(Please insert fig. 1 about here)

Baseline characteristics of patients are provided in table 1. No significant differences between-groups were noted on baseline characteristics.

(Please insert table 1 about here)

Clinical Data

Both groups experienced significant improvements in the 6MWT (EG: Δ76m (63.2), 95%CI 51 to 101; CG: Δ27m (56), 95%CI 4.9 to 49.2; partial η^2= 0.44).

The magnitude of the improvement in the 6MWT was higher in the EG than in the CG (Mean diff. between groups: 49m 95%CI 16.4 to 81.6; partial η^2=0.15). Also, the distance walked by the EG significantly exceed the MID (Mean diff. 46m 95%CI 21 to 71; ES=1.48). No difference was observed in the CG (Mean diff. -3m 95%CI -25.1 to 19.2; ES=0.11). Both groups significantly improved in the modified Borg Scale and self-reported sputum**.** Only the EG improved in the modified Medical Research Council questionnaire. No other differences between groups were found (Table 2).

(Please insert table 2 about here)

Face-to-face interviews

From the 27 transcripts of the interviews, four different themes were identified regarding the impact of the RP intervention on patients' recovery and overall health status, these were: *impact on patients' recovery; patients' self-management and empowerment; the physiotherapist; organisational aspects of the intervention.* The interviews lasted on average 25±2.4 minutes.

Impact on patients' recovery

Patients felt that RP sessions were of "*great value*" [Rose, 45yrs] and "*essential*" [Vivian, 58yrs] to relieve dyspnoea (9/27; 33%), sputum production (4/27; 15%), fatigue in performing daily activities (4/27; 15%) and wheezing (2/27; 7%).

"This [the RP intervention] was really good for reducing my breathlessness" [Alice, 54yrs]

"(…) The RP intervention helped me to get it all out [sputum] and I became much better. The medication alone probably wouldn't have been enough." [Joanna, 40yrs]

*"I feel better when I breathe because before (…), I used to feel wheezy. And now, since I started doing the sessions, I don't feel it anymore". [*John, 80yrs]

*"I now get less tired with the same amount of effort." [*Mary, 62yrs].

Patients also reported improvements in their overall health status (19/27; 70%): "*… This helped me to recover faster than I expected. (…) I am better in some points of my health than I would be if I had only taken the medication*" *[*Richard, 34yrs]; and on their personal and family life (5/27; 19%) as it helped them to value themselves more as individuals (2/27; 7%) and involved their family members in the recovery process (3/27; 11%):

"Even in my family life, this has helped me! Now, I value my life and the ones who surround me, more than before."[Rose, 45yrs].

"My wife used to read the information sheets with me, so we could understand and perform the exercises together."[Michael, 69yrs].

Eleven patients (11/27, 41%), contacted with RP for the first time and referred to it as a "*new experience"* (9/27; 33%) that *"should be more disclosed to people who have LRTI, so they can have access to professional help as we did*." [Paul, 33yrs].

Patients' self-management and empowerment

Acquisition of self-management skills to control and prevent future LRTI was the most reported positive outcome of the RP intervention (19/27; 70%). Patients reported that having knowledge on how to perform breathing and airway clearance techniques made them feel more prepared and confident in taking control over their symptoms and dealing with possible future respiratory infections (12/27; 44%).

"It helped me to take control over the disease. Now I know what to do in the next time I have the same problem" [Christian, 30yrs]

*"(…) This [programme] helped me (…) to learn exercises to recover from my respiratory problems! It helped me a lot! " [*Richard, 30yrs]

Nevertheless, 2 patients (2/27; 7%) expressed lack of confidence when performing the breathing techniques without the physiotherapist supervision:

"One thing about the sessions is that if we are next to the physiotherapist we have to do it, and at home we don't do it… Although we start doing it at home, once we feel tired, we stop and there is no one nearby to tell us "let's do it again/keep going"". [Anna, 74yrs]

"The thing is that, we are dependent because we have the "crutch" by our side saying: "now breathe four times, now three, now two and do it this way…" [Luca, 81yrs]

Empowerment on preventing future infections was reported by 11 patients (11/27; 41%). Patients who presented risk behaviours for LRTI recurrence stated that the information provided in the RP sessions have motivated them to change sedentary lifestyles (5/27; 19%), nutrition habits (3/27; 11%) and quit smoking (2/27; 7%).

"Now I exercise and before I didn't." [Martha, 36yrs]

"Since I started to come to the sessions, I have been more careful with what I eat, because now I know what is bad for my health…" [Vivian, 58yrs]

"(…) I was a smoker since I was thirteen … And (…) I was not 100% informed of what smoking could cause. Only after reading the information sheet I started thinking: if I do not quit now, I'll never will!" [Paul, 33yrs]

The physiotherapist

Patients reported high levels of satisfaction with the physiotherapist's performance (20/27; 74%). Competent (6/27; 22%) and enlightening (6/27; 22%) were the most used attributes to describe the physiotherapist, followed by careful (4/27; 15%) and patient (2/27; 7%).

"The intervention is really helpful, as well as the physiotherapist who has the closest contact with us." [Anna, 74yrs]

"I always asked things: "Why are we doing this? What is that for?"… and the physiotherapist always answered me, so I could understand. And only then I would do the tasks." [Ernest, 58yrs]

Organisational aspects of the intervention

Most patients (15/27; 56%) reported that the duration and length of the intervention/sessions were "*perfectly adequate to recover from the disease process*." [Marc, 60yrs]. However, 5 (5/27; 19%) patients considered that the intervention should be extended either in duration (add one or two more weeks) or in frequency (increase from 3 to 4 days a week), to achieve plenitude of their treatment:

"I think that if we had done more [sessions]… one or two more weeks, maybe it would have been better to be completely re-established…" [Anna, 74yrs]

Some patients highlighted the quality and pertinence of the material used during the sessions (12/27; 44%) as well as the adequacy of the sessions' organisation to their health condition (6/27; 22%).

Telephone surveys

Results on follow-up telephone surveys are presented in table 3. Three months after the first hospital visit, more patients from the CG accessed health services due to worsening of their respiratory symptoms (8/27; 15% vs 2/27; 4%; p=0.04).No significant differences were found regarding the number of health service visits (p=0.67), number of hospitalisations (p=0.75), length of hospitalisation (p=0.50) and days with symptoms (p=0.89).

(Please insert table 3 about here)

DISCUSSION

The RP intervention impacted significantly on exercise tolerance of patients with LRTI and on their empowerment to relieve respiratory symptoms and control/prevent future LRTI. These patients also reported significantly less health-care utilisation due to recurrent LRTI, three months after the first hospital visit.

Significant improvements were found in the 6MWT in both groups but especially in EG. It is further important to note that only patients from the EG improved significantly beyond the MID[16]. These results are similar to those achieved by patients with COPD who participate in rehabilitation programs[27, 28] and reflect RP importance to recover functional and aerobic capacities[19].

No significant differences were found in dyspnoea and sputum between groups, which might suggest that the respiratory manoeuvres had little effect on patients' symptoms. However, the instruments used to assess patients' symptoms should be taken into consideration. In clinical practice, scales are considered to be simple, non-invasive and economic methods to assess RP interventions[29], but are not sensitive enough to detect small and moderate changes[29]. Within this context, patients' reports are of great value to fully understand the changes promoted by RP interventions. Specifically, patients valued RP for enhancing their self-management skills to breathe properly, perform air clearance techniques, reduce their breathlessness (19/27; 70%) and prevent future LRTI (19/27; 70%). Furthermore, RP also impacted on having fewer patients visiting health services due to LRTI recurrence in a 3 months

period after the intervention, which has clinical relevance not only for respiratory physiotherapists but for the national health services.

The effectiveness of the RP intervention, when compared with the conventional medical treatment only, can be explained by the improvement of patient's self-efficacy and confidence towards the disease. These new competencies may have enhanced patients' efficacy towards an early detection and self-management of the typical symptoms of the disease at home. The importance of self-efficacy for self-management is well reported for patients with chronic respiratory diseases and has been associated with patients' improved health-related quality-of-life[30] and reduced healthcare use[31]. These results reinforce the need of also empowering patients with acute respiratory diseases.

The physiotherapist attributes were also valued by patients, similar to what has been found in studies conducted with patients with musculoskeletal disorders, where the physiotherapist's skill, knowledge, professionalism, friendly attitude, and effective communication were highlighted[32]. These factors seem to have a high impact in patients' perspectives about physiotherapy regardless of the area of intervention.

Overall, the organisational aspects of the intervention were perceived as being adequate to patients' fully recovery and acquisition of self-management skills. However, older patients reported that they felt more confident when performing the exercises in the RP session than at home and also exhibited the need of having more RP sessions to achieve a full recovery. It is known that self-efficacy is one of the strongest determinants of engagement in an activity in

older people[33]. Thus, if these patients did not feel that they mastered the techniques, they might not perform them at home, delaying their rehabilitation process. Nevertheless, age should not be seen as a limitation in patient's perceived ability or personal efficacy beliefs[34], but adjustments in the length or structure of the intervention may be required.

This study highlights that additional to conventional medical treatment, patient-centered interventions involving exercise and education are required to improve patients' recovery from the respiratory disease, return to their active life and prevent future LRTI and hospital visits.

Limitations and future work

This study has some limitations that need to be acknowledged.

Firstly, information regarding previous LRTI and treatments were not gathered, which might limit to conclude about the impact of the RP program on patients' rehabilitation. However, physiotherapy is not commonly recommended in LRTI[11] and thus it is not believed that patients were ever enrolled in RP for LRTI. Also, patients from the EG showed more exercise tolerance and less hospital visits due to recurrence of the disease than those from the CG. These results still points towards a better rehabilitation process achieved with physiotherapy than with medication only, independently of previous LRTIs.

Secondly, the RP protocol implemented was not the most suitable for older patients, who required more and/or longer sessions to fully recover. Adjustments in the interventions may be performed using behavioural strategies

or motivational interviews. Behavioural strategies could include home visits and the involvement of a family member in the RP sessions, as it is known that positive reinforcement and social support from family is a strong predictor of activity[33]. Motivational interviewing could also be added during the educational time of the session. This has been shown to increase adherence to physiotherapy treatments among individuals with a variety of conditions (e.g., heart failure, obesity)[35].

Finally, power calculations for the 6MWT, were performed based on a study conducted with patients with parenchymal lung disease, as, to the authors best knowledge, no previous studies exist establishing the MID for LRTI. Although, LRTI comprises conditions that directly imply an affection of the parenchyma, such as pneumonia, it also includes other conditions that do not, such as acute bronchitis. Thus, studies exploring the MID in patients with LRTI are needed.

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Conflict of interest: nothing to declare.

REFERENCES

[1] Zhang X, Wang R, Di X, Liu B, Liu Y. Different microbiological and clinical aspects of lower respiratory tract infections between China and European/American countries. J Thorac Dis. 2014;6(2):134-42.

[2] World Health Organization. The global burden of disease - 2004 update Switzerland: World Health Organization, 2008.

[3] Woodhead M, Blasi F, Ewig S, Garau J, Huchon G, Ieven M, et al. Guidelines for the management of adult lower respiratory tract infections--full version. Clin Microbiol Infec. 2011;17 Suppl 6:E1-59.

[4] Welte T, Torres A, Nathwani D. Clinical and economic burden of community-acquired pneumonia among adults in Europe. Thorax. 2012;67(1):71-9.

[5] World Health Organization. The World Health Report 2008: Primary Health Care - Now more than ever. Geneva, Switzerland World Health Organization, 2008.

[6] Oppong R, Coast J, Hood K, Nuttall J, Smith RD, Butler CC. Resource use and costs of treating acute cough/lower respiratory tract infections in 13 European countries: results and challenges. Eur J Health Econ. 2011;12(4):319-29.

[7] Vestbo J, Hurd SS, Agusti AG, Jones PW, Vogelmeier C, Anzueto A, et al. Global strategy for the diagnosis, management, and prevention of chronic obstructive pulmonary disease: GOLD executive summary. Am J Respir Crit Care Med. 2013;187(4):347-65.

[8] Stoilkova A, Janssen DJ, Franssen FM, Spruit MA, Wouters EF. Coping styles in patients with COPD before and after pulmonary rehabilitation. Respir Med. 2013;107(6):825-33.

[9] Rubí M, Renom F, Ramis F, Medinas M, Centeno MJ, Górriz M, et al. Effectiveness of Pulmonary Rehabilitation in Reducing Health Resources Use in Chronic Obstructive Pulmonary Disease. Arch Phys Med Rehabil. 2010;91(3):364-8.

[10] Bott J, Blumenthal S, Buxton M, Ellum S, Falconer C, Garrod R, et al. Guidelines for the physiotherapy management of the adult, medical, spontaneously breathing patient. Thorax. 2009;64 Suppl 1:i1-51.

[11] Yang M, Yan Y, Yin X, Wang BY, Wu T, Liu GJ, et al. Chest physiotherapy for pneumonia in adults. Cochrane Database Syst Rev. 2013;2:CD006338.

[12] Singanayagam A, Chalmers JD, Welte T. Epidemiology of CAP in Europe. In: Chalmers J, Pletz M, Aliberti S, editors. European Respiratory

Monograph 63: Community-Acquired Pneumonia. 63: European Respiratory Society; 2014.

[13] Dinis J, Oliveira A, Pinho C, Campos G, Rodrigues J, Marques A, editors. Automatic wheeze and respiratory phase detectors to evaluate respiratory physiotherapy in LRTI: a preliminary study. Healthinf - 6th International Conference on Health Informatics; 2013; Barcelona.

[14] Asadi-Lari M, Tamburini M, Gray D. Patients' needs, satisfaction, and health related quality of life: towards a comprehensive model. Health Qual Life Outcomes. 2004;2:32.

[15] Kwok CS, Loke YK, Woo K, Myint PK. Risk prediction models for mortality in community-acquired pneumonia: a systematic review. BioMed research international. 2013;2013:504136.

[16] Holland AE, Hill CJ, Conron M, Munro P, McDonald CF. Small changes in six-minute walk distance are important in diffuse parenchymal lung disease. Resp Med. 2009;103(10):1430-5.

[17] Greulich T, Kehr K, Nell C, Koepke J, Haid D, Koehler U, et al. A randomized clinical trial to assess the influence of a three months training program (gym-based individualized vs. calisthenics-based non-invidualized) in COPD-patients. Respir Res. 2014;15(36):1-8.

[18] Miller MR. Standardisation of spirometry. Eur Respir J. 2005;26(2):319-38.

[19] American Thoracic Society. ATS statement: guidelines for the six-minute walk test. Am J Resp Crit Care. 2002;166(1):111-7.

[20] Borg G. Borg's Perceived Exertion and Pain Scales. United States of America: Human Kinetics; 1998.

[21] Doherty DE, Belfer MH, Brunton SA, Fromer L, Morris CM, Snader TC. Chronic Obstructive Pulmonary Disease: Consensus Recommendations for Early Diagnosis and Treatment. J Fam Practice. 2006:S1.

[22] Leidy NK, Rennard SI, Schmier J, Jones MK, Goldman M. The breathlessness, cough, and sputum scale: the development of empirically based guidelines for interpretation. Chest. 2003;124(6):2182-91.

[23] Cooper K, Smith BH, Hancock E. Patients' perceptions of self-management of chronic low back pain: evidence for enhancing patient education and support. Physiotherapy. 2009;95(1):43-50.

[24] Sheppard LA, Anaf S, Gordon J. Patient satisfaction with physiotherapy in the emergency department. Int Emerg Nurs. 2010;18(4):196-202.

[25] Vaismoradi M, Turunen H, Bondas T. Content analysis and thematic analysis: Implications for conducting a qualitative descriptive study. Nurs Health Sci. 2013;15(3):398-405.

[26] Collins KMT, Onwuegbuzie AJ, Johnson RB, Frels RK. Using debriefing interviews to promote authenticity and transparency in mixed research. Int J Mult Res Approaches. 2013;7(2):271-84.

[27] Beauchamp MK, Evans R, Janaudis-Ferreira T, Goldstein RS, Brooks D. Systematic review of supervised exercise programs after pulmonary rehabilitation in individuals with COPD. Chest. 2013;144(4):1124-33.

[28] Jacome C, Marques A. Pulmonary rehabilitation for mild COPD: a systematic review. Respir Care. 2014;59(4):588-94.

[29] Crisafulli E, Clini EM. Measures of dyspnea in pulmonary rehabilitation. Multidiscip Respir Med. 2010;5(3):202-10.

[30] Disler RT, Gallagher RD, Davidson PM. Factors influencing self-management in chronic obstructive pulmonary disease: an integrative review. Int J Nurs Stud. 2012;49(2):230-42.

[31] Bourbeau J, van der Palen J. Promoting effective self-management programmes to improve COPD. Eur Respir J. 2009;33(3):461-3.

[32] Hush JM, Cameron K, Mackey M. Patient satisfaction with musculoskeletal physical therapy care: a systematic review. Phys Ther. 2011;91(1):25-36.

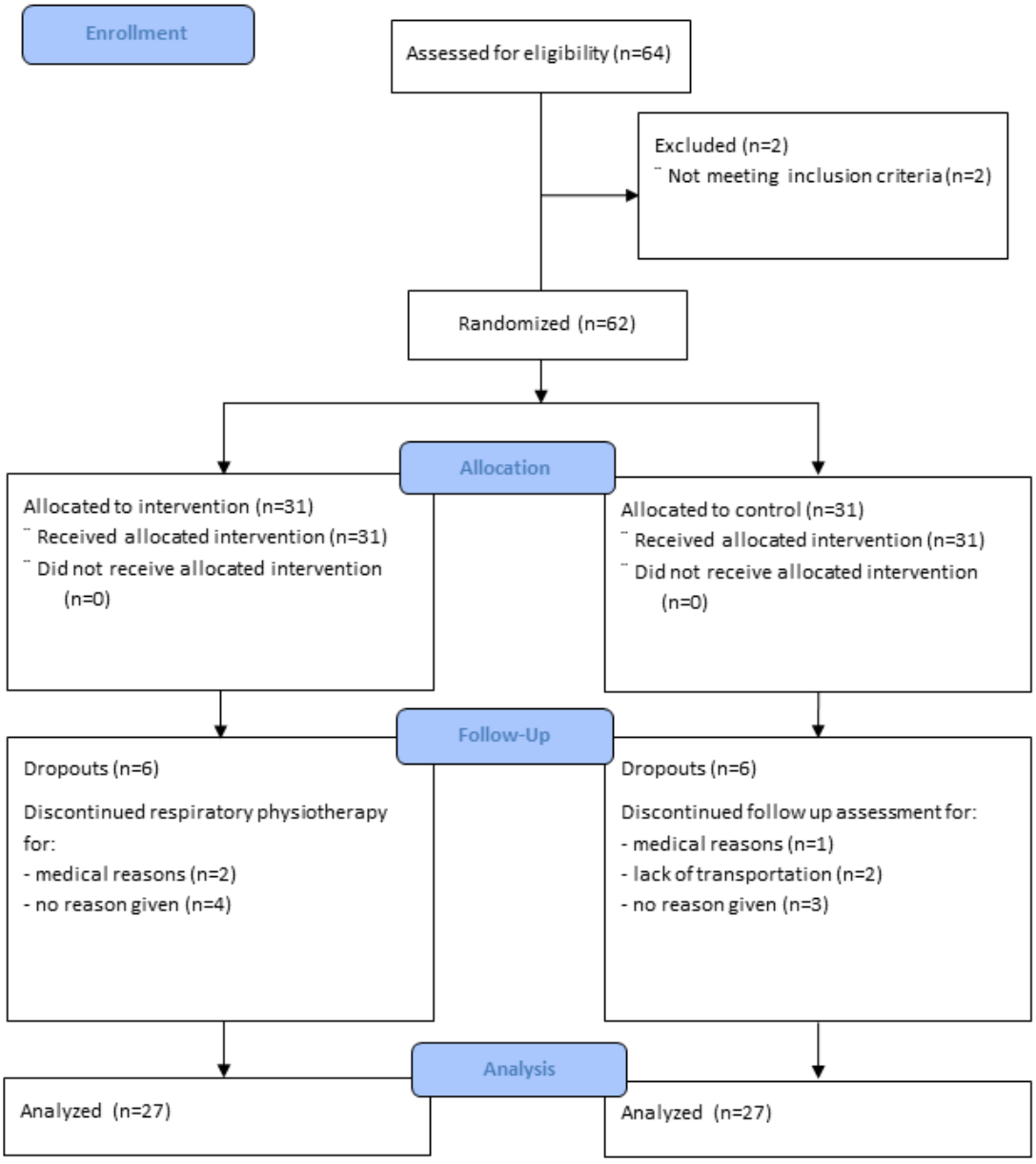
[33] Koeneman MA, Verheijden MW, Chinapaw MJ, Hopman-Rock M. Determinants of physical activity and exercise in healthy older adults: a systematic review. Int J Behav Nutr Phys Act. 2011;28(8):142.

[34] Margie E. Lachman, Neupert SD, Agrigoroaei S. Part 3: Social and Health Factors that Impact Aging. In: Schaie W, Willis SL, editors. Handbook of the Psychology of Aging. 7th ed. London: Academic Press; 2011. p. 175-90.

[35] McGrane N, Galvin R, Cusack T, Stokes E. Addition of motivational interventions to exercise and traditional Physiotherapy: a review and meta-analysis. Physiotherapy. 2015;101(1):1-12.

Figure legends

Figure 1 - Consolidated Standards of Reporting Trials (CONSORT) flow diagram.



Tables

Table 1 Patients' socio-demographics, general clinical data, lung function and smoking habits

Characteristics	Control group (*n*=27)	Experimental group (*n*=27)	*P*-value
Sex			1.00
Male	10 (37)	10 (37)	
Female	17 (63)	17 (63)	
Age (years), mean (SD)	53 (17)	59 (17)	0.27
Academic qualifications			0.06
No qualifications	1 (4)	4 (15)	
Primary school	16 (59)	13 (48)	
Secondary school	7 (26)	8 (30)	
High school	1 (4)	2 (7)	
University degree	2 (7)	0 (0)	
Smoking status			0.40
Current smokers	4 (15)	3 (11)	
Past smokers	5 (19)	2 (7)	
Non-smokers	18 (67)	22 (82)	
Diagnosis			0.70
Pneumonia	9 (33)	6 (22)	
AECOPD	5 (19)	5 (19)	
Acute bronchitis	10 (37)	14 (52)	
AE asthma	3 (11)	2 (7)	
FEV_1 (% predicted), mean (SD)	66 (27)	71.7 (20)	0.36

FVC (% predicted), mean (SD)	73 (23)	78.4 (19)	0.33
FEV_1/FVC, mean (SD)	72 (18)	71.1 (17)	0.99

Data shown as *n* (%) unless otherwise stated.

1 Abbreviations: FEV1, forced expiratory volume in one second; FVC, forced vital capacity.

2

Table 2 Clinical characteristics of patients from control and experimental groups.

	Control group (*n*=27)		Experimental group (*n*=27)					
	Pre	Post	Pre	Post	Diff[a]	Diff[b]	*P*-value	ES
6MWT, mean (SD)	371 (112)	398 (101)	347.6 (106)	424 (109)	27 (56) 95% CI 5 to 49	76 (63) 95% CI 51 to 101	0.004*†	0.15†
MBS, median (IQR)	3 (2, 4)	1 (0, 3)	3 (0, 10)	0.5 (0, 4)	-2 (-3, 0) 95% CI -2.3 to -0.6	-1 (-3, 0) 95% CI -2.6 to -0.7	0.92‡	0.01‡
mMRC, median (IQR)	2 (1, 4)	2 (1,3)	2 (1, 4)	1 (0, 4)	0 (-1, 0) 95% CI -0.7 to 0.1	-1 (-1, 0) 95% CI -1.2 to -0.4	0.08‡	0.24‡
Sputum, median (IQR)	2 (2, 4)	2 (1, 2)	3 (1, 4)	2 (0, 4)	0 (-1, 0) 95% CI -0.9 to -0.1	-1 (-1, 0) 95% CI -1.1 to -0.2	0.32‡	0.13‡

Diff, mean difference; a, control group; b, experimental group; ES, effect size; MBS, Modified Borg scale; mMRC, Modified British Medical Research Council scale; BCSS, Breathlessness, Cough and Sputum scale; 6MWD, six-minute walking distance; SD, standard deviation; CI, confidence interval; IQR, interquartile range.

*P<0.05;

† result of the two-way analysis of variance with repeated measurements

‡ result of the comparison between the pooled differences of pre and post assessments in each group performed with Mann Whitney U-tests

Table 3 Follow-up telephone surveys performed 3 months after hospital visit to patients of the control and experimental groups.

Variable	Control group (n=27)	Experimental group (n=27)	p
No. of patients using HS	8(14.8%)	2(3.7%)	0.04*
Health services visits	1[1, 3]	1[1-1]	0.67
No. of patients hospitalised	3(30%)	1(10%)	0.75
Days hospitalised	10[8.5, 10.5]	3[3, 3]	0.18
Days with symptoms	8.5[10, 15]	7[11, 15]	0.89

Values shown as Median[interquarlile range] or n(%).

Abbreviations: HS, health services; RP, respiratory physiotherapy; *p<0.05.

Online Data Supplement

An exploratory mixed methods study of respiratory physiotherapy for patients with Lower Respiratory Tract Infections.

Ana Oliveira, Alda Marques

Intervention Protocol

Control group: participants were treated with conventional medical treatment, consisting in azithromycin for people with no comorbidities, amoxicillin with clavulanate for people presenting comorbidities (e.g., chronic heart, pulmonary or renal disease and diabetes mellitus, COPD) and an ipratropium bromide inhaler if the person suffered from a long term respiratory disease, such as COPD and asthma. All participants were advised to reduce their physical activity for approximately 10-15 days[1].

Experimental Group: participants were treated with the same medical treatment as the control group plus 9 sessions of respiratory physiotherapy for 3 weeks. The RP sessions were composed by three main components: i) breathing techniques; ii) exercise training and iii) education.

Breathing techniques were performed for approximately 25 minutes and consisted of: breathing retraining to reduce energy costs of breathing and dyspnoea[2]; slow inspiratory techniques, such as incentive spirometry and exercises at inspiratory controlled flow (EDIC) [3] to increase pulmonary expansion[4], prevent atelectasis and aid sputum clearance[5]; and airway clearance techniques, such as the active cycle of breathing techniques, to help mobilising and clearing bronchial secretions[6].

Exercise training consisted of approximately 25 minutes of exercises including a warm up and a cool down period, exercises for thoracic mobility, expansion and flexibility to increase pulmonary volumes (5-10 min)[7] and endurance training.

The training intensity was adjusted according to patient's symptoms on the modified Borg Scale (4 to 6 on perceived dyspnoea/fatigue was an indicator of adequate training intensity)[2] and heart rate (60-80% of the patient maximal heart rate calculated using the following equation: 206.9 - (0.67 × age))[2].

Ten to fifteen minutes of each session were used to provide education about the disease and its management, self-performance of airway clearance techniques and home exercises. This approach aimed to ensure an on-going intervention and to provide the patient with skills to manage the disease[8]. From session 1 to session 5, an information sheet with relevant information on LRTI was provided and discussed with participants, so they could build a handbook. The protocol was similar to all patients, however, the time spent in each technique was adapted according to patients' symptoms reported on the modified Borg Scale [2] and their heart rate [2]. Table 1 summarises the respiratory physiotherapy protocol.

Table 1 – Summary of the respiratory physiotherapy intervention.

	GOALS	TECHNIQUES (DURATION)	PROGRESSIONS	EDUCATION
WEEK 1	• ↓ Dyspnoea • ↓ Energy cost and work of breathing • ↑ Airway clearance • Prevent atelectasis • ↑ Total Lung Capacity • ↑ Thoracic mobility and expansion	**Breathing control and bronchial hygiene** • Postural relief of dyspnoea (10 min.) • Pursed lips breathing (10/15 cycles) • slow inspiratory techniques: Incentive spirometry + EDIC (10 cycles – apnoea 3s) • ACBT (3-5 cycles). **Exercise training** • Warm up: upper limbs movements. (2-5 min.) • Upper body: scapula rotations; arms abduction; proprioceptive neuromuscular facilitation techniques (2 series; 10 rep.) • Cold down: starching exercises (neck and shoulder muscles (2 series; 10s)	Day 2/3: Diaphragmatic breathing Day 2/3: 8 cycles – apnoea 4s Exercises performed with therabands.	10 min./session to discuss Day 1: i) breathing retraining techniques; ii) Incentive spirometry iii) Postural relief of dyspnoea; Day 2: iv) anatomy and physiology of the respiratory system; v) signs and symptoms of LRTI; vi) airway clearance techniques Day 3: vii) physical exercise

WEEK 2	• Airway clearance maintenance • ↑ Thoracic mobility and flexibility • ↑ Physical fitness	**Breathing control and bronchial hygiene** • Pursed lips breathing + diaphragmatic breathing (5 cycles – apnoea 5s) • slow inspiratory techniques: Incentive spirometry + gymnastic ball (5 cycles – apnoea 5s) • ACBT (3-5 cycles). **Exercise training** • Warm up: upper limbs and trunk movements. (2-5 min.) • Upper body: scapula retractions; arms abduction and adduction; proprioceptive neuromuscular facilitation techniques (2 series; 10 rep.) • Trunk: lateral inclination and rotation • Cold down: stretching exercises (shoulder, arm, trunk, hip and leg muscles (2 rep.; 20s)	Day 6: 5 min. walking in the treadmill.	10 min./session to discuss Day 4: viii) Nutrition Day 5: iv) Smoking habits.

WEEK 3	• ↑ Thoracic mobility and flexibility • ↑ Physical fitness	**Breathing control and bronchial hygiene** • Pursed lips breathing + diaphragmatic breathing (5 cycles – apnoea 5s) • slow inspiratory techniques: Incentive spirometry (5 cycles – apnoea 5s) **Exercise training** • Warm up: upper/lower limbs and trunk movements. (2-5 min.) • Upper limbs: shoulder flexion (2 series; 10 rep.) • Trunk: abdominals, cat arching breathing (2 series, 10 rep.) • Lower limbs: 10-20 min. walking in the treadmill and 5-10 min. in the cycloergometer. • Cold down: stretching exercises (trunk, hip, leg and foot muscles (2 rep.; 30s)	ACBT should only be performed if informed by pulmonary auscultation Load in the treadmill/ cycloergometer increased according: • Dyspnoea on the modified Borg Scale (4-6); • Heart rate (60-80% of the patient maximal heart rate	10 min./session to discuss participants' doubts and worries.

Abbreviations: ACBT: active cycle of breathing techniques; EDIC: exercises at inspiratory controlled flow; min.: minutes; rep.: repetitions; s: seconds

Qualitative analysis

Consolidated criteria for reporting qualitative studies (COREQ): 32-item checklist[9]

No. Item	Guide questions/description	Response
Domain 1: Research team and reflexivity		
Personal Characteristics		
1. Inter viewer/facilitator	Which author/s conducted the interview or focus group?	Oliveira A. Lopes, L (not an author)
2. Credentials	What were the researcher's credentials? E.g. PhD, MD	Degree in Physiotherapy Physiotherapy Student
3. Occupation	What was their occupation at the time of the study?	Research fellow Student
4. Gender	Was the researcher male or female?	Females
5. Experience and training	What experience or training did the researcher have?	Oliveira A. and Lopes, L. had completed coursework in qualitative methods at their undergraduate studies. Their work was also supervised by Marques, A, an experienced researcher.
Relationship with participants		
6. Relationship established	Was a relationship established prior to study commencement?	No
7. Participant knowledge of the interviewer	What did the participants know about the researcher? e.g. personal goals, reasons for doing the research	No
8. Interviewer characteristics	What characteristics were reported about the inter viewer/facilitator? e.g. Bias, assumptions, reasons and interests in the research topic	Information was provided about the role of the interviewer in the investigation, e.g., participants were told that the interviewer was a research fellow.
Domain 2: study design		
Theoretical framework		
9. Methodological orientation and Theory	What methodological orientation was stated to underpin the study? e.g. grounded theory, discourse analysis, ethnography, phenomenology, content analysis	Thematic analysis
Participant selection		
10. Sampling	How were participants selected? e.g. purposive, convenience, consecutive, snowball	Consecutive
11. Method of approach	How were participants approached? e.g. face-to-face, telephone, mail, email	Face-to face
12. Sample size	How many participants were in the	54

	study?	
13. Non-participation	How many people refused to participate or dropped out? Reasons?	Dropouts (n=12) Discontinued follow up assessment for: - medical reasons (n=3) - lack of transportation (n=2) - no reason given (n=7)
Setting		
14. Setting of data collection	Where was the data collected? e.g. home, clinic, workplace	Data was collected at well-equipped rooms at the University of Aveiro.
15. Presence of non-participants	Was anyone else present besides the participants and researchers?	No
16. Description of sample	What are the important characteristics of the sample? e.g. demographic data, date	Socio-demographic data, dyspnoea, sputum, lung function and exercise capacity.
Data collection		
17. Interview guide	Were questions, prompts, guides provided by the authors? Was it pilot tested?	Yes. Based on previous literature: • Cooper K, Smith BH, Hancock E. Patients' perceptions of self-management of chronic low back pain: evidence for enhancing patient education and support. Physiotherapy. 2009;95(1):43-50. • Sheppard LA, Anaf S, Gordon J. Patient satisfaction with physiotherapy in the emergency department. Int Emerg Nurs. 2010;18(4):196-202
18. Repeat interviews	Were repeat inter views carried out? If yes, how many?	No
19. Audio/visual recording	Did the research use audio or visual recording to collect the data?	Yes. Audio recorders.
20. Field notes	Were field notes made during and/or after the interview or focus group?	No.
21. Duration	What was the duration of the interviews or focus group?	25±2.4 minutes
22. Data saturation	Was data saturation discussed?	No
23. Transcripts returned	Were transcripts returned to participants for comment and/or correction?	No
Domain 3: analysis and findings		
Data analysis		
24. Number of data coders	How many data coders coded the data?	Two
25. Description of the coding tree	Did authors provide a description of the coding tree?	No.

26. Derivation of themes	Were themes identified in advance or derived from the data?	Derived from the data.
27. Software	What software, if applicable, was used to manage the data?	N/A
28. Participant checking	Did participants provide feedback on the findings?	No.
Reporting		
29. Quotations presented	Were participant quotations presented to illustrate the themes/findings? Was each quotation identified? e.g. participant number	Yes.
30. Data and findings consistent	Was there consistency between the data presented and the findings?	Yes
31. Clarity of major themes	Were major themes clearly presented in the findings?	Yes
32. Clarity of minor themes	Is there a description of diverse cases or discussion of minor themes?	Yes.

References

[1] Woodhead M, Blasi F, Ewig S, Garau J, Huchon G, Ieven M, et al. Guidelines for the management of adult lower respiratory tract infections--full version. Clin Microbiol Infec. 2011;17 Suppl 6:E1-59.

[2] American College of Sports Medicine. ACSM'S Guidelines for Exercise Testing and Prescription. 9th ed. Pescatello LS, Arena R, Riebe D, Thompson P, editors. Philadelphia: LWW; 2014.

[3] Postiaux G. Kinésithérapie et pathologie du poumon profond: les techniques inspiratoires lentes pour l'épuration des voies aériennes périphériques. Rev Mal Respir. 2000;6(31):552-67.

[4] Weiner P, Man A, Weiner M, Rabner M, Waizman J, Magadle R, et al. The effect of incentive spirometry and inspiratory muscle training on pulmonary function after lung resection. J Thorac Cardiov Sur. 1997;113(3):552-7.

[5] Postiaux G. Fisioterapia respiratória pediátrica, o tratamento guiado por ausculta pulmonar. 2nd ed. Artmed PA, editor2004.

[6] Pryor J, Prasad S. Physiotherapy for Respiratory and Cardiac Problems: Adults and Paediatrics. 4th ed. CL. E, editor. UK: Churchill Livingstone; 2008.

[7] Tucker B, Jenkins S. The effect of breathing exercises with body positioning on regional lung ventilation. Aust J Physioth. 1996;42(3):219-27.

[8] Wyka K. Patient Education and Long-Term Care. EGAN´S: Fundamentals of Respiratory Care. 9th ed. St. Louis: MOSBY Elsevier; 2009.

[9] Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups2007 2007-12-01 00:00:00. 349-57 p.