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Increasing Physical Activity in Patients with Chronic Obstructive Pulmonary Disease

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Abstract

It is well acknowledged that levels of physical activity in patients with COPD are considerably lower than healthy-age matched individuals, with physical inactivity recognised as a key predictor of hospitalisation and mortality. Pulmonary rehabilitation has become a major tool for managing symptoms of COPD and the associated extra-pulmonary effects. However, inconsistencies surrounding its effectiveness in terms of improving physical activity remain due to the complex nature of physical activity. To overcome these inconsistencies, both pharmacological and behavioural interventions have been documented to aid improvements in physical activity, with the benefits of behavioural interventions alongside PR found to be the most effective tool to promote levels of physical activity. Healthcare professionals must therefore look to incorporate an interdisciplinary approach in order to best achieve improvements in physical activity levels in patients with COPD.

Introduction

Chronic Obstructive Pulmonary Disease (COPD) is a highly prevalent respiratory disease that is characterised by persistent respiratory symptoms and airflow limitation, primarily affecting individuals with a history of exposure to cigarette smoke and/or other noxious particles and gases (GOLD, 2020). The most common respiratory symptoms include dyspnea (breathlessness), cough and/or sputum production (GOLD, 2020). In addition to progressive chronic airflow limitation and the associated levels of dyspnea, many patients also suffer extra-pulmonary effects, including skeletal muscle dysfunction/wasting and weight loss, leading to reductions in functional capacity and physical activity (Watz et al., 2014). Although regular physical activity is recommended by the European Respiratory Society (ERS) statement on physical activity, it remains well acknowledged that levels of activity are significantly lower in patients with COPD compared to healthy age-matched individuals

(Troosters et al., 2010; Watz et al., 2014). Furthermore, physical activity levels have been recognised as a key predictor of mortality and hospitalisation in patients with COPD, making physical inactivity a key risk factor that healthcare professionals must consider when prescribing management goals to patients with COPD (Garcia-Aymerich, Lange, Benet, Schnohr, & Antó, 2006).

The mechanisms associated with physical inactivity

The fundamental mechanisms of physical inactivity in COPD are poorly understood, with a number of published theories available (Barnes & Celli, 2009; Troosters et al., 2013). One widely accepted theory known as "the vicious cycle of physical inactivity model" was developed by (Troosters et al., 2013). Based on this theory, symptoms of dyspnea and leg discomfort, that are associated with physical inactivity, are a result of skeletal muscle wasting and airway remodelling that limit airflow and increase the requirements of ventilation. A greater prevalence of these symptoms makes conducting activities of daily living an unpleasant experience, creating fear of performing such activities. The associated fear factor naturally inclines those individuals to become more sedentary and depressed. The subsequent inactive lifestyle advances a decline in the ability to conduct activities of daily living and may further reduce cardiovascular functions and skeletal muscle deconditioning as well as deteriorating peoples physical state and increasing the frequency of breathlessness. Thus, patients are forced into a more sedentary lifestyle, creating a vicious cycle of inactivity and worsening symptoms (Troosters et al., 2013).

COPD symptoms and physical inactivity

There is a consistent association between levels of physical activity and the clinical and functional determinants of COPD, with symptoms of dyspnea and leg discomfort found to have

a significant negative impact on an individual's ability to conduct activities of daily living (Spruit, Pitta, McAuley, ZuWallack, & Nici, 2015). Specifically, physical activity and the extent of dyspnea have been well linked in COPD patients, with a worsening experience of breathlessness while performing activities of daily living a major indicator for avoiding overall activity (Watz et al., 2014). Qualitative data reported that subjective dyspnea displayed a strong correlation with daily life activities, assessed via a questionnaire (r= -0.37, P <0.01) (Katajisto et al., 2012). Similar results were reported in two quantitative studies using accelerometer derived physical activity, with significant associations between Medical Research Council (MRC) dyspnea scores and physical activity levels (Waschki et al., 2012; Watz et al., 2009). Subjectively measured leg discomfort, measured through the 'Multidimensional Fatigue Inventory', was associated with reduced levels of physical activity. (Wong, Goodridge, Marciniuk, & Rennie, 2010). Meanwhile, patients who reported spending less time outdoors were associated with greater levels of leg discomfort during activities of daily living in a separate study from Baghai-Ravary et al. (2009). With these findings in mind, it is well recognised that providing improvements in levels of physical activity can significantly benefit symptoms associated with COPD.

Pulmonary rehabilitation

Pulmonary rehabilitation (PR) has become a major tool for managing symptoms of COPD and the associated extra-pulmonary effects. This multidisciplinary program consists of supervised exercise training, self-management education that is relevant to the needs and requirements of the individual patient, nutritional counselling, as well as psychological and social support from a range of practice nurses and healthcare professionals (Bolton et al., 2013; Spruit et al., 2013). The primary objectives of PR are to reduce symptoms of dyspnea and leg discomfort and improve levels of functional capacity and health related quality of life (Bolton

et al., 2013; GOLD, 2020; Spruit et al., 2013). To achieve these objectives, PR covers a scope of non-respiratory problems including; muscle deconditioning and cardiovascular limitations, anxiety and depression, social isolation and malnutrition (Bolton et al., 2013; Spruit et al., 2013). Based on these objectives, it has been extensively documented that PR is effective in reducing symptoms of dyspnea and leg discomfort as well as improving exercise capacity and health related quality of life (Egan et al., 2012; Ries et al., 2007; Verrill, Barton, Beasley, & Lippard, 2005). Moreover, it is commonly reported that PR emphasises behaviour change through collaborative self-management and education, which alongside increased exercise capacity, may translate into improvements in physical activity levels (Spruit et al., 2015). Despite this rationale, studies have shown inconsistent findings surrounding the benefits of physical activity after PR, even though concomitant improvements in exercise capacity and health related quality of life have been reported (Egan et al., 2012; Mador, Patel, & Nadler, 2011; Pitta et al., 2008). This disparity highlights the fact it remains unknown how to effectively translate gains in exercise capacity, that PR commonly provides, into enhanced levels of physical activity. One of the primary reasons for this mismatch is associated with physical activity being a complex health behaviour, with determinants of physical activity influenced by personal, interpersonal, environmental and global factors (Bauman et al., 2012). Furthermore, although physical activity is now listed as one of the primary outcome measures of PR, many healthcare professionals fail to identify physical activity as a key outcome measure of PR, limiting the analysis of physical activity throughout PR programmes (Spruit et al., 2015). In order to address the complex nature of physical inactivity in patients with COPD, practice nurses, healthcare professionals and researchers must look towards additional interventions that may promote a more physically active lifestyle.

Alternative approaches to improve physical activity:

Behaviour change modification

An understanding of the behavioural factors related to both participation and the long-term adherence to physical activity in patients with COPD has become more common, leading researchers and healthcare professionals to develop numerous exercise and behavioural modification tools that target both the physical and behavioural aspects of physical activity (Bauman et al., 2012; Mantoani, Rubio, McKinstry, MacNee, & Rabinovich, 2016). In order to produce effective behavioural tools, a number of key components are required including; goal setting, action plan development, support with problem solving, relapse prevention, self-motivation and self-esteem. In addition, motivational interviewing has been documented as an effective strategy to collaborate and communicate with patients surrounding their challenges towards behaviour change (Greaves et al., 2011).

The effectiveness of behavioural modification tools through the implementation of physical activity coaching/counselling on levels of physical activity in COPD have been reported by numerous randomised controlled trials, with the implementation of goal setting and pedometer feedback documenting a significant improvement in steps per day, greater than the minimal important difference of 600 steps per day (Armstrong et al., 2019; Demeyer et al., 2016). Incorporating physical activity coaching/counselling into a patient's treatment plan provides a healthcare professional with the ability to assess a patient's physical activity and provide structured feedback, as well as develop individualised activity goals that can be supported by motivational interviewing, to best cover all aspects of this complex behaviour (Armstrong et al., 2019). Patients are able to use these skills to understand successes and failures surrounding their activity levels, in order to develop behavioural traits towards achieving future activity goals (Mantoani et al., 2016). The implementation of physical activity coaching/counselling alongside PR has gained increased knowledge over the last few years. Specifically, the pooled analysis of randomised controlled trial's implementing goal setting and pedometer feedback

alongside exercise training as part of comprehensive PR provided improvements in steps per day greater than both exercise training alone and physical activity coaching/counselling alone (Armstrong et al., 2019; Lahham, McDonald, & Holland, 2016).

Tele-coaching is another widely accepted physical activity coaching tool, with a 12 week programme of semi-automated tele coaching found to be well accepted and feasible in patients with COPD (Loeckx et al., 2018). In addition, improvements in steps per day have been reported by (Demeyer et al., 2017) following a 12-week semiautomated tele coaching programme, with the addition of improvements in walking time and movement intensity.

- *Pharmacotherapy*

Pharmacological therapies are prescribed to reduce symptoms of COPD and reduce the frequency and severity of exacerbations, influencing the functional capacity and health status of individual patients (GOLD, 2020). Bronchodilator therapy is a well-known treatment to improve dynamic hyperinflation, with studies clearly demonstrating improvements in patients experiences of breathlessness and health status during rest and exertional activity. Interestingly, a number of studies have demonstrated the impact of bronchodilator therapy on levels of physical activity (Kesten, Casaburi, Kukafka, & Cooper, 2008; O'Donnell et al., 2011; Troosters et al., 2014). Of those studies, a randomised controlled trial from Kesten et al. (2008) specified improvements in physical activity after the delivery of bronchodilators, albeit physical activity was assessed using self-reported questionnaires. Meanwhile, two further randomised controlled trials were unable to demonstrate any effects of long-acting bronchodilator therapy on physical activity levels (O'Donnell et al., 2011; Troosters et al., 2014).

- Oxygen therapy

Knowledge surrounding the influence of ambulatory oxygen therapy as a treatment tool for physical activity is limited, with the bulk of literature surrounding improvements in exercise

tolerance in hypoxemic patients (Bradley, Lasserson, Elborn, MacMahon, & O'Neill, 2007). In a small number of randomised controlled trial's that have assessed physical activity, long-term oxygen therapy was in fact independently associated with lower levels of physical activity (Casaburi et al., 2012; Garcia-Aymerich et al., 2004).

Barriers to the implementation of such interventions:

As discussed in this clinical article, the ability of PR to improve levels of physical activity remain inconclusive, with heterogeneous effects across studies. To ensure patients make significant improvements in physical activity moving forward, longer durations of PR, pharmacological therapies' and the inclusion of targeted behavioural interventions to PR may be needed, however, barriers towards their effectiveness should be noted.

In targeted behavioural interventions, specifically physical activity coaching/counselling, the existence of heterogeneity, predominantly due to methodological variables (types of goal setting, feedback provided and length of intervention) and patient demographics (severity and baseline levels of physical activity), have caused a barrier towards its effectiveness (Armstrong et al., 2019; Qiu et al., 2018). To uncover these barriers, a recently published meta-analysis from our research group uncovered the specific aspects of physical activity coaching/counselling in order to outline the optimal way to deliver this intervention (Armstrong et al., 2019). It was found that regardless of the way physical activity coaching/counselling was implemented, improvements in steps per day were greater than the documented minimal important difference (Demeyer et al., 2016). However, it was noticed that interventions of this nature were more effective in patients with greater baseline physical activity levels (>4000 steps/day) (Armstrong et al., 2019). This theory was previously proposed by which patients with COPD exhibiting greater exercise capacity prior to PR were more likely to achieve greater improvements in physical activity levels after an intervention of physical

activity coaching (Osadnik et al., 2018). Such theories portray that for patients with very low baseline physical activity levels, the most effective intervention to improve physical activity levels may involve a combination of PR and physical activity coaching/counselling. A combined intervention of this nature can provide patients with the ability to build both muscular strength/endurance and cardiovascular fitness as well as implement behaviour change strategies that can assist the complex pathway between improved levels of functional capacity and physical activity. Moreover, therapies such as Cognitive Behavioural Therapy (CBT) that have been found to be effective in reducing high levels of anxiety and depression (Heslop-Marshall et al., 2018), may provide an additional tool towards combatting physical inactivity in more severe patients.

Consequently, in line with the findings of our research team, those patients with worsened disease state may require an interdisciplinary approach, that incorporates aspects of exercise training, pharmacological therapies and behavioural interventions to best manage symptoms and improve levels of physical activity.

Finally, the implementation of semi-automated tele coaching as a tool to promote physical activity has provided promising findings, however it remains difficult to fully implement due to the dependency of technology, with many COPD patients unable to afford such technologies. It is envisaged that this intervention will become more clinically and cost effective in the broader healthcare system alongside smartphones in the future (Loeckx et al., 2018).

Conclusion

Improving levels of physical activity in patients with COPD has become increasingly important due to the relationship between physical inactivity and greater risk of hospitalisation and mortality. PR remains the most effective tool to modify symptoms of COPD and the associated extra-pulmonary effects, however its ability to influence physical activity remains inconclusive. Well known pharmacological therapies have documented improvements in

physical activity, however it is the use of physical activity coaching/counselling that has provided the most effective improvements in physical activity in patients with COPD. Therefore, the ability to modify physical activity behaviour in COPD patients' needs to involve an interdisciplinary approach, bringing together pulmonary rehabilitation, behavioural modification and pharmacological therapies.

Recommended strategies to promote physical activity in the clinical setting:

- Health care professionals should talk to patients about the option of buying cheap pedometers or using mobile phone apps to record and track steps per day.
- Health care professionals may incorporate physical activity diaries into home-based patient care, whether that involves reporting daily step counts or simply reporting time spent conducting physical activity.
- Provide weekly goal setting to patients who exercise the use of a pedometer or mobile app for tracking steps per day. This can be implemented in person during PR sessions or over the telephone as a remote tool.
- Employ motivational interviewing to discover patients' barriers and enablers towards promoting greater levels of physical activity. This tool will allow healthcare professionals to understand patients favourite activities and plan goals around those activities.

Key points to take home:

- Levels of physical activity are significantly lower in patients with COPD compared to age-matched healthy individuals.
- Increased physical inactivity is associated with worsening COPD symptoms, greater hospital admissions and mortality rates.
- Pulmonary rehabilitation remains the most effective tool to modify symptoms of COPD, however its ability to modify symptoms of physical activity remains inconclusive.
- Both pharmacological and behavioural interventions have been documented to improve levels of physical activity.

- Physical activity coaching/counselling provides the most effective improvements in physical activity, with improvements in steps per day greater than the documented minimal important difference.
- Barriers towards the effectiveness of physical activity coaching/counselling in all COPD patients remain, with the suggestion that healthcare professionals should begin these interventions in patients with greater baseline physical activity levels.

Key words:

- Chronic Obstructive Pulmonary Disease
- Pulmonary Rehabilitation
- Physical activity
- Behaviour change

Abbreviations:

COPD: Chronic Obstructive Pulmonary Disease
ERS: European Respiratory Society
MRC: Medical Research Council
PR: Pulmonary Rehabilitation
CBT: Cognitive Behavioural Therapy

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