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Physical Activity and Pulmonary Diseases. A Systematic Review

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Abstract

Lung diseases represent a major public health problem worldwide, but especially in our country. Official statistics elaborated by the World Health Organization rank Romania in the top of the European countries regarding the prevalence of lung diseases. This article is a systematic review of the literature in order to reveal the benefits of physical activity on the organism in patients diagnosed with various lung diseases. In this research we have introduced all original studies that included the two variables, physical activity and lung disease. The lung diseases included in the systematic review are: chronic obstructive pulmonary disease (COPD), asthma, lung cancer, pulmonary hypertension, pneumonia, pulmonary embolism, chronic respiratory diseases. The systematic review of the studies was made on the effects of physical activity on: COPD (35%) lung cancer (17%), asthma (14%) and chronic respiratory diseases (6%), pulmonary hypertension (8%) and pulmonary embolism (12%), as well as pneumonia (8%).The overview of the qualitative assessment reveals that physical activity has an instrumental potential in recovering patients, irrespective of the diagnostic form and associates significantly with the improvement of the quality of patients' life. We consider that this systematic review can inform the conduct health policy in the future and these must be based on the best scientific evidence and relevant research.

Keywords: physical activity; pulmonary diseases; quality of life; Qualitative Assessment.

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Introduction

Our business domain experts may face many situations where those who practice physical activities may suffer from chronic or acute illnesses (metabolic, respiratory, heart issues) (Stanescu, 2006, p.285). As official statistics say, Romania is the country that opens the top of European countries regarding the prevalence of pulmonary diseases (WHO, 2013). Experts believe that through the high prevalence, the consequences, the costs involved in patient care, pulmonary diseases represent an important public health problem in Romania (The Third National Conference of Pneumology, 2013). The main pulmonary diseases with major impact on the population, which we have introduced in the systematic analysis, are: COPD, asthma, lung cancer, pulmonary hypertension, pneumonia, pulmonary embolism, chronic respiratory diseases.

Bronchial asthma is defined as a chronic inflammatory disease of the airways in which are attending numerous types of cells, especially mast cells, eosinophils, T lymphocytes, macrophages, neutrophils and epithelial cells. Airway inflammation causes increased bronchial reactivity to a variety of stimuli. Among the risk factors and triggers of asthma, both exercise and hyperventilation are included, because they do not induce airflow limitation in people without asthma, including those with other airway diseases such as COPD cystic fibrosis or bronchiectasis. Exercise is the most frequent trigger of short symptomatic episodes especially in children and young adults. The mechanism is most likely related to changes in the mucosa induced by hyperventilation or the modification associated with the cooling of the osmolarity of fluid film that papers the bronchial wall (Miron, 2008).

Official statistics reveal that asthma affects over 235 million people and the prevalence of this disease is increasing (Global Asthma Report, 2011). For example, children and young people tend to suffer more and more from this lung disease (*Figure 1*).

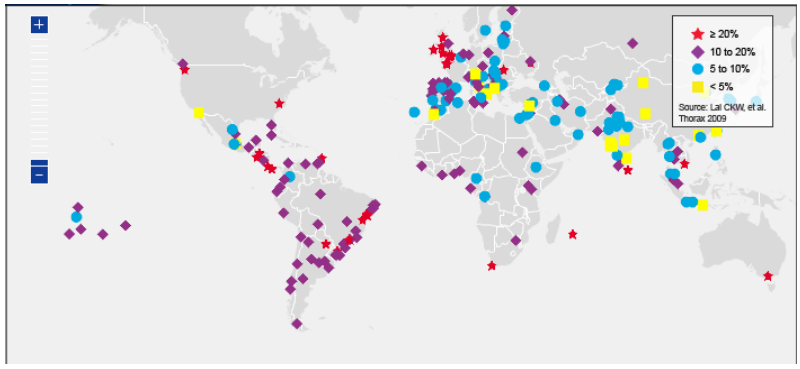

Figure 1. Asthma symptom among 13-14 year olds (Souse: The Global Asthma Report, 2011)

Regarding COPD, they represent a major cause of mortality and morbidity worldwide, being a common illness that can be prevented and treated and that is characterized by persistent and progressive limitation of airflow associated with high inflammatory response of the airways and lung tissue, following exposure to noxious particles and gases. Unlike asthma, in this case, exercise is not a risk factor, but regardless of the disease stage, pulmonary rehabilitation through exercise within rehabilitation programs, increases effort tolerance, reducing dyspnea and the fatigue degree, the duration of a rehabilitation program lasting for a minimum of 6 weeks. Lung cancer deaths take the first place among all types of cancer. Mortality is high due to late diagnosis, for which the main risk factor is smoking. In recent years prestigious companies such as American Cancer Society, European Respiratory Society and The European Association for Bronchology strongly emphasize the need to develop guidelines for the early detection of lung cancer (Ulmeanu, 2012). This review aims to give an overview of available published evidence concerning the association between physical activity and pulmonary diseases in children, adolescents and adults, on which national policies can be implemented to prevent and treat patients with lung diseases.

Method

In this research we have introduced all original studies that included the two variables, physical activity and lung disease. The qualitative evaluation of the articles was based on the PICOS elements necessary for an evaluation protocol:

- *Review objective:* The research aims to evaluate the clinical effects of physical activity programs in pulmonary diseases, regardless of age, sex or lung disease.
- *Participants:* Studies of participants (children, adolescents and adults) diagnosed with lung diseases.
- *Interventions:* Any type of program or exercise combinations in which the subjects participate.
- *Results:* Any clinical outcomes reported by the studies included in the systematical review.
- *Study design:* Systematical reviews, case study, cohort study, controlled trials, case report.

Database searching

We chose the PubMed search engine because it represents the interface of the largest medical platform, Medline, in which the major impact journals in the medical field are indexed. PubMed was searched using a comprehensive controlled vocabulary, Medical Subject Headings (MeSH), *pulmonary disease*, as

well as the key words: *physical activities*, *physical exercise*, *lung disease*. Thus, the search results have revealed a number of 1075 free full text articles, published between 1975-2013.

Inclusion criteria

The review included studies which have had as an objective the highlighting of the effects of the physical activity on the quality of life in patients diagnosed with various pulmonary diseases. From the total number of 1075 articles, 1003 (48%) were excluded: no abstract available (543, 54%), unable to provide further information, to make assessments (460, 46%). The number of articles that met the eligibility criteria for inclusion in the qualitative analysis is 72. Out of these, 17 (42%) were excluded because they represented duplicate studies, 8 (24%) had no relevant data to our study, 10 (30%) were not full text articles, and 5 (15%) did not meet the eligibility criteria. The studies included in the qualitative analysis are eventually 32 (3%) of the total 1075 (Figure 2). Out of the 32 titles included in the systematic review, seven (21%) articles were reviews of the literature, 19 (61%) studies have targeted adults and 6 (18%) children and young people.

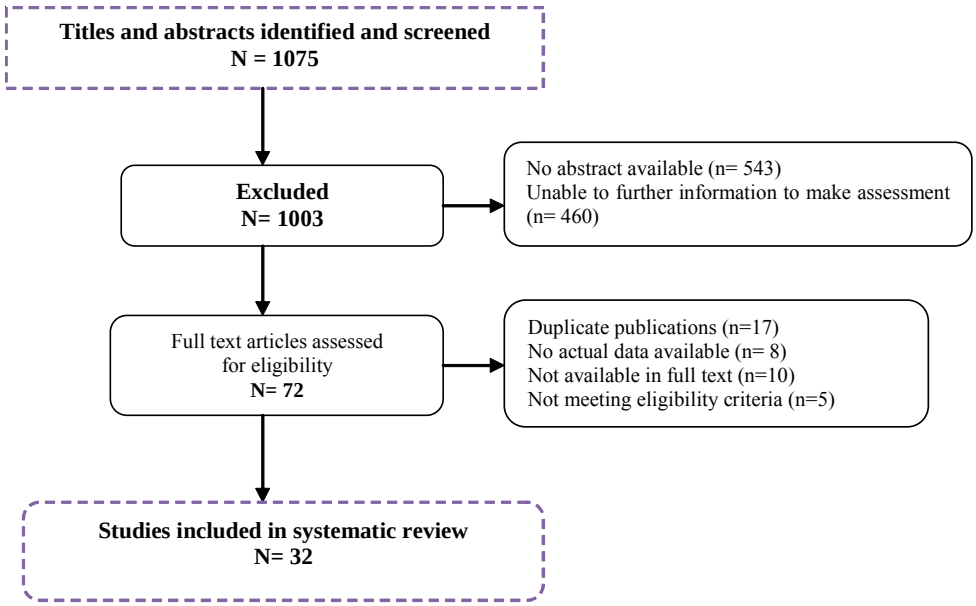

Figure 2. Study flow diagram

Results of systematic review

Studies characteristics

The systematic review of the studies was made on the effects of physical activity on: COPD (35%) lung cancer (17%), asthma (14%) and chronic respiratory diseases (6%), pulmonary hypertension (8%) and pulmonary embolism (12%), as well as pneumonia (8%). Tables 1, 2 and 3 offer a brief overview of the effects of the physical activity on these lung diseases.

Main findings

The effects of the physical activity on the human body are well known and scientifically substantiated. It is known that physical activity reduces oxidative stress on the body, has a strong anti-inflammatory effect and reduces respiratory tract infections (Hopkinson & Polkey, 2010), the most common respiratory diseases being COPD and asthma (Eves & Davidson, 2011). Based on the present study, most patients with COPD are reported to be less physically active than both their age- and sex-matched healthy counterparts and patients with other chronic diseases such as rheumatoid arthritis or diabetes (Katajisto *et al.*, 2012). Recent research has demonstrated that physical activity is significantly lower in COPD versus smoking controls (Van Remoortel *et al.*, 2013) and moderate-intensity physical activity in patients with COPD is more reduced than previously known (Vitorasso, 2012). Cohort studies have shown that in patients with severe COPD, with different illness degrees, the physical activity level significantly correlated with the 6-minute walking distance [6MWD] (van Gestel, 2012; Chen *et al.*, 2012), the intensity parameter walking intensity correlated most strongly with the 6MWD in healthy subjects and COPD patients (Annegarn *et al.*, 2012), as well as with the body's ability to carry oxygen throughout the body [VO^2] (Díaz *et al.*, 2010). Studying the effects of the exercise programs among patients with chronic lung disease, Dourado *et al.* (2009) demonstrated that physical exercises have an impact on muscle strength, endurance capacity of patients and the quality of life, the subjects tolerated more activity with less dyspnea-related distress and improved their functional performance (Doneskz-Cuenco *et al.*, 2009).

Statistics show advanced lung cancer is incurable and is the leading cause of cancer deaths world-wide. Despite this reality, clinical studies whose objective was to investigate the effects of physical activity programs on patients diagnosed with lung cancer, reported that physical activity reduces the risk of cancer recurrence, death from cancer and death from all causes for breast and colon cancer patients (Holmes *et al.*, 2005; Ballard-Barbash *et al.*, 2012, cited by Dhillon *et al.*, 2012), and the high and medium levels of physical activity have a beneficial effect on lung cancer by reducing the overall risk of tumor development among patients (Sun, Shi & Xu, 2012).

Table 1. *Overview of studies on physical activities and chronic obstructive pulmonary disease (COPD)*

Study	No. of subjects	Patient`s age	Design of study	Measurement of PA	Odds ratio (95 % CI)	Outcomes
Van Remoortel *et al.*, 2013	59	Adults	Control study	6 min walking distance	(7986±2648 vs 9765±3078 steps, 64 (27-120) vs 110 (55-164) min of MVPA, 1.49±0.21 vs 1.62±0.24 PAL respectively, all p<0.05)	PA was significantly lower in COPD versus smoking controls
Vitorasso *et al.*, 2012	73	Adults	Cross-sectional study	DynaPort and SenseWear activity monitors for 12 hours/day during 2 days	There was significant difference between TW and TPA>moderate (53 [36-80] versus 12 [3-33] minutes/day, respectively; P<0.0001)	The majority of patients with moderate-very severe COPD walk more than 30 minutes/day
Katajisto *et al.*, 2012	719	Adults	-	Postal questionnaire	Training activity was significantly correlated with patients' reported subjective dyspnea (r=0.32, P<0.001), health-related quality of life (r=0.25, P<0.001), mobility score (r=0.37, P<0.001), and bronchial obstruction (r=0.18, P<0.001)	Dyspnea was strongly associated with exercise activity among the participants
van Gestel *et al.*, 2012	70	Adults	Predictive study	SenseWear Pro™ accelerometer	PA was found to be significantly and independently associated with the 6MWD (r=0.69, 95% CI 0.54 to 0.80, p<0.001), STST (r=0.51, 95% CI 0.31 to 0.66, p=0.001) and TEEZPAQ (r=0.50, 95% CI 0.30 to 0.66, p<0.001) but not with hand-grip strength.	the 6-Minute Walk Test, and the Zutphen Physical Activity Questionnaire cannot be used to reliably predict physical inactivity
Chen *et al.*, 2012	150	Adults	Constatative study	6MWT and pulmonary function	The 6MWD and 6MWORK both correlated with some spirometric parameters (0.34 to 0.67; P < 0.05) in severe and very severe patients, and the SPO2*** % correlated with the dyspnea Borg scale in four severities (r = -0.33, - 0.34, -0.39, -0.53; P < 0.05).	6MWT may be used to monitor changes of pulmonary function in these patients.

**PA - physical activities; **CI- confidence interval; **SPO2%- saturation level of oxygen in hemoglobin*

Table 2. Overview of studies on physical activities and lung cancer

Study	No of subjects	Patient`s age	Design of study	Measurement of PA	Odds ratio (%)	Outcomes
Schmidt *et al.*, 2012	302	Adults, smoker and non-smoker	Case-control study	2 questions adapted from the BSI?	OR = 0.53*; CI = 0.29-0.97	physical activity seems to be a possible factor that protects against lung cancer
Coups *et al.*, 2009	175 survivors lung cancer	Adults	Control study	Leisurely walking	Participants reported an average of 77.7 min of moderate/strenuous weekly activity and 64.6% reported engaging in leisurely walking at least three times per week	Multiple social cognitive constructs were associated with moderate/strenuous activity and leisurely walking
Coups *et al.*, 2009	175	Adults	-	A modified version of the Godin Leisure-Time Exercise Questionnaire	Participants' reported engagement in both moderate and strenuous intensity activities was lower during the post-treatment period compared with before diagnosis and at the current time (ts ≤ 1.42, χ2s ≤5.58, Ps ≥ .114).	Current engagement in physical activity is associated with better QOL**
Leitzmann *et al.*, 2009	501,148	Men and women (50–71 years)	Prospective study	Questionnaire on medical history, diet, and physical activity	(≥5 times/week vs. inactive) were 0.93 (95% confidence interval (CI): 0.67, 1.28), 0.79 (95% CI: 0.67, 0.94), 0.73 (95% CI: 0.57, 0.93), and 0.61 (95% CI: 0.38, 0.98)	Increased physical activity is associated with reduced risk of total lung carcinoma and individual lung carcinoma histologic types among current and former smokers
Dhillon *et al.*, 2012	72	-	Randomised controlled trial	Actigraph GT1M accelerometer	80% power (two-tailed α 0.05	Physical activity improves fatigue and QOL in this patient population
Sun *et al.*, 2012	Meta-analysis	1,644,305 participants	14 prospective studies	-	for high level, RR = 0.77, 95%CI 0.73-0.81, P < 0.001; for medium level, RR = 0.87, 95%CI 0.83-0.90, P < 0.001	high and medium levels of physical activity have a beneficial effect on lung cancer

*BSI- *Berkman-Syme Index; **QOL- quality of life;*

Table 3. *Overview of studies on physical activities and asthma, chronic respiratory disease and pulmonary arterial hypertension*

Study	No of subjects	Patient`s age	Design of study/disease	Measurement of PA*	Odds ratio (%)**	Outcomes
James *et al.*, 2008	406	Adults		Cardiopulmonary Exercise Testing	305 patients (90%) were referred to clarify the etiology of exertional intolerance	Exercise parameters were not sufficiently sensitive in to distinguish EIPAH* from normal
Eijkemans *et al.*, 2012	39 studies	-	systematic review and meta-analysis/ asthma	Systematic review	(odds ratio 0.88 (95% CI: 0.77-1.01	Physical activity is a possible protective factor against asthma development
Nagel *et al.*, 2012	35	16 women;19 men	Prospective study/pulmonary hypertension	Walked	61±54 meters after 3 weeks (p<0.001), 71±70 meters after 15 weeks (p=0.001)	may be effective in patients with CTEPH** to improve work capacity, quality of life and further prognostic
Fowler *et al.*, 2011	76 health care professionals	-	Prospective study	Questionnaire PAH* in WHO	58% of respondents recommended patients undertake daily activities 'as tolerated'	two-thirds of the respondents reported they would refer patients for exercise rehabilitation
Rakkhong *et al.*, 2011	53	children (12.3 +/- 2.6 years)	cross-sectional study/asthma	Exercise challenge test	72.7% vs. 28.6%, p 0.013, 0.2 years vs.1.9 years, p 0.012,	Physical examination and pulmonary function are insufficient to diagnose asthma

**EIPAH- Exercise-induced pulmonary arterial hypertension; **PAH - Pulmonary Arterial Hypertension; **CTEPH - chronic thromboembolic pulmonary hypertension*

The relationship between physical activity and the effects of chronic respiratory diseases was demonstrated relevantly in clinical studies which have shown that physical activity improves health outcomes and does not substantially increase the risk of harm, and there is no direct evidence regarding the risk of exercise for patients with COPD or asthma (Eves & Davidson, 2011; Burr, 2012). Thus the activities recommended in patients diagnosed with asthma are those avoiding prolonged hyperventilation, such as volleyball, gymnastics, while endurance type activities are forbidden.

Regarding the lack of the physical activity among patients with pulmonary embolism, prospective studies reveal that there was an association between time of sitting and risk of idiopathic pulmonary embolism, whereas the risk of

pulmonary embolism is more than twofold in women who spent the most time sitting compared with those who spent the least time sitting (Kabrhel *et al.*, 2011). The effects of physical activities on children and adolescents diagnosed with asthma have been revealed in numerous studies, which demonstrated differences in exercise capacity between the asthmatic and healthy individuals and the physical performance, whereas the responses obtained in the study were correlated with the MVV, Body mass index (BMI) and physical activity level (Basso *et al.*, 2010). As for the attitude of asthmatic children for physical activity, the studies have demonstrated that they did not differ significantly in mild, moderate and overall level of physical activity from children without asthma but they participated less in intense and systematic exercise (Dimitrakaki *et al.*, 2013).

Summarizing the results of the qualitative research, we believe that patients who are diagnosed with lung diseases, regardless of condition, show significantly lower levels of physical activity compared to clinically healthy subjects and the lower physical activities are associated with poorer health and with more severe disease (Marín *et al.*, 2011; Vorrink *et al.*, 2011); in these situations researchers believe that the activity should be significantly reduced, in the stages of disease debut, because the reductions in physical activities at moderate intensity seem to precede the reduction in the amount of physical activities at lower intensity (Troosters *et al.*, 2010). Also, studies have shown that the functional performances in subjects diagnosed with chronic lung disease are significantly lower (Kapella *et al.,* 2011).

Discussions

Movement is life. Speaking about the effects of physical activity, Esteban (2009) points out that the importance of physical activity lies in its direct relation with several health outcomes both in healthy individuals and in the general population, independently of age or sex, and in its association with prevalent chronic diseases, such as pulmonary diseases. Thus, even those suffering from serious illnesses and whom disease condemns to motor disabilities, need to move, which, in its various forms, is a means or method of therapy.

Clinical research has revealed that practicing physical exercise programs has significant positive effects on the quality of patients' life and the present research provides a high-level of evidence regarding the effects of physical activities programs on patients with pulmonary diseases and their quality of life level. The major purpose of physical activity programs used in the clinical studies was that to improve the quality of life of patients with lung disease, regardless of age, gender or the disease stage. In these situations, children and adolescents should be viewed as a population who should be given more attention, considering, on the one hand their fragility to the multitude of stress factors and, on the other hand,

the need for proper training of the habit of exercising, within their own social environment (Epuran, 2013: 407). In these cases age is a positive factor by which the disease may be delayed.

Some studies have shown a strong association between improved quality of life and physical activity level (Vitorasso *et al.*, 2012, Dhillon *et al.*, 2012 Coups *et al.*, 2009, Schmidt *et al.*, 2012 James *et al.* 2008). Studies suggest that physical activity has a significant potential in treating patients with various lung diseases, and the most used physical activity programs have been 6MWD (Van Remoortel *et al.*, 2013, Van Gestel *et al.*, 2012; Chen *et al.* 2013), walking (Neagel *et al.*, 2012; Coups *et al.*, 2009), yoga (Donesky-Cuenco *et al.*, 2009). In this respect, we mention that the physiological effects of walking are felt within the cardio-respiratory system, blood vessels, blood and muscle level. Also, jogging is one of the most convenient modality, is a common social phenomenon that millions of practitioners keenly feel and consume tenaciously with immense pleasure and benefits (Bota, 2006). Regular exercise helps patients to improve the health conditioned fitness, because it can improve the level of its components, even if patients do not have sports attitudes. In conclusion, most articles included in the qualitative assessment show that increased physical activity is associated with the improvement of the quality of patients' life. It was found that systematic exercise influences the quality of life for patients with asthma, that high and medium levels of physical activity have a beneficial effect on lung cancer, that dyspnea was strongly associated with exercise activity among the participants.

Conclusions

From this study we note the importance the official bodies of the European Union give to patients, by correlating physical activity programs with the health level. This systematic review can inform the conduct health policy in the future. We consider necessary a national implementation of policies that promote physical activity among patients, as in fact happens in many European clinical centers. Finally, the study has the potential to change the care for people with pulmonary diseases by using a simple and effective means like physical exercise in order to improve the quality of life, as much as possible, and we consider that the health policy must be based on the best scientific evidence and relevant research.

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