

# Sex inequality for hospital readmissions due to pulmonary diseases: a sex perspective in management is warrant

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## Research article

**Keywords:** Pulmonary disease, readmission risk, sex differences, older people

**Posted Date:** July 30th, 2019

**DOI:** <https://doi.org/10.21203/rs.2.12188/v1>

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**Version of Record:** A version of this preprint was published on January 14th, 2020. See the published version at <https://doi.org/10.1186/s12889-019-8138-6>.

# Abstract

**Background** Pulmonary diseases are a common and costly cause of 30-day readmissions. In this study we analysed the association between sex and the risk of readmission in a cohort of patients admitted to the hospital for COPD exacerbation and other major pulmonary diseases. The goal is to tailor disease management programs to improve clinical outcomes and prevent waste in resource use. **Methods** This was a retrospective cohort study based on administrative data collected in the Veneto Region in 2016. We included 15,069 hospital admissions among residents aged  $\geq 65$  years for DRGs of the most common disorders of the respiratory system: bronchitis and asthma, pneumonia, pulmonary edema, respiratory failure, and COPD. Multilevel logistic regressions were performed to test the association between 30-day hospital readmission and sex, adjusting for confounding factors. **Results** For bronchitis and asthma, male patients had a twofold significantly higher odd of 30-day readmission than female patients (aOR, 2.07; 95% CI, 1.11-3.87). The odd of readmission for men was also significantly higher for pneumonia (aOR, 1.40; 95% CI, 1.13-1.72), for pulmonary edema and respiratory failure (aOR, 1.28; 95% CI, 1.05-1.55), and for COPD (aOR, 1.34; 95% CI, 1.00-1.81). **Conclusions** This study found that male sex is a major risk factors for readmission in patients aged more than 65 years with a primary pulmonary diagnosis. More studies are needed to understand the underlying determinants of this phenomena and to provide targets for future interventions

## Background

Countries with developed healthcare systems are working to reduce unnecessary hospital readmissions to reach the triple aim of reducing costs, improving patient satisfaction, and improving health. Readmissions impact both health and satisfaction of patients, as multiple hospitalisations of subjects with chronic comorbidities are associated with emotional distress, loss of function, nosocomial infections, and increased mortality (1). Moreover, hospital readmissions are also considered an index of low-quality care and in some health systems incur financial penalties for hospitals (2). It is therefore important to analyse which factors lead to readmissions and to develop efficient strategies to reduce unnecessary readmissions, both at the hospital and health system levels.

Among the top 20 causes of readmission within 30 days are several respiratory diagnoses, including respiratory insufficiency and respiratory arrest (3<sup>rd</sup> place), COPD and bronchiectasis (9<sup>th</sup> place), and aspiration pneumonia (11<sup>th</sup> place) (3). While several studies (4, 5, 6) have analyzed the risk factors for rehospitalisation in patients with pulmonary disease, few have focused on the difference in risk between men and women. In this study we analysed data from a cohort of patients from the Veneto Region to determine the association between sex of the patient and readmission to the hospital. The ultimate goal is to use this information to help tailor a discharge program to prevent readmission and waste in resource use.

## Methods

In the Veneto Region, regional authorities coordinate and control local health units (LHU), each of which is a separate unit in the Italian National Health System (NHS). The NHS plans and delivers health services, primary care, and hospital care to its local community, based on a regional health plan. This was a population-based descriptive cross-sectional study conducted in any facility operating under the NHS in the Veneto Region in 2016 (population 4,907,529)

In order to select the “Index Admissions” (IA), we included DRGs of common respiratory diagnoses involving residents aged  $\geq 65$  years: bronchitis and asthma (DRG 96 and 97); pneumonia (DRG 89 or 90); pulmonary edema and respiratory failure (DRG 87); and COPD (DRG 88). We excluded patients meeting the following criteria: admission with ICD-9-CM principal diagnostic codes cancer (140.-239.), admission with psychiatric DRG (425-433 and 523), admission with DRG of chemotherapy and radiotherapy (409, 410, 492), admissions for childbirth during pregnancy or puerperium (principal diagnosis codes from 630 to 677), admissions for day hospital care or rehabilitation, and those concerning patients residing outside the region. We also excluded patients whose discharge was due to voluntary discharge, transfer to another public or private care institution for acute cases, transfer to another ward of the same structure, or transfer to a rehabilitation institute. If the same patient was admitted to hospital for the same condition several times, all the admissions were considered as IA. “Hospital readmission” was defined as the same patient readmitted for the same Major Diagnostic Category (MDC) within 30 days of the IA.

Multilevel logistic regression models were created with hospital readmissions within 30-days for each pulmonary condition above as the dependent variable (attributing a value of 1 for each indicator associated with a readmission, as defined earlier) and considering the sex as the independent variable. Potential confounders included at first admission level: age as a continuous variable, formal education (university, high school, middle school and no education/primary school), citizenship (Italian/Not Italian), length of stay as continuous variable, type of discharge (at home, at home with domiciliary care, residential care), and the Charlson Comorbidity Index (CCI) (7) as a continuous variable; at second level the type of care institute (university, not university). The Charlson Comorbidity Index measure the comorbidities inside each hospital admission and is an extensively used comorbidity index with predictive validity for a range of outcomes, including readmission and death. The CCI comprises 19 medical conditions weighted 1-6 on the basis of their association with mortality. (8)

Statistical analyses were performed using STATA software, version 12.1. All p-values reported are two-sided and results with p-values below 0.05 were considered statistically significant.

During the period considered, we identified 1,140 admissions of bronchitis and asthma, 6,458 admissions for pneumonia, 5,260 admissions for pulmonary edema and respiratory failure and 2,211 admissions for COPD, collected in the Veneto Region in 2016.

## Results

Table 1 shows the number of Index Admissions and the percentage of readmissions overall and by sex for selected respiratory conditions, the frequency of readmission was statistically higher for men in bronchitis and pneumonia conditions.

Table 2 shows the results of the multilevel logistic regression analyses. For bronchitis and asthma, male patients showed a twofold odd than female patients (aOR, 2.07; 95% CI, 1.11-3.87) to be readmitted. Significant associations emerged with sex also for pneumonia (aOR, 1.40; 95% CI, 1.13-1.72), for pulmonary edema and respiratory failure (aOR, 1.28; 95% CI, 1.05-1.55) and for COPD (aOR, 1.34; 95% CI, 1.00-1.81).

## Discussion

This population-based study found that male sex is a risk factor for readmission in patients aged more than 65 years admitted to hospital with the diagnosis of several common respiratory diseases: bronchitis and asthma, pneumonia, pulmonary edema and respiratory failure and COPD.

This sex gap has been reported previously in other studies conducted in various settings, where male sex is indicated as an independent risk factor for readmission for COPD (9, 10). Dal Negro (11), analysing Italian patients diagnosed with COPD, chronic bronchitis and emphysema, concludes that direct costs for management are higher in male than in female patients. Moreover, this study draws attention to the fact that the major part of direct costs for the management of this diseases is yielded by the inpatient hospitalization. With regards to pneumonia, our findings are concordant with the literature, which shows that mortality is higher in men than in women within each age group (12) and that women have less risk to be readmitted for pneumonia than men (13).

This relevant phenomenon is difficult to explain clinically but could be due to management of disease after discharge. In fact, men report less help-seeking behavior, which may delay accessing care when it is needed (16). Moreover, men use primary care health services less frequently than women, are less involved in preventive initiatives and are less health literate. (17) For instance, it has been seen that fewer men understand and attend their follow-up appointments after acute hospitalization compared with women (15).

Indeed, it could be useful to talk about gender-based medicine and prevention strategies, in order to address the resources in the most efficient way to reduce readmission rate and, consequently, costs for the health system.

To achieve this goal, it is important to give high risk patients in particular adequate access to providers and personnel of intermediate and long term care plans (18). Several effective action have been described, such as an early follow-up with a primary care physician or pulmonologist, adequate preparation for and timing of discharge, attention to the needs of carers, management of medications, and sufficient nursing and social services support. In this way it could be possible to avoid up to 59% of readmissions (5, 19). These instruments should be applied stratifying patients according their risk as sex.

In particular currently, there are few studies that evaluate the effectiveness of interventions that promote the access of men to primary care. A recent review found that physical activity, education, peer support-based interventions improve quality of life in men with long-term conditions (20). More studies are needed to understand what is successful in improving elderly men's health and reducing the risk of readmission.

## Conclusions

This study found that male sex is a risk factors for readmission in patients aged more than 65 years with several pulmonary diseases.

More studies taking sex perspective into account are needed in order to provide targets for patient management interventions.

## Key Points

- Few studies have focused on the effect of sex on the risk of rehospitalization for lung diseases.
- Male patients showed a significantly stronger risk of readmission than female patients.
- Gender-based medicine and prevention strategies could be useful to improve health outcomes and reduce waste of resources.

## Declarations

### Authors' contributions:

VB obtained funding, coordinated all study phases, and approved the final manuscript as submitted.

M Sperotto carried out the statistical analyses, and approved the final manuscript as submitted.

M Saia coordinated and supervised data collection, and approved the final manuscript as submitted.

PF obtained funding and designed the data collection tools, and approved the final manuscript as submitted.

AD, CB, TB drafted the manuscript, and approved the final manuscript as submitted.

AB conceptualized the study, coordinated all study phases, took part in data collection and approved the final manuscript as submitted.

MLS, GV, SC critically reviewed the interpretation of the data and revised the manuscript, and approved the final manuscript as submitted.

## **Ethics approval and consent to participate**

Data were treated with full confidentiality in accordance with Italian legislation. Before the database was made available to the authors, patient identifiers were replaced with anonymous codes that make it impossible to identify the individuals concerned. It was unnecessary to obtain patients' informed consent, given the anonymous nature of the data and its mandatory recording (anonymized data may be analyzed and used in aggregate form for scientific studies without further authorization) [43]. This study complies with the Declaration of Helsinki.

## **Conflict of interest**

The authors have no conflict of interest to disclose.

## **Consent for publication**

Not applicable

## **Availability of data and material**

All relevant data are within the paper. Requests for additional information should be addressed to the corresponding author and data may be provided on reasonable request.

## **Competing interests**

The authors declare that they have no competing interests.

## **Acknowledgements**

Not applicable.

## **Funding**

The Department of Cardiologic, Vascular, and Thoracic Sciences and Public Health, University of Padua, funded this research with a competition for grants designed to stimulate collaboration between

colleagues within the department. The Department had no role in the design of the study, the collection, analysis, or interpretation of the data, the writing of the manuscript, or the decision to submit the paper for publication.

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## Tables

Table 1. Number of index admissions and % of readmissions overall and by sex for selected pulmonary diseases in adults age 65 years and older

	Total		Male			Female		
	IA*	% R**	IA*	% R**	95% CI	IA*	% R**	95% CI
Bronchitis and asthma	1140	4,1	445	5,6	3,5-7,8	695	3,2	1,9-4,5
Pneumonia	6258	6,5	3220	7,3	6,4-8,2	3038	5,7	4,9-6,5
Pulmonary edema and respiratory failure	5260	9,5	2580	10,4	9,2-11,6	2680	8,6	7,6-9,7
COPD	2211	9,5	1152	10,8	9,0-12,6	1059	8,1	6,5-9,8

\*\* R= ReAdmissions = IA with following recovery with the same patient ID, the same MDC and no more than 30 days passed between the IA and the new admission

Table 2. Adjusted odds ratios (aOR) and 95% CI for readmission in selected pulmonary diseases in adults age 65 years and older.

	Gender (ref. Female) Male
Bronchitis and asthma	2.07 (1.11-3.87)
Pneumonia	1.40 (1.13-1.72)
Pulmonary edema and respiratory failure	1.28 (1.05-1.55)
COPD	1.34 (1.00-1.81)

Multi-level Logistic Regression Model, adjusted for: age, formal education, citizenship, length of stay, CCI, type of discharge, the type of care institute.  
Results in bold are statistically significant ( $p < 0.05$ )