Original Article

The most common pulmonary diseases length of stay, and characteristics of patients admitted to pulmonary service

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Abstract:

BACKGROUND: Although chronic respiratory diseases are prevalent in Saudi Arabia, there are limited data on the patient burden and associated factors. The aim of this study is to identify the chronic respiratory diseases frequently admitted to pulmonary services and to determine the patient's characteristics, associated comorbidities readmission rate, and reason for a more extended stay in hospital.

METHODS: A prospective study was conducted over a 5-year period at King Abdulaziz Medical City-Riyadh, Saudi Arabia, in the Pulmonary Division, between March 2015 and December 2019. Data on demographics, comorbidities, and chronic respiratory diseases were collected.

RESULTS: Total patients admitted were 1315 patients, female 54.2%, the mean age was 62.4 (SD±17.6), and the ages ranged from 14 to 98 years. Overall, chronic obstructive pulmonary disease was the most common respiratory disease requiring admission (17.9%), followed by interstitial lung disease (15.8%), bronchiectasis (11.9%), and obesity hypoventilation syndrome (10.8%). The most common comorbidities were obesity (42.5%), diabetes 49.1%, and hypertension 54.9%. Only 135 (10.3%) were readmitted within 30 days posthospital discharge. Among the patients who were readmitted, 103 (76.3%) were readmitted due to issues related to previous admission diagnosis, noncompliance 75 (55.5%), social reasons, and premature discharges in 51 (37.8%) and 29 (21.5%) of the cases, respectively. The respiratory disease varied significantly by gender, age, obesity status, comorbidities, length of stay (LOS), and admissions.

CONCLUSION: Chronic respiratory diseases are prevalent in our population and are mainly influenced by gender, age, obesity status, comorbidities, LOS, and admissions. Policymakers and health professionals need to recognize the burden of chronic respiratory diseases on patients and health systems and implement effective prevention programs.

Keywords:

Burden, chronic respiratory diseases, comorbidities, length of stay

Chronic respiratory conditions impose an enormous social and health-care burden on the Kingdom of Saudi Arabia (KSA). Chronic respiratory disease among adults is generally divided into obstructive and restrictive conditions, with the obstructive conditions being further divided into reversible and irreversible diseases.[1]

Respiratory diseases are among the leading causes of death worldwide. For example, globally lower respiratory infections account for 3.5 million (6.1%), chronic obstructive pulmonary disease (COPD) 3.3 million (5.8%), lung cancer 1.4 million (2.4%), and tuberculosis (TB)

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1.3 million (2.4%).[2] The same four diseases accounted for one-tenth of the disability-adjusted life-years lost worldwide in 2008.[2]

According to the 2016 World Health Organization World Health Report, the top global causes of death include four respiratory diseases: COPD (third cause), lower respiratory tract infection (fourth), lung cancer (sixth), and TB tenth.[3] Approximately 7% of all hospital admissions are due to lung disease, almost half of respiratory admissions are due to lower respiratory infection, and more than one-quarter of admissions are due to lung cancer and COPD.[2]

Epidemiological studies about the prevalence of chronic respiratory disease in Middle Eastern countries, including the KSA, are scanty. The prevalence of COPD in the KSA is reported at between 2.4% and 14.3%,[4-6] while the prevalence of bronchial asthma among adults is reported from 4.05% to 19%.[7,8] A study of the management of COPD-related respiratory symptoms in ten countries in the Middle East and North Africa Region reported 20.4% of COPD patients required hospitalization, with a mean of 2.3 ± 3.7 hospitalizations per year.[9]

There is very limited knowledge about patients' characteristics and the prevalence and type of common respiratory conditions that require admission in the KSA. King Abdulaziz Medical City (KAMC) is the largest tertiary care hospital in the Middle East with a capacity of over 1800 beds. Pulmonary service was established in the year 2000, with a capacity of 20 inpatient beds. This study aims to assess prospectively and over 5 years the common chronic respiratory diseases frequently admitted to pulmonary services, the patients' characteristics, associated comorbidities, readmission rate, and the reasons for a longer stay in hospital.

Methods

This is a cross-section study conducted at KAMC-R, the Pulmonary Division, between March 2015 and December 2019. The study obtained ethical approval from the Ministry of National Guard-Health Affairs, Institution of Research Board (IRB) registered under number Ref No: IRBC/0997/20.

Pulmonary services consist of 10 full-time consultants, inpatient services, ventilator weaning unit, consultation service, outpatients' clinics, sleep disorder center, pulmonary rehabilitation center, and pulmonary physiology laboratory. Outpatients service compose of multiple subspecialty clinics, including TB, pulmonary vascular disease, interstitial lung diseases (ILD), lung cancer, sleep disorders clinics, bronchiectasis, and severe asthma.

As a clinical performance improvement project, we prospectively collected data about demographics, including age, gender, and comorbidities. We also documented the discharge diagnosis by treating team, length of stay (LOS), and the reason for LOS if more than 5 days. The reason for LOS of more than 5 days was clarified by the team: Whether it is related to acute illness, comorbidities, social reasons, investigations, procedures, or waiting for biopsy results. We include all diffuse parenchymal diseases including all subclassifications of interstitial pulmonary disease under one category: ILD. Obesity hypoventilation syndrome (OHS) was defined as a combination of obesity (body mass index [BMI] $\geq$30 kg/m^2) and daytime hypercapnia (arterial carbon dioxide tension $\geq$45 mmHg) after ruling out other disorders that may cause alveolar hypoventilation.[10] Some of the cases with irreversible obstructive airway disease in the absence of smoking history and hypercapnia, with or without obesity (overlaps syndrome), were included under COPD. We also collected information about whether the admission was a new admission or readmission (defined as within 30 days from discharge).[11] The reasons for readmission were clarified by the treating team whether it was due to new medical issues not related to the previous diagnosis or related to the previous admission diagnosis. If it was related to the previous diagnosis it was listed as because of premature discharge, social reasons, or noncompliance. All the data were collected daily by our division coordinator and tabulated by month and year from March 2015 to December 2019. All the gathered information was clarified and confirmed by one of our pulmonary staff and a consultant. We did not include patients with respiratory conditions admitted under other medical services or those followed by our consultation team.

Data analysis

Data analysis was performed in IBM SPSS 25 (Chicago, Il, USA) and Excel. Descriptive data analysis was performed by reporting frequency (*n*) and percent (%) [Table 1]. A Chi-squared test was used to assess the association between the year of reporting the diseases and gender, obesity, admission type, diabetes mellitus (DM), hypertension (HTN), comorbidities, acute illness, and year [Table 1]. ANOVA was used for comparisons of age and LOS in days by medical conditions [Table 2]. The distribution of medical conditions was reported by bar and error charts.

Results

The total admission to pulmonary services over a period of 5 years was 1315. The demographic and medical characteristics are displayed in Table 1. This table shows that 54.2% were females, BMI $\geq$30 were 42.5%, 49.1% had diabetes, and 54.9% had HTN, with

Table 1: Demographic and medical characteristics (*n*=1315)

Levels	*n* (%)
Gender	
Male	602 (45.8)
Female	713 (54.2)
Comorbidities	
Obese	
Yes	559 (42.5)
No	757 (57.5)
DM	
Yes	645 (49.1)
No	669 (50.9)
HTN	
Yes	723 (54.9)
No	593 (45.1)
Admission type	
Readmission	
Yes	135 (10.3)
New admission	
Yes	1180 (89.7)
Reason for readmission	
Related to previous admission	
Yes	103 (76.3)
No	32 (23.7)
Social reasons	
Yes	51 (37.8)
No	84 (62.2)
Noncompliance	
Yes	75 (55.5)
No	60 (44.5)
Premature discharge	
Yes	29 (21.5)
No	106 (78.5)
Reasons for LOS of >5 days	
Acute illness	
Yes	949 (72.1)
No	367 (27.9)
Comorbidities	
Yes	210 (16.0)
No	1106 (84.0)
Waiting for biopsy results	
Yes	194 (14.7)
No	1122 (85.3)
Waiting for equipment	
Yes	17 (1.3)
No	1299 (98.7)
Waiting for tests results	
Yes	50 (3.8)
No	1266 (96.2)
Lack of social support	
Yes	43 (3.3)
No	1273 (96.7)
Number of admissions per year	
2015	227 (17.3)
2016	316 (24.0)
2017	274 (20.8)
2018	263 (20.0)
2019	235 (17.9)

DM=Diabetes mellitus, HTN=Hypertension, LOS=Length of stay

a mean age of 62.4 (±standard deviation [SD] 17.6) and ages ranging from 14 to 98 years. Only 135 (10.3%) were readmitted within 30 days posthospital discharge. Among the patients who were readmitted, 103 (76.3%) were readmitted due to issues related to previous admission diagnosis and noncompliance 75 (55.5%), along with social reasons and premature discharges in 51 (37.8%) and 29 (21.5%) of the cases, respectively. The most common causes of overall stay in hospital for more than 5 days were acute illness 949 (72.1%), comorbidities 210 (16%), and waiting for biopsy results 194 (14.7%). According to Figure 1, COPD was the most common respiratory disease requiring admission (17.9%), followed by ILD (15.8%), bronchiectasis (11.9%), and OHS (10.8%). Distribution of medical condition for each year displayed in Figure 2, and Table 2, asthma (29.54%) and COPD (27.1%), respectively, were the dominant medical conditions in 2015, while ILD was the dominant medical condition (35.1%) in 2019. The association between medical conditions and other clinical characteristics reveals that in Table 2, the highest readmission rate was among bronchiectasis and OHS patients, 17.3% and 17.6%, respectively, while among all medical conditions, plural effusion and pulmonary infection (pneumonia and TB) had the highest LOS, 22 ± 17 and 17 ± 14 days, respectively. The most common reason for waiting for more LOS than 5 days was acute illness across all the medical conditions, and waiting for the biopsy results was the second most common reason for lung mass and pleural effusion patients, 56.3% and 50%, respectively. Other significant differences in frequency of medical conditions include gender, obesity, DM, HTN, admission type, acute illness, comorbidities, and percentage of admission and readmission of each medical condition for each year presented in Table 2. TB, pleural effusion, and lung mass were more prevalent in male patients as compared to asthma, COPD, OHS, and pulmonary HTN, which were significantly higher among females (P = 0.001). Comorbidities: DM, HTN, and obesity were significantly higher in COPD and OHS (P = 0.001). The average LOS in days was 13.6 (±SD 12.7). LOS is the mean ± SD for each medical condition presented in Table 2, where pleural effusion was significantly the highest LOS (22 ± 17 days) (P = 0.001). Differences in LOS in days and age for each disease are presented in Table 2 and Figures 3, 4.

Discussion

This study was intended to assess pulmonary clinical performance indicators for all patients admitted to pulmonary services rather than looking in depth at each medical condition in great detail or at all possible factors related to admission, readmission, or LOS. The finding is interesting particularly because there are limited data in literature that look at the common medical

Table 2: Association between medical conditions and clinical characteristics

Levels	ILD (%)	Asthma (%)	Bronchiectasis (%)	COPD (%)	Lung mass (%)	OHS (%)	PHT (%)	Pleural effusion (%)	Pneumonia (%)	TB (%)	Other	*P*
Gender												
Male	43.3	35.3	47.4	39.8	63.6	28.2	12.3	62.5	50.0	64.4	66.7	0.001
Female	56.7	64.7	52.6	60.2	36.4	71.8	87.7	37.5	50.0	35.6	33.3	
Age												
Mean±SD	66±15	56±18	61±15	70±11	68±15	62±17	50±20	59±20	58±20	52±21	60±19	0.001
Obese BMI >30												
Yes	37.5	41.2	24.4	54.2	27.3	100	36.8	45.0	38.6	24.8	46.7	0.001
No	62.5	58.8	75.6	45.8	72.7	00	63.2	55.0	61.4	75.2	53.3	
DM												
Yes	43.0	56.9	45.5	61.4	45.8	56.3	42.1	42.5	47.9	39.0	45.0	0.001
No	57.0	43.1	54.5	38.6	54.2	43.7	57.9	57.5	52.1	61.0	55.0	
HTN												
Yes	54.8	41.2	48.7	69.1	55.4	67.6	57.9	52.5	47.1	34.3	50.0	0.001
No	45.2	58.8	51.3	30.9	44.6	32.4	42.1	47.5	52.9	65.7	50.0	
LOS (days)												
Mean±SD	11±9	10±6	10±6	12±13	14±10	16±19	14±11	22±17	17±15	17±14	11±10	0.001
Admission												
Readmission	8.7	9.8	17.3	11.4	0.8	17.6	12.3	2.5	5.7	10.5	8.3	0.001
New admission	91.3	90.2	82.7	88.6	99.2	82.4	87.7	97.5	94.3	89.5	91.7	
Reasons for readmission												
Social	50.0	20.0	45.8	43.8	0.0	56.5	0.0	0.0	0.0	14.3	0.0	
Noncompliance	60.0	80.0	25.0	68.8	0.0	65.2	85.7	0.0	40.0	42.9	50.0	
Premature discharge	20.0	20.0	25.0	6.3	0.0	39.1	0.0	0.0	40.0	42.9	0.0	
Reason for LOS >5 days												
Acute illness	88.4	91.2	92.7	92.3	87.5	95.4	88.6	100.0	95.3	95.2	92.3	
Comorbidities	12.3	11.8	16.4	21.4	11.5	25.0	22.7	11.8	26.2	25.3	15.4	
Waiting for biopsy results	32.6	8.8	5.5	3.0	56.3	2.8	6.8	50.0	10.3	16.9	15.4	
Waiting for equipment	3.6	0.0	1.8	0.6	2.1	1.9	4.5	2.9	0.9	0.0	0.0	
Waiting for tests results	2.9	5.9	1.8	0.6	10.4	3.7	15.9	2.9	4.7	4.8	5.1	
Lack of social support	2.9	0.0	5.5	3.6	1.0	7.4	2.3	2.9	2.8	4.8	2.6	
Number of admissions/year												
2015	10.1	29.4	13.5	27.1	21.7	14.1	19.3	17.5	10.0	17.1	16.7	0.001
2016	16.3	21.6	30.1	27.1	18.3	28.2	15.8	30.0	22.9	29.5	23.3	
2017	18.3	11.8	17.9	18.6	23.3	19.7	17.5	22.5	30.0	23.8	26.7	
2018	20.2	13.7	24.4	14.8	20.0	24.6	26.3	12.5	20.7	20.0	20.0	
2019	35.1	23.5	14.1	12.3	16.7	13.4	21.1	17.5	16.4	9.5	13.3	

DM=Diabetes mellitus, HTN=Hypertension, SD=Standard deviation, ILD=Interstitial lung disease, COPD=Chronic obstructive pulmonary disease, OHS=Obesity hypoventilation syndrome, PHT=Pulmonary hypertension, TB=Tuberculosis, BMI=Body mass index, LOS=Length of stay

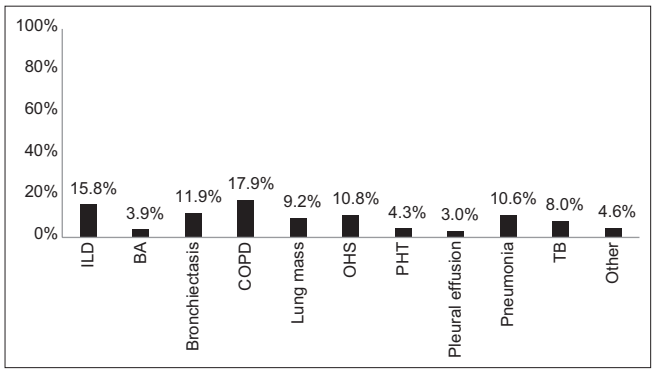

Figure 1: Overall frequency of medical conditions

conditions admitted under pulmonary services at specific institutions nationally or internationally. Most published studies address specific diseases. This is the first study done locally in a large tertiary care specialist hospital that looked at the trend in respiratory diseases admitted over time and considered medical comorbidities and demographic characteristics. In our study, the most common disease was COPD (17.9%), followed by ILD (15.8%), bronchiectasis (11.9%), OHS (10.8%), and pneumonia (10.6%). Alamoudi O[12] retrospectively reviewed 810 patients hospitalized with respiratory diseases in King Abdulaziz University Hospital, over a 5-year period. The most common diseases hospitalized were asthma (38.6%), COPD (17.2%), pneumonia (11.5%), lung cancer (8.4%), TB (7.2%), pleural effusion (4.3%), and ILD including idiopathic pulmonary fibrosis (IPF) (3.8%) and bronchiectasis 1.7%. The Meservey *et al*.[13] study

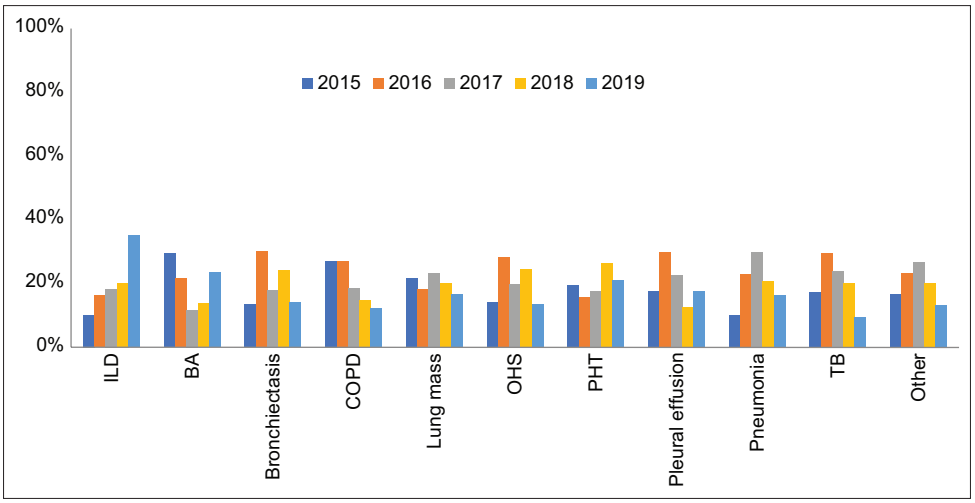

Figure 2: Frequency of medical conditions by years

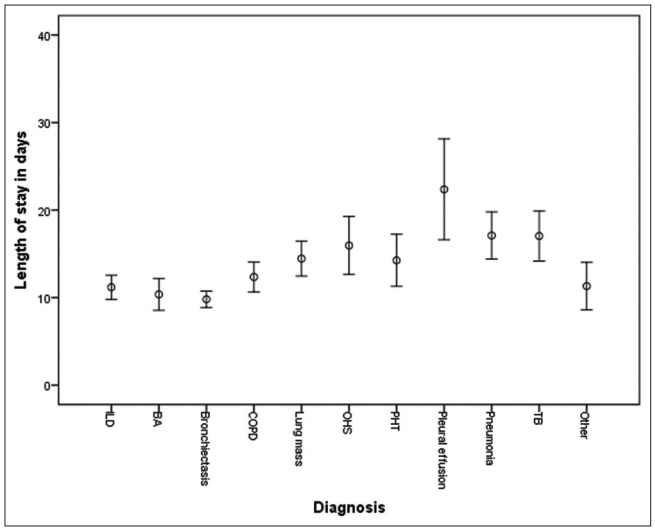

Figure 3: Length of stay in days by medical conditions

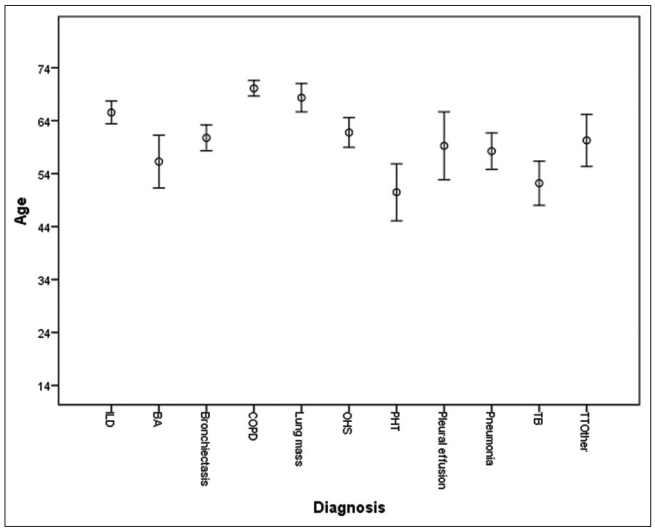

Figure 4: Age by medical conditions

showed that the most common cause of admissions to hospital was acute chronic respiratory failure (10%) and was due to OSA and OHS, 46% COPD, and 10% asthma. The prevalence of obesity, diabetes, and HTN in Saudi Arabia is quite high, and these were the important comorbidities that were highlighted in our study that resulted in hospital admissions for chronic respiratory conditions.[14,15] Comorbidities in our patients presented in more than half of the cases, DM 49%, HTN 54.95, and obesity 42.5%, compared to other studies where reported morbidities ranged from 16% to 31%.[16,17] However, they were higher than another local study by Alamoudi O,[12] where DM was 22.8% and HTN was 15.1%.

The present study identified the overall rate of readmission as 10.3% within 30 days.

The rate of readmission varies according to the underlying respiratory conditions, but overall, compared to other studies, it is low. The readmission rate among our patients was 11.4%, which is less than the 22% rate reported within the United States, 16.7% in Taiwan, and 14%–20% in London,[11,18,19] but is similar to studies from England and The Netherlands, 11.17% and 9.83%, respectively.[20] The 30-day readmission rates of COPD patients have been reported to be as low as 5.6% and as high as 35%.[11,21,22] In our study, the readmission rate for COPD was 11.4%. In the Alaithan *et al*.[23] study about the characteristics of 178 patients admitted with COPD exacerbation, more than one-third were above 65 years with a mean age of 72 ± 13.3 years. The majority had comorbidities, and the median (range) LOS was 9 (2–33) days. Our study was similar, with the average age of COPD patients being 70 ± 11 years, the majority having comorbidities, and the mean LOS among our COPD patients being 12 ± 13 days compared to the 7–14 days of the Alamoudi O[12] study. Bronchiectasis, among all

other conditions, had the highest readmission rate in our study (17.3%) similar to the readmission rate reported by Kshitij Chatterjee *et al*.[24] The highest LOS was for pleural disease, OHS, TB, and pneumonia. A 1988 survey on standards of practice of 28 metropolitan health departments in the U. S. found that 18% of reported TB patients were initially hospitalized for treatment, and that percentage had increased to 38% by 1996.[25,26] One study from Saudi Arabia reported that TB accounts for 7.2% of all admissions,[12] which is similar to our study, where the rate of TB admission was 8%. The most common cause of LOS of more than 5 days was due to acute illness of the primary diagnosis (88.4%–100%) of the cases. The second most common cause was waiting for biopsy results.

One of the interesting findings is the progressive increase in the cases admitted with ILD since 2015. In one local study, in 2000, ILD accounted for approximately 2% and another study reported 3.8%.[12] In our study, the number of ILD cases increased steadily over the period of the study from 10% in 2015 to 35% in 2019. We understand this observation could be due to (1) more awareness of ILD, (2) more access to high-resolution computed tomography scans, and (3) the fact that ILD is a disease of the aging population, and our study does suggest the average age is higher than other local studies. The above factors are probably identified more by establishment of comprehensive specialized services run by two subspecialized ILD consultants and their teams; an increase in the number of new referrals to our ILD services; the availability of specialized radiological, serological, and physiological diagnostic tests; onsite medical and surgical diagnostic tissue diagnostic services; regular ILD Multidisciplinary team (MDT); and approval of new antifibrotic agents in our institution.

The main strength of our study is the comprehensive, accurate diagnoses by hospital specialists in a large pulmonary division. The services provided are based on subspecialty work and all the diagnoses are made according to internationally published guidelines. There are well-established multidisciplinary meetings in the area of ILDs, and each patient is given an accurate diagnosis based on the latest agreed-upon international diagnostic guidelines.

The overall prevalence of IPF in the U. S. is estimated to be between 13 and 63 per 100,000 persons, depending on the study population,[27] with an estimated annual prevalence of 12.6–35.5 per 100,000 person-year depending on the definitions used in Italy.[28] Approximately 3 million people worldwide and 130,000 people in the United States have IPF.[29] Fan *et al*.[17] followed up on 300 patients included in the Pulmonary Fibrosis Prospective Outcomes, reporting an overall probability of hospitalization of 18% and 30% at 6 and 12 months, respectively, and the probability of the first hospitalization was 25% and 51% at 6 and 12 months, respectively. Associated comorbidities were present in 16%–31%, and bacterial pneumonia in 38.5%, COPD in 38.2%, asthma in 8.6%, lung cancer in 1.8%, ischemic heart disease in 28.4%, and congestive heart failure in 27.8% of the patients with IPF.[16,17] From a total of 42,924 IPF patients admitted to US hospitals, 55% were related to respiratory conditions, elective admission accounts for 15.7%, and 66.7% through the emergency departments, and the mean LOS was 7.4 ± 0.15 days.[16]

Nevertheless, the exact prevalence of ILD in general and IPF in particular for our population is not known. A retrospective study that looked at all the patients diagnosed with IPF at two tertiary care hospitals in KSA reported the IPF patients' frequency of hospital admission was 2.4 ± 1.7 per year and the duration of hospital stay was 17.4 ± 23.8 days. In another study,[30,31] our patients with ILD also had comorbidities, and some of them had advanced cases of ILD. These patients were slightly older, 66 ± 15, compared to 64 ± 13 years in another local study[30] and Middle Eastern patients were 54.7 ± 15.2.[32] The LOS in patients with ILD was shorter in our patients, 11 ± 9 versus 17.4 ± 23.8 days by Sherbini *et al*.,[30] but higher than LOS reported by Mooney *et al*., 7.4 ± 0.15 days.[16]

OHS is defined as a combination of obesity (body mass index ≥30 kg/m^2), daytime hypercapnia (arterial carbon dioxide tension ≥45 mmHg), and sleep-disordered breathing, after ruling out other disorders that may cause alveolar hypoventilation.[10] The exact prevalence of OHS in the general population remains unknown, particularly in some cases where it may be misdiagnosed as COPD. In one study OHS accounts for 10% of total admissions of acute chronic respiratory failure to a hospital.[13] Nowbar *et al*.[17] reported that 48% of obese inpatients with a BMI >50 kg/m^2, admitted to medicine, were diagnosed with OHS and 31% of obese inpatients did not have a previous diagnosis of OHS, despite having met the criteria for this diagnosis.

OHS compared to OSA has more comorbidities and adjusted mortality, and therapy by continuous positive airway pressure or noninvasive ventilation has reduced mortality significantly.[33,34]

The incidence and prevalence of pulmonary HTN are unknown: Studies from Scotland and France revealed an incidence of 2.5–7.1 cases/million and a prevalence ranging from 5 to 52/million adults.[35-37] One study by Bergot *et al*. reported that approximately 50% of the reasons for admissions among pulmonary HTN patients

were for monitoring and 20% due to worsening of the clinical state of the patient, while the mean LOS was 6.7 days.[38]

Unfortunately, underdiagnosis and overdiagnosis have been widely reported in the literature.[39,40] The major limitations of this study, are a single center experience, and we did not account for all factors related to length of stay and readmission. Furthermore, we did not look in depth at each medical condition in great detail concerning all possible factors related to admission, readmission, or LOS.

Conclusion

The study shows society's burden of chronic respiratory diseases. Chronic respiratory diseases are prevalent in our population and mostly influenced by gender, age, obesity status, comorbidities, LOS, and admissions. Policymakers and health professionals need to recognize the burden of chronic respiratory diseases on patients and health systems and implement prevention programs.

Ethics approval

The study obtained ethical approval from the Ministry of National Guard-Health Affairs, IRB. Ref No. IRBC/0997/20. This study was completed prior to Dr. Anwar Ahmed joining the Uniformed Services University of the Health Sciences and Henry M Jackson Foundation for the Advancement of Military Medicine.

Authors' contributions

HA, AA, AA, and KA participated in the study concepts, design of the study, development of the questionnaire, and data acquisition and entry. AA, HA, MA, SA, and MA contributed to data analysis and statistical analysis of the data, participated in the intellectual content, reviewed, and summarized the published literature and clinical studies. HH, AA, and SA participated in outlining the result themes and manuscript preparation, editing, and review. Corresponding author HA takes responsibility for the integrity of the work as a whole. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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