The burden of obstructive lung disease in the Nordic countries

Amund Gulsvik, Gunnar Boman, Ronald Dahl, Thorarinn Gislason, Markku Nieminen

Department of Thoracic Medicine, Institute of Medicine, University of Bergen, Haukeland University Hospital, Bergen, Norway
Respiratory Medicine and Allergology, Akademiska sjukhuset, Uppsala University, Uppsala, Sweden
Department of Respiratory Diseases, University Hospital Aarhus, Aarhus, Denmark
Department of Pulmonary Medicine, National University Hospital, Reykjavik, Iceland
Department of Respiratory Diseases, University of Tampere, Tampere University Hospital, Finland

KEYWORDS
Asthma; Chronic obstructive pulmonary disease; Costs; Physicians; Health care payers

Summary
About 25 million people are living in the Nordic countries, which include Denmark, Finland, Iceland, Norway and Sweden. Population demography, growth and economic status of the countries as well as distribution of known risk factors for obstructive diseases are of importance for building the evidence base for a health program. Immigration, changes in lifestyle, increased mobility of the population and changes of health care services may have an effect on the frequency of the disease. However, the increase in average age, tobacco smoking and the cumulative exposure to occupational agents or indoor pollution will cause the greatest impact on the frequency of obstructive pulmonary disease. This report shows that there is a huge discrepancy in data availability and reliability and implies an urgent need to collect accurate and comprehensive vital statistics on obstructive lung diseases in the Nordic countries.

Introduction
Information about the comparative magnitude of various diseases and injuries is a critical input when building the evidence base for better health

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doi:10.1016/j.rmed.2006.03.021
Obstructive lung disease in the Nordic countries

Obstructive lung disease includes asthma and chronic obstructive pulmonary disease (COPD). Both conditions show wide spread narrowing of the bronchial airways, at least on expiration, causing an increased resistance to airflow. Clinical staging of these diseases can be useful in management decisions, when gauging the effectiveness of therapy, in identifying groups of patients in clinical trials, when making prognosis for individual patients and in predicting medical resource utilisation.

Asthma is usually defined as a syndrome with symptoms and clinical signs of intermittent or reversible obstructive lung disease. Most of the epidemiological studies use variations of one of two asthma questions: “Have you ever had asthma?” or “Have you ever been diagnosed as having asthma by a doctor?” The severity of asthma is classified as mild intermittent, mild persistent, moderate persistent and severe persistent. It has been suggested that severe asthma may be a different disease compared with mild to moderate asthma. The inter- and intra-observer repeatability of grading disease using symptoms, signs and actual treatment has not been extensively examined.

COPD is a disease state characterised by not fully reversible airflow obstruction and defined by spirometric criteria. The global initiative of COPD (GOLD) has recommended a simple cut-off point for disease with a FEV1/FVC ratio <0.7 after bronchodilatation. The severity of obstruction is defined by a level of FEV1 in percent predicted. However, there is neither agreement on what prediction equations to be used when standardising for age, sex and body size, nor on what type of drug or dosing of bronchodilator or length of time after inhalation to repeat the spirometry measurement. The grading after bronchodilation, following the GOLD classification, is as follows: Very severe disease with FEV1 below 30% of predicted and severe disease with FEV1 levels 30–49% of predicted while moderate disease include FEV1 levels 50–79% of predicted and mild disease with FEV1 levels of 80% or higher of predicted. A consequence of the arbitrary nature of the boundaries selected for severity classification is that patients close to the boundaries may be re-classified as more or less severe if seen on different days. Furthermore, the concept of severity stages reflecting biological changes may not be valid for COPD and more scientific work is needed.

A major strength of the GOLD definition is its widespread acceptance, simplicity and emphasis on spirometry for the diagnosis of airflow obstruction. However, a considerable fraction of the asymptomatic non-smoking population older than 70 years has a FEV1/FVC ratio <0.7. This may be due to reduced perception or increased tolerance of symptoms in the elderly. The current Swedish guidelines for COPD (www.slmf.se/kol 2005) outline how age-related spirometry values can be included for the diagnosis of COPD. The quality of life and life prognosis in elderly people with FEV1/FVC <0.7 have not been thoroughly examined. Furthermore, confusion remains regarding the etiologic, pathologic and clinical overlap between asthma and COPD.

Mortality

In the 10th revision of the international classification of diseases (ICD), obstructive lung disease includes categories J 40 to J 46. The mortality data are in many ways incomplete, but most importantly is the fact that they do not contain any information on previous presence of spirometric airway obstruction. One must therefore rely on the diagnosis made by doctors reporting the case. Furthermore, the quality of the death certificates may have deteriorated during the last decades in the Nordic countries as less than 10% of deaths now are examined post-mortem.

In the Nordic countries altogether 9000 persons die prematurely every year due to obstructive lung disease. The death rates vary among the Nordic countries being 64 per 100,000 in Denmark (3499 deaths in 1998), 39 per 100,000 in Norway (1774 deaths in 1999), 25 per 100,000 in Iceland (61 deaths in 1997), 28 per 100,000 in Sweden (2593 deaths in 1999) and 24 per 100,000 in Finland (1187 deaths in 2000). The overall mortality of obstructive lung disease has been steadily increasing during the last 30 years in the Nordic countries. The ratio between death rates of asthma and COPD varies greatly being lowest for Denmark and highest in Sweden. Asthma deaths are rare in children and young adults with 1–4 deaths per 1 million inhabitants below 35 years. The male/female ratio of death rates is highest in Finland and lowest in Iceland and Denmark. In Denmark, where smoking
has been prevalent for decades, mortality rates are now higher among women than among men in the younger age groups. Other indices of an increasing proportion of women with severe obstructive lung disease are the larger fraction of women than men in the Swedish Home Oxygen Registry and in the Norwegian Lung Transplantation Registry. Patients with obstructive lung disease die more frequently than patients with non-obstructive lung disease from smoking related lung cancer, cardiovascular and other non-respiratory diseases. Incidental lung cancer is also heavily depending on lung function impairment. In elderly the mis-classification of death certification may underestimate the impact of COPD more than for conditions such as cancer or ischaemic heart disease. COPD is often not included in the vital statistics as it is mentioned on death certificates more often as a contributory and not as an underlying cause of death. Inclusion of obstructive lung disease as contributory cause of deaths increased the death rate by 40% in Norway (Frostad, 2005, pers. commun.). Formal medical record review is now needed to definitely determine the degree to which death certificates underestimate the contribution of obstructive lung disease to mortality.

The Global Burden of Disease Study has projected COPD mortality rates from 1990 to 2020 and estimated that COPD will account for over 6 million deaths per year in 2020, which will move COPD from the sixth- to the third-leading cause of death worldwide over this period. Overall mortality of obstructive lung disease will increase in the Nordic countries due to the increased proportion of females who smoke as well as to the increasing average age of the population.

Prevalence

Self-reporting respiratory symptoms

Respiratory symptoms are the main reason why patients with respiratory diseases take contact with health care professionals. Health-related quality of life is heavily dependent on the negative impact of both incidence and persistence of respiratory symptoms. The causes of the respiratory symptoms may be due to variable or irreversible airflow limitation as well as cardio-vascular disease, anaemia and anxiety. However, the majority of severe diseases causing respiratory symptoms are obstructive lung diseases.

The prevalence of a set of 11 respiratory symptoms (cough, phlegm, wheezing, acute breathlessness or functional dyspnoe) increased in a community population aged 15–70 years in Norway from 51% in 1972 to 62% in 1998. The most prevalent symptoms in the Nordic communities are cough (35%), wheezing (18%), attacks of breathlessness (12%) and dyspnoe on moderate level (13%). The largest increase in symptom frequency during these 28 years was observed for asthma-like symptoms and long lasting cough after a cold. In an 11-year community report the cumulative remission varied from 42% for morning cough to 58% for chronic cough.

Physicians or spirometric diagnosis

The prevalence of asthma and COPD has been distorted by the use of different diagnostic terms and lung function criteria. Furthermore, a meaningful evaluation of estimates demands knowledge of age distribution and the smoking habits in examined populations.

The prevalence of self-reported physicians’ diagnosed asthma in Oslo in 1998 varies in adults between 5% and 10% and it is higher in those below 30 years compared with those above 50 years. The physicians’ diagnosis of asthma has increased from 1972 to 1998 by a factor of more than 3 in young adults, but somewhat less in those middle aged and elderly. The overall increase in respiratory symptoms was however considerably less than for physicians’ diagnosis of disease. The prevalence of asthma-like symptoms and asthma diagnosis was similarly in the 1990s for the age group 20–44 years in Bergen, Gothenburg, Umeå and Uppsala, but lower in Reykjavik. The distribution of asthma severity in a worldwide survey was 44% intermittent, 19% mild persistent, 19% moderate persistent and 18% severe persistent. The size and natural history of allergic asthma versus non-allergic asthma has not been extensively studied. However, a populations based study in Glostrup, Denmark in 1989 and 1998 showed a clear trend of increased prevalence of allergic asthma defined as shortness of breath being near grass, trees or flowers; shortness of breath being near furry animals or shortness of breath when cleaning rooms or making bed, or when in bed.

For the years 1960–2000 the prevalence of COPD has been estimated in community surveys in several Nordic countries applying physicians’ use of a combination of various criteria from spirometry and symptom questionnaires. These older population-based studies indicate that 4–6% of the adult population suffers from clinically relevant COPD. Prevalence increases heavily with age and show only small differences between men and women. A spirometry survey in 1987–88 of a general population in Western Norway aged 18–73 years and with 59% ever-smokers showed a prevalence of 6%
for airflow limitation defined as FEV1/FVC ratio below 0.7. Altogether 12% had a FEV1 less than 80% of predicted using Norwegian reference values, while 4.5% had this ratio as well as FEV1 of less than 80% of predicted. Below the age of 45 years severe COPD is a rare disease. A spirometry survey in 1996–1997 from the same area with a general population aged 26–82 years and 62% ever-smokers gave a prevalence of 9.6% of people with FEV1/FVC ratio below 0.7. Altogether 18% of this population had a FEV1 below 80% of predicted, while 6.7% had a ratio below 0.7 as well as FEV1 of less than 80% of predicted. Using the severity grading of GOLD without adrenergic bronchodilation 3% of the population had a mild stage of COPD, 5.1% a moderate stage, 1.3% a severe stage while 0.2% of the total population had a very severe stage of COPD. Furthermore, a rather large fraction of the general population (11%) had a FEV1 below 80% predicted and a FEV1/FVC > 0.7. After inhalation of salbutamol the prevalence estimates of COPD decreased by approximately 30%. The prevalence of COPD (FEV1/FVC < 0.7 after bronchodilatation) was 10 times higher in the age group 70–82 years compared to those aged 26–44 years (Fig. 1). Less than half of the persons with spirometric defined COPD had a physician’s diagnosis of obstructive lung disease. The fraction with self-reported physicians’ diagnosis increased with lung function impairment.

Incidence

The incidence of physicians’ diagnosis of asthma among adults showed a wide range of results and varies from 0.4 to 11 per 1000 person-years, indicating that the results are largely depending on methods used as well as sex and age distribution of the population under risk. In Northern Sweden the cumulative incidence of physicians’ diagnosed asthma in a long-term follow-up from 1986 to 1996 in adults aged 37–67 years was 3.2% in men and 4.5% in women. Similar incidence estimates, being 4% in men and 3.5% in women, were observed for the population of Western Norway aged 15–70 years, who were followed from 1985 to 1996/97. In a large prospective study among adults aged 20–44 years followed from 1989–1991 to 1999–2001 the incidence rate of asthma was 2.2 cases per 1000 person-years. The incidence was highly dependent on the extent to which respiratory symptoms like wheezing, nocturnal dyspnoea, chest tightness and cough were excluded from follow up. The pooled estimates of all adult general population cohort studies in Europe and United States was 5.9 and 4.4 per 1000 person-years in women and men, respectively. This review shows that estimates of adult asthma incidence have tended to be higher in later studies implying a rise in asthma incidence in adults within the timeframe of observations. The incidence of physicians’ diagnosed asthma in childhood is considerably higher in short-term follow-up in Sweden and has been estimated at 7–10 per 1000 persons-years in the age group 8–10 years. Longitudinal studies of lung function have shown that the development of airflow limitation is heavily depending on smoking habit and dust exposure as well as ageing. The decline seems to occur along a slowly accelerating curvy-linear pathway. In the cohort of the general population in Western Norway aged 18–74 years the incidence of COPD was examined from 1987/88 to 1996/97. Cumulative 9 years incidence of COPD was 6.7% after bronchodilatation. Sex did not have an independent effect of COPD while age was the most important contributing factor to COPD closely followed by smoking (Fig. 2) while living in an urban or rural area had little effect.

The influence of various phenotypes of obstructive lung disease on survival is so far poorly known. Why do some COPD patients survive for years with very low level of lung function while others only may survive for a few years?
Disability

Obstructive lung disease is a growing cause of disability in the Nordic societies. Disability adjusted life years are the sums of years lost because of prematurely death and years lived with disability adjusted for the severity of the disability. The utility weight for untreated COPD was initially estimated by The World Health Organisation and World Bank to be 0.57 using a person trial off method. However this utility weight must be heavily depending on the severity of the disease; being higher in patients with a mild disease compared with patients with a severe disease. Perfect health is weighted as 1 and death as 0. Further data on health status and quality of life in patients with variable and irreversible obstructive lung disease is highly necessary. The Euroquale scale (EQ-5D) is due to its simplicity recommended to use because it is possible to compare quality of life in patients with COPD with quality of life in patients with other diseases.

Estimated disability adjusted life years (DALYs) lost due to COPD was 2.3 million DALYs in 1990 in countries with established market economy. Given the size of the population in the Nordic countries a crude estimate of DALYs lost in the Nordic countries due to COPD will thus be 69,000 per years. According to the projection of the 1990 WHO’s Global Burden of Disease Study, COPD will rank 5th in 2020 responsible for 4% of total DALYs lost. Only ischaemic heart disease, major depression, traffic accidents and cerebro-vascular disease will cause a greater burden.

Comorbidites

The health care workers of respiratory medicine have tended to neglect the contributions that comorbid conditions have on outcome of COPD. In fact, randomised clinical trials of new treatments for COPD usually exclude persons with serious comorbid conditions. Mapel et al. found in patients in a health management organisation that COPD cases had almost two times higher prevalence of congestive heart disease, localised cancer, ulcers, gastritis and depression compared with non-COPD cases. Hospitalisation and out patient
visits are thus much more common in COPD patients than in age and sex adjusted controls without COPD. When including COPD patients more attention should be paid also to comorbid diseases in clinical trials and research.

**Economic burden**

Cost of illnesses provides insight into the economic impact of a disease. The direct cost is the value of health care resources devoted to diagnosis and medical management of the disease. Indirect costs reflect the monetary consequences of disability, missed work and school, premature mortality, and caregiver or family costs resulting from the illness. It has been estimated that for the total financial burden of lung diseases in Europe is 17% due to inpatient care, 9% due to ambulatory care, 7% due to drug supply, 20% due to premature mortality and rehabilitation and 47% due to lost working days.  

In the Nordic countries the health services are a public matter. It is provided in accordance with legalisation and they are largely financed by public spending or through compulsory health insurance schemes. For many years there has been a trend in the Nordic countries to close down small hospitals. Resources have been concentrated in fewer units. There are, however, large differences in the use of health personnel in the Nordic countries, both in total and for the different categories of health personnel.  

Asthma and COPD accounted each for about SEK 3 billion in Sweden in 1991, together roughly 2% of the economic cost of all diseases. The direct cost of COPD related to medical care in Sweden was estimated to be 1 billion SEK in 1991. The estimated indirect cost of COPD was an additional 1.7 billion SEK. More recent estimates from Sweden have given figures which are almost three times larger being 9.1 billion SEK for COPD alone. Currently, COPD is a more costly disease than asthma. The health care costs per patient per year with COPD were estimated for severe disease to be three times as high as costs for moderate disease and more than ten times as high as for mild disease. Using the classification of severity recommended by the British Thoracic Society, subjects with mild disease (83% of all cases) account for 29% of the costs while subjects with moderate disease (13% of all cases) account for 41% of the total costs. The subjects with severe disease (<4%) account for the remaining 30% of the total costs. In Sweden the drug and primary care costs due to asthma and COPD during the last decades have increased considerable since 1999. Hospital costs due to asthma have decreased while COPD costs have increased.

Exacerbations are the key drivers in the costs of COPD. Precise estimates for overall frequency of resource-defined exacerbation by severity of disease are so far unknown for the Nordic countries. However, subjects with lower lung function experienced more often and more severe exacerbations than those with moderate reduced lung function. The average health care costs per exacerbation were SEK 120 for a mild (self-managed exacerbation), SEK 2,111 for a moderate (health care visit) and SEK 21,852 for a severe (hospitalisation) exacerbation. Exacerbations account for 35–45% of the total per capita health care costs for COPD in Sweden. Ministry of Social Affairs and Health in Finland has estimated that treatment periods and hospitalisation days for COPD may increase by 2010 by up to 55% for men and 24% for women as compared with the situation in the 1990s.

While patients and physicians make decisions for the good of individuals, health care payers focus on decision making on the population level. Outcome measures of interest to health care payers making decisions on treatment approaches within the area of obstructive lung disease include improvement in FEV1, improvement in symptom-free days, reduction in exacerbations and improvement in health-related quality of life. Measures that combine costs and utility measures such as EQ-5D and costs per exacerbation avoided are of particular interest for the health care payers and should be studied more extensively in the Nordic countries by scientific teams of economists and physicians.

**Physicians**

The total number of active physicians in the Nordic countries in 2001 varied between 940 (Iceland) and 25,000 (Sweden) and capita per active physician being lowest for Sweden (307) and highest in Finland (350). Precise data on general practice consultations per 100,000 inhabitants for obstructive lung diseases is lacking. However, estimates for COPD consultations in Copenhagen was 1000–1500 per 100,000 inhabitants per year which is much lower than in United Kingdom. Patients with mild or moderate obstructive lung disease seek outpatient medical attention because of cough and production of mucus, breathlessness or respiratory infections.

Population (in thousands) per active chest physician in the Nordic countries is as follows: Denmark 59, Finland 26, Iceland 13, Norway 21 and Sweden 21. Patients with severe and very severe COPD in the Nordic countries requires continuously monitoring and medications by specialists. The number of
chest physicians may decrease in Finland during the next few years due to expected retirement, which will not be compensated by the specialist currently in training. Furthermore, the gender distribution, changing activities considering clinical work versus free time may reduce the available time for patient’s work in hospitals for the future.

Hospitals beds
The number of beds for each patient group is calculated by dividing hospitalisation days by 365 days. Hospital admissions may reflect the combined impact of prevalence, severity and quality of care. In Norway more than 20% of all hospital admissions of children are due to acute asthma. A steady increase in hospitalisation rates was observed particulary among children below the age of 5 years. However, from 1990 to 1995 re-admissions has decreased markedly, probably related to the marked increased use of inhaled steroids.

The estimates based on Finnish national disease-specified and hospital registries warned on the huge increase on hospitalisation due to COPD. In 1998, Ministry of Health and Social Affairs in Finland launched the National Programme for Prevention and Treatment for COPD to stop the predicted huge increase of COPD patients and their increased use of medical services.

Altogether 300–400 hospitalisations due to obstructive lung diseases per year per 100,000 inhabitants have been estimated for Western Norway. For those older than 60 years of age, the rates were more than 1000 per 100,000 inhabitants. The average length of a hospital stay in 1997 was approximately 9 days for patients with COPD and 5 days for patients with asthma. It has declined further during the later years. Admission rates have increased more in women than in men and in the elderly compared with young. Hospitalisation rates for obstructive lung disease are also dependent on the organisation of emergency units and home care as well as the availability of hospital beds. Hospitalisations due to exacerbations of obstructive lung disease are serious events with 25% probability for death within 2 years and 60% probability of re-hospitalisation within 12 months.

For hospital beds in general the number of beds for admissions with obstructive lung disease has been drastically declining to 613 beds in Finland and 460 beds in Sweden in 1998. At the same time hospitalisation periods have been markedly shortened and it may be further shortened in the future. The patient’s general practitioner or nurse in primary health care may also help more in the future by active participating in the process and decision-making when the patients are discharged from hospitals. Furthermore, we must re-consider novel alternatives like home hospitals. Whether this is more cost-effective than hospital admissions have to be shown.

Drugs
The sales in the Nordic countries of medical products to the respiratory systems cost about 800 million € in 2000. Approximately 2/3 of the cost is due to drugs for obstructive airway diseases. Expenditure per capita for respiratory system drugs is 45€ in Iceland, 43€ in Norway, 34€ in Finland, 33€ in Denmark and 26€ in Sweden. The costs of drugs have since the 1980 increased considerably for both asthma and COPD.

However, the overall use of defined daily doses of obstructive lung disease drugs per 1000 inhabitants have not changed much from 1999 to 2003 in the Nordic countries. The sales of combinations of inhaled steroids and long lasting adrenergic β₂ agonists have increased dramatically since it was introduced in 1999. In 2003 the sales of xanthines have declined to approximately a fourth of what it was used in 1985 while the sales of anti-leukotriene drugs and long acting cholinergic is slowly increasing. When the use of anti-asthmatic drugs is properly targeted in asthma and COPD treatment with good patient adherence, it will decrease both severity and exacerbation rates of obstructive lung disease, and thereby cost effective.

Conclusions
The increased burden of obstructive lung disease has to come to the awareness of the public, governments and health authorities in the Nordic countries. Obstructive lung disease is the only leading cause of death that is increasing in prevalence worldwide. The Nordic countries should establish national management strategies including patient registries for obstructive lung diseases as a research tool to prevent the disease and to improve the care for this very large population of patients. Health professionals should be more active partners to implement strategies for effective prevention, diagnosis and treatment of these disabling and life-threatening diseases.

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