



Chronic bronchitis in relation to hospitalization and mortality over three decades



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ABSTRACT

Background: The study examines the predictive value of chronic bronchitis for all cause and cause-specific hospitalizations and for mortality during the last three decades.

Methods: The study population consists of altogether 47 896 men and women aged 25–74 years who participated in the National FINRISK Study between 1982 and 2007. The study protocol included a standardized questionnaire on the symptoms of chronic bronchitis, smoking habits and other risk factors and clinical measurements at the study site. Data on hospitalizations were obtained from the National Hospital Discharge Registry, and data on the underlying causes of deaths from the National Causes of Death register. The study cohorts were followed up until the end of 2011.

Results: In study subjects with symptoms of chronic bronchitis the mean annual days of hospitalization were almost two-fold higher than in study subjects without chronic bronchitis. The increase was seen in all age -groups and both in 5-year periods for each cohort and during the whole 30-year follow-up. More specifically, hospitalizations were increased for respiratory diseases and cancer. Chronic bronchitis increased hospitalizations more in smokers and ex-smokers than in never smokers. Furthermore, chronic bronchitis was associated with increased all-cause mortality (hazard ratio (HR) 1.23) and mortality from respiratory causes, cardiovascular diseases and cancer. Smokers and ex-smokers with chronic bronchitis had an increased risk to die (HRs 2.89 and 1.69, respectively) compared with never-smokers without chronic bronchitis.

Conclusion: Symptoms of chronic bronchitis can help to identify individuals who are at risk for increased hospitalizations and mortality.

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1. Introduction

The major risk factor for chronic bronchitis, characterized by chronic mucus production from airways, is cigarette smoking [1,2]. Exposure to airborne particles may also contribute to the development of chronic bronchitis [3,4]. Chronic bronchitis itself has been associated with an accelerated decline in lung function and the development of airway obstruction [5,6], an increased risk for respiratory infection [7], increased medical costs [8] and increased respiratory, cardiovascular and all-cause mortality [5,9,10]. There are only a few studies examining the relation between chronic

bronchitis and hospitalizations [6,8,11,12]. In these studies the durations of the follow-ups have varied from three months to one year, and only the relations between chronic bronchitis and all-cause hospitalizations or COPD hospitalizations have been studied [6,8,11,12].

In the present study, we first examined how the symptoms of chronic bronchitis in 1982 were related to hospitalizations during 30 years of follow-up. Then we studied how the symptoms of chronic bronchitis were associated with hospitalizations during a 5-year period after each examination. We also investigated if there were any trends in the association between chronic bronchitis and hospitalization by the year of examination. The relation between chronic bronchitis and 30-year mortality was also studied to clarify the whole process from chronic bronchitis to increased morbidity and mortality.

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2. Methods

2.1. Subjects

Cross-sectional risk factor surveys have been conducted every fifth year in Finland by the National Public Health Institute since 1972 [13–15]. In each survey, an independent population sample was drawn from the population register in five geographical areas: the provinces of North Karelia and Kuopio in eastern Finland since 1972, the Turku-Loimaa region in south-western Finland since 1982, the capital area including the cities of Helsinki and Vantaa since 1992 and the Oulu province in north-western Finland since 1997 and Lapland since 2002. In each study year, a random sample stratified by sex and 10-year age group was taken from each study area so that at least 250 people (at least 200 in 2007) were included in each subgroup [13–15]. The sampling and study methods complied with the protocol of the World Health Organisation Multi-national MONItoring of trends and determinants in CARDiovascular disease (MONICA) project [16], and since 2002, the later recommendations of the European Health Risk Monitoring project (EHRM) [17].

The study population consisted of altogether 47896 men and women who participated in the cross-sectional surveys between 1982 and 2007 (Table 1). Subjects without data on smoking were excluded. Also those who had quit smoking less than one month before the examination were excluded (because of their short abstinence they could not be recorded as ex-smokers). In addition, those subjects who had no data on the symptoms of chronic bronchitis or asthma (altogether $n = 1540$) and subjects reporting asthma diagnosed by a doctor (altogether $n = 1727$) were also excluded [13].

2.2. Measurement of chronic bronchitis, smoking status and other variables

At each study year, the participants completed a self-administered questionnaire [13]. Definition of chronic bronchitis was based on a positive response to the same standard question 'Do you bring up phlegm on most days or nights for at least three months each year' [5,13,18]. Smoking, marital status, education, a history of diagnosed hypertension during the preceding 12 months and a history of diagnosed myocardial infarction were asked with standardized questions in a self-administered questionnaire. Body mass index (BMI) (kg/m²) [2] was calculated from height and weight measured at the examination.

Smoking status was classified into the three categories: never-, ex- and current smokers (Table 1). Smokers had smoked regularly at least one year (cigarettes, cigars or pipe) and had smoked during the preceding month. Ex-smokers had stopped smoking at least one month before the survey. The educational background was classified into four categories: an elementary school, a vocational school, an upper secondary school/college and an academic degree. Marital status was classified into four categories: married/cohabitation without marriage, unmarried, divorced and widowed. The area of residence was classified into four categories: North Karelia and Kuopio, south-western Finland (Turku-Loimaa area), Oulu and Lapland, and the capital area.

2.3. Assessment of hospitalization and mortality

The annual days of hospitalization were calculated by summing up the days of hospitalization and then dividing the sum by the time of the follow-up in years (or by the time until death if the subject died before the end of the follow-up). The hospitalization data was derived from the National Hospital Discharge Registry, which has the healthcare records of inpatients provided by all hospitals and municipal health centers in Finland. The reports include e.g. admission and discharge dates and discharge diagnoses coded by the doctor responsible for the discharge. After participation in the FINRISK Study data on hospitalizations of the study subjects from that point on was linked to the survey data.

Between 1982 and 2012 three different revisions of the *International Classification of Diseases (ICD)* occurred in Finland (i.e. ICD-8 until 1986, ICD-9 between 1987 and 1995 and ICD-10 since 1996). In the present study, the concordance table was used for bridging the three revisions of ICD [19], and the first-listed (main) discharge diagnoses were classified into the following four major categories (Table 2): respiratory causes (the corresponding ICD-8, ICD-9 and ICD-10 codes are listed in at Table 2), cardiovascular diseases, cancer and other causes. COPD (= chronic obstructive pulmonary disease), ischemic heart disease and lung cancer were also re-analysed separately.

There were altogether 31883 subjects with hospitalizations (total of 199887 hospitalizations) between 1982 and the end of 2011 (Table 1). The data on the length of the visit was missing in 3238 hospital visits, and the data on the main discharge diagnosis was missing in 53 hospitalizations.

Data on the underlying causes of death were obtained from the National Causes of Death register. There were altogether 7257 deaths between 1982 and the end of 2011. The underlying causes of

Table 1
Description of the study population by the year of examination.

n	Year of examination						Total
	1982	1987	1992	1997	2002	2007	
Invited	11,395	7932	7927	11,500	13,498	12,000	64,252
Examined (men/women)	4615/4732	3109/3370	2849/3202	4253/4193	4482/5098	3740/4253	23048/28848
Non-responders (men/women)	1212/836	853/600	1116/760	1747/1307	2267/1651	2260/1747	9455/6901
Subjects with hospitalizations between examination and 2011	8453	5660	4690	5973	4910	2197	31,883
Subjects with hospitalizations during 5 years after examination	3950	2830	2479	3522	3398	2197	18,376
Number of deaths during 1982–2011	3181	1484	817	1161	472	142	7257
Smoking status							
never smokers	3962	2804	2596	3752	4294	3634	21,042
ex-smokers	2289	1675	1622	2317	2490	2425	12,818
current smokers	2791	1805	1811	2117	2725	1855	13,104
excluded ^a	305	195	22	260	71	79	932
Chronic bronchitis ^b	1284	785	855	1085	1175	879	6063

^a Subjects without data on smoking or when they had last smoked as well as ex-smokers who had quit smoking less than one month ago were excluded.

^b In subjects having data on the smoking status.

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