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DYNAMO-HIA
Work Package 11: COPD
Activities Report
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Abstract

The main purpose of the Chronic Obstructive Pulmonary Disease (COPD)-related part of work package 11 was to collect age- and sex-specific data on the epidemiology of COPD for as many of the 27 countries of the European Union as possible. The epidemiological data required consists of estimates of incidence, prevalence and mortality (IPM) of the disease. In addition to reporting the final data which is to be the input of the DYNAMO-HIA model this document also summarizes the data search activities and data manipulations and methods which were necessary in order to arrive at the data estimates.

List of Abbreviations

The following abbreviations are used in this report:

CCHS	Copenhagen City Heart Study
COPD	Chronic Obstructive Pulmonary Disease
DYNAMO-HIA	Dynamic Model for Health Impact Assessment
EC	European Commission
(E)HIS	(European) Health Interview Survey
EHEMU	European Health Expectancy Monitoring Unit
EHLEIS	European Health Life Expectancy Information System
EU	European Union
GPRD	General Practice Research Database
HIS	Health Interview Survey
ICD	International Classification of Diseases
IMCA	Indicators for Monitoring COPD and Asthma in the EU-Project
IPM	Incidence-Prevalence-Mortality
OECD	Organization for Economic Co-operation and Development
RR	Relative Risk
SHARE	Survey of Health, Ageing and Retirement in Europe
WHO	World Health Organization
WHS	World Health Survey
WP	Work package
WP11	Work package 11, specifically the part pertaining to COPD

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For the estimates for the United Kingdom this report used data provided by the General Practice Research Database (GPRD) (see http://www.gprd.com/home/default.asp).

This report was prepared by Margarete C. Kulik, Department of Public Health, Erasmus Medical Center Rotterdam, The Netherlands.

1. Introduction

The main purpose of the COPD-WP was to provide incidence (I), prevalence (P) and mortality (M) information for the current EU-27 countries: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden and United Kingdom.
The IPM data is to be sex- and age-specific (1-year age groups) and mortality is to be expressed as COPD-specific excess mortality (case fatality) and/or RRs associated with disease exposure. As COPD is a disease which usually does not manifest itself before the age of 40 this is also the cut off age used for this project (Buist et al. 2007, Rennard et al. 2002). The oldest age of interest is 95 and the data target period is ideally 2000 to 2005.

The DYNAMO-HIA (DYNAmic MOdel for Health Impact Assesment – http://www.dynamo-hia.eu) project is an EU funded project aiming to design, build and illustrate a web-based instrument to quantify the health impact of policies in the European Union (EU) through their influence on health determinants. The model is delivered with the following diseases: five cancers, ischaemic heart disease, stroke, diabetes, COPD and with three risk factors: overweight, alcohol consumption and smoking. The tool itself is generic and hence adaptable to other health determinants and diseases relevant for a policy in question. The model is applicable throughout the EU and is publicly available.

This document provides information on the project's 11th workpackage: "WP11 – COPD". It focuses on the sources of data and their manipulation that were used to deliver the required age- and gender-specific data on COPD incidence, prevalence and mortality.

WP11 – COPD, part of WP 11 (Scenarios and COPD) - was led by the Public Health Department of the Erasmus Medical Center Rotterdam, The Netherlands. The two main objectives of WP11 - COPD were:

1. To deliver: age- and gender-specific IPM data on COPD in as many EU countries as possible, using existing publicly available data sources

   This information provides input for the DYNAMO-HIA model

2. To contribute to the discussion on specification of scenarios in WP11 ("Scenarios")

The main output of this WP is a set of data on the epidemiology of COPD in Europe.
The following sections discuss the data collection methods used to gather information on COPD epidemiology (Section 2). Section 3 focuses on the manipulation of the data obtained. Finally, Annex 1 with country-specific details in section 4 summarizes the data used for each of the EU countries.

2. COPD Data Collection

Section 2 describes the data collection activities for all countries. The aim was to collect data on incidence, prevalence, excess mortality/case frailty (absolute number of events and people in group), relative risks (RR) (mortality in those with COPD/mortality in those without COPD), or standardised mortality rates (SMRs) by single-year of age and sex.

2.1. Definitions

In this section we give definitions of COPD as well as of the outcome measures used in this WP: incidence, prevalence and (excess) mortality.

2.1.1. COPD

Finding a precise and universal definition of COPD is complicated. There are several different definitions of the disease and some of them also often depend on the subjective diagnosis of a physician. Obviously, different definitions can lead to different estimates of the occurrence of COPD within a population. Below we list the different definitions which have been used in science as well as in the clinical setting.

- Definition of the American Thoracic Society (ATS): "a disease state characterized by the presence of airflow limitation due to chronic bronchitis or emphysema; the airflow obstruction is generally progressive, may be accompanied by airway hyperreactivity, and may be partially reversible" (American Thoracic Society 1995).
- Definition of the European Respiratory Society (ERS): "reduced maximum expiratory flow and slow forced emptying of the lungs, which is slowly progressive and mostly irreversible to present medical treatment" (Siafakas et al. 1995).
- Definition of the Global Initiative for Chronic Obstructive Lung Disease (GOLD): "a disease state characterized by airflow limitation that is not fully reversible. The airflow limitation is usually both progressive and associated with an abnormal inflammatory response of the lungs to noxious particles or gases" (Global Initiative for Chronic Obstructive Lung Disease 2009).

Still, even among these official definitions the classification of airflow limitation (slowing of expiratory airflow as measured by spirometry), its reversibility and disease severity (degree of lung function impairment expressed in stages) varies. Also, the three institutions listed above do revise their criteria and definitions over time.

Other definitions used for the identification of COPD within databases containing information from general practitioners are based on codes according to which the GP identifies the disease. In such cases severity stages of the disease are usually not taken into account.
In the case of Dutch GP data used in this report diseases are diagnosed based on the diagnostic criteria in the Dutch medical standards (in *Huisarts en Wetenschap*) or are coded according to the ICPC-1/ICPC-2-Code (International Classification of Primary Care,

Lamberts and Wood, eds 1987) and E-Codes in the case of the CMR-N registry (van den Dungen et al. 2000).

Data from the UK-based General Practice Research Database (GPRD) is based on the READ and OXMIS codes according to which a general practitioner diagnoses the disease. See Annex 2 for the complete list of codes used here.

Yet another way to define COPD is the use of the 9th and 10th version of the International Code of Diseases (ICD). However, different institutions/projects again make use of slightly differing definitions.
According to The World Health Organization's "Global Burden of Disease"-Study COPD is identified as ICD-9: 490-492, 495-496 and ICD-10: J 40-44.
COPD death defined by the Indicators for Monitoring COPD and Asthma in the EU-Project (IMCA) is comprised of the following codes: ICD 9: 490-492, 494 and 496; ICD 10: J40-J44, J47.
In the Italian Health Search database COPD is defined as: ICD-9: 491.2x, 496.x and additionally according to drug prescriptions based on the Anatomical Therapeutic Chemical (ATC) Classification System. The ATC code includes: R03A, excluding R03AK; R03C; R03BA; R03BB; R03DA and R03DB; R03DC; R03AK.

Finally, in many surveys COPD is self-reported. As e.g. in the SHARE survey the question is posed as follows: "Did your doctor tell you that you had the following condition? Chronic lung disease such as chronic bronchitis or emphysema?"

While it would have been ideal to rely on DYNAMO-HIA information sources which are all based on the same definition of COPD, this turned out to be impossible given the scarcity of the data sources (see section 2.3 below). Hence, we pragmatically decided to include COPD defined according to all the criteria described above. An important issue was the fact that within a data source a clear distinction was made between COPD and asthma with the latter being excluded from our consideration. Further, younger ages (until age 39) were not incorporated into our analyses as COPD does not emerge until older ages and hence we could also exclude those with similar symptoms but chronic bronchitis only.

2.1.2. Incidence

The incidence rate is a measure of disease occurrence. It is the number of new cases of a disease, in our case COPD, which occur within a population within a predefined time period, usually a year. In order to arrive at a rate the number of cases is then divided by a measure of time, the time this population is under observation. If there is no information about the amount of time the persons are under observation the denominator can be approximated by the number of persons in the observed group at mid-period. If we are observing a population for a year this would then be the population at mid-year.
Incidence can also be expressed as a hazard instead of as a population rate, this means that the number of cases of the disease is not divided by the entire population time but only those who are still without the disease are taken into account in the denominator. Given the entire population we arrive at the incidence hazard by dividing the incidence population rate by (1-prevalence proportion). See section 2.1.3 below for the definition of prevalence proportion. The data provided in DYNAMO-HIA includes the incidence hazard.

2.1.3. Prevalence

The prevalence proportion, usually just referred to as prevalence, measures the proportion of persons within a population who have a disease at a defined point in time (point prevalence). In cases in which in DYNAMO-HIA we calculate prevalence from raw data the point in time we use is January 1st of the year of observation. In order to arrive at the prevalence proportion we divide the number of people with COPD by the number of people in the population observed.

2.1.4. (Excess) Mortality

Mortality can be defined and measured in many different ways. The mortality definition most relevant to the DYNAMO-HIA project is the excess mortality rate, also called case fatality rate in the DisMod II software which we use for this project (see section 3.2). The numerator consists of those dying with their death being associated with the disease, where the disease can be the underlying cause of death on the death certificate, but does not have to be. The denominator includes the person-years of those with the disease. Hence, here only persons with the disease, in our case COPD, are at risk and of interest to the analysis.
As country-specific information is rarely available in this particular format in DYNAMO-HIA we use the relative risk of dying from COPD based on the British GPRD (see section 3.1.3) to calculate excess mortality with the help of the DisMod II software. There case fatality is expressed as an annual hazard.

2.2. Approach Followed for Obtaining COPD Data

As during the data search it became obvious that COPD data in the format needed for DYNAMO-HIA was scarce, our final approach followed to obtain as much country-specific data as possible differed from what we had originally planned (see section 2.3 below for the steps of our original search strategy). The latter section chronologically depicts the procedure which resulted in the final approach we followed in this WP, while here we present a short summary of this resulting final approach:
We use data from the British GP registry (GPRD) (see section 3.1.3 for more details) from which incidence, prevalence and mortality are available from one source. We use this data for the UK and, assuming that RRs of dying from COPD are comparable for all the EU member states, we use these RRs to calculate excess mortality for all EU countries. The only other country with at least two out of the three IPM indicators coming from the same source is The Netherlands (see section 3.1.2). Together with the RRs we use prevalence information from SHARE (section 3.1.1) for the following countries: Greece and Poland and we approximate COPD incidence from smoking information (see sections 2.4.2 and 3.1.4) for these countries: Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Portugal, Slovakia, Spain and Sweden.
For the countries just mentioned above, with the exception of the UK and the Netherlands, this leaves us with two pieces of information out of the three pieces of the information necessary for DYNAMO-HIA, while there is no or no suitable information on incidence nor prevalence for Austria, Bulgaria, Cyprus, Luxembourg, Malta, Romania and Slovenia. In order to complete our IPM datasets for the countries with at least two data inputs we use the

software DisMod II (see section 3.2). As DisMod II needs at least three inputs for estimation we use the two inputs just mentioned plus information on remission. As COPD is a chronic disease, remission can be set to zero and hence is our third input into the software.
See table 4 in section 2.5 for a summary of the data used for each country and for an assessment of its quality.

2.3. Potential Data Sources and Search Strategy

2.3.1. Original Search Strategy

As DYNAMO-HIA aims to use data which can be easily obtained and extended by future users we followed a stepwise approach in the assessment of the best sources. We first prioritized toward data available from ready to use sources which would also provide comparable information for more than one country. We then continued with a PUBMED literature search from which we hoped to find high-quality county-specific information. We rounded off the search by exploring the internet in order to collect any other relevant information possibly available. As already mentioned above in the discussion of COPD definitions the search showed that appropriate data was harder to find than expected. Below follows a list of the databases we searched, amended with a short explanation why data was suitable or not suitable for our purposes.

We searched in general relevant international databases and surveys (*fall/winter 2008*), including the:

The only suitable finding of this part of the search was:

SHARE, second wave collected 2006/07 (http://www.share-project.org/)

This source has detailed information on prevalence of COPD, however it is self-reported. See discussion in Section 2.4.1.

The following sources did not yield any relevant results:

WHOSIS database of WHO (http://www.who.int/whosis/en/): this database, however, did not yield any COPD-relevant information.

WHO-World Health Survey (http://www.who.int/healthinfo/survey/en/): data is of lesser quality than e.g. the *SHARE* dataset.

WHO mortality database (http://www.who.int/healthinfo/morttables/en/): has detailed information on COPD-specific mortality, but mortality is underestimated, see discussion in Section 2.3.3.

Eurostat database (http://ec.europa.eu/health/ph_information/dissemination/echi/echi_en.htm): also did not yield any COPD-relevant information.

EHIS (http://ec.europa.eu/health/ph_information/dissemination/reporting/ehss_01_en.htm): data was not yet available at the time of the search.

EHLEIS/EHEMU (http://www.ehemu.eu/database/index.php?option=data): has no COPD specific information.

OECD Health Data (http://www.oecd.org/document/30/0,2340,en_2649_34631_12968734_119656_1_1_1,00.html): only has numbers of deaths from "diseases of the respiratory system", rather than COPD-specific information.

We further performed a systematic search of the literature in *PUBMED* (http://www.ncbi.nlm.nih.gov/sites/entrez?db=pubmed) to identify national registries, reports and/or studies on incidence, prevalence and excess mortality for COPD. As searching terms we used: "COPD", "name of country", "epidemiology", "incidence", "prevalence".

We retrieved potential studies and data sources mentioned in the searched papers or references lists. The most relevant result of this search was the BOLD-Study (Burden of Obstructive Lung Disease Study, (http://www.boldstudy.org/), an international study which includes several European countries and which collected information on COPD prevalence. Countries relevant to DYNAMO-HIA are: Austria, Germany and Poland (Schirnhofer et al 2007; Geldmacher et al 2008; Nizankowska-Mogilnicka et al 2007). Further details on the reasons why the BOLD-Study was not used in this project can be found in Section 2.3.3.
A further finding was the "Confronting COPD International Survey" which was performed in the USA, Canada, France, Italy, Germany, The Netherlands, Spain and the UK in 2000 with 3265 COPD participants. This information was, however, not used as the focus of this survey was on costs, symptoms and hospitalisations. Detailed data on incidence and prevalence was not provided. Also it was "only" a self reported telephone interview, and the definition of COPD sometimes seemed too broad.

We also found COPD prevalence data from surveys/reports for Belgium, Denmark and Italy. The respective country subsections in Section 4 list reasons why the decision was made not to use these sources within this project.

We further searched on the website of the IMCA (Indicators for monitoring COPD and asthma in the EU) project (http://www.imca.cat/ (access to data with password only)) to find possible sources of prevalence and mortality data (incidence data is not collected in this project) or contact persons.

We searched on the Internet to find additional studies, surveys or registries.

Finally, we also contacted personally (email) authors of papers linked to potentially relevant data collections or studies to request additional information (e.g. less aggregated data by age of sex, more recent years, etc).

2.3.2. Modified Strategy

By the end of the search it became obvious that COPD data is scarce. Hence, we considered the approach of investing in data for one or a few countries which could serve as a Gold Standard for countries with less data. In this situation, to prioritise towards international data sources became less important than building a good Gold Standard country based on the best data for that specific country. As it would not be feasible to retrieve information from large-scale registries, we could only use these data if tables from the data could be provided by the owners of the databases, within the time path and within the budget of DYNAMO-HIA. This was the case for the Netherlands: GP registries (http://www.rivm.nl/vtv/object_document/o1805n27712.html) as well as for the UK: GPRD-General Practice Research Database (http://www.gprd.com/home/default.asp). See sections 3.1.2 and 3.1.3 for further information about these two sources. The UK finally served as the country which provided the Relative Risks of dying from COPD for all other EU Member States.

In sum, much information for the required IPM modelling was missing (see also section 2.3). We finally used data from the British GP registry (GPRD) (see section 3.1.3 for more details) from which incidence, prevalence and mortality was available from one source. We used this data for the UK and, assuming that RRs of dying from COPD are comparable for all the EU member states, we used these RRs to calculate excess mortality for all EU countries. The only other country with at least two out of the three IPM indicators coming from the same source was The Netherlands (see section 3.1.2). Together with the RRs we used prevalence information from SHARE (section 3.1.1) for the following countries: Greece and Poland and we approximated COPD incidence from smoking information (see sections 2.4.2 and 3.1.4) for these countries: Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Portugal, Slovakia, Spain and Sweden. The user should keep in mind that the latter data is only an approximation.
For the countries just mentioned above, with the exception of the UK and the Netherlands, this left us with two pieces of information out of the three pieces of the information necessary for DYNAMO-HIA, while there was no or no suitable information on incidence nor prevalence for Austria, Bulgaria, Cyprus, Luxembourg, Malta, Romania and Slovenia. In order to complete our IPM datasets for the countries with at least two data inputs we used the software DisMod II (see section 3.2). As DisMod II needs at least three inputs for estimation we used the two inputs just mentioned plus information on remission. As COPD is a chronic disease, remission could be set to zero and hence was our third input into the software.

2.3.3. Reasons for not Using Certain Available Data Sources

Though available, we took the decision not to use hospital registries as a potential source of COPD incidence. The reason is that only a selected part of the COPD patients (those with very severe COPD or co-morbidity) visits a hospital (Holguin et al. 2005). Also, data from hospital registries are only available for a very limited number of countries and extracting data from hospital registries is not feasible within the DYNAMO-HIA project.

We also did not use mortality data based on cause-of-death data from the WHO Database as research shows that there is underreporting/ misreporting in mortality statistics, which use cause-specific information (e.g. WHO). “Fewer than half of those who had moderate and severe COPD at baseline and died had a diagnosis of COPD listed anywhere on their death certificate” (Mannino et al. 2003). Further, variability in coding practices between countries

(Cooreman et al. 1990) introduces uncertainty in assessing the reliability of the COPD mortality data." (Harbers et al. 2008). Given these a-priori limitations, we performed a data check for the United Kingdom which showed an underestimation when using WHO cause-specific mortality data.

We further decided not to use COPD prevalence data from the BOLD-Study. Though the design of the study is the same and thus comparable between the countries which participate, results show that COPD prevalence for all three countries is unexpectedly high in BOLD. In the case of Poland and Austria the authors of the study themselves point to the fact that the prevalence they found is surprisingly high (Nizankowska-Mogilnicka et al 2007, Schirnhofer et al 2007).

We also made the decision not to use SHARE prevalence information for Austria, Belgium, the Czech Republic, Denmark, France, Italy and Sweden. This is because there the patterns are not plausible with women having a considerably higher prevalence of COPD between the ages 40 to 60, as well as for ages older than 80, in the case of France and Sweden in particular. For the Czech Republic the level of prevalence was also decreasing until about age 70. Belgian information resulted in similar prevalence levels for all ages which is not plausible, while Austrian, as well as Danish, German, Italian and Spanish prevalence levels were not consistent with the other parameters in our model. In these cases, except for Austria which we had to finally exclude from the group of countries with available data, IPM datasets based on incidence derived from smoking resulted in more believable patterns.

Reasons why certain other information obtained during the PubMed search was not used for this project are listed by country in section 4.

2.4. (Dis-)advantages of Data Sources Used

As already established, COPD data needed for DYNAMO-HIA are not readily available from databases or literature. And if available, there is sometimes a problem with the reliability. This is the situation for prevalence data based on the SHARE study and other self-reported surveys or incidence data based on smoking prevalence. In this section we briefly discuss the advantages and disadvantages of the data we chose to use in DYNMO-HIA. This section also includes the option to use the software DisMod II with which it is possible to back calculate data when certain information is missing, thus when data is at least partially available.

2.4.1. Prevalence Data from SHARE

We questioned a-priori the reliability of the SHARE data as disease is self-reported and in different countries there might be differing diagnostic approaches and ways to communicate COPD. Also because of COPD being a chronic disease with sometimes few symptoms self-reporting can be of lesser quality than for more "permanent" diseases. However, given the poor data availability, we examined whether in practice the limitations of using SHARE data are really that serious. We examined the SHARE data for all member states included in SHARE. What is worrying is that, in contrast with existing evidence, COPD prevalence from SHARE for several countries is similar for both sexes, or even higher for women in some

countries. Another limitation of SHARE is that its data is available between the ages 50 and 85, for younger and older ages the value at 50 and 85 would have to be extended to the ages 40 to 49 and 86 to 95 respectively. Our conclusion is that though data from SHARE has important limitations, it still provides important information. Hence, we do use it as a source of information for Greece and Poland while keeping its shortcomings in mind.
SHARE countries and sample size: Austria (n=1341); Belgium (n=3169); Czech Republic (n=2827); Denmark (n=2615); France (n=2968); Germany (n=2568); Greece (n=3241); Italy (n=2983); Netherlands (n=2661); Poland (n=2467); Spain (n=2227); Sweden (n=2745)

2.4.2. Incidence Proxy Data Based on Smoking Prevalence

As already mentioned in the final approach (section 2.2), where no other data was available we decided to use information on the prevalence of current, former and never smokers collected by the DYNAMO-HIA Smoking-WP6 in order to reconstruct incidence rates from a country where incidence rates are available.
For this purpose age/country-specific prevalence of current smokers, past smokers and never smokers as well as age-specific COPD RRs according to smoking status were provided by the DYNAMO-HIA WP6 (Smoking, Esteve Fernandez). This information largely comes from the EUROTHINE database, the RRs are summarized in table 1 below. Incidence of never smokers comes from either UK or NL, based on GPRD/GP registries, as these two countries were chosen as the Gold Standard countries (see sections 3.1.2 and 3.1.3 for more information on data from these countries). Use of this information would ideally result in COPD incidence information for all EU countries.

Table 1: COPD RRs according to smoking status

	MALE			**FEMALE**		
	Never Smoker	**Current Smoker**	**Former Smoker**	**Never Smoker**	**Current Smoker**	**Former Smoker**
Age 35-39	1 (ref.)	1	1	1 (ref.)	1	1
Age 40-44	1 (ref.)	1	1	1 (ref.)	1	1
Age 45-49	1 (ref.)	1	1	1 (ref.)	1	1
Age 50-54	1 (ref.)	8.13	3.06	1 (ref.)	12.92	7.39
Age 55-59	1 (ref.)	9.80	8.25	1 (ref.)	9.47	5.55
Age 60-64	1 (ref.)	13.21	12.65	1 (ref.)	11.19	6.63
Age 65+	1 (ref.)	18.93	11.92	1 (ref.)	14.72	9.73

Sources: Ellison LF et al. Health consequences of smoking among Canadian smokers: An update. Chronic Dis Can 1999; 20:36-9.
American Cancer Society´s Cancer Prevention Study II age-specific relative risks (1982-1988).
Tanuseputro P, Manuel DG, Schultz SE, Johansen H, Mustard CA. Improving population attributable fraction methods: examining smoking-attributable mortality for 87 geographic regions in Canada. Am J Epidemiol. 2005 Apr 15;161(8):787-98.

After a data validation by using available GPRD data, we conclude that COPD incidence based on smoking prevalence should be used as a viable data proxy for DYNAMO-HIA. Not using the data would result in the loss of too much information.

Users of the DYNAMO-HIA software are however explicitly advised that the data which is based on smoking information is to be regarded as "proxy" data.

2.5. Summary Tables: Data availability and quality

In this section we summarize data availability and quality.
In table 2, X means that there is data available from GP registries (NL), GPRD (UK), BOLD-Study (Austria, Germany, Poland) or other country-specific surveys/studies/reports (Belgium, Denmark, Italy). "Smoking" indicates that there is data on smoking prevalence from which we can back-calculate COPD incidence. RR indicates COPD mortality Relative Risks/Excess Mortality which are based on GPRD data from the UK and are used for all EU Member States. The table summarizes the general data availability. Brackets indicate that data was available but not used (see section 2.3.3 and the Country Details in section 4 for more information on why certain data was used or not).

Table 2: General data availability

MEMBER STATE	INCIDENCE	PREVALENCE	EXCESS MORTALITY
Austria		(SHARE, also X)	RR
Belgium	smoking	(SHARE, also X)	RR
Bulgaria			RR
Cyprus			RR
Czech Republic	smoking	(SHARE)	RR
Denmark	smoking	(SHARE, also X)	RR
Estonia	smoking		RR
Finland	smoking		RR
France	smoking	(SHARE)	RR
Germany	smoking	(SHARE, also X)	RR
Greece		SHARE	RR
Hungary	smoking		RR
Ireland	smoking		RR
Italy	smoking	(SHARE, also X)	RR
Latvia	smoking		RR
Lithuania	smoking		RR
Luxembourg			RR
Malta			RR
Netherlands	X	(X)	RR
Poland		SHARE (also X)	RR
Portugal	smoking		RR
Romania			RR
Slovakia	smoking		RR
Slovenia			RR
Spain	smoking	(SHARE)	RR
Sweden	smoking	(SHARE)	RR
United Kingdom	X	X	X

Table 3 sums up the criteria we used in order to assess the quality of the data used for each country. The country-specific data quality information is displayed in the last column of table 4. Further, the latter table shows which data and which form of calculation was finally used in order to obtain complete IPM datasets.

Table 3: Criteria used to summarize the quality of data

DEGREE OF QUALITY	DATA
I	Incidence, prevalence and mortality from single source
II	Incidence and prevalence from single source, RR from GPRD
III	Incidence/prevalence from country-specific data, incidence/prevalence (the missing information respectively) from DisMod II, RR from GPRD
IV	All data derived: Incidence from smoking, prevalence from DisMod II, RR from GPRD

Table 4: Data, data quality and calculations used to obtain complete IPM data sets

Member State	Incidence	Prevalence	Excess Mortality	Calculation	Data Quality
Austria				NO PLAUSIBLE DATA AVAILABLE	NO DATA
Belgium	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Bulgaria				NO DATA AVAILABLE	NO DATA
Cyprus				NO DATA AVAILABLE	NO DATA
Czech Republic	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Denmark	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Estonia	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Finland	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
France	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Germany	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Greece		SHARE	Assuming RR/EM from GPRD	DisMod II back-calc from SHARE, RR and Remission = 0	III
Hungary	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Ireland	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Italy	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Latvia	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Lithuania	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Luxembourg				NO DATA AVAILABLE	NO DATA
Malta				NO DATA AVAILABLE	NO DATA
Netherlands*	GP Registry		Assuming RR/EM from GPRD	DisMod II back-calc from incidence, RR and Remission = 0*	III*
Poland		SHARE	Assuming RR/EM from GPRD	DisMod II back-calc from SHARE, RR and Remission = 0	III
Portugal	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Romania				NO DATA AVAILABLE	NO DATA
Slovakia	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Slovenia				NO DATA AVAILABLE	NO DATA
Spain	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
Sweden	smoking		Assuming RR/EM from GPRD	DisMod II back-calc from smoking, RR and Remission = 0	IV
United Kingdom	GPRD	GPRD	GPRD	GPRD	I

* Although prevalence data available form same source, it was not used for DYNAMO-HIA, see section 3.1.2

Table 5 shows a summary of the characteristics of the data used, the GPRD for the UK, the GP registries for The Netherlands, the Health Search data for Italy, the HIS for Belgium and the SHARE dataset for Austria, Denmark, Germany, Greece, Poland and Spain.

Table 5: Characteristics/details of data used for DYNAMO-HIA

COUNTRY	DATA SOURCE	TOTAL AGE RANGE	SAMPLE SIZE	YEAR
United Kingdom	GPRD	0-119	n=11.5 million	2000-2007
The Netherlands	GP registries	0-85+	n=0.5 million	2003
Greece	SHARE	50+	n=3241	2006/07
Poland	SHARE	50+	n=2467	2006/07

3. Data manipulation

The following section summarizes the data manipulation which we used in order to arrive at a data format which is suitable for DYNAMO-HIA, data for men and women, between the ages 40 and 95, 1-year age groups. The explanations are ordered in the following way: manipulation of SHARE dataset; manipulations of individual country data for The Netherlands and the United Kingdom; estimation of COPD incidence proxy-data based on smoking information and finally a short description of the DisMod II software which is used to back-calculate missing data.

3.1. Manipulation of the Different Data Sources

3.1.1. SHARE

We used the second wave of the SHARE survey (release 1.0.1), as it includes more countries than the first wave. The data was collected in 2006/07. The survey focuses on the older population of ages 50 and above with the countries included being: The Netherlands, Poland, Denmark, Sweden, Austria, France, Germany, Belgium, Spain, Italy, Greece and Czech Republic. As stated in section 2.3.3 we did not use the data for the Czech Republic, France and Sweden. We weighted the sample with the weight "wgtACI" (calibrated individual weight for the two SHARE samples jointly) since the weighting did not only account for age and sex but also adjusted for some other factors in some of the countries.

In order to calculate the prevalence we used the question (PH006_) "Did your doctor tell you that you had the following condition? Chronic lung disease such as chronic bronchitis or emphysema?" The prevalence by single-year of age and sex was calculated by weighing the prevalent cases by the number of respondents of that age. The data was smoothed by using logistic regression with the influence of age being modelled by polynomials of the first and second degree. Due to the uncertainties caused by few respondents at oldest ages, for the regression we only took data between 50 and 85 into account. For younger and older ages the value at 50 and 85 was extended to the ages 40 to 49 and 86 to 95 respectively.

3.1.2. Netherlands – GP Registries

Incidence and prevalence data from the following Dutch GP registries was used (provided by the "Centrum Volksgezondheid Toekomst Verkenningen, RIVM" http://www.rivm.nl/vtv/object_document/o1805n27712.html):

CMR (Continuous Morbidity Registry Nijmegen)
RNH (Registration Network General Practices)

RNUH-LEO (Registration Network of General Practitioners Associated with Leiden University)
LINH (Netherlands Information Network of General Practice)
Transitie (Transition Project)

Data supplied as "Chronic Bronchitis/COPD", with cases of incidence and year prevalence. Data was collected in 2003. Original data was given in 5-year age groups between the ages of 0 and 85+. The age group 85+ was transformed to be the 5-year age group 85-89. COPD was identified by physicians and coded accordingly (see section 2.1.1 for additional information).
We used poisson and logistic regression models to describe the Dutch GP data by single-year age groups and sex, up to age 95 as required by DYNAMO-HIA. We accounted for random effects of different registries within the database. The influence of age was modeled by means of polynomials of the first and second degree, numbers of persons/ person-years were used as weights.
For the Netherlands the data from general practice registries is viewed as very reliable and considered the best source of information on incidence and prevalence. As already mentioned, we left out ages below 40, as COPD is unlikely at such young ages and since most analyses in publications also do not start at any younger age. Also, excluding these age groups means that we exclude most of the younger people with chronic bronchitis only (see summary information on Dutch data in table 5 above).

Although valid incidence and prevalence data were available from the same source we chose to use incidence from the original Dutch data together with RRs based on GPRD data and a remission of zero and run these in DisMod II in order to get a trend free steady state prevalence and excess mortality. We did this as preliminary analyses showed that the combination of incidence and prevalence were not in a steady state. The latter being the data most preferred for DYNAMO-HIA.

3.1.3. United Kingdom – GPRD

For the United Kingdom we used data from the GPRD database, which was provided by the GPRD, tabulated by sex and 5-year age groups (0-119) with counts of incidence, prevalence and mortality and the total numbers of patients in each group. The data covers the years 2000-2007 (2008 only partly available). It was derived using the live-database on 30/03/2009 containing 434 practices. We used a 12 month lead-in time in order to obtain the correct levels of incidence. This means that in order to be considered in the analysis, patients had to be registered in the GPRD on January 1st of the analysis year as well as for the previous 12 months. In order to be consistent these criteria were not only applied to the incidence data but also to the data on prevalence and mortality. The rationale for using a lead-in time was to avoid overestimation of incidence given the assumption that a patient can only become incident once. By allowing for a 12 month lead in time we could make sure that the patient was not counted as incident again just because he or she had not visited the physician for a long time (Lewis et al. 2005). We also tried out a 24 lead-in time, but as results were very similar to those with a shorter time period of prior observation we chose for the shorter lead-in time.
Within the GPRD COPD was identified by physicians using the READ and OXMIS codes (see Annex 2 for a full list of codes).

Data manipulation included adding the different years between 2000 and 2007 in order to make use of all the available information. We used poisson and logistic regression models to describe the GPRD data by single-year age groups and sex, up to age 95 as required by DYNAMO-HIA. The influence of age was modeled by means of polynomials of the first and second degree, numbers of persons/ person-years were used as weights.
GPRD mortality data included information on all-cause mortality (numbers of persons who died by sex and 5-year age group (ages 0-119), for the years 2000 to 2007. Further, we were provided with the numbers of deaths of people with a prior diagnosis of COPD, also stratified accordingly. From this information we were able to derive the death rates for COPD and non-COPD deaths which were modelled by means of natural splines. In the next step we used this information to calculate relative risks (RRs) of dying from COPD by dividing the death rate of those with COPD by the death rate of those without COPD.

For the UK the GPRD data is viewed as very reliable and considered the best source of information on incidence, prevalence and mortality. As already mentioned we left out ages below 40, as COPD is unlikely at such young ages and since most analyses in publications also do not start at any younger age (see summary information on British data in table 5 above).

3.1.4. Estimation of Proxy Incidence from Smoking Information

When no other data is available for a country besides smoking prevalence we estimate COPD incidence from this information. Our approach for obtaining COPD incidence is to use incidence of never smokers in reference country (UK or NL depending on smoking history) and to calculate, based on prevalence of smoking (current, former and never smokers) by age and sex and RR, the incidence of the overall population. See section 2.4.2 for more information on the data.
This, of course, is based on the assumption that the COPD incidence of never-smokers is the same within groups of EU member states with similar smoking patterns, and that current smoking prevalence by status (instead of historic data) can approximate current COPD incidence. For a more elaborate version of the approach which additionally includes time since quitting see Hoogenveen et al. (2008). As information on time since quitting was available for fewer countries and given certain resource limitations within DYNAMO-HIA we used a simplified version of the model.

3.2. Final Steps in Estimation: DisMod II

In the sections above we discussed the data manipulations undertaken. It, however, remains obvious that the data search and data manipulation did not result in complete estimates of COPD incidence, prevalence and excess mortality for each country. This is why in addition to using existing data for the estimation of the three indicators, we apply the DisMod II software (Barendregt et al. 2003) in order to back-calculate from existing information to information which is still lacking. DisMod II needs at least three different inputs in order to be able to calculate a full set of epidemiological data. One can choose among incidence, prevalence,

remission, case fatality (excess mortality), disease duration, disease mortality and RR mortality. As COPD is a chronic disease, remission can be set to zero and hence it is one of the inputs into the software. The RRs are the second input. This leaves us with the necessity for one more input which then is either COPD prevalence or proxy-incidence based on smoking. This information is summarized in table 4 above.

However, there is an issue to consider in back-calculating IPM rates from incomplete IPM data, namely the assumption that the rates are stable over time. As there are e.g. past smoking trends, we have to keep in mind that the rates are not stable over time.

Country-specific information on overall mortality and total population which was needed to finalize the IPM calculations for each country was taken from the European Health Expectancy Monitoring Unit (EHEMU database) and the Human Mortality Database of the University of California at Berkeley/Max Planck Institute for Demographic Research.

3.3. Discussion

The previous sections showed the difficulties in finding reliable data on COPD incidence, prevalence and mortality. Even if sources are identified the results might not be entirely reliable and uncertainty remains. Caution is advised when using this information as input for further analyses. Although one of the goals of DYNAMO-HIA is to use actual data as input for the software tool, due to lack of data we had to resort to using a data proxy for most countries: the COPD incidence which is based on smoking prevalence for most countries.

We conclude that COPD incidence based on smoking prevalence should be used as a viable data proxy for DYNAMO-HIA. Not using the data would result in the loss of too much information.
Users of the DYNAMO-HIA software are however explicitly advised that the data which is based on smoking information is to be regarded as "proxy" data.

4. Annex 1: Country Details

Literature listed in the "Data not used" country-specific sections below appears in the order it was retrieved from PubMed searches.
For all sources not used, we documented the main reasons. For each country they are listed below the sources which were not used in DYNAMO-HIA.

4.1. Austria

Data used:

NO PLAUSIBLE DATA AVAILABLE (see also Section 2.3.3)

Data not used:

BOLD-Study Austria:
Schirnhofer L, Lamprecht B, Vollmer WM, Allison MJ, Studnicka M, Jensen RL and Buist AS. COPD Prevalence in Salzburg, Austria: Results From the Burden of Obstructive Lung Disease (BOLD) Study. Chest 2007;131;29-36.
Data from the BOLD study was not used in this project as it showed COPD levels to be implausibly high. A further important note on the Austrian data is that numbers from SHARE as well as from the BOLD-Study both show a higher level of COPD prevalence among women. Given past smoking behavior this is not a common pattern and is not usually observed.

Prevalence information from SHARE Database resulted in prevalence levels which were not consistent with the other parameters in our model.

Further information not used:

Firlei N, Lamprecht B, Schirnhofer L, Kaiser B, Studnicka M. The prevalence of COPD in Austria--the expected change over the next decade. Wien Klin Wochenschr. 2007;119(17-18):513-8. [Article in German]

- Based on BOLD article above, future projections

Lamprecht B, Studnicka M. [COPD today and in the year 2020] Wien Klin Wochenschr. 2007;119(17-18):501-2. [Article in German]

- Descriptive only, based on BOLD article above

4.2. Belgium

Data used:

COPD incidence based on smoking data (NL Gold Standard for men and GPRD Gold Standard for women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Belgium. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the DisMod II software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

Information from the SHARE database was not used for Belgium as the prevalence data output was not plausible, especially for Belgian women. Their level of COPD prevalence remains a horizontal line over all age ranges.

In addition to SHARE, COPD prevalence data for Belgium was found in the Belgian Health Interview Survey (Demarest et al. 2004). However, prevalence levels were too high in order to be consistent with the other model parameters and hence we did not use this data source.

No further articles/data sources were found in PUBMED.

4.3. Bulgaria

No data on COPD was found for Bulgaria.

4.4. Cyprus

No data on COPD was found for Cyprus.

4.5. Czech Republic

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for the Czech Republic. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

Vondra V. [The importance of chronic obstructive pulmonary disease] Vnitr Lek. 2004 Sep;50(9):654-8. [Article in Czech]

- Article does not really have any detailed Czech data. It states that there has been a lack of Czech COPD prevalence studies since 1990.

Information from the SHARE database was not used for the Czech Republic as the prevalence data output was not plausible, especially for Czech women. The data shows a considerably higher prevalence of COPD between the ages 40 to 60, while it is at the same time it is decreasing until about age 70.

4.6. Denmark

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Denmark. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

The Copenhagen City Heart Study (CCHS)
Løkke A, Fabricius PG, Vestbo J, Marott JL, Lange P. [Prevalence of chronic obstructive pulmonary disease in Copenhagen. Results from The Copenhagen City Heart Study] Ugeskr Laeger. 2007 Nov 12;169(46):3956-60. [Article in Danish]

- The COPD prevalence in the CCHS is implausibly high

Prevalence information from SHARE Database resulted in prevalence levels which were not consistent with the other parameters in our model.

Information on COPD prevalence from the national hospitalisation register (including in- and out patients) could be obtained from http://www.sst.dk/Informatik_og_sundhedsdata/Registre_og_sundhedsstatistik/Beskrivelse_af_registre/Landspatientregister.aspx?lang=en . However, as this data is connected to hospital admissions it would miss a considerable part of patients with COPD whose condition is not severe enough in order to be hospitalised (see also section 2.4).

4.7. Estonia

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Estonia. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3)

constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

Pallasaho P, Meren M, Raukas-Kivioja A, Rönmark E. Different labelling of obstructive airway diseases in Estonia, Finland, and Sweden. Eur J Epidemiol. 2005; 20(12):975-83. FinEsS Study

- Data is from 1996, so it is old and it also is not detailed enough

Pallasaho P, Lundbäck B, Meren M, Kiviloog J, Loit HM, Larsson K, Laitinen LA. Prevalence and risk factors for asthma and chronic bronchitis in the capitals Helsinki, Stockholm, and Tallinn. Respir Med. 2002 Oct; 96(10):759-69. FinEsS Study

- Data is from 1996, so it is old and it is chronic bronchitis only

4.8. Finland

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Finland. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

Laitinen et al: Choronic brochitis and chronic obstructive pulmonary disease: Finnish National Guidelines for Prevention and Treatment 1998-2007. Mini-Suomi study, conducted by the Finnish Social Insurance Institution from 1978 to 1981.

- Source not used as data is very old and not specific enough

Ikäheimo P, Hartikainen S, Tuuponen T, Hakko H, Kiuttu J, Klaukka T. What lies behind relief and worsening of asthma symptoms? A register-based study of adults with asthma and other chronic obstructive pulmonary diseases in Finland. Prim Care Respir J. 2006 Oct;15(5):278-85. Epub 2006 Sep 15.

- Not used as article is almost only about asthma, based on register of the Finnish Social Insurance Institution. Attempts to contact the Finnish Social Insurance Institution for more information were unsuccessful.

Kotaniemi JT, Sovijarvi A, Lundback B. Chronic obstructive pulmonary disease in Finland: prevalence and risk factors. COPD: J Chronic Obstructive Pulm Dis 2005;3:331–9. FinEsS Study (an international epidemiological respiratory survey performed in Finland, Estonia and Sweden).

- Not used since the study took place in 1995-96 and hence is too old. Further, the data was collected in Northern Finland only.

von Hertzen L, Reunanen A, Impivaara O, Malkia E, Aromaa A. Airway obstruction in relation to symptoms in chronic respiratory disease—a nationally representative population study. Respir Med 2000; 94(4):356–363.

- Not used because data was collected prior to 1999 and is too old. Also, the definition of COPD cases as opposed to other airway obstruction is not entirely clear.

4.9. France

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for France. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

Information from the SHARE database was not used for France as the prevalence data output was not plausible. The data shows a much higher level of COPD prevalence for women than for men between ages 40 to 60 as well as for those older than 80.

Overall information based on 2003 French Decennial Health Interview Survey

- There is only self reported data and the quality is comparable to the SHARE information or less

Piperno D, Huchon G, Pribil C, Boucot I, Similowski T. The burden of COPD in France: results from the Confronting COPD survey. Respir Med. 2003 Mar;97 Suppl C:S33-42.

- General prevalence information only and focus on costs
- Only very limited recent epidemiological data, according to references and to the "Confronting COPD Survey".

BEH-Bulletin epidemiologique hebdomadaire 3 juillet 2007 / n°27-28, Numéro thématique - La bronchopneumopathie chronique obstructive (BPCO), Special issue - Chronic obstructive pulmonary disease (COPD).

- Articles only give general overall numbers and refer to studies already mentioned in Giraud et al. 2008, see below

Raherison C. Presse [Epidemiology of chronic obstructive pulmonary disease]Med. 2009 Mar;38(3):400-5. Epub 2009 Jan 29. [Article in French]

- No specific IPM information

Giraud V, Ameille J, Chinet T. [Epidemiology of COPD in France] Presse Med. 2008 Mar;37(3 Pt 1):377-84. Epub 2008 Feb 7. [Article in French]

- Review, total prevalence and mortality numbers only, no own data; articles mentioned in review are either very old, focus on general mortality information, or on chronic bronchitis only

Boutin-Forzano S, Moreau D, Kalaboka S, Gay E, Bonnefoy X, Carrozzi L, Viegi G, Charpin D, Annesi-Maesano I. Reported prevalence and co-morbidity of asthma, chronic bronchitis and emphysema: a pan-European estimation. Int J Tuberc Lung Dis. 2007 Jun;11(6):695-702.

- Information on one French city mixed with other European cities

Roche N, Huchon G. [Epidemiology of chronic obstructive pulmonary disease] Rev Prat. 2004 Sep 15;54(13):1408-13. [Article in French]

- Descriptive COPD information only

4.10. Germany

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Germany. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

BOLD-Study Germany:
Geldmacher H [The prevalence of chronic obstructive pulmonary disease (COPD) in Germany. Results of the BOLD study] Dtsch Med Wochenschr. 2008 Dec;133(50):2609-14. Epub 2008 Dec 3. [Article in German]

The COPD prevalence in the BOLD-Study is implausibly high. Further, for women it is higher than for men. These points disqualify it as reliable source of information in DYNAMO-HIA.

Prevalence information from SHARE Database resulted in prevalence levels which were not consistent with the other parameters in our model.

Most German articles found in PubMed are on pharmacology and cost effectiveness.

Andreas S, Herth FJ, Rittmeyer A, Kyriss T, Raupach T. Smoking, chronic obstructive pulmonary disease and lung cancer Pneumologie. 2007 Sep;61(9):590-4. [Article in German]

- Only smoking, disease prevention

Kornmann O, Beeh KM, Beier J, Geis UP, Ksoll M, Buhl R; Global Initiative for Obstructive Lung Disease. Newly diagnosed chronic obstructive pulmonary disease. Clinical features and distribution of the novel stages of the Global Initiative for Obstructive Lung Disease. Respiration. 2003 Jan-Feb;70(1):67-75.

- Data is from 1995

Morr H. Respiratory insufficiency. Epidemiology, economic burden and health care facilities needed as exemplified by COPD. Internist (Berl). 2001 Mar;42(3):373-8. Review. [Article in German]

- Only outdated overall prevalence number and the focus in on costs

Results of the COPD health care costs study. COPD in Germany--unrecognized and cost intensive. Krankenpfl J. 2003;41(7-9):158-61. [Article in German]

- Costs, no relevant data

4.11. Greece

Data used:

Prevalence information from SHARE Database (see sections 2.4.1 and 3.1.1 for details), together with remission set to zero and RRs based on GPRD data (see section 3.1.3), was used as input for the DisMod II software (see section 3.2). In this way we were able to also obtain age and sex-specific information on incidence and excess mortality.

Data not used:

Sichletidis L, Tsiotsios I, Gavriilidis A, Chloros D, Kottakis I, Daskalopoulou E, Konstantinidis T. Prevalence of chronic obstructive pulmonary disease and rhinitis in northern Greece. Respiration. 2005 May-Jun;72(3):270-7. (2000-2001)

- Data not detailed enough, attempts to contact authors unsuccessful

Tzanakis N, Anagnostopoulou U, Filaditaki V, Christaki P, Siafakas N; COPD group of the Hellenic Thoracic Society. Prevalence of COPD in Greece. Chest. 2004 Mar;125(3):892-900.

- Only about smokers of at least 100 cigarettes per day

4.12. Hungary

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Hungary. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

Molnar LD. Regional frequency of lung cancer and COLD-mortality. Stat Szle. 1994 Jul;72(7):577-83.

- Some numbers between 1980 and 1989 only

Szilasi M, Dolinay T, Nemes Z, Strausz J. Pathology of chronic obstructive pulmonary disease. Pathol Oncol Res. 2006;12(1):52-60. Epub 2006 Mar 23.

- Descriotive pathology, no numbers/data

4.13. Ireland

Data used:

COPD incidence based on smoking data (NL Gold Standard for men and GPRD Gold Standard for women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Ireland. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the DisMod II software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

No other information found in PubMed.

4.14. Italy

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Italy. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

Prevalence information based on the Health Search Report 2007/2008, a research database run by the Italian Society of General Medicine (SIMG) containing information from Italian GPs resulted in a prevalence level which was too high to be plausible and thus this data was not used.

Prevalence information from SHARE Database resulted in prevalence levels which were not consistent with the other parameters in our model.

Dal Negro R, Rossi A, Cerveri I. The burden of COPD in Italy: results from the Confronting COPD survey. Respir Med. 2003 Mar;97 Suppl C:S43-50.

- COPD management and costs, prevalence references in article are either too old or pertain to specific population groups

Trerotoli P, Bartolomeo N, Moretti AM, Serio G. Hospitalisation for COPD in Puglia: the role of hospital discharge database to estimate prevalence and incidence. Monaldi Arch Chest Dis. 2008 Sep;69(3):94-106.

- Regional and hospitalisation data only

Viegi G, Matterelli G, Angino A, Scognamiglio A, Baldacci S, Soriano JB and Laura Carrozzi. The Proportional Venn Diagram of Obstructive Lung Disease in the Italian

General Population. CHEST 2004; 126:1093–1101.

- Information between 1988 and 1993 only

Faustini A, Cascini S, Arcà M, Balzi D, Barchielli A, Canova C, Galassi C, Migliore E, Minerba S, Protti MA, Romanelli A, Tessari R, Vigotti MA, Simonato L. [Chronic obstructive pulmonary disease prevalence estimated using a standard algorithm based on electronic health data in various areas of Italy] Epidemiol Prev. 2008 May-Jun;32(3 Suppl):46-55. [Article in Italian]

- Period 2000 to 2004, but severe and exacerbated cases only, because use of hospital discharge data

Viegi G, Pistelli F, Sherrill DL, Maio S, Baldacci S, Carrozzi L. Definition, epidemiology and natural history of COPD. Eur Respir J. 2007 Nov;30(5):993-1013.

- Overall review only, also an older version available

Faustini A, Marino C, D'Ovidio M, Perucci CA. The concurrent COPD mortality doubles the mortality estimate from COPD as underlying cause in Lazio, Italy. Respir Med. 2007 Sep;101(9):1988-93. Epub 2007 Jul 13.

- Mortality only

de Marco R, Accordini S, Cerveri I, Corsico A, Antó JM, Künzli N, Janson C, Sunyer J, Jarvis D, Chinn S, Vermeire P, Svanes C, Ackermann-Liebrich U, Gislason T, Heinrich J, Leynaert B, Neukirch F, Schouten JP, Wjst M, Burney P. Incidence of chronic obstructive pulmonary disease in a cohort of young adults according to the presence of chronic cough and phlegm. Am J Respir Crit Care Med. 2007 Jan 1;175(1):32-9. Epub 2006 Sep 28.

- Young adults only

4.15. Latvia

Data used:

COPD incidence based on smoking data (NL Gold Standard for men and GPRD Gold Standard for women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Latvia. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the DisMod II software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

No further articles/data sources were found in PUBMED.

4.16. Lithuania

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Lithuania. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3)

constituted the third input for the DisMod II software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data no used:

Lesauskaite V. Age-related trends in mortality from COPD in Lithuania, 1989 to 1998. Chest. 2003 Jul;124(1):90-3.

- Mortality rates only. Only primary causes of death from official statistics, and likely to be an underestimation. Other references from this article are too old to use.

4.17. Luxembourg

No data on COPD was found for Luxembourg.

4.18. Malta

No data on COPD was found for Malta.

4.19. Netherlands

Data used:

COPD incidence data from the following Dutch GP registries was used (provided by the "Centrum Volksgezondheid Toekomst Verkenningen, RIVM" http://www.rivm.nl/vtv/object_document/o1805n27712.html): CMR-Nijmegen, Transitie, RNH, RNUH-LEO probleemlijst, LINHwas as one of the DisMod II inputs (see section 3.2). Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the DisMod II software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality. See section 3.1.2 for the reasons why registry based prevalence data was not used.

Data not used:

LMR Dutch national hospital discharge registry: not used as this would miss too many cases of COPD patients who do not go to a hospital.

SHARE dataset showed implausible results by indicating a higher level of COPD prevalence in women than in men.

4.20. Poland

Data used:

Prevalence information from SHARE Database (see sections 2.4.1 and 3.1.1 for details), together with remission set to zero and RRs based on GPRD data (see section 3.1.3), was used as input for the DisMod II software (see section 3.2). In this way we were able to also obtain age and sex-specific information on incidence and excess mortality.

Data not used:

BOLD-Study Poland:
Nizankowska-Mogilnicka E et al. Prevalence of COPD and tobacco smoking in Malopolska region – results from the BOLD Study in Poland (Częstość występowania POChP i rozpowszechnienie palenia tytoniu w Małopolsce – wyniki badania BOLD w Polsce). POLSKIE ARCHIWUM MEDYCYNY WEWNĘTRZNEJ 2007; 117 (9).
Data from the BOLD study was not used in this project as it showed COPD levels to be implausibly high.

Data from the following two studies was also not used as it only had one overall estimate of prevalence and age and sex specific information was not available:

Plywaczewski R, Bednarek M, Jonczak L, Zielinski J. Prevalence of COPD in Warsaw population. Pneumonol Alergol Pol. 2003; 71: 329-335.

Niepsuj G, Kozielski J, Niepsuj K, et al. Chronic obstructive pulmonary disease in inhabitants of Zabrze. Wiad Lek. 2002; 55: 354-359.

4.21. Portugal

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Portugal. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the DisMod II software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

No further articles/data sources were found in PUBMED.

4.22. Romania

No data on COPD was found for Romania.

Murărescu ED, Mitrofan EC, Mihailovici MS. Chronic obstructive pulmonary disease in a new concept. Rom J Morphol Embryol. 2007;48(3):207-14.

- Only descriptive

4.23. Slovakia

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Slovakia. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the DisMod II software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

No further articles/data sources were found in PUBMED.

4.24. Slovenia

No data on COPD was found for Slovenia.

4.25. Spain

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Spain. Remission was set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:
Prevalence information from SHARE Database resulted in prevalence levels which were not consistent with the other parameters in our model.

Miravitlles M, de la Roza C, Morera J, Montemayor T, Gobartt E, Martín A, Alvarez-Sala JL. Chronic respiratory symptoms, spirometry and knowledge of COPD among general population. Respir Med. 2006 Nov;100(11):1973-80. Epub 2006 Apr 12.

- Not used because COPD cannot be distinguished clearly and it is a self reported phone survey

Peña VS, Miravitlles M, Gabriel R, Jiménez-Ruiz CA, Villasante C, Masa JF, Viejo JL, Fernández-Fau L. Geographic variations in prevalence and underdiagnosis of COPD: results of the IBERPOC multicentre epidemiological study. Chest. 2000 Oct;118(4):981-9.

- Not used as IBERPOC study took place in 1996, plus information is not detailed enough

Izquierdo JL. The burden of COPD in Spain: results from the Confronting COPD survey. Respir Med. 2003 Mar;97 Suppl C:S61-9.

- Based on IBERPOC study, so disadvantages are the same as above

4.26. Sweden

Data used:

COPD incidence based on smoking data (GPRD Gold Standard for men and women, see section 3.1.4 for more explanation) was used as one of the DisMod II inputs (see section 3.2) for Sweden. Remission set to zero, while RRs based on GPRD data (see section 3.1.3) constituted the third input for the DisMod II software. In this way we were able to also obtain age and sex-specific information on prevalence and excess mortality.

Data not used:

Information from the SHARE database was not used for Sweden as the prevalence data output was not plausible, especially for Swedish women. The data shows a considerably higher prevalence of COPD between the ages 40 to 60, while it is at the same time it is decreasing until about age 70.

Further information not used:

Swedish Intensive Care Registry

- Information on COPD exacerbations only, so that it misses all the less severe cases

Lindberg A, Eriksson B, Larsson LG, Rönmark E, Sandström T, Lundbäck B. Seven-year cumulative incidence of COPD in an age-stratified general population sample. Chest. 2006a Apr; 129(4):879-85.

- Open questions about the results remain, up to this point author could not be reached for clarification

- The information in the following two articles was not used because the definition of COPD did not correspond with the possible definitions in DYNAMO-HIA:

Wiréhn AB, Karlsson HM, Carstensen JM. Estimating disease prevalence using a population-based administrative healthcare database. Scand J Public Health. 2007;35(4):424-31.

Stenfors N. Physician-diagnosed COPD global initiative for chronic obstructive lung disease stage IV in Ostersund, Sweden: Patient characteristics and estimated prevalence. Chest. 2006 Sep;130(3):666-71.

- The information in the following four articles was not used because data was too old:

Lindberg A, Jonsson AC, Rönmark E, Lundgren R, Larsson LG, Lundbäck B. Prevalence of chronic obstructive pulmonary disease according to BTS, ERS, GOLD and ATS criteria in relation to doctor's diagnosis, symptoms, age, gender, and smoking habits. Respiration. 2005b Sep-Oct; 72(5):471-9.

Lindberg A, Bjerg A, Rönmark E, Larsson LG, Lundbäck B. Prevalence and underdiagnosis of COPD by disease severity and the attributable fraction of smoking Report from the Obstructive Lung Disease in Northern Sweden Studies. Respir Med. 2006 Feb;100(2):264-72. Epub 2005a Jun 21.

Lindberg A, Jonsson AC, Rönmark E, Lundgren R, Larsson LG, Lundbäck B. Ten-year cumulative incidence of COPD and risk factors for incident disease in a symptomatic cohort. Chest. 2005 May;127(5):1544-52.

Lindström M, Jönsson E, Larsson K, Lundbäck B. Underdiagnosis of chronic obstructive pulmonary disease in Northern Sweden. Int J Tuberc Lung Dis. 2002 Jan;6(1):76-84.

4.27. United Kingdom

Data used:

We used data from the GPRD database which was provided by the GPRD, with counts of incidence, prevalence and mortality and the total numbers of patients in each group. Annual data is available for the years 2000-2007 (2008 only partly available).

Data not used:

Nacul LC et al. Model for estimating the population prevalence of chronic obstructive pulmonary disease: cross sectional data from the Health Survey for England. Popul Health Metr. 2007 Sep 26; 5:8.

- Not used because COPD is loosely defined as the presence of airflow obstruction

Soriano, JB, Maier WC, Egger P, et al. Recent trends in physician diagnosed COPD in women and men in the UK. Thorax 2000; 55: 789-94.

- Not used as data is too old

Britton M. The burden of COPD in the U.K.: results from the Confronting COPD survey. Respir Med. 2003 Mar 97 Suppl C: S71-9.

- Not used as the aim is an economic analysis and there are only general numbers on physician visits

Hansell A, Hollowell J, McNiece R, Nichols T, Strachan D, Validity and interpretation of mortality, health service and survey data on COPD and asthma in England. Eur Respir J 2003, 21:279-286.

- Too old

5. Annex 2: Codes to Identify COPD

The table below shows the codes used to identify COPD within the GPRD from the UK:

Read/OXMIS codes for identifying a medical diagnosis of COPD

gprdmedcode	Term Type	Readoxmisterm	Read / OXMIS Term
207194	READ	H31..00	Chronic bronchitis
207195	READ	H312011	Chronic wheezy bronchitis
207198	READ	H3y..00	Other specified chronic obstructive airways disease
216142	READ	H312200	Acute exacerbation of chronic obstructive airways disease
216143	READ	H32y200	MacLeod's unilateral emphysema
216150	READ	H3y..11	Other specified chronic obstructive pulmonary disease
216151	READ	H3z..00	Chronic obstructive airways disease NOS
225243	READ	H311z00	Mucopurulent chronic bronchitis NOS
225244	READ	H31yz00	Other chronic bronchitis NOS
225245	READ	H320000	Segmental bullous emphysema
225246	READ	H320200	Giant bullous emphysema
225247	READ	H32y100	Atrophic (senile) emphysema
234374	READ	H32..00	Emphysema
234375	READ	H32yz00	Other emphysema NOS
234376	READ	H32yz11	Sawyer - Jones syndrome
234377	READ	H32z.00	Emphysema NOS
243388	READ	H3...11	Chronic obstructive airways disease
252513	READ	H311000	Purulent chronic bronchitis
252514	READ	H312z00	Obstructive chronic bronchitis NOS
252516	READ	H320311	Tension pneumatocoele
252524	READ	H3y0.00	Chronic obstruct pulmonary dis with acute lower resp infectn
256647	OXMIS	492 PP	PUFFER PINK
261743	READ	H310000	Chronic catarrhal bronchitis
261744	READ	H312100	Emphysematous bronchitis
261745	READ	H313.00	Mixed simple and mucopurulent chronic bronchitis
261746	READ	H31y100	Chronic tracheobronchitis
261747	READ	H31z.00	Chronic bronchitis NOS
261758	READ	H3y1.00	Chron obstruct pulmonary dis wth acute exacerbation, unspec
261759	READ	H3z..11	Chronic obstructive pulmonary disease NOS
265866	OXMIS	492 AB	APICAL BULLAE
265867	OXMIS	492 AC	EMPHYSEMA APICAL BULLAE
271037	READ	H311100	Fetid chronic bronchitis
271038	READ	H312.00	Obstructive chronic bronchitis
271039	READ	H320100	Zonal bullous emphysema
271040	READ	H320300	Bullous emphysema with collapse
271041	READ	H321.00	Panlobular emphysema
275013	OXMIS	491 BT	BRONCHITIS OBSTRUCTIVE
280081	READ	H3...00	Chronic obstructive pulmonary disease
280085	READ	H310.00	Simple chronic bronchitis
280086	READ	H311.00	Mucopurulent chronic bronchitis
280087	READ	H312000	Chronic asthmatic bronchitis
280088	READ	H320.00	Chronic bullous emphysema
280089	READ	H320z00	Chronic bullous emphysema NOS
280090	READ	H32y.00	Other emphysema
280091	READ	H32y000	Acute vesicular emphysema
280094	READ	H36..00	Mild chronic obstructive pulmonary disease

289195	READ	H310z00	Simple chronic bronchitis NOS
289203	READ	H38..00	Severe chronic obstructive pulmonary disease
298476	READ	H31y.00	Other chronic bronchitis
298477	READ	H322.00	Centrilobular emphysema
298483	READ	H37..00	Moderate chronic obstructive pulmonary disease
303970	OXMIS	491	CHRONIC BRONCHITIS
303971	OXMIS	491 AC	BRONCHITIS ACUTE ON CHRONIC
303972	OXMIS	491 E	CHRONIC BRONCHITIS WITH EMPHYSEMA
303973	OXMIS	492	EMPHYSEMA PULMONARY
304061	OXMIS	5192CM	OBSTRUCTIVE LUNG DISEASE COMPENSATORY
304065	OXMIS	5199C	OBSTRUCTIVE AIRWAYS DISEASE
304067	OXMIS	5199CL	OBSTRUCTIVE LUNG DISEASE
304071	OXMIS	5199G	OBSTRUCTIVE AIRWAYS DISEASE CHRONIC
304072	OXMIS	5199GE	EXACERBATION COAD
304073	OXMIS	5199GL	COLD (CHRONIC OBSTRUCTIVE LUNG DISEASE)
304074	OXMIS	5199GP	COPD (CHRONIC OBSTRUCTIVE PULMONARY DISE
305740	OXMIS	9906E	RADIOLOGICAL EMPHYSEMA
306529	OXMIS	491 R	BRONCHITIS RECURRENT
306530	OXMIS	492 CM	HYPERINFLATION COMPENSATORY

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