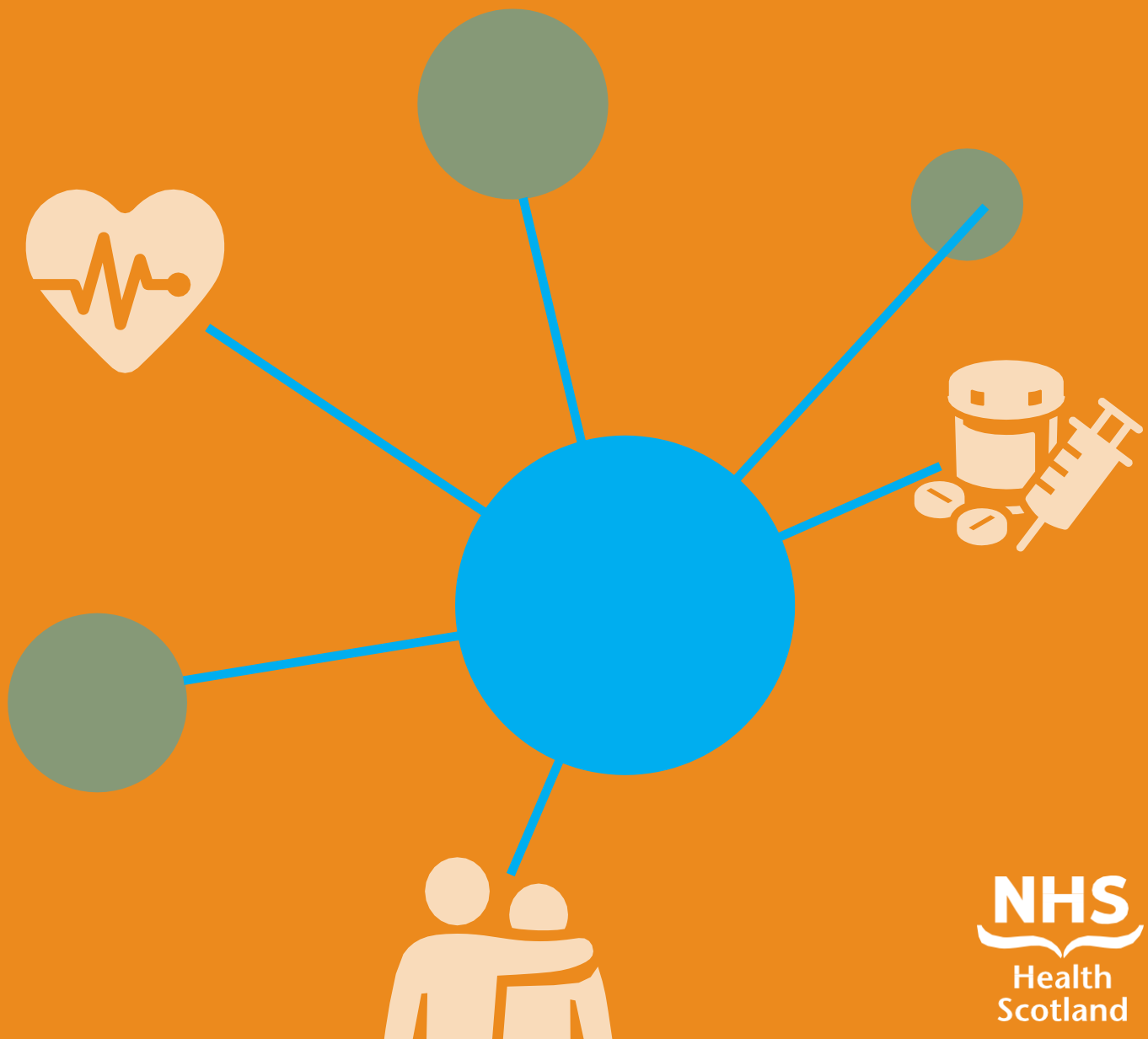# The Scottish Burden of Disease Study, 2016

Ischaemic heart disease technical overview

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Background

The Scottish Burden of Disease (SBoD) study team have published comprehensive estimates of the burden of disease and injury in Scotland for 2016 [1]. The purpose of this technical overview is to provide background information on the data and methodology used, noting any caveats associated with estimating the burden of Ischaemic Heart Disease (IHD) in SBoD.

Burden of disease studies aim to estimate the difference between ideal and actual health in a country or region at a specific point in time. Individuals can suffer non-fatal health loss due to suffering disability attributable to a disease, or injury, or suffer fatal health loss which is early death due to a disease or injury. To quantify the total burden, non-fatal and fatal health loss are combined to produce a single metric called the Disability-Adjusted Life Year (DALY).

In SBoD 2016, all data are presented as three year averages for period 2014-2016. A three year period is used to smooth out most of the effect if the mortality or morbidity of a single year happens to be unusual. Further information about the SBoD study, including a more thorough explanation of the methodology used, overview reports, detailed results and other specific disease briefings, can be found on the website of the Scottish Public Health Observatory (ScotPHO) [1].

Estimated burden due to ischaemic heart disease

IHD was the leading cause of disease burden in Scotland in 2016, resulting in a total of approximately 93,700 DALYs. Of this total burden, 87% was due to the fatal burden of IHD, with 13% being attributed to the non-fatal burden.

**Figure 1 Percentage of total DALYs by gender and age-group for IHD**
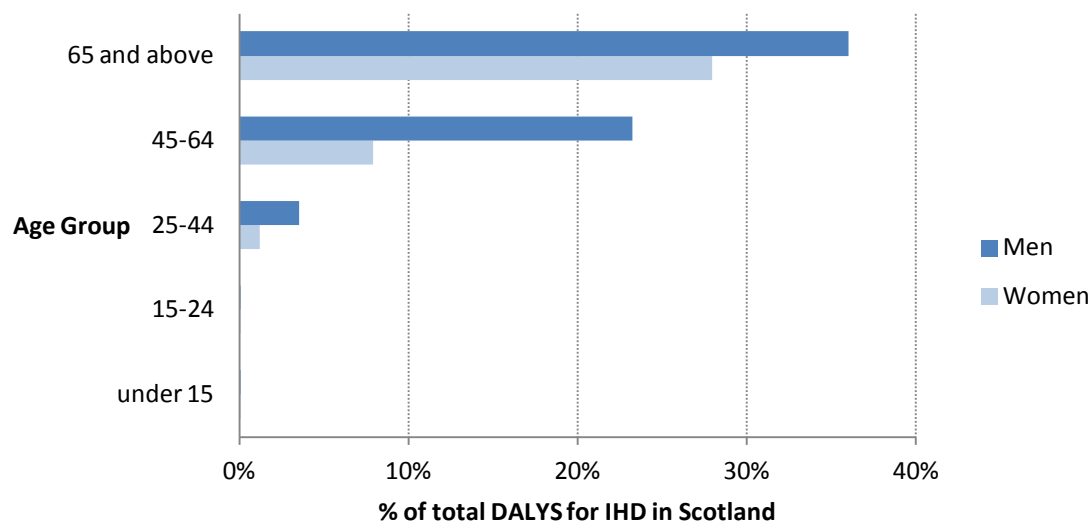
Men contributed a higher proportion of the burden (63%) than women (37%). Overall, 64% of the total IHD burden was contributed by individuals aged 65 years and over (Figure 1); men in this age group contributed a higher proportion (36%) to the total IHD burden than women (28%). Men aged 45-64 years accounted for a further 23% of the total IHD burden. Note that the burden we are describing above is the absolute burden and has not been adjusted for the age/gender case-mix.

The age standardised DALY rates for ischaemic heart disease, by deprivation[1] decile, are shown in Figure 2. The DALY burden increased with increasing levels of deprivation: individuals in the most deprived decile experienced a burden that was 3 times greater than individuals in the least deprived decile.

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[1] We used the Scottish Index of Multiple Deprivation (SIMD 2016) to analyse patterns of inequality in the burden of disease across Scotland. SIMD2016 is categorised into deciles 1 (most deprived) to 10 (least deprived), SIMD2016 calculates deprived areas, not deprived individuals.

Figure 2 DALY (rates per 100,000^2) of total ischaemic heart disease burden by deprivation decile
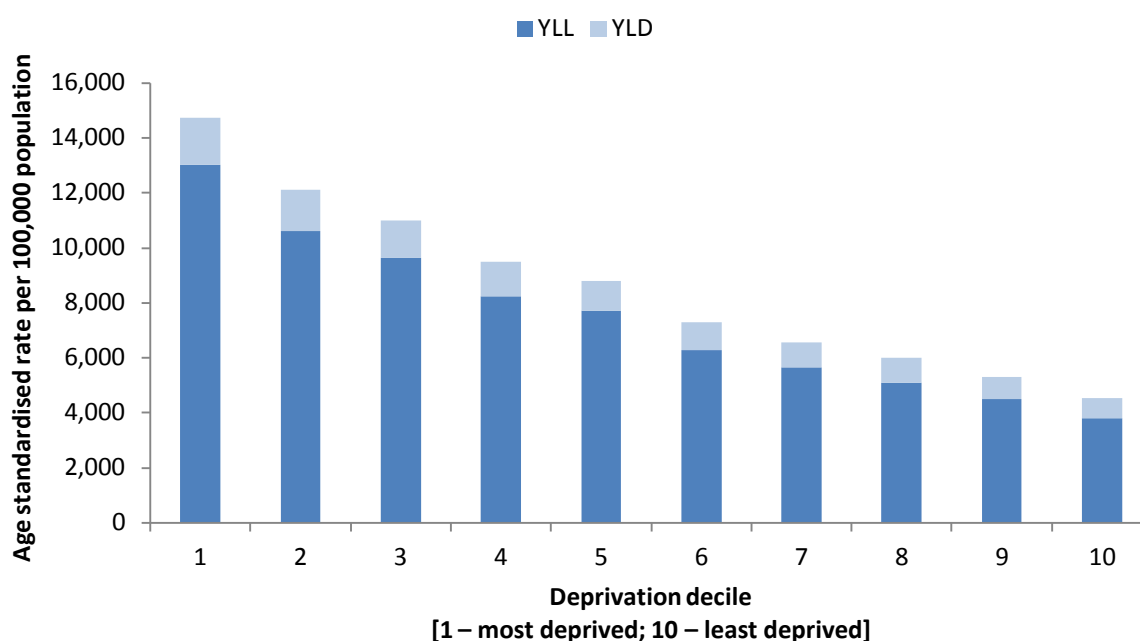
How did we produce these estimates?

DALYs attributed to a disease or injury are calculated by combining estimates from two individual metrics: Years of Life Lost (YLL) due to premature mortality and Years Lived with Disability (YLD).

Years of life lost (YLL) due to ischaemic heart disease

YLL measures the years of life lost due to premature deaths i.e. the fatal component of burden of disease. YLLs are calculated by subtracting the age at each IHD death from the expected remaining life expectancy for a person at that age.

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[2] Where the data were age-standardised, this was done directly using the 2013 European Standard Population to account for differences in age structure between SIMD deciles."

Estimating the number of deaths

For the period 2014-2016, we estimated an average of 7,400 deaths per year caused by IHD. These deaths were identified from the underlying cause of death on the National Records of Scotland (NRS) register of deaths [2]. To classify deaths the GBD 2016 cause list was used, which has been created using the International Statistical Classification of Diseases and Related Health Problems (ICD-10) [3, 4]. The NRS register of deaths has a Community Health Index (CHI) number attached to each death, which allows for demographic data such as gender, geographical area of residence and age at death to be established for each individual.

Included in the total IHD mortality count are deaths that have come from what are termed ill-defined causes of death in burden of disease studies. These ill-defined deaths are causes of death that have been coded with ICD-10 codes in vital registers but for the purposes of burden of disease studies, are not regarded as sufficiently specific causes of death. Ill-defined deaths are redistributed amongst specific causes of death across the burden of disease cause list based on the secondary causes of death recorded on the death certificate. For a small number of cases, where there was no additional information relating to secondary causes of death, the individuals clinical history was evaluated to inform the target cause for redistribution. For disease IHD, approximately 7% of the mortality count comes from these ill-defined deaths. For this reason, the number of deaths due to IHD which have been reported are different from that of officially reported sources. Further explanation of this method is available in the Invited chapter of The Registrar General's Annual Review of Demographic Trends [5].

Life expectancy and YLL

Each single death contributes to the total YLL through calculating the difference between the age at death and the life expectancy at that age. Life expectancy was defined using the 2014-2016 gender-specific National Life Tables for Scotland [6]. There were approximately 81,600 YLL due to IHD in Scotland in 2016. Dividing the total YLL for IHD by the total mortality count indicates that, on average, individuals who die due to IHD die approximately 11 years earlier than would otherwise be expected on the basis of the life expectancy of the general population.

Years lived with disability (YLD) due to ischaemic heart disease

Years lived with disability (YLD) are estimated using:
- disease and injury prevalence estimates
- levels of severity
- disability weights

Our sources of information for these three components are as follows:

Estimating the number of individuals suffering disability

To estimate the number of individuals suffering disability due to IHD, the number of prevalent cases of IHD and the number of acute Myocardial Infarction (MI) events during 2016 were estimated. Cases were identified using a linked dataset at individual level, comprising of records from the Scottish Morbidity Record 01 (SMR01) [7] and the New Prescribing Information System (PIS) [8].

The SMR01 dataset contains structured data in the form ICD-10 codes relating to diagnoses made on discharge from general and acute hospitals during inpatient episodes and day cases. There are up to six individual ICD-10 codes that can be recorded, where the primary diagnosis relates to the main reason for the hospital episode of care, and the other secondary diagnoses refer to co-morbidities that may affect care during that hospital episode of care. The PIS dataset contains records for reimbursement purposes on prescription items dispensed in the community to individuals. It holds structured data relating to the issued generic or branded drug item such as the date of dispensing, strength, formulation and quantity. Both datasets have a Community Health Index (CHI) number attached to each record which has allowed us to source records from the NRS register of deaths, to exclude individuals that have died from estimates following their date of death.

When estimating the number of individuals suffering disability due to IHD, three separate sequelae were considered: angina, myocardial infarction (MI) and heart failure (HF). A hierarchical approach of allocation to chronic sequelae was used, whereby an individual would be assigned to the sequelae that generated the largest disability if their records suggested they had multiple complications of IHD. The number of individuals that had a hospital diagnosis of IHD from 1 January 1996 to 31 December 2016 were used to estimate the number of prevalent cases. To refine our estimates of IHD, individuals that were dispensed nitrate treatment as defined by prescription items under sub-section 2.6.1 of the British National Formulary (BNF) during 1 January to 31 December 2016 were also considered cases. Individuals that had a diagnosis of IHD and HF in the sampling frame were considered to be suffering from HF due to IHD. In addition, a percentage[3] of the number of individuals that had a diagnosis of HF from 1 January 1996 to 31 December 2016, for whom we could not assign a specific cause[4] were added to the prevalent count of HF due to IHD. For those patients that did not have a diagnosis of HF, they were assumed to be suffering from angina due to IHD.

To identify the number of acute MIs in 2016, the number of individuals that had a primary diagnosis of acute MI between the period 1 January to 31 December 2016 were used. If individuals had multiple primary diagnoses in a given year, then assuming that their consultations were more than 28 days apart, additional cases were recorded.

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[3] 75% of the cases, this is extracted from the worldwide prevalence estimates of heart failure according to the aetiology, published by GBD 2016 [16].
[4] These are diseases in GBD2016 that can cause heart failure including hypertensive heart disease, cardiomyopathy and myocarditis, rheumatic heart disease, endocarditis and chronic obstructive pulmonary disease.

Using this method of identifying prevalent cases of IHD, we estimated that there were approximately 209,000, individuals in the Scottish population suffering disability due to prevalent IHD in 2016.

Severity distribution and disability weights

The levels of severity and disability due to IHD in Scotland were based on the specifications of the GBD study [9]. This allowed prevalent cases to be disaggregated by levels of severity and the associated disability at each level of severity. The disability weights were developed by the GBD study through surveys of the general public and take into account the consequences of each disease, condition and injury [10]. The severity distribution and disability weights for IHD are outlined in Table 1.

Once the severity of IHD and associated disability were taken into account, individuals were estimated to be suffering approximately 12,100 YLDs in 2016 due to living with IHD.

Table 1 Description and allocation to severity levels for IHD with corresponding disability weight

Severity level	Description	% of individuals	Disability weight
Heart failure			
Mild	Is short of breath and easily tires with moderate physical activity, such as walking uphill or more than a quarter-mile on level ground. The person feels comfortable at rest or during activities requiring less effort.	32	0.041
Moderate	Is short of breath and easily tires with minimal physical activity, such as walking only a short distance. The person feels comfortable at rest but avoids moderate activity.	12	0.072
Severe	Is short of breath and feels tired when at rest. The person avoids any physical activity, for fear of worsening the breathing problems.	55	0.179
Angina			
Asymptomatic	Has disease or infection but experiences no symptoms by virtue of, for instance being on treatment or because of the natural course of the condition.	44	Nil
Mild	Has chest pain that occurs with strenuous physical activity, such as running or lifting heavy objects. After a brief rest, the pain goes away.	18	0.033
Moderate	Has chest pain that occurs with moderate physical activity, such as walking uphill or more than half a kilometer (around a quarter-mile) on level ground. After a brief rest, the pain goes away.	10	0.080
Severe	Has chest pain that occurs with minimal physical activity, such as walking only a short distance. After a brief rest, the pain goes away. The person avoids most physical activities because of the pain.	28	0.167
Myocardial infarction			
Acute MI first 2 days	Has severe chest pain that becomes worse with any physical activity. The person feels nauseous, short of breath, and very anxious.	7	0.432
Acute MI 3 to 28 days	Gets short of breath after heavy physical activity, and tires easily, but has no problems when at rest. The person has to take medication every day and has some anxiety.	93	0.074

Data quality

In order to provide a measure of the degree of accuracy[5] and relevance[6] of the estimated disease DALYs to users, a measure of data quality has been developed for the SBoD study. This measure assigns a RAG (Red; Amber; Green) status to each disease or injury indicative of the accuracy and relevance of the estimates. Interpretation of the RAG status can be defined as follows:

®Ⓐ**G** **Highly accurate and relevant**

Estimates have been derived using relevant and robust data sources with only a small degree of adjustments performed to the input data.

®Ⓐⓖ **Moderately accurate and relevant**

Estimates have been derived using reasonably relevant and robust data sources with only a moderate degree of adjustments performed to the input data.

RⒶⓖ Uncertainties over accuracy and relevance

Estimates have been derived using less comprehensive or relevant data sources with a high degree of adjustments performed to the input data.

The data quality has been assessed using three main criteria:

- Relevance and accuracy of the data source used to measuring the population of interest
- Likelihood that the implemented disease model captured the overall burden of disease or injury
- The relative contribution of ill-defined deaths to YLL, and YLL to DALY.

These criteria are subjectively assessed and each criterion is scored on a scale of 1 to 5. Further details on these data quality measures are available on the ScotPHO website [1].

Based on these criteria, the estimates of burden of IHD in Scotland are ®Ⓐ**G** **highly accurate and relevant**.

Our study estimated an IHD prevalence of 3.9% in Scotland in 2016. In comparison, the Global Burden of Disease study (GBD) 2016 estimated a higher IHD prevalence of 4.4% [11]. A broadly comparable estimate was derived from the 2015/16 Quality and Outcomes Framework (QOF) in Scotland, which estimated a prevalence of 4.1% [12], whilst results from the Scottish Health Survey 2016 (SHES) indicated a prevalence of 5.4% [13]. In addition to this, routinely published data from a sample of Scottish GP practices estimated that 3.3% of patients consulted for IHD in the calendar

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[5] How precise, unbiased or certain the estimate is.
[6] Do we measure the thing we want to measure?

year 2012/13 [14]. Our estimate of 3.9% is at the slightly lower end of other comparable Scottish-based findings.

Our decision to choose hospital episode records and community prescriptions as preferred data sources was driven by the ability to follow-up and classify individuals due to complication and censor upon death. In addition to this, it provides vital demographic, geographic and socioeconomic information necessary for understanding the distribution of the burden of IHD. The drawback to this approach is that our estimate of the non-fatal burden of IHD may be a slight underestimate, due to the criteria we have used for case ascertainment. The use of nitrates as a proxy is likely to be too insufficiently sensitive, as there are other long-term treatments such as aspirin, beta blockers, statins, amongst others, all of which were not included in our search due to their other non-IHD treatment indications [15]. In addition to this, hospital episode data is likely to represent a subset of all individuals with IHD, as not all individuals will require treatment in a secondary care setting. However, as IHD can be a fatal disease with poor outcomes and complications, it is likely that our case ascertainment would improve with rising severity of IHD. This means the effect of undercounting prevalent cases is likely to have a less profound effect on YLD, as poor outcomes and therefore higher levels of health loss are likely to result in hospitalisation.

What next to improve estimates for ischaemic heart disease?

Future work on the SBoD study will attempt to refine the estimates of prevalence and acute events. This work will include reviewing the coding and recording of IHD in alternative national datasets and exploring surveys and local area datasets for information. The development of the Scottish Primary Care Information Resource (SPIRE) will help us to improve our estimates of the burden of disease in Scotland [15]. Further to this, work will be carried out to attempt to derive estimates of severity levels that are dependent on age and that are specific to the Scottish population.

These improvements are partly dependant on exploring other data sources and reviewing evidence from high quality research that it is relevant to Scotland. Please contact the SBoD project team (nhs.healthscotland-sbod-team@nhs.net) for enquiries and suggestions on how to improve our estimates.

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