Public Health Scotland

Scottish Burden of Disease

Future prevalence and burden of diabetes

A Management information release for Scotland

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Context

Scotland is expected to see a rapidly ageing population, within the context of a slight overall decrease in population, over the next two decades.[1] Public Health Scotland's Scottish Burden of Disease (SBoD) study has recently been adapted to forecast how these demographic and population health trends are expected to combine, to anticipate the extent of future public health challenges. Initial work focused on the impact of the changing demographic situation only and found that, despite a projected 1.2% decrease in the Scottish population, the combined annual disease burden from all causes of disease and injury is forecast to increase 21% in the next 20 years.[2] Absolute increases in annual disease burdens are forecast to be largest for cardiovascular diseases, cancers, and neurological diseases – together accounting for approximately two-thirds of the total increase in forecasted disease burden.

These findings are set alongside the context of a projected reduction in working-age population over that same time period with an old-age dependency ratio projected to increase from 57% in 2022 to 64% in 2042.[1] These changes will have important implications for public health and the health and social care system. To address these challenges, alongside financial constraints and sustainability, decision makers need to consider both more effective approaches to prevention and different models of care. In doing so, alongside demographic change, consideration of epidemiological changes is needed as these have the potential to either ease or add to the pressure within an already stretched system.

Background

Disease prevalence is a measure of the overall occurrence of a disease at a point in time. It is a helpful metric as it outlines the scale of population-level health demands that are likely to arise from living with a disease. This in turn can inform discussions over how best to meet these health needs through health and social care service provision, and over how these needs could be reduced through public health interventions.

Disease prevalence is directly impacted by three epidemiological concepts:

- The rate of new cases (incidence)
- The rate of remission (cure)
- The survival rate of prevalent cases (death).

The consequences from diabetes can vary from person to person and can include an increased risk of early death. The prevalence of diabetes is largely influenced through two main pathways: the incidence of the disease, and the survival rate of prevalent cases. In addition, better detection of type 2 diabetes may also increase recent prevalence rates.[3] If improvements in mortality are not met by equivalent improvements in disease prevention, the number of prevalent cases will grow.

In this report, we project the prevalence of diabetes (Type 1 and type 2 combined) over the next two decades by incorporating information on historic trends of the prevalence of diabetes, alongside projected changes in the Scottish population. The SBoD 2019 study found diabetes was the 15th leading cause of disease burden in Scotland, with an estimated 45,500 disability-adjusted life years (DALYs). Diabetes exhibits sizeable absolute and relative inequalities, with 40% of DALYs estimated to be attributable to inequalities in multiple deprivation.[4]

Methodology

Data

Estimates of the number of people living with diabetes in Scotland were calculated for each year from 2005 to 2019. Prevalence figures for 2005 to 2016 by age and sex were provided by the Electronic Data Research and Innovation Service (eDRIS) team at Public Health Scotland and sourced from the Scottish Care Information – Diabetes Collaboration (SCI-DC).[5] Type 1 and Type 2 cases were included if a valid age and sex were recorded. Prevalent cases from 2017 to 2019 were sourced from the Scottish Diabetes Surveys 2017 to 2019.[6] Data were available at age group level and cases for 2017 to 2019 were distributed by sex according to previous age-specific sex distributions seen in the SCI-DC data held by eDRIS 2005-2016.

Analyses

Future estimates of prevalence were projected using age-period-cohort (APC) regression models. APC models allow the independent effects of age, period and birth cohorts to be included in the model, as well as a linear trend. There are several advantages to this approach, the main one being that period and cohort effects serve as proxies for events such as risk factors, public health and medical interventions, which are often difficult to measure directly.

APC models - were fitted to sex-specific data and the best fitting model, based on goodness-of-fit criteria, were selected. In addition, where the linear period trend was included in the model, either the full trend (from 2005-2019) was used or the more recent trend only (from 2010-2019). The period trend was selected based on whether a significant change was estimated between the two time periods. Following selection of the best-fit model, these resulting age and sex specific prevalence estimates were combined with the Office for National Statistics (ONS) 2020-based interim national population projections, recommended for use by the NRS, to generate future estimates of prevalence. [7]

For both male and female models, a full age-period-cohort model was identified as the best fitting model. In addition, the linear trend for the two most recent time periods (2010-2019) was applied. As it's unlikely current trends will continue at the same rate throughout the projection period, the linear trend parameter was cut by 0%, 25% and 50% in the first, second and third 5-year period, respectively, to decrease the effect of current trends.

As a comparator, future estimates of prevalence incorporating demographic changes only were calculated. Here, the sex-specific diabetes prevalence for 2019 was calculated by five-year age group. These age and sex-specific estimates were then applied to population projections to generate future estimates. These estimates assume that prevalence remains constant over the forecast period. That is, all future changes would be due to the changing demographics in Scotland ignoring the time trends identified in APC models. Estimates included in this report are those which include the impacts of projected demographic changes and historic epidemiological trends, unless stated.

Estimates of prevalence for diabetes reported here may differ to other published estimates of prevalence in Scotland, as these estimates follow the disease models and definitions outlined by the SBoD study (for example the requirement to have valid data on age and sex).

Main points

- The number of people with diabetes in Scotland is estimated to increase by 36% from 2019 to 2044, from 307,800 prevalent cases to 419,200 prevalent cases. This equates to an additional 111,400 people living with diabetes in 2044, compared to 2019.

- Absolute and relative changes differ between the age groups and sexes. The largest absolute change in prevalence is projected to be in males and females aged 65 to 84 years. The largest relative increases are projected to be in males and females aged 85 years and over.

- Due to projected increases in the number of prevalent cases, unless mitigated by reductions in disease severity, the non-fatal burden of diabetes will increase between 2019 and 2044.

- Any increase in prevalence is likely to impact the sustainability of services in the future.

- These projected increases in prevalence and burden of diabetes are not inevitable - effective prevention at all levels can contribute to reducing the number of people developing Type 2 diabetes and assist those who do develop it to live with lower levels of severity.

Results and commentary

Results

From 2005 to 2019, the number of people with a diagnosis of diabetes increased from 204,500 to 307,800; an increase of 50% (Figure 1). Through incorporating the impact of projected population changes (age-effects) from 2019 onwards and assuming the underlying prevalence rate remains the same as it was in 2019, we estimate the number of people with diabetes could rise from 307,800 to 354,600 from 2019 to 2044; an increase of 15% (Figure 1 and Table 1). Refining these estimates further by incorporating historical pre-pandemic age, period- and cohort-effects identified in underlying historic data, we estimate that the number of people with diabetes would increase from 307,800 in 2019 to 419,200 in 2044; an increase of 36% (Figure 1 and Table 1).

Figure 1: Trend in the number of people with diabetes (2000 to 2019) with projections to 2044 (mean value per five-year period)

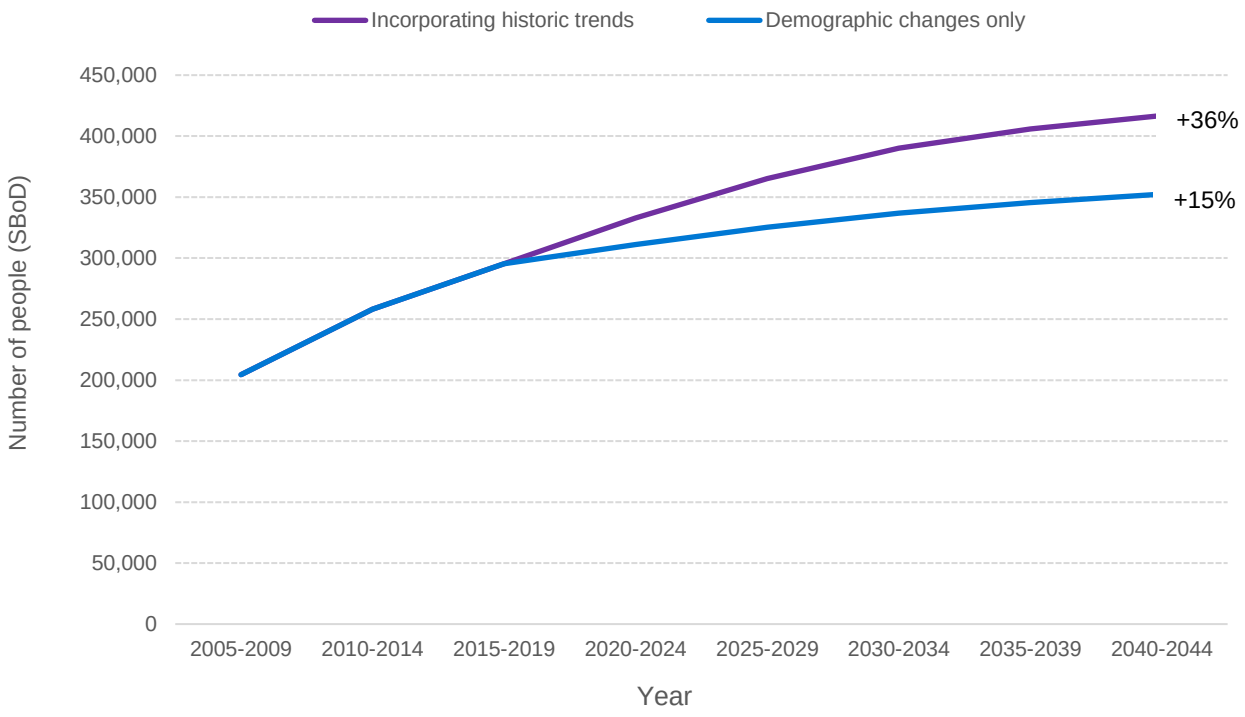


Table 1: Estimated number of people with diabetes in Scotland using two different methods (selected years) with projections to 2044[1]

Sex	2019	2024	2029	2034	2039	2044	Change (n) (2019 to 2044)	Change (%) (2019 to 2044)
Demographic changes only	307,773	316,967	330,383	340,550	348,674	354,564	+46,791	+15.2%
Incorporating historic trends and demographic changes	307,773	339,018	370,942	394,399	409,322	419,177	+111,404	+36.2%

1. Please note the figure reported here for the estimated number of people with diabetes in 2019 will differ from the overall figure reported by the Scottish Diabetes Survey 2019 due to the exclusion of cases without age or sex reported and includes Type 1 and Type 2.

In the full model, incorporating historic trends and demographic changes, similar relative increases are expected to be seen for both males and females. For males an increase of 36% is projected, representing an absolute increase of 61,100 prevalent cases (Table 2). For females, there is projected to be a 37% increase in prevalence, representing an absolute increase of 50,300 prevalent cases.

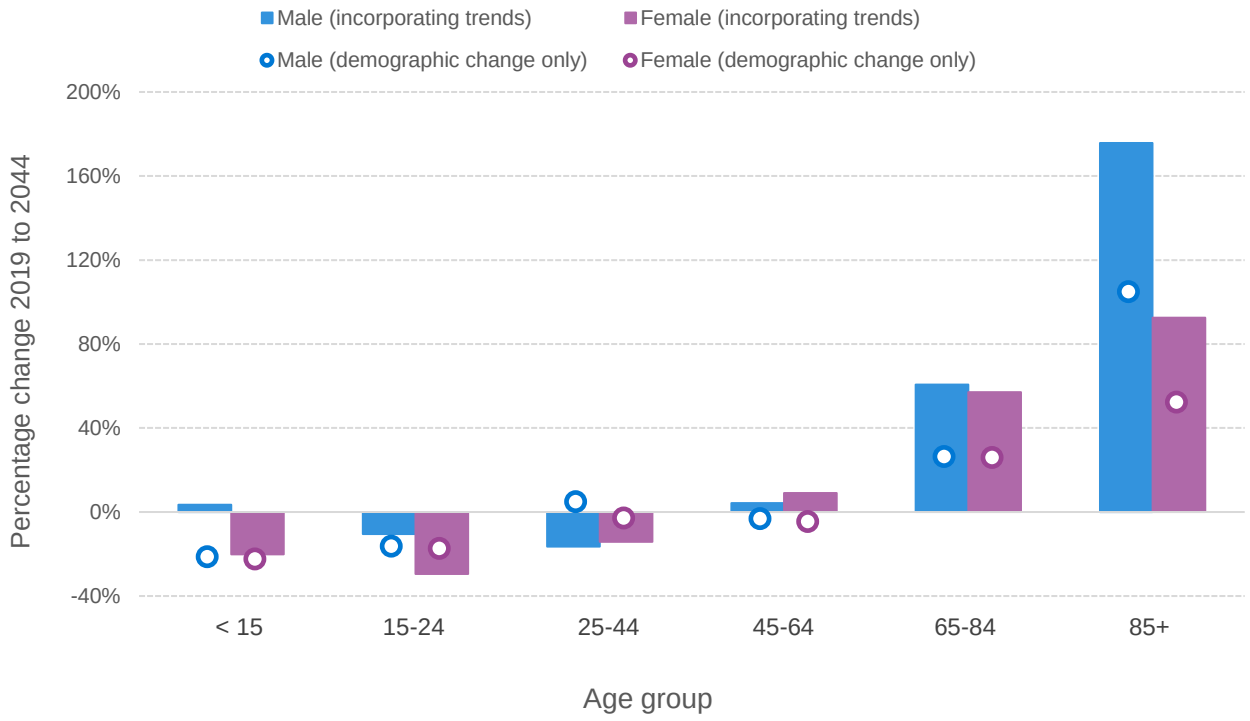
Table 2: Estimated number of people with diabetes incorporating historic trends with projections to 2044, by sex (selected years)

Sex	2019	2024	2029	2034	2039	2044	Change (n) (2019 to 2044)	Change (%) (2019 to 2044)
Male	171,104	189,922	208,083	221,022	228,185	232,190	+61,086	+35.7%
Female	136,669	149,096	162,859	173,377	181,137	186,987	+50,318	+36.8%
Persons	**307,773**	**339,018**	**370,942**	**394,399**	**409,322**	**419,177**	**+111,404**	**+36.2%**

Estimated future prevalence is noticeably driven by age (Figure 2). Prevalence is projected to increase in all age groups over 45 years of age. There is a clear trend to these increases, where the estimated relative increase is larger in older age groups. The largest absolute increases are projected in the 65 to 84 years age group. For males aged 65 to 84 years an absolute increase of 47,300 prevalent cases is projected from 2019 to 2044, representing a relative increase of 61%. For females aged 65 to 84 years an absolute increase of 37,700 prevalent cases is projected from 2019 to 2044, representing a relative increase of 57%.

Projections resulting from the demographic change only model generally follow the same pattern, however with smaller relative and absolute increases in all age groups.

Figure 2: Percentage change (2019-2044) in the estimated number of people with diabetes by sex and age group



In burden of disease studies, prevalence is used to calculate the non-fatal burden [years lived with disability (YLD)] of a condition, along with estimates of the severity and disability associated with the disease. Applying burden of disease methodology to the projected values of prevalence, we estimate that the non-fatal burden due to diabetes is also projected to increase. YLD is projected to be 29,600 YLDs in 2044, up from 21,600 in 2019, representing an absolute increase of 8,000 YLDs and a relative increase of 37%. Considering males and females stratification, the projected increases in YLD following the same trends as seen in prevalence.

Overall burden (DALYs) is a composite measure incorporating both non-fatal and fatal burden. This projected increase in non-fatal burden will not necessarily lead to a similar change in the overall burden, as the latter will also be influenced by projected changes in mortality and fatal burden for a disease. Further work by the SBoD team is focussed on future projections of mortality and fatal burden, in order to develop forecasts of the overall burden of diabetes in Scotland.

Summary

Both the prevalence and non-fatal burden of diabetes are forecast to increase over the next 20 years. Recent data from the Scottish Diabetes Survey illustrated that the combined incidence rate for Type 1 and Type 2 diabetes decreased slightly from 381 per 100,000 in 2019 to 340 per 100,000 in 2020, before increasing to 455 per 100,000 in 2021 and 459 per 100,000 in 2022.[6] Therefore, our prevalence estimates may be under-estimates as they do not include the recent increases in incidence.

Any projected increases in prevalence and burden are likely to affect the sustainability of services in the future. However, these projected increases are not inevitable. We can reduce the rate of new cases of diabetes occurring through effective primary prevention. and in people living with diabetes or those at-risk of diabetes we can through deploying effective secondary and tertiary prevention strategies reduce complications of diabetes and their impact on health-related quality of life (i.e. disability), and risk of early death.

Limitations

Projections, by definition, are unstable and become less robust the longer the forecast period. External events, changes to population projections and limitations in the original models can all impact the robustness of projections. For example, the use of pre-pandemic period time trends in diabetes prevalence do not take into account any changes in incidence and mortality from 2020 to 2023.

In these projections, as well as technical uncertainties, there may also be uncertainties in the calculation of future burden. When estimating the future non-fatal burden of diabetes using YLD, these projections assume the distribution across severity levels will remain constant over time. This may not be the case, particularly when decreased mortality rates may cause people to live longer and develop further complications of diabetes. Any changes to the distribution of prevalence across the severity levels throughout the projection period will affect YLD estimates.

Conclusion and next steps

The estimated increase in the prevalence of diabetes over the next two decades is not inevitable. Change is possible through investing in prevention. Tackling the underlying mechanisms which increase the risk of diabetes can reduce the number of new cases which occur, whilst ensuring timely, and accessible, services are available for those who develop complications of diabetes, will ensure that people live longer lives in better health.

The SBoD team are doing further work on the future projections of mortality and fatal burden, in order to develop forecasts of the overall burden of diabetes in Scotland. They are also working to build upon these projections to explore how forecasts may be influenced by various scenarios. Examples include: changes to the prevalence of underlying risk factors for diabetes and the introduction of any novel treatments or public health interventions. In addition, the SBoD team are working with the Whole Systems Modelling team at PHS to determine how these various projections and scenarios are likely to impact service provision in the health and social care systems over the next 20 years.

Glossary

Burden of disease (and injury)

The quantified impact of a disease or injury on a population using the disability-adjusted life years (DALY) measure.

DALY (disability-adjusted life year)

A standardised metric that can be used to quantify the health loss due to dying prematurely or to living with the health consequences of diseases, injuries or risk factors. DALYs are a summary metric of population health. DALYs are an absolute measure of health loss; they count how many years of healthy life are lost due to death and non-fatal illness or impairment. They reflect the number of individuals who are ill or die in each age-sex group and location.

Disability

In burden of disease studies, this is synonymous for “loss of health”, or any, short or long term, departure from full health.

Disability weight

Numerical representations of the severity of health loss associated with a health state. Disability weights are numbers between 0 and 1 that are multiplied by the time spent living with a health loss to determine the years lived with disability associated with the cause of that loss. In the GBD, disability weights are derived from a worldwide, cross-cultural study to compare the relative severity of health problem.

Early death

The burden from dying prematurely. Often used synonymously with **years of life lost**.

Fatal burden

The burden from dying prematurely as measured by years of life lost. Often used synonymously with **years of life lost**.

Health loss

The total burden from early death and ill-health. Often used synonymously with **disability adjusted life year (DALY)**

Health states

The consequences of diseases and injuries or their risk factors. Health state refers to an individual's levels of functioning within a set of health domains such as mobility, cognition, pain, emotional functioning, self-care, etc. Health states do not refer to general well-being (which is a broader construct) or to aspects of participating in society, although they clearly affect these other aspects of life and may be affected by them.

Ill-health

Often used synonymously with **years lived with disability**.

Life expectancy

The average number of years of life expected to be lived by individuals who survive to a specific age

Non-fatal burden

The burden from living with ill-health as measured by years lived with disability. Often used synonymously with **years lived with disability**.

Sequelae

Consequences of diseases and injuries for which epidemiological estimates and YLD calculations are made. It encompasses not only the traditional clinical meaning, but also a broader categorization of health outcomes such as severity levels for a particular disease, injury or impairment.

Severity distribution

Severity distributions are a means of summarising the range of health loss suffered to disease which enables estimates of disease occurrence to be paired with disability weights to estimate Years Lost to Disability in burden of disease studies.

YLD (Years of Life lived with a Disability)

In burden of disease studies this is also referred to as ‘ill-health’. YLDs are computed as the prevalence of different disease-sequelae and injury-sequelae multiplied by the disability weight for that sequela. Disability weights are selected on the basis of surveys of the general population about the loss of health associated with the health state related to a disease sequela.

YLL (Years of Life Lost due to premature mortality)

YLLs are computed by multiplying the number of deaths at each age x by a standard life expectancy at age x. In SBoD we use an aspirational world life expectancy table developed for the Global Burden of Disease study.

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Appendices

Appendix 1 – Publication metadata

Publication title

Scottish Burden of Disease: Future prevalence and burden of diabetes

Description

Release of Scottish Burden of disease prevalence estimates for diabetes for 2020-2044.

Theme

Population health and forecasts

Topic

Burden of disease

Format

PDF

Data source(s)

Please see methodology section for full data sources and time periods.

Date that data are acquired

Please see methodology section for full data sources and time periods.

Release date

04/06/2024

Frequency

Ad hoc

Timeframe of data and timeliness

The basis for the publication is SCI-DC data from 2005 to 2016 and Scottish Diabetes Survey data from 2017-2019.

Continuity of data

Please see methodology section for information on continuity of data and coding.

Revisions statement

Revisions relevant to this publication

Concepts and definitions

Please see **Glossary**

Relevance and key uses of the statistics

Population health surveillance; service planning and sustainability; quality improvement and assurance.

Accuracy

The report contains projections of the prevalence of disease in Scotland to 2044. Projections and forecasts, by definition, are unstable and become less robust the longer the forecast period. Please see **Limitations** section for full details.

Completeness

Please see methodology section for information on completeness of data.

Comparability

The prevalence described in this report is estimated following the disease models and definitions outlined by the SBoD study and therefore may not be directly comparable to other estimates of prevalence.

Accessibility

It is the policy of Public Health Scotland to make its websites and products accessible according to published guidelines. More information on accessibility can be found on the **PHS website**.

Coherence and clarity

Measures to enhance coherence and clarity within this report include: explanatory

chart/table notes, minimal use of abbreviations/abbreviations explained in the text, comprehensive notes on background and methodology.

Value type and unit of measurement

Figures are shown as absolute number, percentages and relative change. Units of measurement are disability-adjusted life years (DALYs); years lived with disability (YLDs) and years of life lost (YLL) and prevalence of disease. Please see **Glossary** for further details.

Disclosure

The PHS protocol on Statistical Disclosure Protocol is followed

Official statistics accreditation

Management information

UK Statistics Authority assessment

Not put forward for assessment

Last published

First publication

Next published

To be confirmed.

Date of first publication

Not applicable

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Appendix 2 – Early access details

Pre-release access

Under terms of the 'Pre-release Access to Official Statistics (Scotland) Order 2008', PHS is obliged to publish information on those receiving pre-release access ('pre-release access' refers to statistics in their final form prior to publication). The standard maximum pre-release access is five working days. Shown below are details of those receiving standard pre-release access.

Standard pre-release access:

Scottish Government Department of Health and Social Care (DHSC)

NHS board chief executives

NHS board communication leads

Early access for management information

These statistics will also have been made available to those who needed access to ‘management information’, i.e. as part of the delivery of health and care:

Early access for quality assurance

These statistics will also have been made available to those who needed access to help quality assure the publication:

Appendix 3 – PHS and official statistics

About Public Health Scotland (PHS)

PHS is a knowledge-based and intelligence driven organisation with a critical reliance on data and information to enable it to be an independent voice for the public's health, leading collaboratively and effectively across the Scottish public health system, accountable at local and national levels, and providing leadership and focus for achieving better health and wellbeing outcomes for the population. Our statistics comply with the **Code of Practice for Statistics** in terms of trustworthiness, high quality and public value. This also means that we keep data secure at all stages, through collection, processing, analysis and output production, and adhere to the Office for National Statistics '**Five Safes**' of data privacy.

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