Kent JSNA cohort model

Technical appendix

April 2018

Contents

1 Introduction

1.1 About this document

This technical document supports the Kent JSNA cohort modelling tool, developed by Whole Systems Partnership in collaboration with Kent County Council in 2017/18. The JSNA cohort modelling tool is a system dynamics model with the aim of projecting the long-term incidence, prevalence and mortality of health and wellbeing cohorts (section 1.2).

1.2 Model scope – population lifespan

The model is split into two sections, children and young people (under 18 years and under 25 years for selected conditions) and adults (18 years and over). The children and young peoples (CYP) model and adult model run independently and have a different design but the CYP model provide projected populations at age 18 years (and 25 years for selected conditions) which form inputs to the adult model.

1.3 Model scope – timescale

The starting point for the model uses the incidence, prevalence and mortality for each cohort in 2012 and projects forward to 2037. This is calculated using local data analysis from the Kent Integrated Dataset and nationally published longitudinal studies.

1.4 Model scope – health and wellbeing

The approach uses epidemiological information to estimate the contributions of changes in population-level risk factors relating to health and wellbeing (where impacts are mainly on incidence) and changes in the uptake of evidence-based interventions (where impacts are mainly on case fatality) over time.

It is the intention to develop the model scope to incorporate additional risk factors relating to socioeconomic circumstances. The tables included in this supplementary appendix provide details about the sources and methods that are used to accommodate socio-economic circumstances. We used the socio-economic status as a proxy indicator of socioeconomic circumstances. This model examines the effects of changes in treatment uptake and risk factor trends on changes in cohort incidence and mortality from the Kent population.

1.5 Primary outcome measures

The primary outcome measures of the model are:

- cohort incidence, prevalence and deaths projected over the model timescale;
- the impacts of cohort incidence and prevalence on potential demand for health and wellbeing services.

1.6 Comparison with other modelling approaches

A policy model like the JSNA cohort model stands in contrast to a typical multivariate regression model. A typical multivariate regression model represents a statistical approach to describing a single data-set, for instance generated by a single cohort or randomised controlled trial. In contrast, a policy model such as this seeks to integrate and synthesise best estimates from a variety of sources to reliably estimate the extent to which a range of factors, acting in combination, explain or predict certain health outcomes.

Baseline values for the parameters in this model are not obtained by running regressions. Rather, the model incorporates the best coefficients derived directly from meta-analysis or randomised controlled trials of the reduction in incidence and mortality

attributed to interventions, and/ or the effect of a unit change in a risk factor on cohort incidence and mortality.

1.7 Modelling the impact of change

The calculation of the modelled impacts of change on incidence and mortality rests on utilising two well-studied relationships:

- firstly, that between risk factor change and the relative reduction in incidence and mortality;
- secondly, that between treatment uptake and reductions in mortality.

The impact of a change in a risk factor is a corresponding change in the rate of transition between cohorts.

The model applies a relative risk reduction (quantified in previous randomised controlled trials and meta-analyses) to estimate the incidence and mortality reduction attributable to:

- temporal change in the prevalence of risk factors within each cohort, enabling the model to calculate and project the changes in incidence and mortality that are 'explained' by specific risk factor trends;
- net change over the period in the uptake of specific health and care interventions, enabling the model to calculate and project the incidence and mortality 'explained' by changes in 1-year incidence and case fatality rates.

The incidence and mortality benefits from the risk factor reduction in the population, and the treatment and intervention benefits in patient groups are then summed. This summing uses a cumulative approach (rather than an additive approach), in order to avoid double counting of benefits in the same individual. (This approach is detailed in Section 1.5). This sum represents the changes in incidence and mortality 'explained' by policy changes made within the model.

Examples of the calculation method used for estimating the impact for continuous and binary risk factor change (Examples 1 and 2, respectively) treatment uptake (Example 3) are provided below.

2 Cohort segmentation

2.1 Cohort segmentation for children and young people

To calculate changing population dynamics for children and young people the population aged under 25 years is initially segmented into 11 cohorts and 6 age groups using the Kent Integrated Dataset (KiD). The hierarchy for segmentation is illustrated in Figure 1.

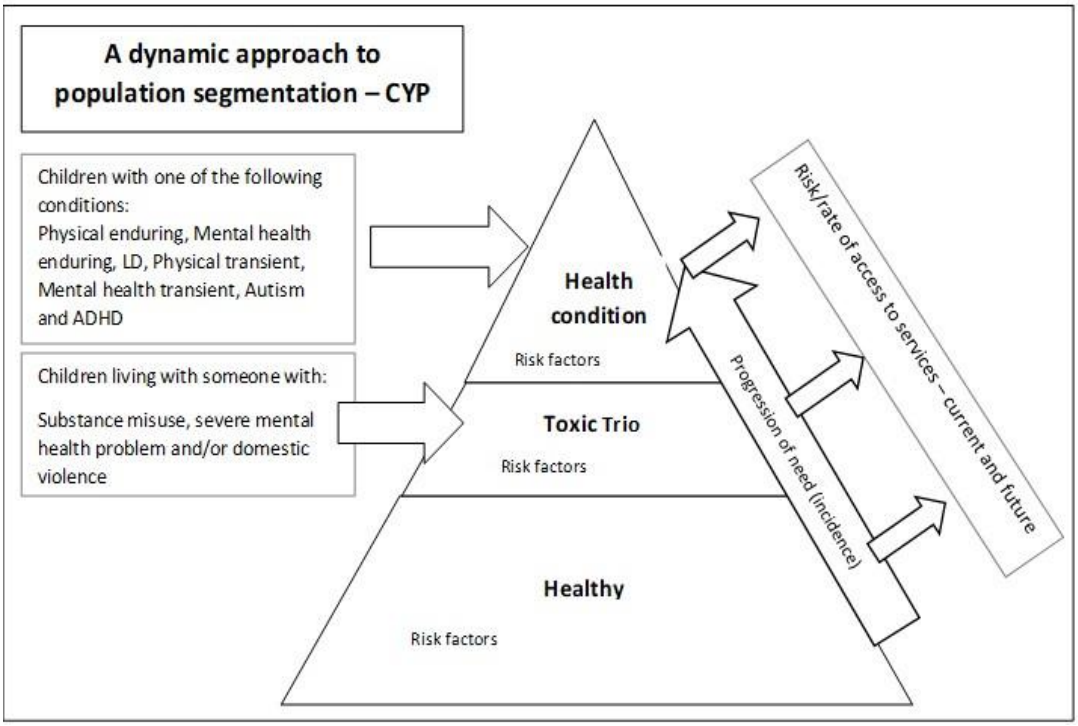

Figure 1 Logic tree for segmentation and its relationship to cohort modelling, progression of need and service utilisation for children and young people

The following cohorts are identified in the C&YP model, in the order below:

1. Health conditions, where a child or young person has one of the following conditions:
    a. Physical enduring;
    b. Mental Health enduring;
    c. Learning Disability;
    d. Physical transient;
    e. Mental Health transient;
    f. Autism and;
    g. ADHD.
2. Toxic trio, where a child or young person (who does not have a health condition identified in step 1) lives in a household where they experience one or more of the following: **Replace with ACE across all cohorts??**
    a. An adult with severe mental health problem;
    b. An adult who has a substance misuse and or;
    c. Domestic abuse.
3. No identified risk – none of the conditions in 1-2 above apply.

This list is comprehensive and includes 100% of all people within the KiD. The full list of conditions included in each cohort is listed in Appendix 1.

2.2 Cohort segmentation for adults

To calculate changing population dynamics the adult population of Kent is segmented into 13 cohorts using the Kent Integrated Dataset (KiD) and replicated using the English Longitudinal Study of Ageing (ELSA) for validation and to gain insight about the progression of need and mortality. The hierarchy of segmentation is illustrated in Figure 2.

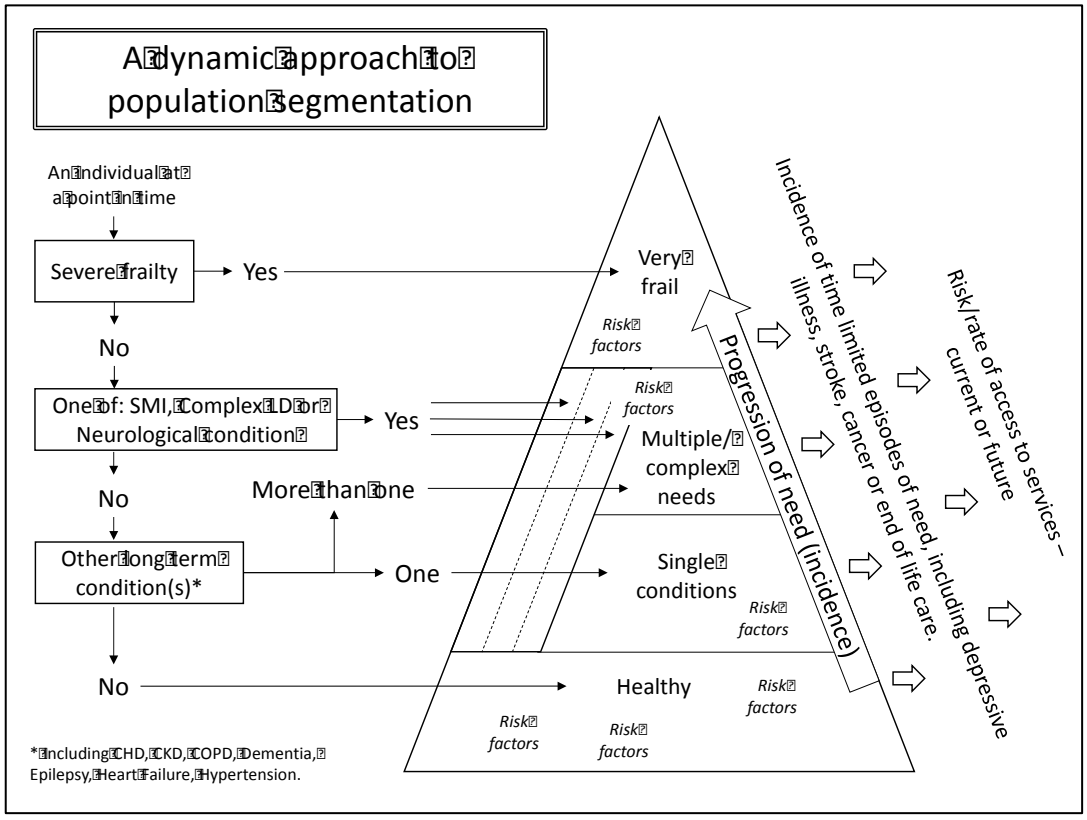

Figure 2 Logic tree for segmentation and its relationship to cohort modelling, progression of need and service utilisation for adults

The following cohorts are included in the adult model, in order:

1. Severely Frail, defined as a score of 6 or more disabilities equivalent moderate and severe frailty within the electronic frailty index (eFI).
2. Single conditions with high levels of need, but not severely frail[1], and including people who have one of 2a /b /or c plus other conditions listed in 3:
    a. Serious Mental Illness (informed by Mental Health Cluster data);
    b. Severe Learning Disability;
    c. Dementia;
    d. Neurological Conditions.
3. Multiple conditions – more than one of the list below, but excluding anyone who is either severely frail or who has one of the high need single conditions:

[1] A very small number of people will have two or more of the identified 'high needs' single conditions. In this case the first condition in the list will be dominant. This will be kept under review.

a. Asthma;
b. Coronary Heart Disease;
c. Chronic Obstructive Pulmonary Disease;
d. Type 2 diabetes;
e. Heart Failure;
f. Stroke;
g. Moderate frailty.

4. Single conditions – any one of those listed under 3, but excluding people already identified as severely frail or with a high need single condition.
5. Healthy – none of 1-4 above.

This list is comprehensive and includes 100% of all people within the KiD.

Is there more detail on conditions included eg on how LD is defined?

3 The Kent JSNA model

The model structure of a SD model uses stocks, flows and converters.

3.1 Children and young people

The structure and mechanics of the children and young people model is illustrated in Figure 3. The model represents the movement of the Kent population from birth through 5/6 age grouping whilst also moving between different health and toxic trio cohorts.

- Stocks represent the number of people in an age and cohort group at a point in time (prevalence). In the CYP section of the model 16 stocks are identified that represent the CYP population of Kent by age and cohort group.
- Flows represent the number of people entering and progressing between stock (or age group or cohort).
    - the thick arrows represent the natural flow of the population from birth, on to different age groups and exiting the model at 18 and 25 years. For physical and mental enduring and LD cohorts they leave the CYP model at 25 years and progress to the same cohort group in the adult model. For all other cohorts they leave the CYP model at 18 years and progress to the adult model as healthy.
    - the thin arrows represent the progression or recovery of people who are flowing from different cohorts or health states over time (incidence).

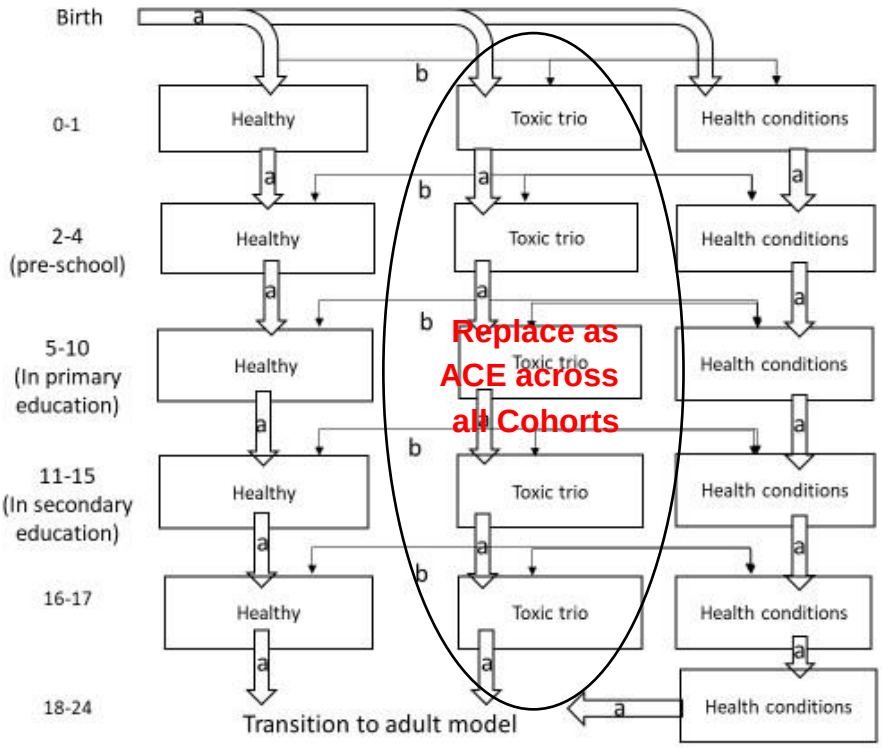

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Figure 3 Conceptualisation for children and young population cohorts

3.2 Adults

The structure and mechanics of the JSNA model for adults are illustrated in Figure 4.

- Stocks represent the numbers of people in a cohort at a point in time (prevalence). In this model we have 13 stocks that represent the cohorts of the adult population (Appendix 2).
- Flows represent the number of people entering or progressing to each stock (incidence) or exiting a stock (progression or mortality) per unit of time. In Figure 4:
    a) represents people flowing from one cohort to another cohort, e.g. from healthy to a single condition;
    b) represents people flowing into or out of the geography covered by the model via net migration per cohort and;
    c) represents people flowing out of a stock via death.
- Converters, not shown in Figure 4, are used to inform the rate at which people flow in and out of a stock. Converters are illustrated in Appendix 2, which also illustrates the SD model structure in more detail.

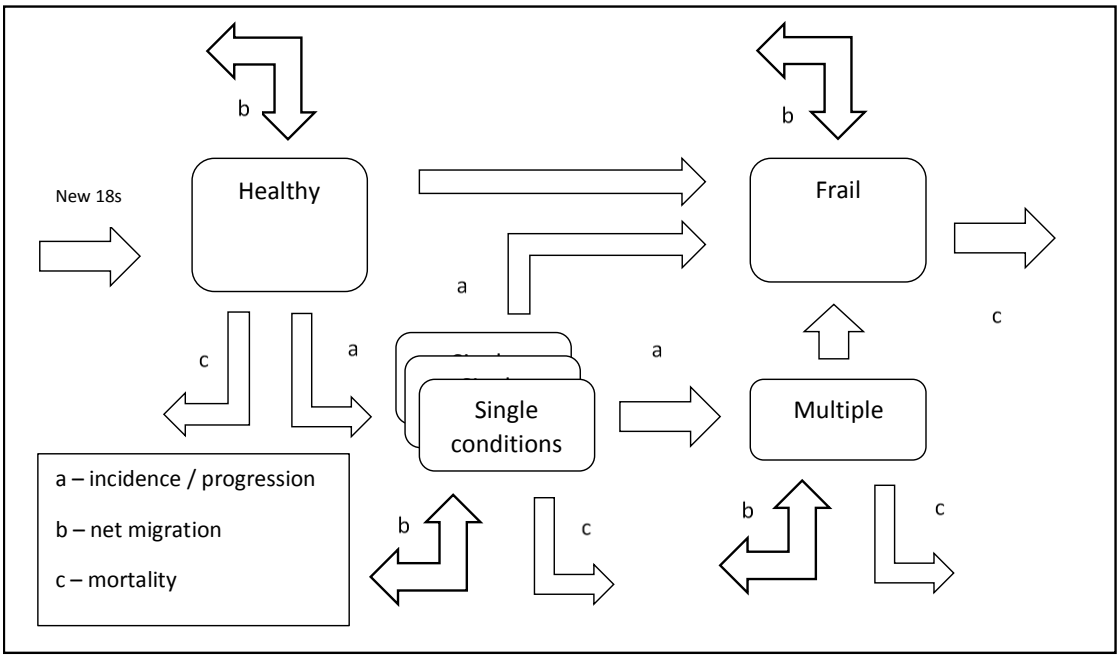

Figure 4 Conceptualisation for adult population cohorts

4 Population health and wellbeing data used in the model

4.1 Population and migration

KCC Household population projections are identified that project future populations and net migration use. They are expected to be more sensitive to future net migration in Kent than ONS projections. These projections are available for Kent County Council and Kent and Medway local authority districts. Additional population projections are available from ONS sub-national population projections and would be used for CCG models.

Population data that inform the model includes (Appendices X/y/z etc):

- Projected number of births per year;
- projected number of new 18-year olds per year;
- projected population by age groups (0-1, 2-4, 5-10, 11-15, 16-17, 18-24 (for high intensity conditions), 18-49, 50-59, 60-64, 65-74, 75-84 and 85+);
- net migration by age groups (18-49, 50-59, 60-64, 65-74, 75-84 and 85+);

4.2 Prevalence

The age specific prevalence for each cohort is calculated from KiD and applied to the Kent population to provide a baseline prevalence for each cohort in year 2012 (Appendix 7). Data from ELSA has also been used to validate and use within the model where appropriate.

Baseline prevalence estimates are calculated within the JSNA model using KCC household population projections and KiD and ELSA age specific prevalence estimates. This approach allows the model to be updated when new population and epidemiological data becomes available.

4.3 Incidence

At present, it is not possible to calculate cohort incidence rates directly from the KiD because of the lack of complete mortality records. This means that it is unclear whether changes in cohort prevalence are due to incidence or people leaving Kent (KiD) through

mortality. To estimate incidence of new cases as well as progression between cohorts we currently use ELSA (Appendix 8).

4.4 Mortality

As mentioned, it is not currently possible to use the KiD to calculate cohort mortality rates. Therefore, annual mortality rate for each cohort by cause have been calculated from ELSA data (Appendix 8). This provides a breakdown of the rate of death for each cohort and by the main causes of death (Cancers, Cardiovascular, Respiratory and other causes) for each cohort. This allows a validation against ONS annual deaths for the same period as the ELSA and then we use ONS annual deaths in 2012 as the baseline mortality across the cohort. This provides a mortality rate for each cohort and the proportion by cause of death.

4.5 Risk attributable fraction (rate of contact with health and care services)

The rate of health and care service contacts for each cohort group are calculated from the KiD and applied to the cohort prevalence within the model (Appendix 11). This currently provides a static relationship between cohort needs and demands over time.

4.6 Ratio of cohort age impact

In the adult model each cohort is aged in relation to the health cohort. To achieve this the age specific prevalence for each cohort is calculated from 2012 to 2037 using KCC household population projections. The projected prevalence is used to create a ratio within the model layer so that population ageing is considered within the model. This changes the incidence or flow from one cohort to the next dependent upon the projected change in population age groups.

4.7 Allocating areas to socioeconomic status

The population distribution of an area by social grade is used to adjust condition incidence, prevalence and mortality for individual areas, such as CCG and local authorities. To do this the cohorts specific prevalence is calculated by social grade from ELSA and the area level social grade for a CCG / local authority is calculated from the Census 2011 (Table 1). The two are combined to calculate cohort prevalence by social grade DE which is used to compare the local prevalence with the national prevalence to provide a ratio for each area that is imported into the model. the ratio either increases or decreases the local prevalence, incidence and mortality relative to individual areas population by social grade. Generally, areas with higher social grade DE have higher a higher ratio and thus higher baseline prevalence. This method compares the percent of the population from the social grade DE in ELSA (assumed to representative of the England average) with that from the local area of interest (Appendix 7).

Social Grade	Description
AB	Higher & intermediate managerial, administrative, professional occupations
C1	Supervisory, clerical & junior managerial, administrative, professional occupations
C2	Skilled manual occupations
DE	Semi-skilled & unskilled manual occupations, Unemployed and lowest grade occupations

Table 1 Social grade definition

5 Risk factors

This section describes how change(s) in underlying population risk factors impact upon health outcomes. At present, this only applies to the adult part of the model although risk factors are included for CYP as potential interventions (see section 6 for CYP risk factor reductions).

5.1 Risk factors for adults

For adults the Cohort model estimates changes in incidence and deaths related to changes in risk factor levels in the population. The risk factors considered are:

- cigarette smoking,
- total cholesterol,
- systolic blood pressure,
- body mass index and
- physical inactivity.

The Health Survey for England is used to calculate trends in the prevalence (or mean values) of each risk factor (Appendix 4). Two approaches to calculating relative risk reductions from changes in risk factors were used: the regression approach and change in the Population Attributable Fraction (PAF). These are illustrated below (Table 2):

Cohort	Smoking	Physical inactivity	SBP	Cholesterol	BMI
Healthy					
Asthma					
CHD	✓	✓	✓	✓	✓
COPD	✓				
Diabetes_2		✓			✓
HF					
Stroke	✓	✓	✓	✓	✓
Moderately Frail					
Multiple LTC	✓	✓	✓	✓	✓
Severe_MH					
Neuro					
Dementia	✓	✓	✓	✓	✓
LD					
Severe Frail	✓	✓	✓	✓	✓

Table 2 Underlying risk factors impacts upon cohorts

5.1.1 Single risk factor reductions

In the regression approach – used for systolic blood pressure (SBP), total cholesterol and body mass index – the incidence of cohorts in 2012 (the start year) were multiplied by the absolute change in risk factor level, and by a regression coefficient ('beta')

quantifying the estimated relative change in cohort incidence and mortality that would result from a one-unit change in risk factor level (Appendix 12). Natural logarithms were used, as is conventional, in order to best describe the log-linear relationship between absolute changes in risk factor levels and relative change in incidence and mortality.

EXAMPLE 1: Estimation of risk factor changes using regression method

Incidence reduction due to reduction in SBP

For example, in 2012, the incidence rate for CHD is 1.6 per 1000 population

Mean SBP has been reducing by 0.3 mmHg per year. The largest meta-analysis reports an estimated age sex specific reduction in CHD of 50% for every 20 mmHg reduction in SBP, generating a logarithmic coefficient of -0.035 (i.e. natural logarithm of 0.5 divided by 20). The subsequent reduction in incidence is then estimated as the product of three variables:

CHD incidence = expected CHD incidence (had 2012 incidence rates remained constant) × absolute risk factor reduction between 2012 and 2037 × exponential of regression coefficient

CHD incidence = (1-(exponential (regression coefficient × absolute change))) × expected incidence in 2037

Incidence prevented = (1-(exponential (-0.035 × 9.5))) ≈ 28% x CHD incidence 2012

Health Survey for England was used to estimate risk factor trends (Appendix 14), and sources for the regression (beta) coefficients used in these analyses are listed in Appendix 12. A 'fixed gradient' approach was used to stabilise estimates of risk factor change across the quintiles; this method is discussed in Appendix ?.

Estimating risk factor change – PAF approach for binary risk factors

The PAF approach was used for cigarette smoking, diabetes, and physical inactivity. PAF, which can be interpreted as the proportion by which the would be reduced if the exposure were eliminated, as calculated as:

$$PAF = [P \times (RR - 1)] / [1 + P \times (RR - 1)]$$

Where P is the prevalence of the risk factor and RR is the relative risk for incidence associated with risk factor presence. A relative risk of 2.69 associated with smoking, for example, expresses the ratio of risk of CHD in smokers to that in non-smokers. Incidence and mortality were then estimated as the expected CHD incidence in 2037 (had 2012 incidence rates remained constant) multiplied by the difference in PAF for 2012 and 2037.

EXAMPLE 2: Estimation of incidence and mortality changes from risk factor changes using the PAF method

CHD Incidence and mortality decrease due to decrease in smoking prevalence

For example, the prevalence of smoking among the Kent population was 20% in 2012 and is estimated to reduce by 0.4% per year. Assuming a relative risk of 2.69, the PAF at the Kent level for in 2012 was 0.252 and 0.15 in 2037.

Using estimates of smoking prevalence reduction of 0.4% from 2012 to 2037 prevalence and the same relative risk value of 2.5, a 'risk factor' gradient was calculated using the ratio of the PAF at the Kent level. The incidence attributable to the decrease in smoking prevalence was therefore:

CHD incidence = expected CHD incidence / death rates in 2037 (had 2012 incidence / mortality rates remained constant) × (PAF2012 – PAF2037)

Incidence CHD prevented = (0.252 – 0.15) ≈ 10.2% x CHD incidence at 2012

Relative risks estimated by expert working groups for the World Health Organization's Global Burden of Disease 2001 Study were used for smoking and physical activity. The published relative risk values for smoking and physical activity are shown in Appendix 13.

6 Prevention and treatment interventions

6.1 Prevention and treatment options – adults

The adult section of the JSNA model includes 7 potential prevention/ treatment interventions which can be activated to test the projected future impact:

- High cholesterol subjects without CHD eligible for cholesterol lowering therapy such as statins
- Hypertensive individuals without CHD eligible for anti-hypertensive therapy
- Atrial Fibrillation individuals without stroke eligible for treatment
- Smoking cessation services
- Weight management services
- Fuel Poverty for Older People
- Adverse Childhood Experiences (Impact upon adults)

For each cohort, we estimated the proportion of incidence and deaths that were attributable to various treatments or interventions. A list of the treatments considered in the model and the data sources used to estimate the percentage of patients receiving treatments is shown in Appendix 4.

The general approach to calculating the risk reduction from an intervention among a particular cohort, is to multiply the increase in the proportion of patients receiving one of these treatments, by the incidence and mortality rate, and by the relative reduction due to the administered treatment. Sources for treatment uptake are shown in Appendix 4. Sources for estimates of treatment efficacy (relative risk reductions) are shown in Appendix 13.

We obtained the relative risks based on the most recent published systematic reviews and meta-analyses of epidemiological studies.

EXAMPLE 3: Estimation of incidence and mortality changes from a specific treatment

Incidence fall in STROKE patients as a result of taking BP lowering drugs

For example, in England in 2012, about 30% of the population had hypertension. 40% of these were assumed to already be receiving blood pressure lowering drugs.

The relative risk of stroke from hypertension is 5.01 and the risk reduction from reducing blood pressure by 10mmHg is 0.6. The incidence and deaths prevented for at least a year were therefore calculated as:

PAF for hypertension × percent increased treatment x relative reduction × one year incidence

= 58% × 30% × (100-60)% ≈ 7.7% x stroke incidence / mortality

This calculation was then repeated:

6.2 Prevention and treatment options – CYP

The CYP section of the JSNA model includes 5 potential prevention/ treatment interventions which can be activated to test the projected future impact:

- Breastfeeding initiation
- Smoking during pregnancy
- Child obesity
- Fuel Poverty
- Adverse Childhood Experiences (Impact upon CYP)

For each cohort, we estimated the proportion of incidence that were attributable to various treatments or interventions. A list of the risk factors and interventions considered in the model and the data sources used to estimate the percentage at risk is shown in Appendix 4.

The general approach to calculating the risk reduction from an intervention among a particular cohort, is to multiply the change in the proportion of people exposed to a risk factor, by the incidence rate, and by the relative reduction due to the change in intervention or exposure. Sources for current risk factors are shown in Appendix 4. Sources for estimates of treatment efficacy (relative risk reductions) are shown in Appendix 13.

We obtained the relative risks based on the most recent published systematic reviews and meta-analyses of epidemiological studies.

EXAMPLE 4: Estimation of incidence changes from fuel poverty changes

Incidence physical transient patients as a result of fuel poverty changes for CYP

For example, in Kent in 2010, about 17% of the child population were fuel poor (using the Income Deprivation Affecting Children Index).

The relative risk of respiratory incidence from fuel poverty is 3. The incidence prevented for at least a year were therefore calculated as:

(1-(PAF for fuel poverty (respiratory) × percent change in fuel poverty)) x one year incidence

= (1-(0.25 × 25%)) ≈ 0.93 x physical transient incidence / mortality

This calculation is adjusted over time to achieve a reduction over a set time period. The current time period is 2018 to 2025.

6.3 Cumulative risk reduction: Incidence or deaths prevented to calculate cumulative benefit of multiple risk factor changes

Incidence and mortality rates are usually caused by multiple risk factors acting simultaneously. Hence, part of the effect of one risk factor may be mediated through another. For example, physical inactivity may have a direct effect on CHD but may also partly be mediated through its effects on BMI and blood pressure. It is recommended therefore that benefits attributable to risk factors which may be causally related, or which overlap in population groups, should not be combined by simple addition. Ideally, their effects should instead be jointly estimated.

We do not currently have sources that allow joint estimation of relative risks for combinations of risk factors. However, several large cohort studies and meta-analyses have published independent risk reduction coefficients for each risk factor included in this model. These are detailed in Appendices 12 and 13 for continuous and dichotomous risk factors, respectively. One approach commonly used is to calculate the cumulative risk-reduction. This approach accounts for risk factor prevalence overlap but assumes independence of effects. The general equation for cumulative risk-reduction is stated as:

Combined (or cumulative) effect (CR) = 1 – ((1-a) × (1-b) × (1-c) ×….× (1-n)) [1]

Thus for CHD risk factors, the specific equation is stated as:

CR = 1 – ((1-RSBP) × (1-Rsmoke) × (1-Rcholesterol) ×….× (1-Rn))

where R denotes the incidence or mortality change attributable to a specific risk factor.

This is in contrast to additive risk-reduction (AR):
AR = (RSBP) + (Rsmoke) + (Rdiabetes) +…..+ (Rn) [2]

6.4 Implementation

For the purposes of this modelling study we calculated the (additive) reductions in incidence and mortality rates attributed to risk factor change. These were then adjusted down by using the ratio:

Adjustment factor = CR/AR

The adjustment factor would always be expected to be less than 1. In other words, cumulative risk factor reduction would be smaller than the mortality benefits arrived at by a simple summation of the benefits of each risk factor in turn.

The proportional change in cohort incidence and mortality rate over time (denoted by R) was calculated using the following formulas:

Continuous risk factors:

Rcontinuous = 1 – exp(beta × absolute mean risk factor change) [3]

Dichotomous risk factors:

Rdichotomous = PAF × (ΔP/P) [4]

where PAF = [P × (RR - 1)] / [1 + P × (RR - 1)]

and P denotes prevalence at the start-year; RR the relative risk in cohort incidence or mortality associated with risk factor presence; and ΔP the change in prevalence between the start and final years (Ezatti et al., 2004).

Formulas [3] and [4] were used to calculate the proportional change in the incidence and mortality rate (R) for each risk factor and the steps involved in their estimation are detailed below. Additive and cumulative risk-reduction was calculated by using the absolute values of R (i.e. disregarding the direction of risk factor change).

Calculating aggregate change in risk factors

Formulas [3] and [4] require estimates of absolute and relative change in risk factors, respectively.

Estimates of absolute change in the mean levels of risk factors measured on a continuous scale (blood pressure, total cholesterol, and body mass index) were calculated as the average annual reduction per year. Estimates of change in prevalence estimates (smoking, physical activity) were calculated as an average annual reduction per year.

Reductions in risk factors across different areas can be calculated using the projected reduction in mean risk scores and risk factors prevalence across different deprivation and/or social economic groups (Health Survey for England).

6.5 Sensitivity analysis

Sensitivity analysis has not been performed as a standard application within the online cohort model. The aim of sensitivity analysis for the cohort model would be to help understand the effect of changes in input values or assumptions (including boundaries and model functional form) on the outputs. Simple sensitivity analysis procedures can be used to illustrate either graphically or numerically the consequences of alternative assumptions about the future (e.g. different future exposures to risk factors than those currently built in). The software includes built-in statistical distributions that allow the user to adjust the risk factors exposure, impact of risk or underlying outcomes over a set number of runs to assess the confidence and variability of results found within the cohort model. It also helps identify which variables in the model may be having more affect upon an outcome and thereby where to concentrate interventions. Any sensitivity analysis can be performed on request as a further validation of the impacts of risk factors and health interventions.

Appendix 1

Cohort definitions – Children and young people

Cohort group	Cohort specific	Cohort definition	KiD definition
Health/ disability conditions	Enduring physical health	Cystic fibrosis, Cerebral palsy, Other disorders of the nervous system, Diabetes Type 1, Epilepsy, Spina Bifida, Chronic Kidney Disease,	Cerebral_Palsy, Parkinsons, Carpal_Tunnel_Syndrome, MS, Diabetes1, Epilepsy, Spina_Bifida, CKD
	Enduring mental health	Schizophrenia, psychoses, bipolar,	MH, OCD, Tourette
	Non-enduring physical health	Cancers, Cardiac, Asthma	Cancers, Cardiac, Asthma
	Non-enduring mental health	Mild depression, anxiety, eating disorder,	Anorexia_Bulimia, Depression, Anxiety
	Learning disability	Down's syndrome, other learning disability	Chromosome_inc_Downs, LD
	ADHD	ADHD	ADHD
	Autism	Autism	ASD
~~Toxic Trio (link adults condition to a child from address)~~	Domestic Abuse	Alcohol, drug misuse	Adult with Alcoholic_Liver link to child
	Substance Misuse		
	Mental Health	Severe mental health problems	Adult with MH link to child
Healthy	Risk groups	MOSAIC	MOSAIC

Replace with ACE across all cohorts – see Appendix 5

Appendix 2

Cohort definitions – Adults

Cohort group	Cohort specific	Cohort definition	KiD definition
Frail	Severe frailty	Electronic Frailty Index, severe frailty (eFi: > 0.36)	Electronic Frailty Index, severe frailty (Frailty index > 2)
Single conditions with high levels of need	Serious Mental Illness	Schizophrenia, psychoses, bipolar,	MH
	Severe Learning Disability		LD
	Dementia	Diagnosed dementia	Dementia
	Neurological Conditions	Diagnosed parkinsons	Parkinsons
Multiple conditions	Multiple conditions	2 or more listed as Single conditions, but excluding people already identified as severely frail or with a high need single condition.	
Single conditions	Asthma	QoF definition	Asthma
	Coronary Heart Disease	QoF definition	CHD
	Chronic Obstructive Pulmonary Disease	QoF definition	COPD
	Type 2 diabetes	QoF definition	Diabetes2
	Heart Failure	QoF definition	HF
	Stroke	QoF definition	Stroke
	Moderate frailty	Electronic Frailty Index, moderate frailty (eFi: 0.24-0.36)	Electronic Frailty Index, moderate frailty (Frailty index > 2)
Healthy	none of the above	none of the above	none of the above

Appendix 3

Population and patient data sources used in the Kent JSNA model

Information	Source
Population data	
Household population, migration and death estimates and projections:	**Kent Household population projections, 2001-2037**
counts by age, sex, and local authority	
Deaths	
counts by age, cause of death, sex, and local authority	**ONS annual deaths, 2001-2016**
Number of A&E attendances	**KiD**
counts by cohort, age group and CCG	
Number of patients admitted to hospital (emergency)	**KiD**
counts by cohort, age group and CCG	
Number of GP appointments	**KiD**
counts by cohort, age group and CCG	
Number people supported by domicilliary care	**KiD**
counts by cohort, age group and CCG	
Number of people resident in a residential care home	**KiD**
counts by cohort, age group and CCG	
Number of people resident in a nursing home	**KiD**
counts by cohort, age group and CCG	
Patients eligible for primary prevention therapies	
Lipid-lowering drugs	**Health Survey for England**
Prevalence of never having had angina or heart attack and currently taking lipid lowering drugs prescribed by a doctor	**1999-2014**
Hypertension treatment	**Health Survey for England**
Prevalence of never having had angina or heart attack currently taking medication specifically prescribed to treat high blood pressure	**1999-2014**

Appendix 4

Data sources for treatment and intervention uptake levels

Information	Source
Primary prevention therapies:	
Lipid-lowering drugs	Health Survey for England
Prevalence of never having had angina or heart attack and currently not taking lipid lowering drugs prescribed by a doctor	1999-2014
Anti-hypertensive medication	
Hypertension treatment	Health Survey for England
Prevalence of healthy and not currently taking medication specifically prescribed to treat high blood pressure	1999-2014
Smoking cessation	Health Survey for England
Prevalence healthy and a current smoker	1999-2014
Weight management	Health Survey for England
Prevalence healthy and overweight or obese	1999-2014

Appendix 5

Risk factors for CYP – variable definitions and source

Risk factor	Source	Description
Breastfeeding initiation	NHS England	Breast feeding initiation percent (2013/14, 2014/15 & 2015/16 average)
Smoking during pregnancy	NHS England	Smoking during pregnancy percent (2014/15, 2015/16 & 2016/17 average)
Child Obesity	National Child Measurement Programme,	Child obesity prevalence, 11 year olds (2012/13 to 2015/16 average)
Fuel Poverty	IMD 2010 (Index of Deprivation Affecting Children 0-15 years)	Percent of children classed as living in child poverty (proxy for fuel poverty)
Adverse Childhood Experiences (ACE)*	Millennium Cohort Study, 2017	Percent of children with 1+ ACE (indirect), age groups Percent of children with 3+ ACE (indirect / direct), at 15

* ACEs are, as the name implies, experiences that adversely affect children.
The evidence cites issues commonly categorised as ACEs. This is not necessarily an exclusive list. In part based on the CDC ACE questions - refer to the respondent's first 18 years of life.
Five Direct
· Sexual abuse by parent / caregiver.
· Emotional abuse by parent / caregiver.
· Physical abuse by parent / caregiver.
· Emotional neglect by parent / caregiver.
· Physical neglect by parent / caregiver.
Five Indirect
· Parent / Caregiver addicted to alcohol / other drugs.
· Witnessed abuse in the household
· Family member in prison
· Family member with a mental illness.
· Parent / Caregiver disappeared through abandoning family / divorce.

Some surveys also include mother treated violently

Appendix 6

Risk factors for adults – variable definitions and source

The Health Survey for England (HSfE) is a cross-sectional, nationally representative survey reporting the health and health-related behaviours of people living in private households in England.24 Surveys have been conducted yearly since 1993. Samples are selected using a multistage stratified clustered probability sampling design. Data are collected during two household visits; first by an interviewer (face-to-face interviews) then by a nurse.

The magnitude of risk factor change from 1999 to 2009 used for the calculation of reduced incidence and deaths (see Examples 2 and 3) was estimated using a 'fixed gradient' approach to maximise precision. Health Survey for England was accessed from the UK data archive service.

Risk factor HSfE survey	HSfE survey years	Description
Current cigarette smoking	1999-2009	Self-reported status
SBP (mmHg)	1999-2009	Mean SBP from 2nd and 3rd reading
Body Mass Index	1999-2009	Valid height and weight measurements
Total cholesterol (mmol/l)	1999-2009	Those reporting taking lipid lowering drugs were included
Physical inactivity	1999-2004, 2006, 2008, 2009	Low or no activity levels

Appendix 6

Prevalence (%) of CYP cohorts, 2017

Cohorts	Age group (years)					
	0-1	2-4	05-10	11-15	16-17	18-24
Healthy	99.9	98.4	93.9	88.5	85.9	
ADHD	0.0	0.0	0.1	0.3	0.3	
Autism	0.0	0.1	0.5	0.6	0.4	
Mental Health Not Enduring	0.0	1.1	4.5	7.8	8.8	
Physical Not Enduring	0.0	0.0	0.2	1.2	2.8	
LD	0.0	0.0	0.0	0.1	0.2	0.4
Mental Health Enduring	0.1	0.2	0.3	0.3	0.4	0.3
Enduring physical condition	0.0	0.2	0.6	0.9	1.2	1.4

Source: Kent Integrated Dataset, 2017

Prevalence (%) of cohorts aged 18 years and over, 2012

	Age groups (years)					
Cohorts	18-49	50-59	60-64	65-74	75-84	85+
Healthy	89.6	76.8	70.2	58.8	43.2	31.8
Asthma	7.0	8.5	7.0	6.3	4.1	2.9
CHD	0.2	1.6	3.0	5.2	8.3	5.6
COPD	0.2	1.1	2.3	1.7	1.4	1.0
Diabetes type 2	1.0	3.9	5.7	5.5	5.3	4.6
HF	0.0	0.0	0.0	0.0	0.0	0.0
Stroke	0.1	0.5	1.0	1.7	2.9	2.1
Moderately Frail	0.0	1.8	2.2	2.6	5.2	6.0
Multiple LTC	0.9	4.3	6.6	8.7	12.7	11.8
Severe mental health	0.6	0.8	0.5	0.2	0.0	0.0
Neuro	0.0	0.1	0.7	0.4	0.9	0.2
Dementia	0.0	0.3	0.5	0.4	1.7	1.9
LD	0.3	0.3	0.3	0.2	0.1	0.0
Severe Frail	0.0	0.0	0.0	8.5	14.2	32.2

Source: Kent Integrated Dataset, 2017; English Longitudinal Study of Ageing, 2002-2015

Prevalence (%) of cohort within multiple and frail cohorts, aged 18 years and over, 2012

Cohort	Multiple conditions	Frail
Asthma	43.8	4.5
CHD	40.1	6.9
COPD	35.1	4.4
Diabetes_2	40.4	8.1
Heart Failure	4.8	0.6
Stroke	25.9	8.0
Frail moderate	38.5	25.3
Severe mental health	0.0	0.5
Parkinsons	0.0	4.5
Dementia	0.0	12.2

Source: English longitudinal study of ageing, 2002-2015

Prevalence (%) of cohort social grade DE, aged 18 years and over, 2012

	Prevalence by social grade					
Cohorts	DE	Average	Diff	Diff social class adj	Prevalence adj	Prevalence ratio
Healthy	55.84	63.11	-7.27	1.40	64.51	1.02
Asthma	6.25	5.96	0.30	-0.06	5.90	0.99
CHD	4.24	3.94	0.30	-0.06	3.88	0.99
COPD	1.95	1.53	0.42	-0.08	1.44	0.95
Diabetes type 2	6.40	5.45	0.95	-0.18	5.27	0.97
HF	0.03	0.04	-0.01	0.00	0.04	1.00
Stroke	1.53	1.27	0.26	-0.05	1.22	0.96
Moderately Frail	3.26	2.69	0.57	-0.11	2.58	0.96
Multiple LTC	10.37	8.09	2.28	-0.44	7.66	0.95
Severe mental health	0.60	0.43	0.17	-0.03	0.40	0.93
Neuro	0.46	0.42	0.04	-0.01	0.41	0.98
Dementia	0.94	0.86	0.09	-0.02	0.84	0.98
LD	n/a		0.00	0.00	0.00	1.00
Severe Frail	8.13	6.22	1.91	-0.37	5.85	0.94

Source: English longitudinal study of ageing, 2002-2015

Appendix 7
Incidence and mortality

Incidence per 1000 population age 18 and over, 2017

Cohort CYP	Incidence, rate per 1000, age group (years)						
	0	0-1	2-4	5-10	11-15	16-17	18-24
Toxic trio							
from healthy	0.09	0.09	0.11	0.10	0.11	0.11	0.07
Health conditions							
from healthy	0.00	0.05	0.41	0.68	0.85	1.62	0.55
from toxic	0.00	0.10	0.77	1.21	0.86	3.08	0.00

Incidence and mortality rates per 1000 population age 18 and over, 2012

Cohort	Healthy to cohort	Single to multiple	Frail to severe	Death rate
Healthy	0.0	0.5	2.0	4.0
Asthma	1.5	10.7	2.4	3.7
CHD	1.6	25.3	8.0	24.0
COPD	1.1	43.6	25.8	36.9
Diabetes type 2	2.2	33.6	10.3	14.5
HF	0.0	0.0	0.0	0.0
Stroke	1.0	58.3	22.9	23.0
Moderately Frail	2.1	8.5	54.2	50.7
Multiple LTC	4.1		38.9	37.3
Severe mental health	0.1		10.5	8.0
Neuro	0.3		47.6	64.3
Dementia	0.6		65.6	73.8
LD	from CYP model		8.0	
Severe Frail				140.1

Source: Kent Integrated Dataset, 2017; English Longitudinal Study of Ageing, 2002-2015

Appendix 8

Cause of death percent aged 50 and over, 2012

	Cause of death (%)			
Cohort	Cancer	CVD	Respiratory	Other
Healthy	40.7	25.5	7.3	26.5
Asthma	41.7	33.3	8.3	16.7
CHD	31.0	45.2	3.6	20.2
COPD	0.0	71.4	28.6	0.0
Diabetes type 2	48.3	20.0	8.3	23.3
Heart failure	0.0	0.0	0.0	0.0
Stroke	50.0	12.5	25.0	12.5
Moderate frailty	8.8	28.4	42.2	20.6
Multiple LTC	25.9	36.1	17.0	21.0
Severe mental health	100.0	0.0	0.0	0.0
Parkinson's	16.7	0.0	0.0	83.3
Dementia	12.5	26.8	0.0	60.7
Frail severe	19.5	25.9	20.0	34.6
All persons	28.3	29.3	14.3	28.1

Source: English Longitudinal Study of Ageing, 2002-2015

Appendix 9

ONS Mortality by main cause of death, 2012

Age group	CVD	Cancer	Respiratory	Other	Total	Percent
15-24	0	0	0	15	15	0%
25-34	0	0	0	18	18	0%
35-44	6	34	0	55	95	1%
45-54	79	199	6	142	426	3%
55-64	215	484	61	200	960	7%
65-74	570	963	253	328	2114	16%
75-84	1170	1254	587	873	3884	30%
85+	1837	915	1036	1849	5637	43%
Total	3877	3849	1943	3480	13149	100%
Percent	29%	29%	15%	26%	100%	

Appendix 10

Risk attributable fraction (rate of health and care contact per cohort, rate per 1,000 per month) (2017/18)

Children and young people

Cohort	GP attendances	A&E attendances	Emergency admission	Elective admissions	Outpatients attendances
Healthy	148.7	25.8	4.2	1.8	44.3
ADHD	181.6	38.7	3.4	2.8	65.6
Autism	223.5	27.0	4.5	3.0	117.4
Physical Not Enduring	246.1	38.9	5.6	2.8	67.4
Mental Health Not Enduring	318.7	38.3	7.0	2.4	68.7
LD	353.0	35.3	9.6	5.4	212.3
Mental Health Enduring	299.1	40.9	6.3	3.2	79.2
Enduring physical condition	419.0	52.5	17.5	6.8	304.3
All cohorts	157.0	26.7	4.4	1.9	48.5

Adults

cohorts	GP attendances	A&E attendances	Emergency admission	Elective admissions	Outpatient attendances	Domiciliary Care (new start)	Residential Care (resident)	Nursing Care (resident)
Healthy	212.8	18.8	5.0	10.2	87.7	1.0	0.7	0.3
Asthma	393.9	27.0	6.4	12.4	118.0	0.9	0.2	0.0
CHD	610.6	35.1	16.1	27.3	209.1	3.0	1.3	0.7
COPD	706.0	41.9	20.1	29.3	224.6	4.5	1.1	0.4
Diabetes_2	677.4	28.0	10.4	21.8	181.5	3.7	1.2	0.6
HF	838.9	50.4	27.4	30.4	272.5	13.5	4.1	0.6
Stroke	589.1	40.7	19.9	25.1	211.8	22.1	8.1	7.6
Moderate Frail	718.5	38.0	17.8	37.3	259.7	8.9	4.6	2.3
Multiple LTC	605.4	39.7	19.8	28.1	247.4	8.8	2.6	1.3
Severe Mental Health	678.1	52.3	17.0	12.5	170.1	10.4	20.8	1.4
Neurological	761.1	47.2	23.7	24.8	366.3	32.5	15.6	7.3
Dementia	631.5	62.8	35.6	11.5	144.2	51.7	80.0	28.4
LD	580.9	58.3	15.0	9.8	119.9	21.0	160.9	1.0
Severe Frail	1078.3	78.7	44.1	38.7	353.6	39.9	20.6	7.1

Source: Kent Integrated Dataset, 2017

Appendix 11

Beta coefficients for major risk factors

Estimated β coefficients from multiple regression analyses for the relationship between absolute changes in population mean risk factors and percentage changes in coronary heart disease mortality for men and women, stratified by age. Data sources, values and comments.

	Age group				
	25-44	45-54	55-64	65-74	75+
Systolic Blood pressure					
Men (hazard ratio per 20 mmHg)	0.49	0.49	0.52	0.58	0.65
Men (log hazard ratio per 1 mmHg)	-0.036	-0.035	-0.032	-0.027	-0.021
Minimum	-0.029	-0.028	-0.026	-0.022	-0.017
Maximum	-0.043	-0.042	-0.039	-0.032	-0.025
Men (hazard ratio per 20 mmHg)	0.4	0.4	0.49	0.52	0.59
Men (log hazard ratio per 1 mmHg)	-0.046	-0.046	-0.035	-0.032	-0.026
Minimum	-0.037	-0.037	-0.028	-0.026	-0.021
Maximum	-0.055	-0.055	-0.042	-0.039	-0.031

Source: Lewington et al. 2002

Cholesterol	Age group					
	25-44	45-54	55-64	65-74	75-84	85+
Mortality reduction per 1 mmol/l						
Men	0.55	0.53	0.36	0.21	0.21	0.21
Women	0.57	0.52	0.35	0.23	0.23	0.23
Log coefficient						
Men	**-0.799**	**-0.755**	**-0.446**	**-0.236**	**-0.117**	-0.083
Minimum	-0.639	-0.604	-0.357	-0.189	-0.093	-0.067
Maximum	-0.958	-0.906	-0.536	-0.283	-0.140	-0.100
Women	**-0.844**	**-0.734**	**-0.431**	**-0.261**	**-0.174**	-0.051
Minimum	-0.675	-0.587	-0.345	-0.209	-0.139	-0.041
Maximum	-1.013	-0.881	-0.517	-0.314	-0.209	-0.062

Source: Lewington et al. 2007

Body Mass Index (BMI)	Age group				
	<44	45-59	60-69	70-79	80+
Hazard ratio	0.89	0.91	0.95	0.96	0.97
Risk reduction per 1kg/m^2	0.11	0.09	0.05	0.04	0.03
Age gradient (45-59 as reference)	1.22	1	0.56	0.44	0.33
Relative risks, CHD deaths per 5 BMI units (1kg/m^2)		1.16			
Relative risks, CHD deaths per 1kg/m^2 applying age gradients from James et al	1.04	1.03	1.02	1.01	1.01
Log coefficients	**0.0363**	**0.0297**	**0.0165**	**0.0132**	**0.010**
Minimum	0.0255	0.0209	0.0116	0.0093	0.007
Maximum	0.0466	0.0381	0.0212	0.0169	0.0127

Bogers et al (2006), James et al (2004)

Appendix 12

Relative risk for underlying risk, incidence: breastfeeding, smoking in pregnancy, child obesity, fuel poverty and ACE, CYP

Relative risks are used to estimate the impact for categorical risk factors, where an individual has or has not a certain level of risk.

1 Breastfeeding

Cohort / condition	Relative Risk	Age group affected
Asthma	0.91	5-19 yrs
Admission respiratory	0.43	<2 yrs
Overweight and obese	0.74	Child adol & adults
Blood pressure	0.5	Child adol & adults
Diabetes	0.65	Child adol & adults

Source: Cesar et al., 2016

2 Smoking during pregnancy

Cohort / condition	Relative Risk	Age group affected
Stillbirth	1.49	At birth
ADHD	2.39	Child, ad
Conduct Disorder	2.6	16-18
Substance misuse	2.4	16-18
Depression	1.4	16-18
Overweight	1.5	Child, ad

Source: Gaysina et al., 2003; Langley et al., 2005; Oken et al., 2008

3 Fuel Poverty

Children living in cold and damp housing are 1.5-3 times more likely to suffer from Asthma and respiratory diseases (Barnes et al., 2008). A child who develops asthma in this way is more likely to persist into adulthood and to possibly life (Boardman, 2010).

4 Adverse Childhood Experience (ACE)

In this high-risk population, the rate of childhood mental health problems is 3 times higher than children without these risk factors.

The rate of adults diagnosed with chronic diseases was more than twice as high as that of adults with no ACEs, and more than four times higher for type 2 diabetes. Compared with people with no ACEs, those with four or more were (Public Health Wales, 2016):

- 9.5 times more likely to currently be receiving treatment for mental illness
- 6.1times more likely to have ever received treatment for mental illness

- 3.7 times more likely to have ever felt suicidal or self-harmed

Relative risk for underlying risk, incidence and mortality: smoking, diabetes, physical inactivity, hypertension and hypercholesterolaemia and dementia, adults

Relative risks are used to estimate the impact for categorical risk factors, where an individual has or has not a certain level of risk.

1 Smoking (Current, ex-smoking)

		Men		Women		Both	
		Current	Ex	Current	Ex	Current	Ex
Cancers	Age						
lung	35+	23.26	8.70	12.69	4.53	17.98	6.62
upper respiratory	35+	10.89	3.40	5.08	2.29	7.99	2.85
oesophagus	35+	6.76	4.46	7.75	2.79	7.26	3.63
larynx	35+	14.60	6.34	13.02	5.16	13.81	5.75
cervical	35+	1.00	1.00	1.59	1.14	1.30	1.07
bladder	35+	3.27	2.09	2.22	1.89	2.75	1.99
kidney and renal pelvis	35+	2.50	1.70	1.40	1.10	1.95	1.40
stomach	35+	1.96	1.47	1.36	1.32	1.66	1.40
pancreas	35+	2.31	1.15	2.25	1.55	2.28	1.35
unspedified	35+	4.40	2.50	2.20	1.30	3.30	1.90
myeloid leukaemia	35+	1.80	1.40	1.20	1.30	1.50	1.35
Respiratory							
COPD*	35+					6.50	3.00
Chronic airways disease	35+	10.58	6.80	13.08	6.78	11.83	6.79
Pneumonia	35-64	2.50	1.40	4.30	1.10	3.40	1.25
Pneumonia	65+	2.00	1.40	2.20	1.10	2.10	1.25
Pneumonia	35+	2.25	1.40	3.25	1.10	2.75	1.25
Circulatory							
Other Heart		1.78	1.22	1.49	1.14	1.64	1.18
CHD	35+	2.48	1.50	2.90	1.53	2.69	1.51
Other arterial	35+	2.07	1.01	2.17	1.12	2.12	1.07
Stroke	35-54	4.40	1.10	5.40	1.30	4.90	1.20
Stroke	55-64	3.10	1.10	3.70	1.30	3.40	1.20
Stroke	65-74	2.20	1.10	2.60	1.30	2.40	1.20
Stroke	75+	1.60	1.10	1.30	1.00	1.45	1.05
Stroke	35+	2.83	1.10	3.25	1.23	3.04	1.16
aortic aneurism	35+	6.20	3.07	7.07	2.07	6.64	2.57
Atheroscerosis	35+	2.44	1.33	1.83	1.00	2.14	1.17
Digestive disease							
Stomach ulcer	35+	5.40	1.80	5.50	1.40	5.45	1.60
Crohns disease	35+	2.10	1.00	2.10	1.00	2.10	1.00
Periodontal/Perio dontitis	35+	3.97	1.68	3.97	1.68	3.97	1.68
Total death rate						3.84	1.43

Source: Statistics on smoking: England, 2013; * Loche et al., 2006

2 Physical inactivity

Relative risk of Coronary Heart Disease, Stroke and Diabetes from physical (in)activity levels from WHO GBD Study, relative to those considered physically active

	CHD		**Stroke**		**Diabetes**	
Age	**Inactive**	**Insufficient**	**Inactive**	**Insufficient**	**Inactive**	**Insufficient**
15-69	1.71	1.44	1.53	1.1	1.45	1.24
70-79	1.5	1.31	1.38	1.08	1.32	1.18
80+	1.3	1.2	1.24	1.05	1.20	1.11

Notes: Physical (in)activity in the WHO GBD study was treated as a categorical variable with three categories: **Level 1**: Inactive: 'doing no or very little physical activity at work, at home, for transport, or during discretionary time'. **Level 2**: Insufficiently active: 'doing some physical activity but less than 150 minutes of moderate-intensity physical activity or 60 minutes of vigorous-intensity physical activity a week accumulated across work, home, transport or discretionary domains'. **Level 3**: Sufficiently active (unexposed): 'at least 150 minutes of moderate-intensity physical activity or 60 minutes of vigorous-intensity physical activity a week accumulated across work, home, transport or discretionary domains', which approximately corresponds to current recommendations in many countries.

Source: Bull et al (2004); Joubert et al (2007)

3 Obesity and overweight

Relative risk of Coronary Heart Disease, Stroke Hypertension and Diabetes from overweight and obesity levels from WHO GBD Study, relative to those considered physically active

	Overweight		Obese	
	under 65	over 65	under 65	over 65
CHD	1.38	1.00	1.90	1.23
Stroke	1.30	1.00	1.55	1.18
Hypertension	1.40	1.40	2.35	2.35
Diabetes	1.80		8.95	

Source: Mathers et al., 1999; National Audit Office, 2001

4 Dementia

Risk factor	RR
Early life (<18 yrs)	
Less education	1.6
Midlife (45-65 yrs)	
Hypertension	1.6
Obesity	1.6
Hearing loss	1.9
Late life (age > 65)	
Smoking	1.6
Depression	1.9
Physical inactivity	1.4
Social isolation	1.6
Diabetes	1.5

Source: Livingstone et al., 2017

5 Hypertension and Hypercholesterolaemia

Relative risk for CHD and stroke

	CHD	Stroke
Hypertension	2.86	5.08
High cholesterol	3.00	1.50

Source: Ezatti et al., 2004

6 Relative risk reduction for CHD and stroke

Age group (years)	Relative risk 10mmHg decrease		Relative risk 1mmol/l decrease	
	CHD	Stroke	CHD	Stroke
30-44	0.52	0.42	0.51	0.66
45-59	0.60	0.5	0.5	0.66
60-69	0.75	0.64	0.7	0.77
70-79	0.80	0.72	0.77	0.92
80+	0.94	0.83	0.75	0.84

Source: Ezatti et al., 2004

Appendix 13

Observed risk factor levels in 1999 and 2009 by sex and social class

	Professional		Managerial and skill non-manual		Manual skilled		Unskilled manual		England	
	1999	2009	1999	2009	1999	2009	1999	2009	1999	2009
Smoking prevalence, %										
	13.6	8.4	22.1	18.3	32.6	28.5	34.6	33.6	26.3	22.1
Physical inactivity, %										
	34.7	23.9	37.1	33.7	38.0	37.4	38.6	39.9	37.4	34.6
Systolic blood pressure, mmHg										
	134.9	131.1	134.2	129.9	136.2	132.8	138.5	134.2	135.3	131.2
Cholesterol, mmol/l										
	5.48	5.41	5.49	5.46	5.56	5.36	5.60	5.45	5.53	5.42
Body mass index, kg/m^2										
	26.1	26.7	26.3	27.2	26.7	27.5	27.0	28.0	26.3	27.2

Source: Health Survey for England, 1999-2009

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