Workpackage 7: Overweight and Obesity
Report on data collection for overweight and obesity prevalence and related relative risks

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International Association for the Study of Obesity | Revision: Draft 1

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We would like to thank Wilma Nusselder for her guidance throughout and to members of the EUROCADET (www.eurocadet.org) and SHARE (www.share-project.org) projects who have shared their data and sources of data on BMI with us, and to all those who have provided data on BMI for their country (these are described further in the body of the report).

This report was prepared by Dr T Lobstein and Rachel Jackson Leach, of the International Association for the Study of Obesity (www.iaso.org).

Abstract

This document reports the findings of Work Package 7, “WP7 – Overweight and Obesity” of the DYNAMO-HIA project (www.dynamo-hia.eu). It summarises the methods used to obtain age- and gender-specific data on continuous and categorical BMI data in EU countries, as well as age- and gender-specific relative risks for the health outcomes selected for the project in relation to BMI. The main outputs of WP7 are age and gender-specific data for the mean BMI (SD) and the prevalence (%) of BMI-defined overweight and obesity by country across Europe, and estimates of the associated relative risks.

List of abbreviations

The following abbreviations are used in this report:

BMI	Body Mass Index, in kilograms weight / (metres height)^2
CINDI	Countrywide Integrated Non communicable Diseases Intervention
COPD	Chronic obstructive pulmonary disease
CHD	Coronary Heart Disease
CVD	Cardio-Vascular Disease (includes CHD, stroke etc)
DG SANCO	European Commission Directorate-General for Health and Consumers
DYNAMO-HIA	EU-funded project: a Dynamic Model for Health Impact Assessment
EU	European Union
EC	European Commission
HBSC	Health Behaviour in School-aged Children
HIS	Health Interview Survey
HES	Health Examination Survey
IHD	Ischaemic heart disease
INSEE	Institut National de la Statistique et des Etudes Economiques (France)
KTL	National Public Health Institute of Finland
MOH	Ministry of Health
MONICA	Monitoring of Trends and Determinants in Cardiovascular Disease
OECD	Organization for Economic Cooperation and Development
SD	Standard Deviation
WHO	World Health Organization
WP	Workpackage or Work Package

Introduction

DYNAMO-HIA (DYNAmic MOdel for Health Impact Assessment – http://www.dynamo-hia.eu) project is an EU funded project aiming to develop a web-based tool to assess the health impact of policies in the European Union (EU) through their influence on health determinants, including raised BMI. This document provides information on the project's 7th Work Package Overweight and Obesity. It focuses on the sources of data that were used to deliver the required age- and gender-specific data on mean BMI and prevalence of overweight, obesity and the relative risks for selected health outcomes which have been related to raised BMI.

WP7 was led by the International Association for the Study for Obesity but it also involved all associated partners and all 25 collaborating partners. The three main objectives of WP7 were:

1. To deliver: age- and gender-specific data on mean BMI and % prevalence overweight, obesity in as many EU countries as possible, using existing publicly available data sources; and age- and sex-specific relative risks (RRs) of disease incidence. This information provides input for the DYNAMO-HIA model and so links WP7 to the diseases investigated in other DYNAMO-HIA workpackages;
2. To contribute to the discussion on specification of the model and specification of scenarios in WP4 ("Model specification and scenarios). For the purposes of scenario-setting, data for the USA were also collected and reported for Workpackage 7;
3. To contribute to the dissemination of the results.

Part 1 Estimating mean BMI and Prevalence (%) Overweight and Obesity

1. Choice of exposure variable

BMI was chosen as the measure of overweight and obesity. It was recorded on a continuous (mean BMI, SD) and categorical basis (overweight and obesity). The overweight and obesity category in adults were based on those defined by WHO (TRS 894)[1]. Table 1.1.

Table 1.1 World Health Organization Categories of Overweight and Obesity

Category	**BMI (kg/m²)**
Underweight	<18.50
Normal	18.50-24.99
Overweight: Pre- Obese Obese class I Obese class II Obese class III	≥25.00 25-29.99 30-34.99 35-39.99 ≥40.00

For consistency with other workpages and the small numbers of underweight in Europe, BMI <25 was recorded as normal. The term 'overweight' was used to define pre-obese, and 'obesity' to define obese class I, II and III. Insufficient data were available on obese class II and III to warrant the additional categories. The final categories are outlined in Table 1.2 below.

Table 1.2 DYNAMO-HIA Categories of Overweight and Obesity

Category	**BMI (kg/m²)**
Normal	<25.00
Overweight	25-29.99
Obesity	≥30.00

BMI is most reliable when used on a population basis, it is less reliable used at an individual level as it takes no consideration for differences in make up of body mass e.g. a lean individual with a high proportion of muscle mass may be incorrectly categorised as obese.

In children different cut off's can be applied in different countries for classification of overweight and obesity. As this project is multinational it was considered that the most appropriate cut off points were the (IOTF) International Cut off points. Therefore, for the purpose of this study only studies using these IOTF cut off points were used. Table 1.3 outlines the appropriate values by 0.5 year, for children aged 2-17yrs. In this study no data could be provided for children <2yrs as appropriate cut off points were not available. Figures for 2 year olds were used in place. In the future should internationally appropriate cut off points become available for infants in this age range these could be used.

Table 1.3. International cut off points for body mass index for overweight and obesity by sex between 2 and 18 years, defined to pass through body mass index of 25 and 30 kg/m^2 at age 18, obtained by averaging data from Brazil, Great Britain, Hong Kong, Netherlands, Singapore, and United States[2]

	Body mass index 25 kg/m^2		Body mass index 30 kg/m^2	
Age (years)	Boys	Girls	Boys	Girls
2	18.41	18.02	20.09	19.81
2.5	18.13	17.76	19.8	19.55
3	17.89	17.56	19.57	19.36
3.5	17.69	17.4	19.39	19.23
4	17.55	17.28	19.29	19.15
4.5	17.47	17.19	19.26	19.12
5	17.42	17.15	19.30	19.17
5.5	17.45	17.20	19.47	19.34
6	17.55	17.34	19.78	19.65
6.5	17.71	17.53	20.23	20.08
7	17.92	17.75	20.63	20.15
7.5	18.16	18.03	21.09	21.01
8	18.44	18.35	21.6	21.57
8.5	18.76	18.69	22.17	22.18
9	19.10	19.07	22.77	22.81
9.5	19.46	19.45	23.39	23.46
10	19.84	19.86	24	24.11
10.5	20.20	20.29	24.57	24.77
11	20.55	20.74	25.1	25.42
11.5	20.89	21.20	25.58	26.05
12	21.22	21.68	26.02	26.67
12.5	21.56	22.14	26.43	27.24
13	21.91	22.58	26.84	27.76
13.5	22.27	22.98	27.25	28.2
14	22.62	23.34	27.63	28.57
14.5	22.96	23.66	27.98	28.87
15	23.29	23.94	28.3	29.11
15.5	23.60	24.17	28.6	29.29
16	23.90	24.37	28.88	29.43
16.5	24.19	24.54	29.14	29.56
17	24.46	24.7	29.41	29.69
17.5	24.73	24.85	29.7	29.84

It is important to note that throughout the project in any instance where % overweight or % obesity data are provided for individuals <18yrs of age these cut off points have been applied. When presented the % overweight does not include the % obese.

2 General approach for obtaining mean BMI and overweight and obesity prevalence (%) data.

Mean BMI and overweight and obesity prevalence data are available from regional or national health surveys. Some surveys report either or categorical or continuous data. The use of surveys based on self reported heights and weights were not used within this report. The extent of the differences between results obtained from self reported height and weight and measured heights and weights in adults and children varies significantly. Further examples outlining the large variation associated with self reported height and weight compared to measured can be found in Annex 2. It can be seen that the difference is not constant but varies widely between gender, countries and age. No single correction factor can be added or subtracted to account for the differences.[3]

3. Criteria for Data collection

To be eligible for inclusion in the Dynamo project, data had to satisfy the following criteria:

Measured
Only measured anthropometric data were used to assess the national information on BMI, and the prevalence of overweight and obesity. Given the levels of inaccuracy and bias associated with self-reported BMI, the use of such data was considered inappropriate.

Time Frame
Preference was given to surveys carried out since 2000.

Representative
Nationally representative data were preferred. A sufficiently large sample size was preferred, with preference being given to studies investigating ≥1000 individuals. For countries with no data, studies with smaller samples were not excluded.
Clinical data were excluded whenever possible because they reflect a subgroup of the population with particular medical problems and could not be considered nationally representative.

Presentation of data
Data had to be presented by age and gender with as wide an age range as possible. In general different surveys had to be used for children and adults with a few notable exceptions (the exceptions were England, France, Germany and USA). Categorical data had to be presented using the cut off points as outlined in table 1.2.

3.1 Identification of eligible data

Sources investigated include the following:

The World Health Organization Infobase

The WHO provides a listing of sources of information on health status derived from material submitted by national counterparts and others. For more details or to view database visit the WHO Infobase webpages [4]. This includes references to sources of data on BMI and prevalence of obesity and overweight. The data sources were examined for the present study: those using measured heights and weights were included.

Countrywide Integrated Non communicable Diseases Intervention (CINDI) Programme
The CINDI surveys were not national, and not designed to be representative of the whole population. However, they were large, measured height and weight surveys and thus can provide more accurate data than those surveys using self-reported height and weight. The WHO CINDI webpages are currently not working but the 2005 CINDI Highlights are available online.[5] CINDI data is commonly found on the WHO Infobase (see details above). Where no better data were available, the CINDI figures were used to assist in estimating the tables for the Dynamo study.

MEDLINE publications

MEDLINE provides access to a very large database of material published in peer-reviewed, scientific journals. The information includes reports of surveys of the health status of populations. Searches using the PubMed interface[6] were carried out for each country, using keywords: country + obesity +/or overweight [+/or adult +/or child]. Searches went back to 1980. The resulting abstracts were reviewed and potentially useful papers located. Those that met the criteria for eligibility were included in the Dynamo study. In a few instances the papers were either unavailable or non English – translations were made where possible but this was not always feasible.

INTERSALT study

It is understood that the DYNAMO project were interested in obtaining some height and weight data from the INTERSALT study. This study collected measured heights and weights in 52 centres by gender and age. However this was undertaken in 1985-87. Where no better data were available, the INTERSALT figures were used to assist in estimating the tables for the Dynamo study. See *Dyer AR, Elliott P, on behalf of the Intersalt Co-operative Research Group. The Intersalt study: relations of body mass index to blood pressure. Journal of Human Hypertension 1989;3:299-308*

Health Examinations Surveys

Unlike the Health Interview surveys the HES surveys are based on measured heights and weights. On the HIS/HES website little detailed information is available, however, the website includes important contact details through whom data could be made available. The HIS/HES website was developed within the framework of the European Health Survey Information Database (EUHSID) project.[7]

Direct access

- Authors: Where appropriate, authors were contacted to obtain further details of their published data.

- Members of the European Association for the Study of Obesity: EASO member country presidents were invited to assist in the project. Details of the EASO member countries are available on the EASO website[8]. All 28 Presidents were contacted. 6 Presidents responded and a few provided comprehensive data to assist with this project. They are officially acknowledged in Annex II and their assistance was greatly appreciated.

- Other direct contacts: IASO-IOTF has a number of contacts within governments and individuals who work within the field of obesity worldwide. Where IASO-IOTF had appropriate contacts in Europe they were contacted and asked if they (or anyone within their network) could provide published or unpublished data for the purpose of this project. These contacts proved to be very valuable in this project.

- Online datasets: Relevant data sets (namely the Health Survey for England for recent years) were retrieved directly from online sources and re-analysed.

3.2 Details of excluded data.

- Surveys were excluded if they did not categorise BMI according to the categories outlined in Table 1.2.
- Surveys were excluded if the did not present the data by gender separately.
- Surveys were excluded if they did not use measured heights and weights.
- Surveys were excluded if they were too small
- Surveys were excluded relating to individuals <18yrs if they did not use the IOTF International Cut off Points as previously outlined.

Data sources excluded are as follows.

- Health Behaviour in School-aged Children (HBSC), based on self report height and weight so excluded. For further information is available on the HBSC website [9]

- The WHO also provides comparable estimates of mean BMI, Overweight and Obesity prevalence's, for 2002, 2010 and 2015. However these are predictions and not raw data, and are based on a mixture of self-reported and measured data. The results include projections from different years and, if national data are not available, projections from neighbouring countries' datasets. The methodology used was a valuable contribution to the Dynamo study, but the figures provided were not relied upon. For more details, see the WHO Website.[10]

- World Health Survey (WHS), is a large cross-sectional, cross national study, using self-reported height and weight. The figures provided were not relied upon. For further information visit the WHO Website.[11]

- The Organization for Economic Cooperation and Development (OECD). The OECD health information data are based on surveys of self-reported heights and weights and the figures provided were not relied upon. For more details, see OECD Health Pages. [12]

- The Pan-European Union survey on consumer attitudes to physical activity, body weight and health. Nationally representative samples of approximately 1000 subjects (individuals +15 years) were recruited from each member state of the EU (15 countries at the time) conducted in 1997, collected information on physical activity and body mass index, using self reported heights and weights. The figures provided were not relied upon. Further information in the report. [13]

- The Eurostat database[14] provides estimates based on surveys covering the EU-27 (excluding Luxembourg) plus Iceland, Norway, Switzerland. The data are primarily self-reported height and weight from the Health Interview Surveys. The figures provided were not relied upon.

- The SHARE (Survey of Health, Ageing and Retirement in Europe) includes data on the health status of some 45,000 people aged over 50, collected in two rounds, circa 2004 and circa 2006, in 11 EU member states and Israel. Data reported were based on self-reported heights and weights and were not relied upon.

3.3 Trend data

Trend/historic data were supplied when available though in most instances this provides a snapshot over time rather than directly comparable surveys. The data have been supplied in its original format by age and gender. Full details of the surveys are provided in full in Annex II.

3.4 Quality of data

Table 3.4 outlines the quality of data available for current mean BMI and % overweight and obesity data. In some countries proxy data had to be used for some age ranges. Where appropriate data did not cover a suitable age range no data were provided. It was determined that the user can select appropriate proxy data for their own purpose. Making the user select proxy data raises their awareness of the limitations of the data.

Table 3.4 Details of the quality of data used to provide % overweight, obesity and mean BMI data in the DYNAMO-HIA project.

		Data Coverage	
Country	**Overall Sample size (n)**	**Adults**	**Children**
Austria	Adult data only 832 – continuous 1,054 - categorical	Good (No SD)	Proxy
Belgium	Adult data only 5,066	Good	Proxy
Bulgaria	1,326 children (2-17yrs) 1,031 adults	Good	Good
Czech Republic	n=35953 children (5-17) n=2060 adults (15+)	Good	Good
Denmark	11,211 children (5-16yrs) 1,316 adults	Good	Good
France	1,146 children (3-17yrs) 2,594 adults	Good	Good
Finland	4,016 children 4,394 adults	Good	Limited
Germany	15,662 children (2-17yrs) 13,207 adults	Good (No SD)	Good
Ireland	17,549 children (4-16yrs)* 1,311 adults	Good (inc North and South Ireland)	Good
Italy	1,230 children 2 yrs 44,231 children 3-17yrs adults **	Limited – interpolated	No mean
Netherlands	90,071 continuous child data ~8,000 categorical child data*** ~5,200 continuous adult ~3,600 categorical adult	Overweight old	Good
Poland	1216 children (2-	Good	Good

	18yrs) 14403 adults 20-95		
Portugal	8,116 adults	No Mean (Proxy data used)	7-10 yrs Good New child data will become available in the next couple of months
Spain	2057 children 20,589 adults	Good	Good
Sweden	1036 adults	Good	0-8yrs based on proxy data – categorical Continous data extrapolation - poor
UK	Combined data from Scottish Health Survey, Heath Survey for England and Northern Ireland	Good	Good

* no data available for children 10 years of age

** large survey but no details were given, author was contacted but received no response

*** understood to be around 8,000 minimum. Alternative communication from author would suggest that in 1997 their were just under 8,000 children survey between 5-17yrs. These data included children 2-17yrs and therefore the numbers must be greater

3.5 Smoothing

Data had to be provided by individual year for infants, children and adults aged 0-95 years. In children the data were generally provided by individual year, in adults the data were generally provided in 10 year categories – though there were two notable exceptions: the Health Survey for England and the US NHANES data. In all cases the data were smoothed. The data were smoothed using the DisMod approach with manual input, following a moving average and ensuring underlying trends were not lost. Care was taken especially with children not to smooth the data to the point where significant fluctuations during early growth would be lost.

3.6 Missing Data

3.6.1 Elderly

There were large gaps in the primary data for older adults. All available data for countries around Europe were pooled. The changes between set age categories in each country with available data were calculated. A Europe-wide figure for % changes (either increase or decrease) between age categories in overweight, obesity, mean BMI and SD were estimated and are presented in Table 3.5. These estimates from the pooled data were then applied as projections from younger age available data separately for each of the national data sets.

Table 3.6.1 Increase/Decrease between categories. Expressed as a proportion of the previous age category

Males	Overweight	Obesity	Mean BMI	SD	Females	Overweight	Obesity	Mean BMI	SD
Age 55-64	0.011	0.143	0.019	-0.006	Age 55-64	0.141	0.370	0.041	0.036
Age 65-74	0.065	-0.032	0.019	-0.048	Age 65-74	0.099	0.120	0.011	-0.075

Age 75-84	-0.249	0.217	-0.001	*-0.036*	Age 75-84	0.020	-0.372	-0.020	*-0.020*
Age 85-94	0.016	-0.743	*-0.013*	*-0.051*	Age 85-94	-0.334	-0.636	*-0.034*	*-0.068*
Age 95+	*-0.204*	*-0.609*	*-0.026*	*-0.065*	Age 95+	*-0.389*	*-0.868*	*-0.056*	*-0.098*

Worked example	
If the best available data for males are provided only to age 74yrs and shows Overweight 57.5% at that age, then the following estimates apply:	
	% Overweight
Age 75-84	57.5 + (-0.249 x 57.5) = 43.2
Age 85-94	43.2 + (0.016 x 43.2) = 43.9
age 95+	43.9 + (-0.204 x 43.9) = 34.9

The figures in italics in Table 3.6.1 indicate situations where no data were available throughout Europe. A linear trend was applied to all the adult data and proportional change projected. It is important to note that as soon as more appropriate data become available these estimates should be replaced.

The SHARE data was investigated but after careful analysis and discussion it had to be excluded as based on self reported height and weights.

3.6.2 Missing country data

In the absence of any realistic data for a country, data on BMI and prevalence of overweight and obesity were based on interpolated estimates from another country on the basis of:

(a) similar partial data (e.g. similar mean BMI)
(b) similar self-reported data
(c) close proximity (e.g. shared national border).

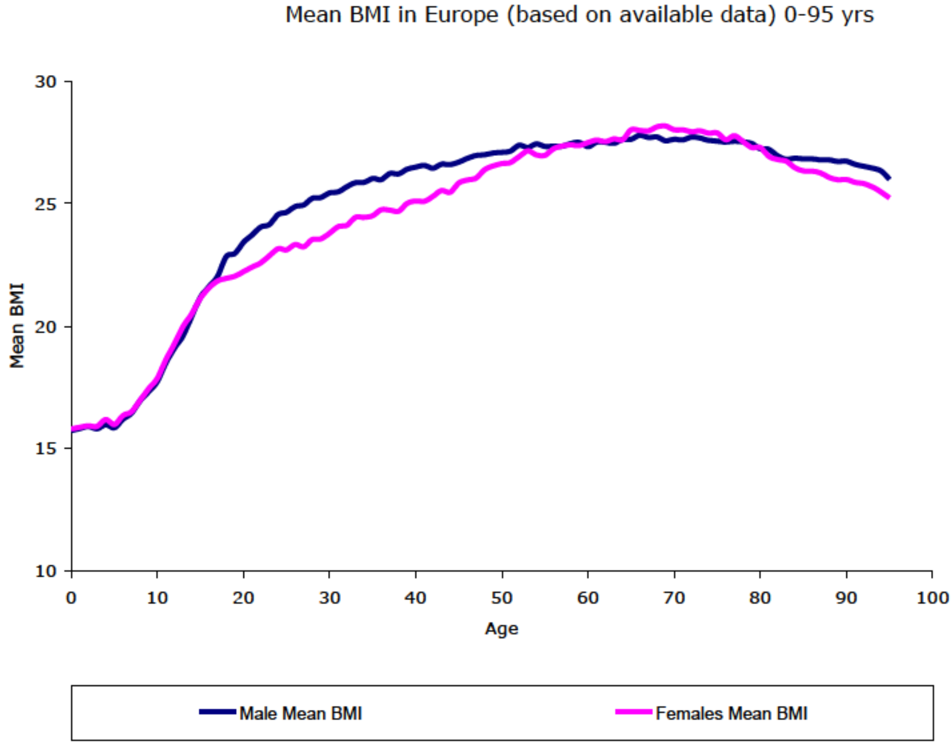
As soon as more appropriate data become available these estimates should be replaced.

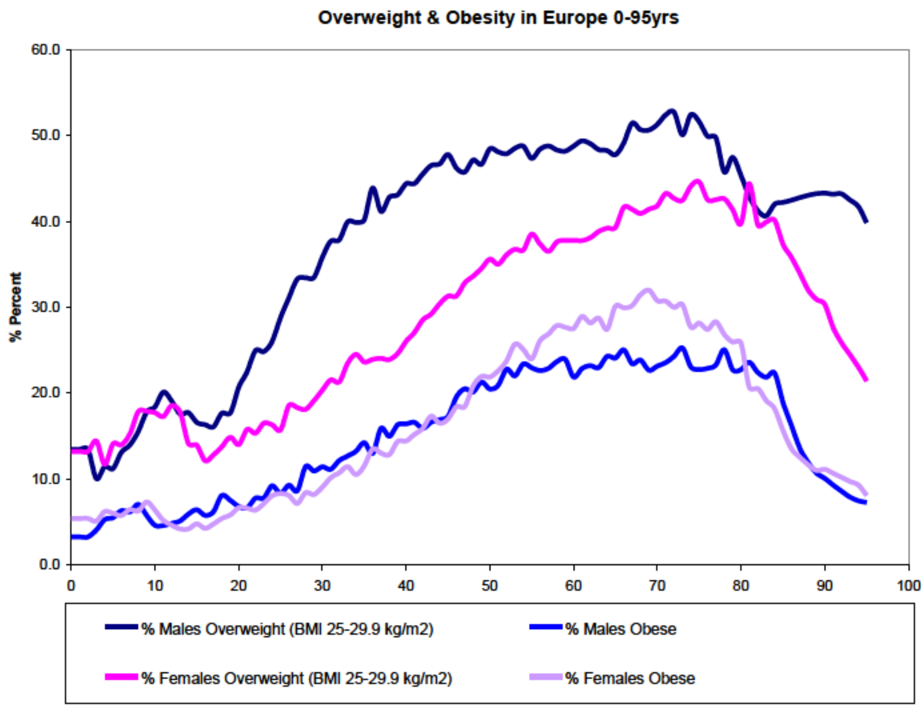
For details of the country data available and the use of alternative or interpolated data, see Annex 2

4. Data on Mean BMI, % Overweight/Obesity in the European Union and for individual member states

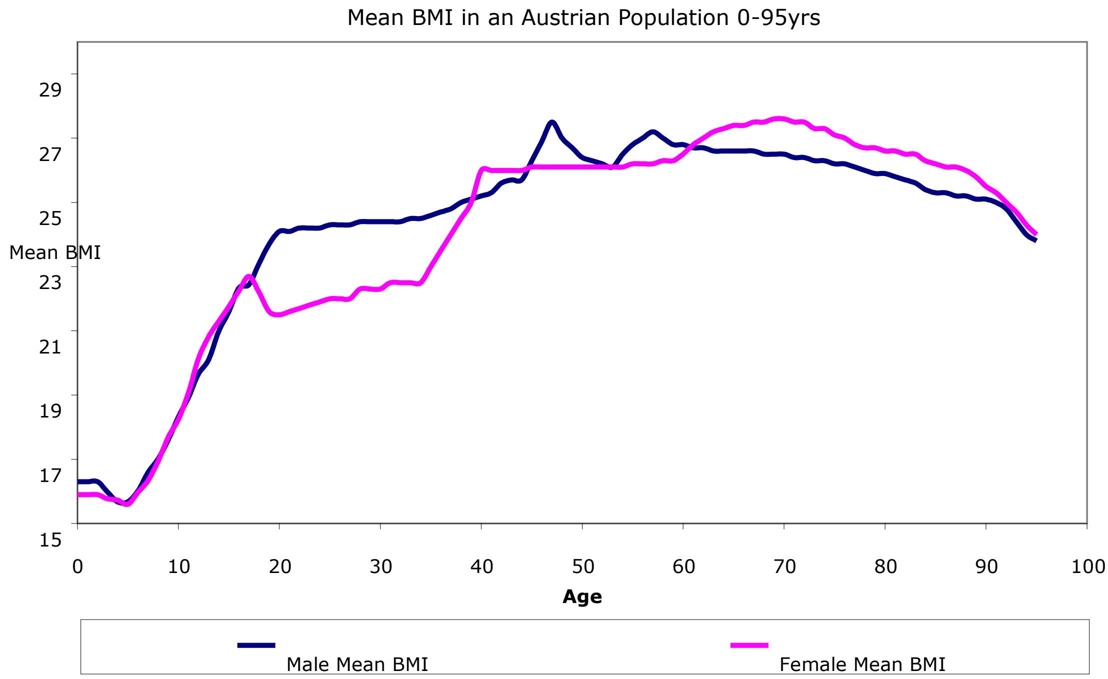
The following figures represent the data supplied (in Excel spreadsheet form) for the DYNAMO-HIA project.

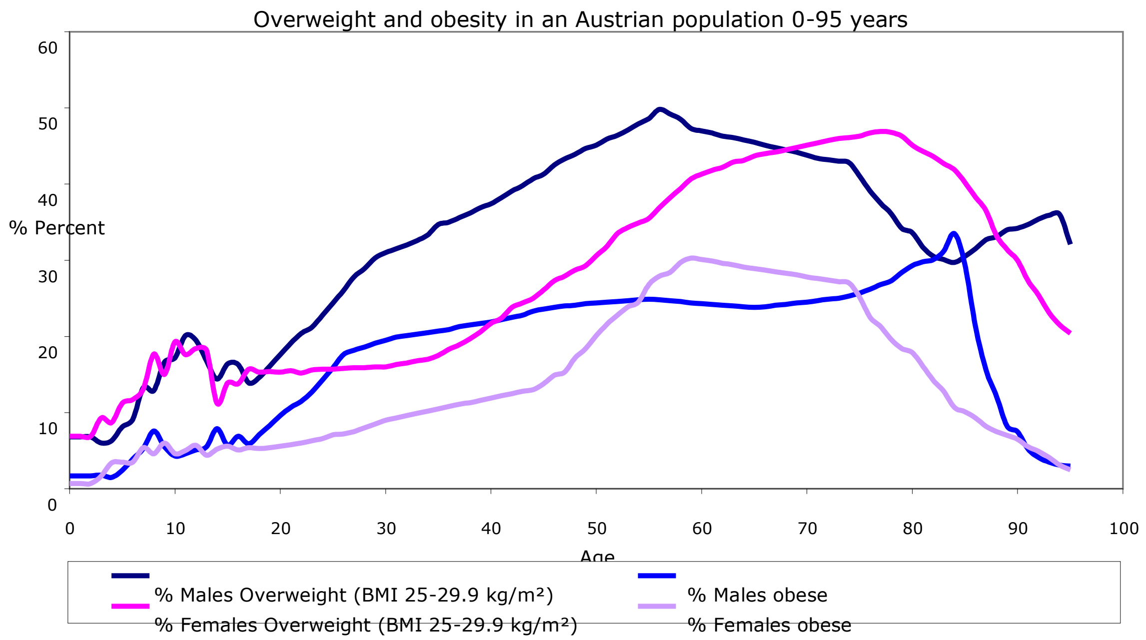
European Union



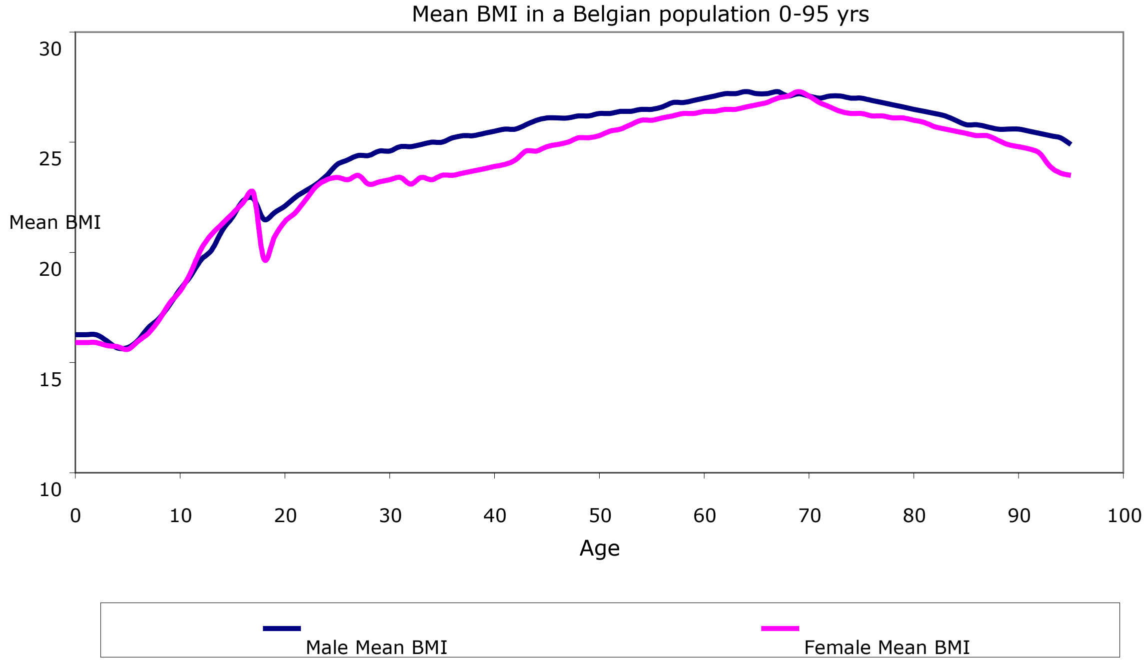


Austria

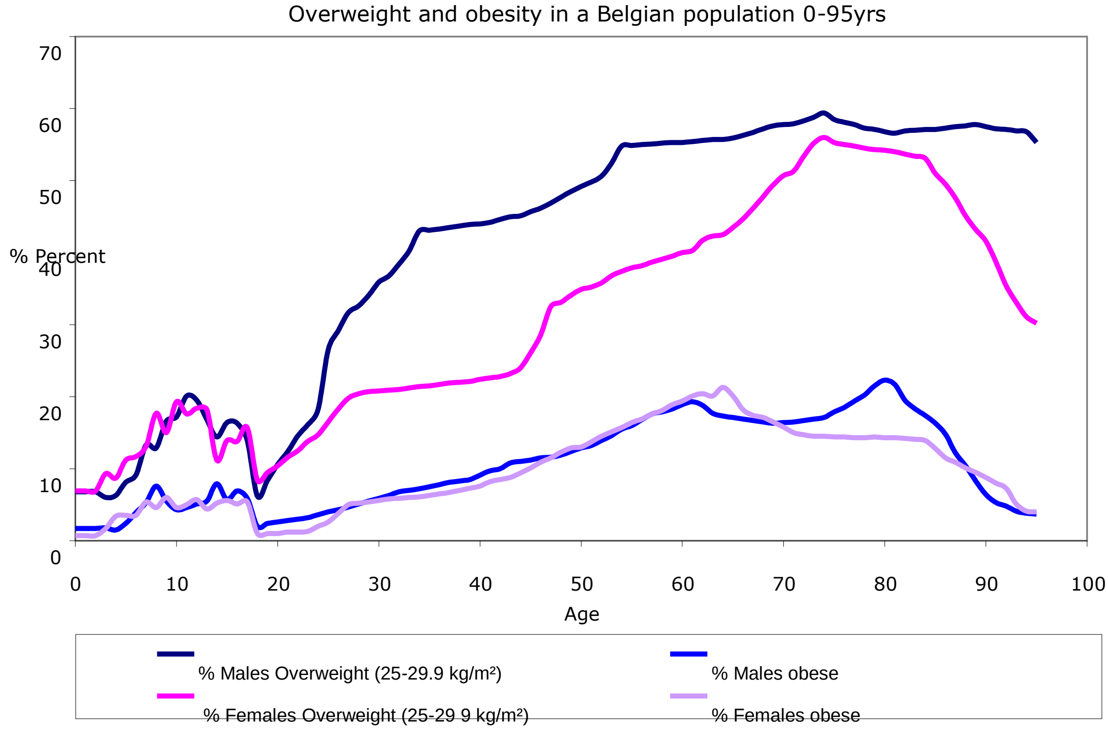

Mean BMI in an Austrian Population 0-95yrs
Mean BMI
29
27
25
23
21
19
17
15
0
10
20
30
40
50
60
70
80
90
100
Age
Male Mean BMI
Female Mean BMI


Overweight and obesity in an Austrian population 0-95 years
% Percent
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Age
% Males Overweight (BMI 25-29.9 kg/m²)
% Females Overweight (BMI 25-29.9 kg/m²)
% Males obese
% Females obese

Belgium

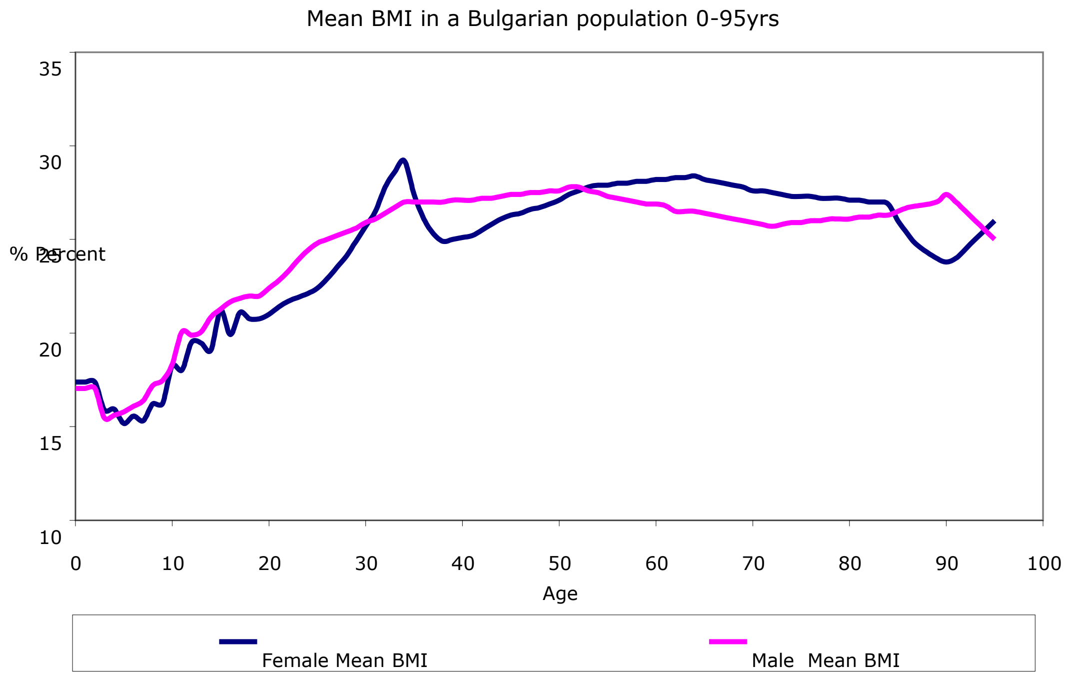


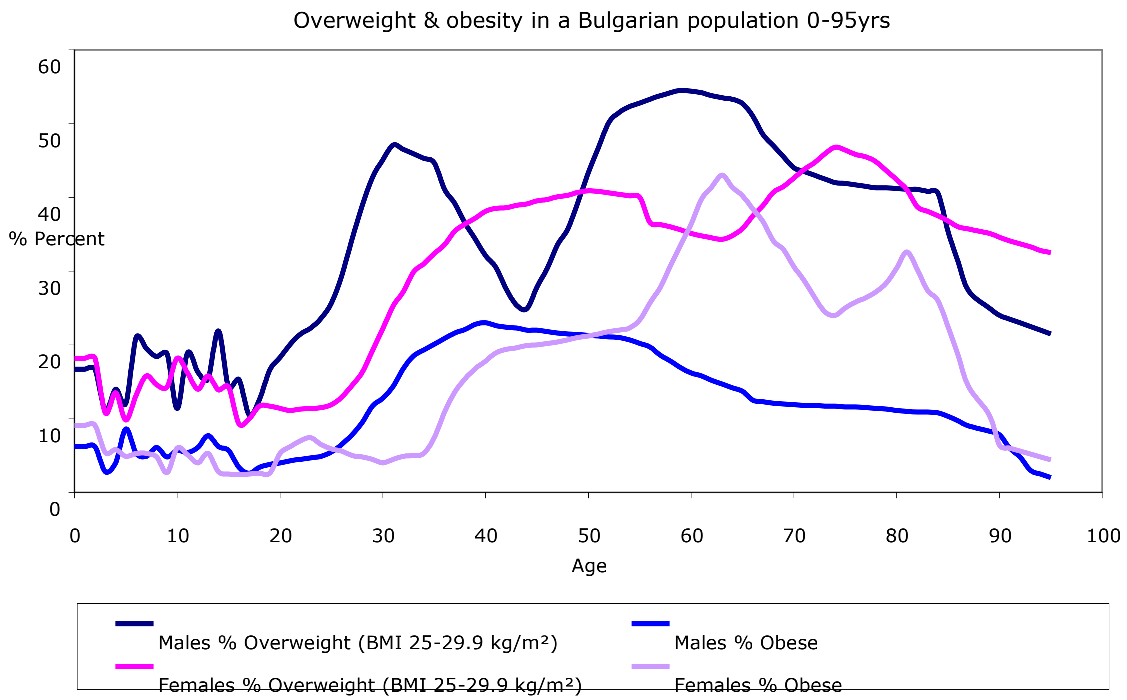
Mean BMI in a Belgian population 0-95 yrs
30
25
Mean BMI
20
15
10
0
10
20
30
40
50
60
70
80
90
100
Age
Male Mean BMI
Female Mean BMI



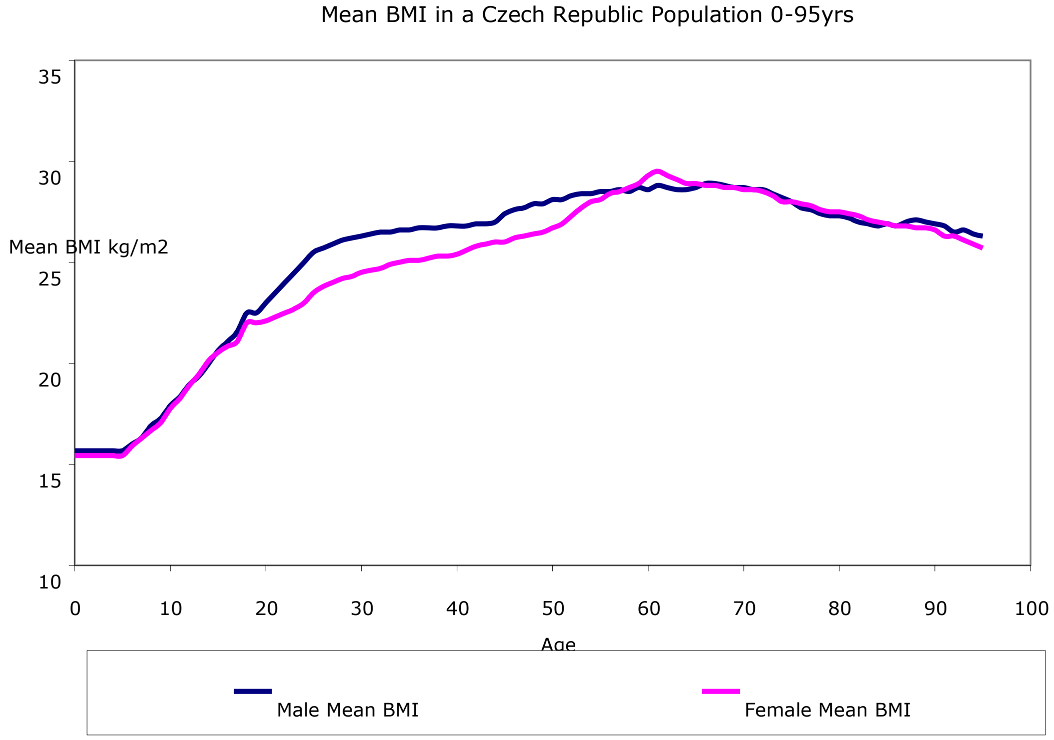
Overweight and obesity in a Belgian population 0-95yrs
70
60
50
% Percent
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Age
% Males Overweight (25-29.9 kg/m²)
% Males obese
% Females Overweight (25-29 9 kg/m²)
% Females obese

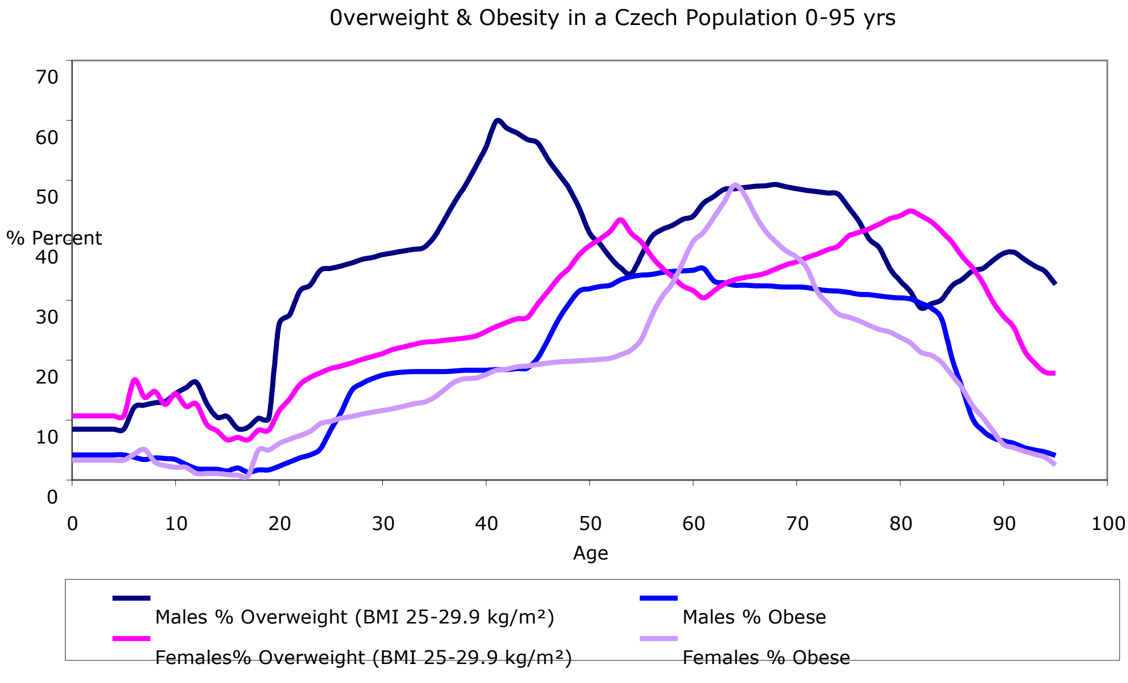
Bulgaria


Mean BMI in a Bulgarian population 0-95yrs
35
30
25
20
15
10
% Percent
0
10
20
30
40
50
60
70
80
90
100
Age
Female Mean BMI
Male Mean BMI

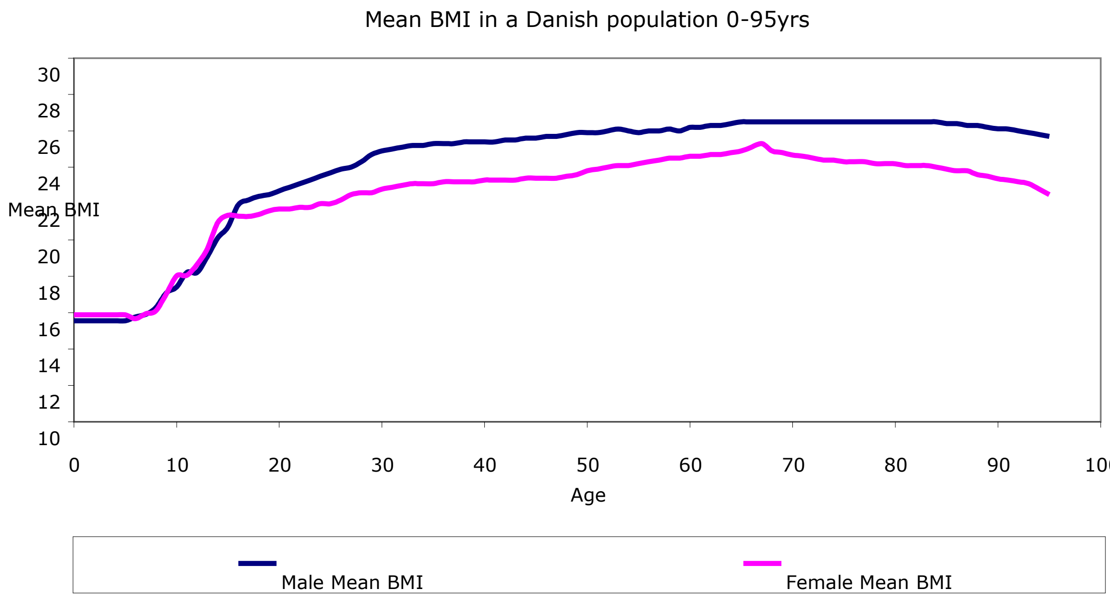

Overweight & obesity in a Bulgarian population 0-95yrs
60
50
40
30
20
10
0
% Percent
0
10
20
30
40
50
60
70
80
90
100
Age
Males % Overweight (BMI 25-29.9 kg/m²)
Males % Obese
Females % Overweight (BMI 25-29.9 kg/m²)
Females % Obese

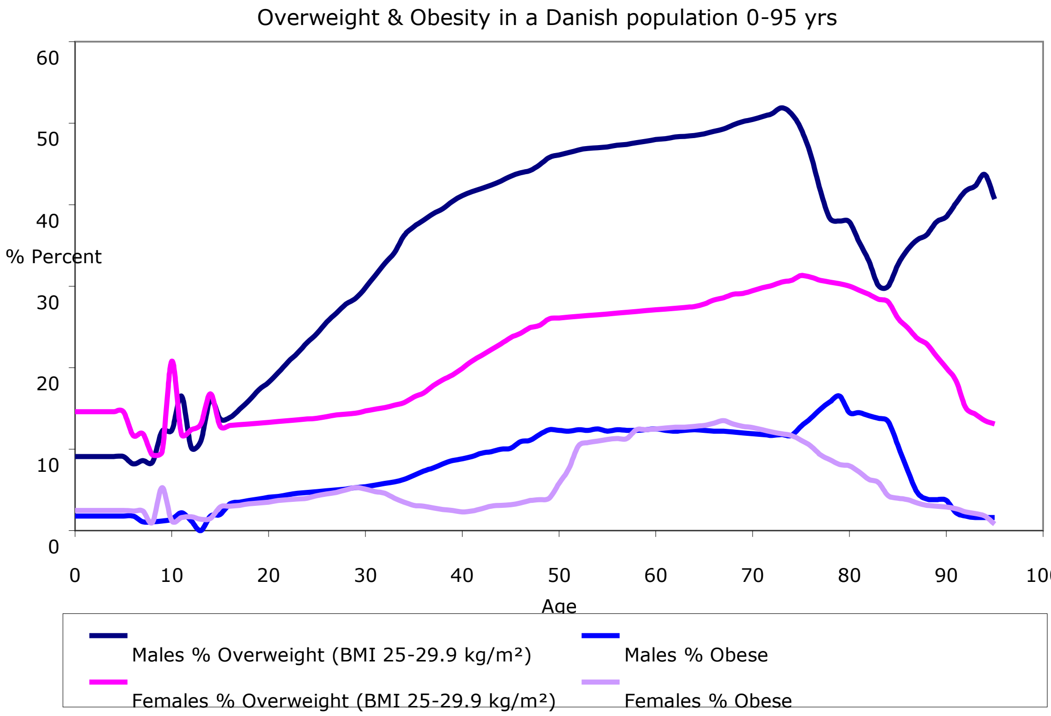
Czech Republic



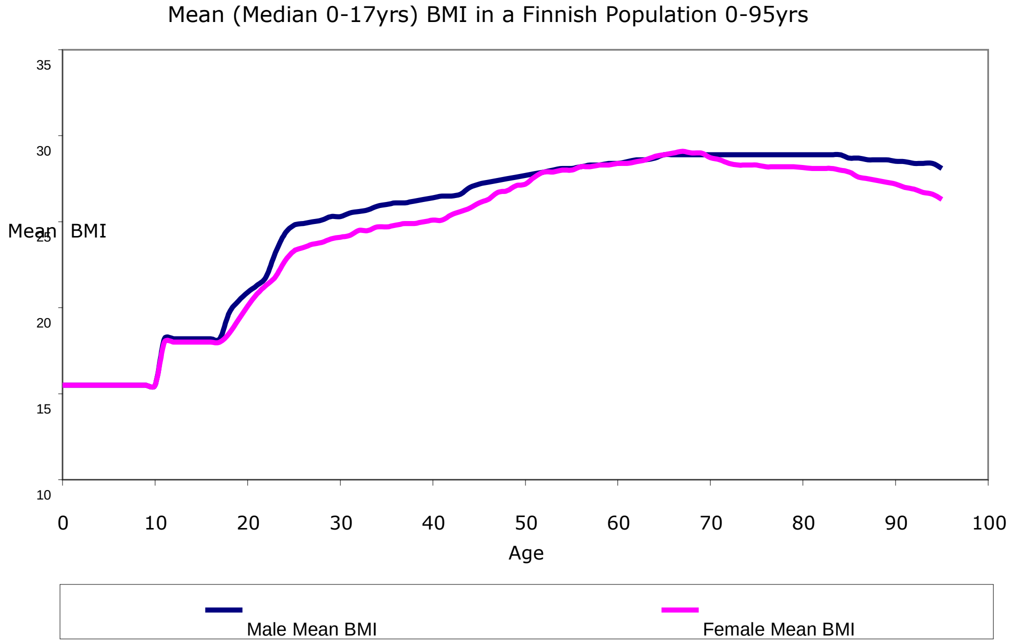


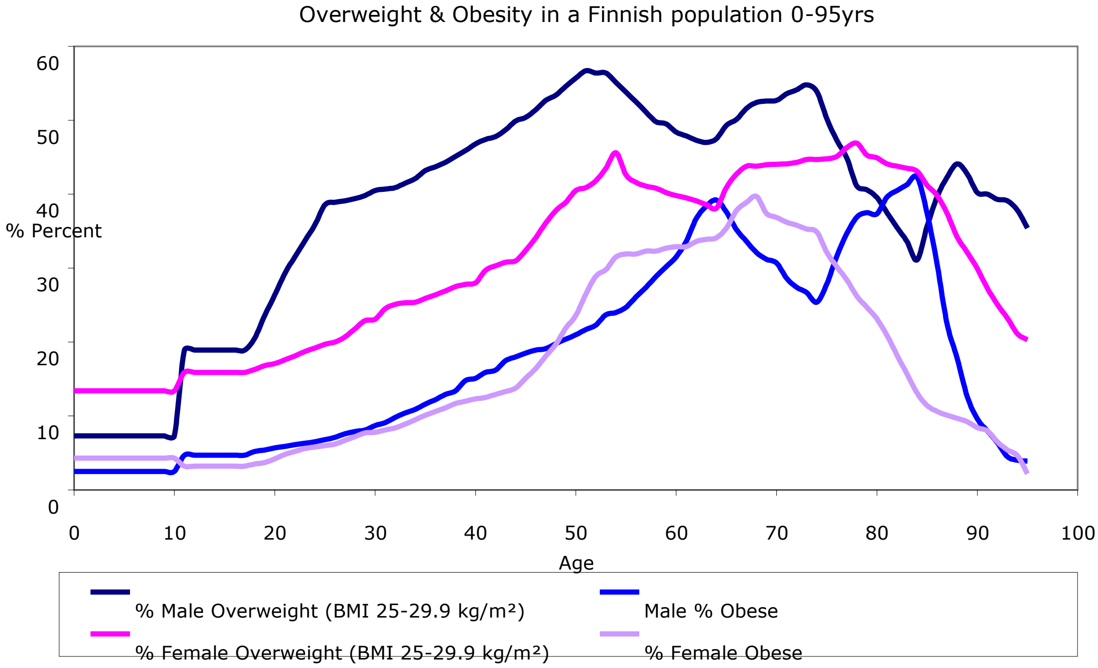
Denmark


Mean BMI in a Danish population 0-95yrs
Mean BMI
30
28
26
24
22
20
18
16
14
12
10
0
10
20
30
40
50
60
70
80
90
100
Age
Male Mean BMI
Female Mean BMI

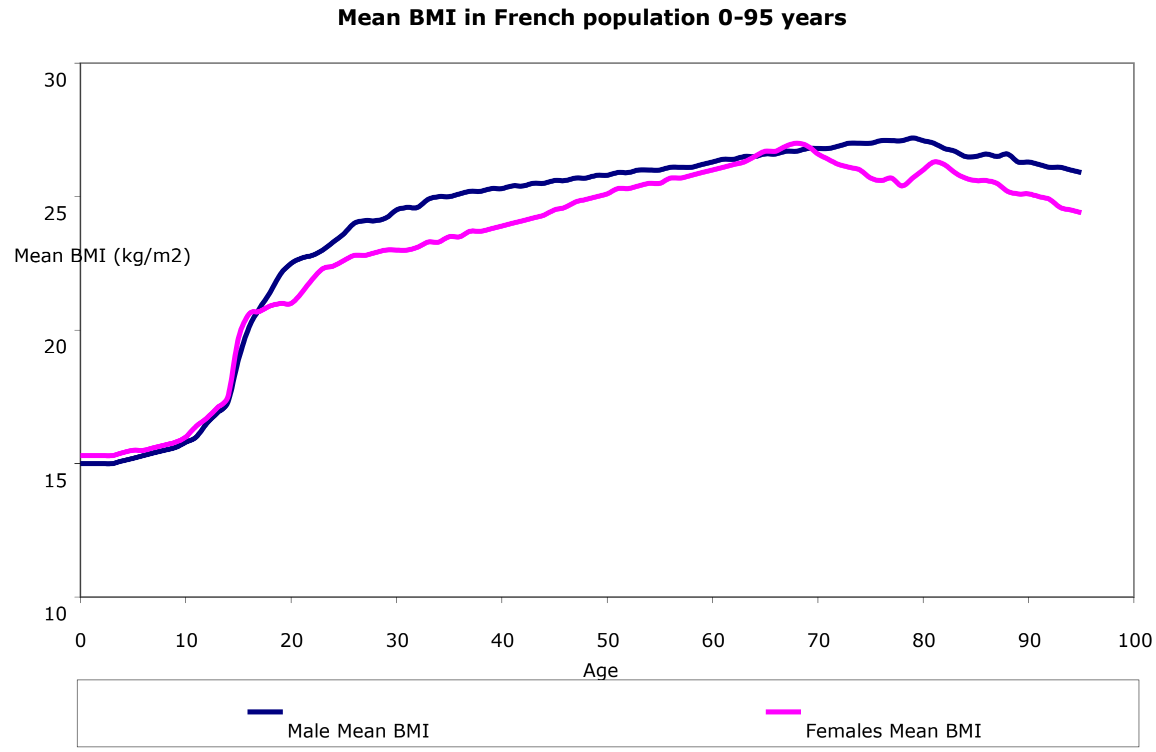

Overweight & Obesity in a Danish population 0-95 yrs
% Percent
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Age
Males % Overweight (BMI 25-29.9 kg/m²)
Males % Obese
Females % Overweight (BMI 25-29.9 kg/m²)
Females % Obese

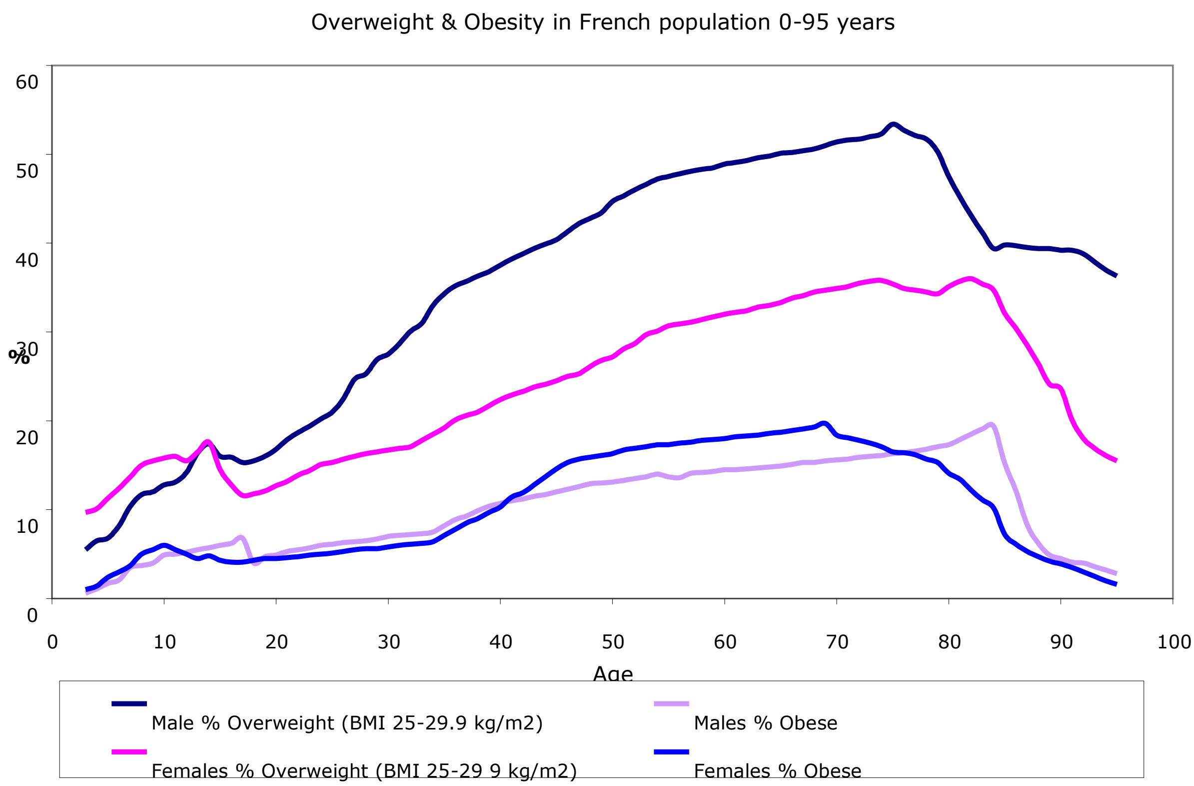
Finland


Mean (Median 0-17yrs) BMI in a Finnish Population 0-95yrs
35
30
25
20
15
10
Mean BMI
0
10
20
30
40
50
60
70
80
90
100
Age
Male Mean BMI
Female Mean BMI


Overweight & Obesity in a Finnish population 0-95yrs
60
50
40
30
20
10
0
% Percent
0
10
20
30
40
50
60
70
80
90
100
Age
% Male Overweight (BMI 25-29.9 kg/m²)
Male % Obese
% Female Overweight (BMI 25-29.9 kg/m²)
% Female Obese

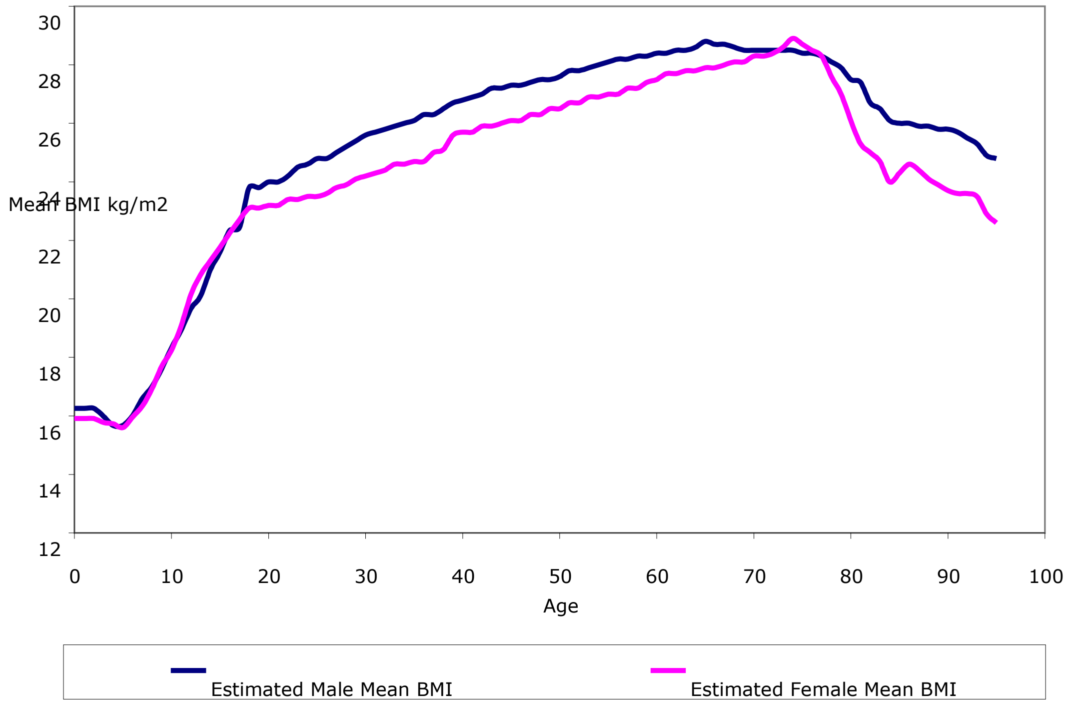
France


Mean BMI in French population 0-95 years
30
25
20
15
10
Mean BMI (kg/m2)
0
10
20
30
40
50
60
70
80
90
100
Age
Male Mean BMI
Females Mean BMI

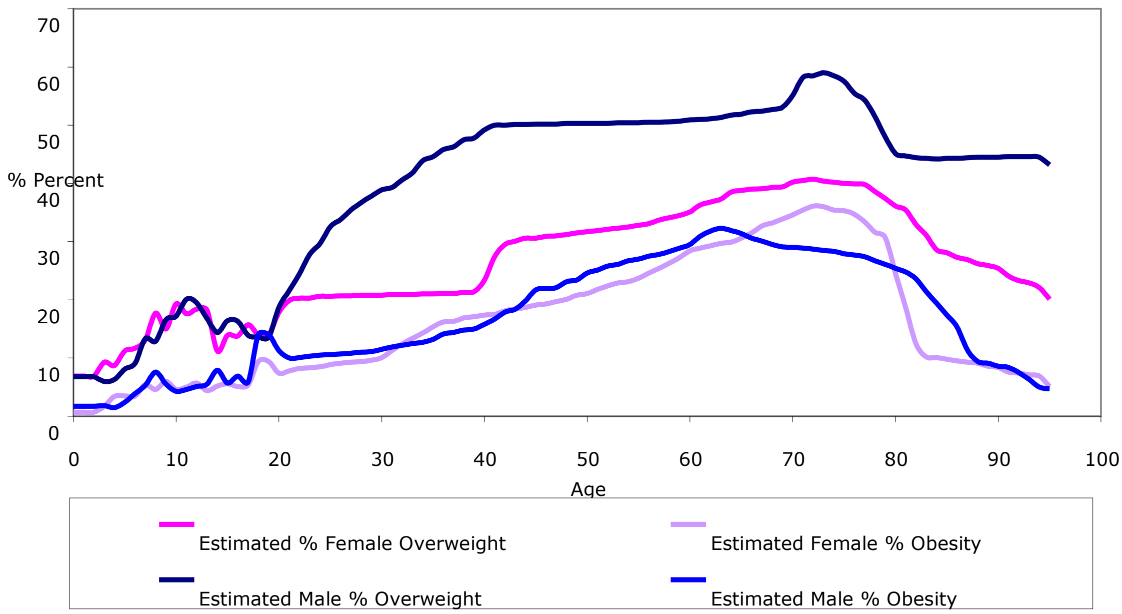

Overweight & Obesity in French population 0-95 years
60
50
40
30
20
10
0
%
0
10
20
30
40
50
60
70
80
90
100
Age
Male % Overweight (BMI 25-29.9 kg/m2)
Males % Obese
Females % Overweight (BMI 25-29 9 kg/m2)
Females % Obese

Germany

Mean BMI in a German population 0-95yrs

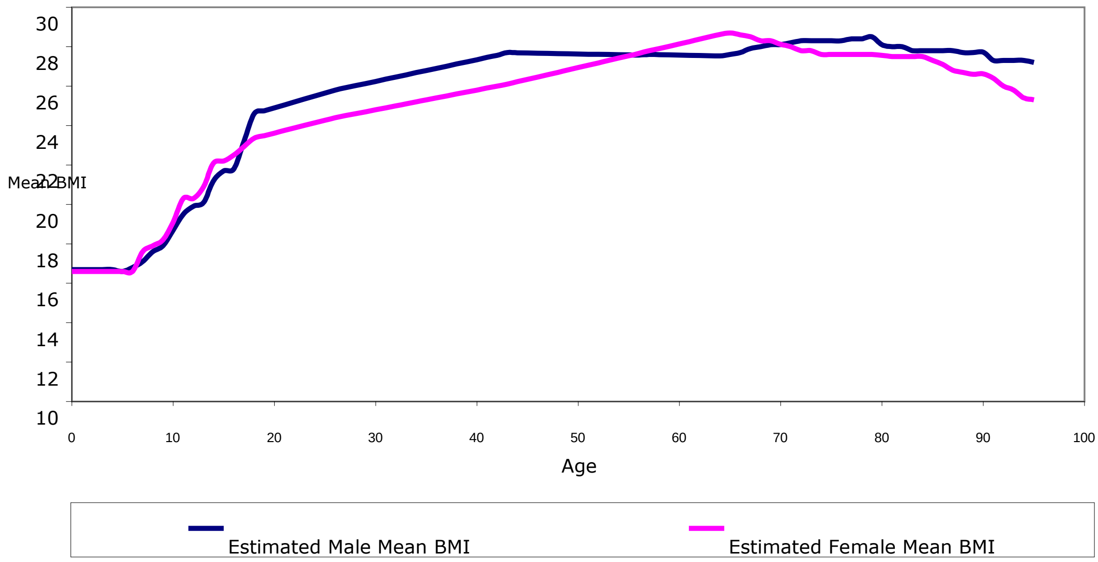


Overweight & Obesity in a German population 0-95yrs

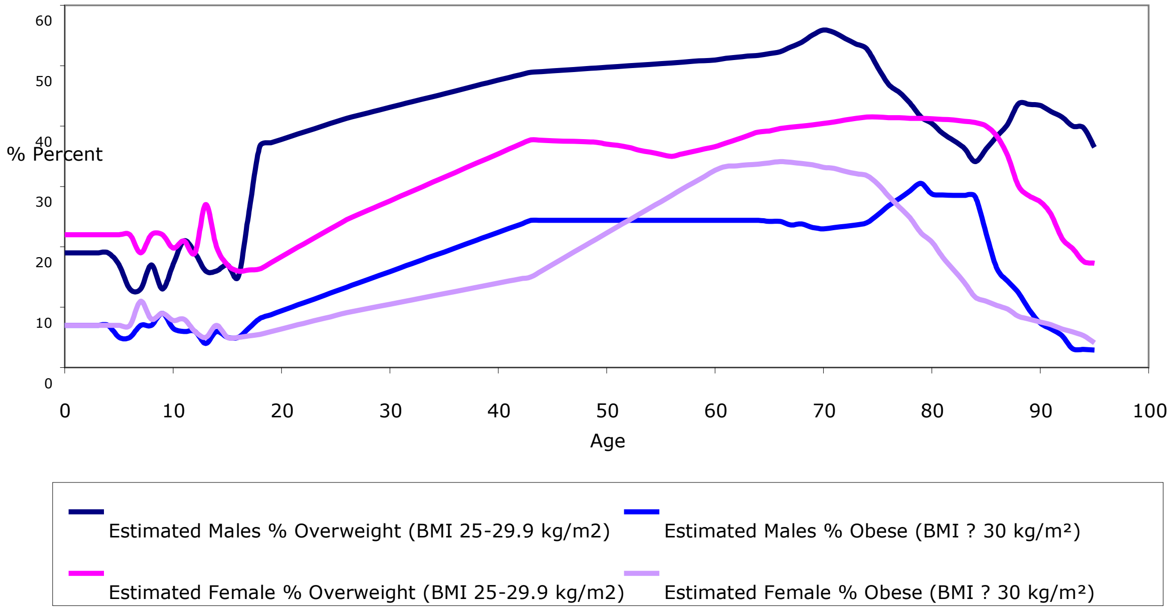


Ireland

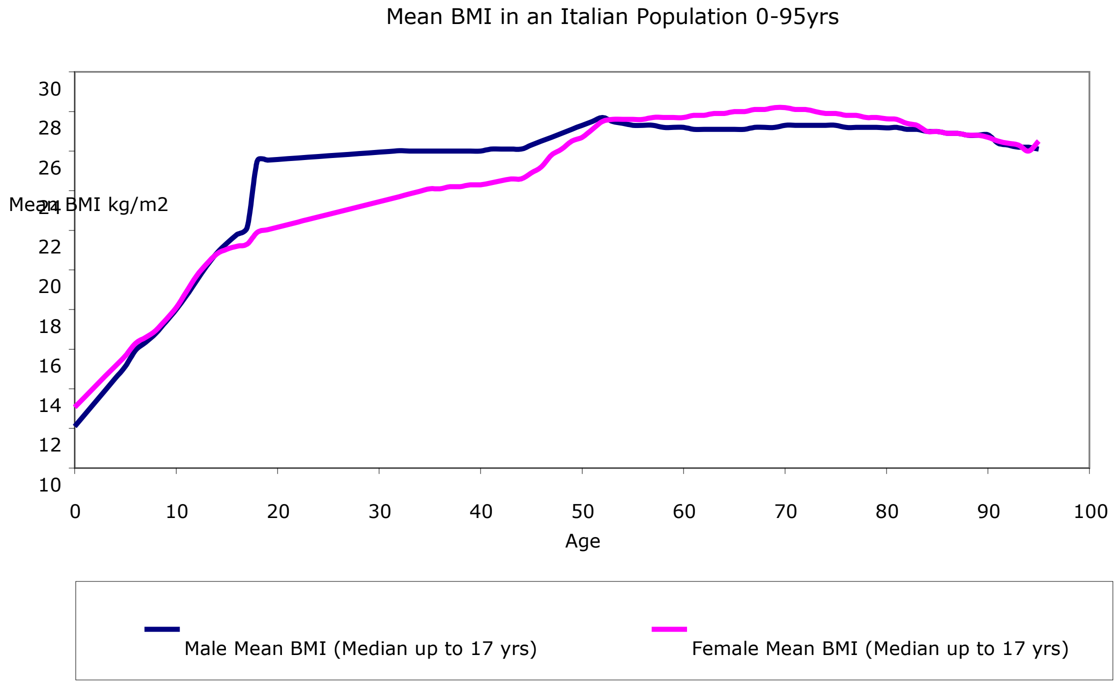
Mean BMI in Republic of Ireland population 0-95 years



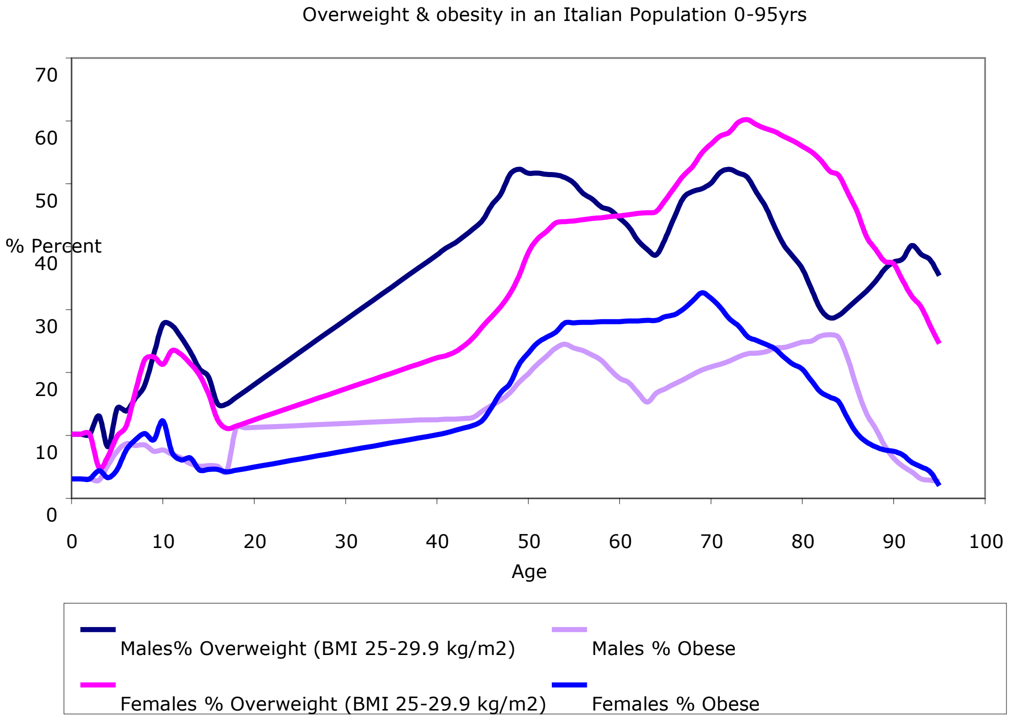
Overweight & Obesity in a Republic of Ireland population 0-95 years



Italy

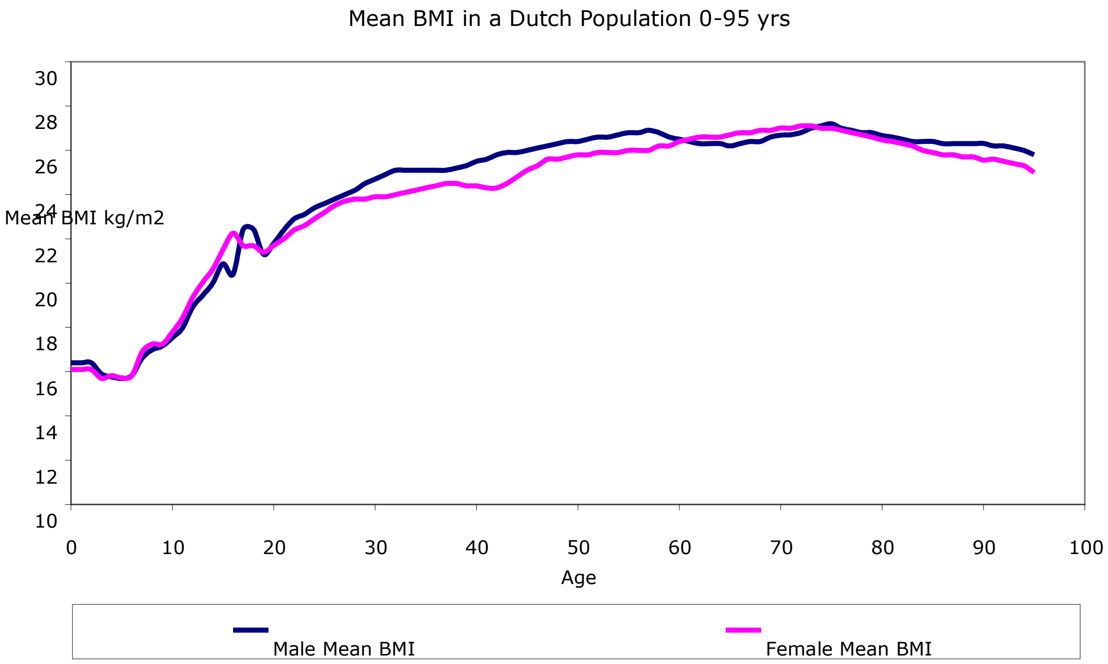


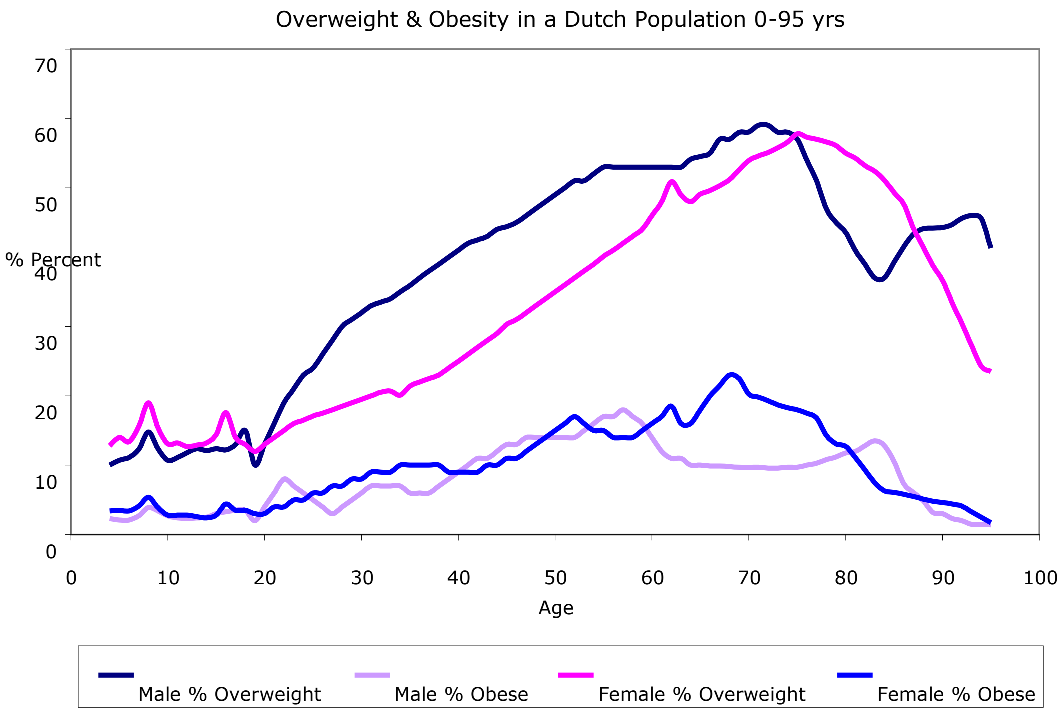
Mean BMI in an Italian Population 0-95yrs
Mean BMI kg/m2
30
28
26
24
22
20
18
16
14
12
10
0
10
20
30
40
50
60
70
80
90
100
Age
Male Mean BMI (Median up to 17 yrs)
Female Mean BMI (Median up to 17 yrs)



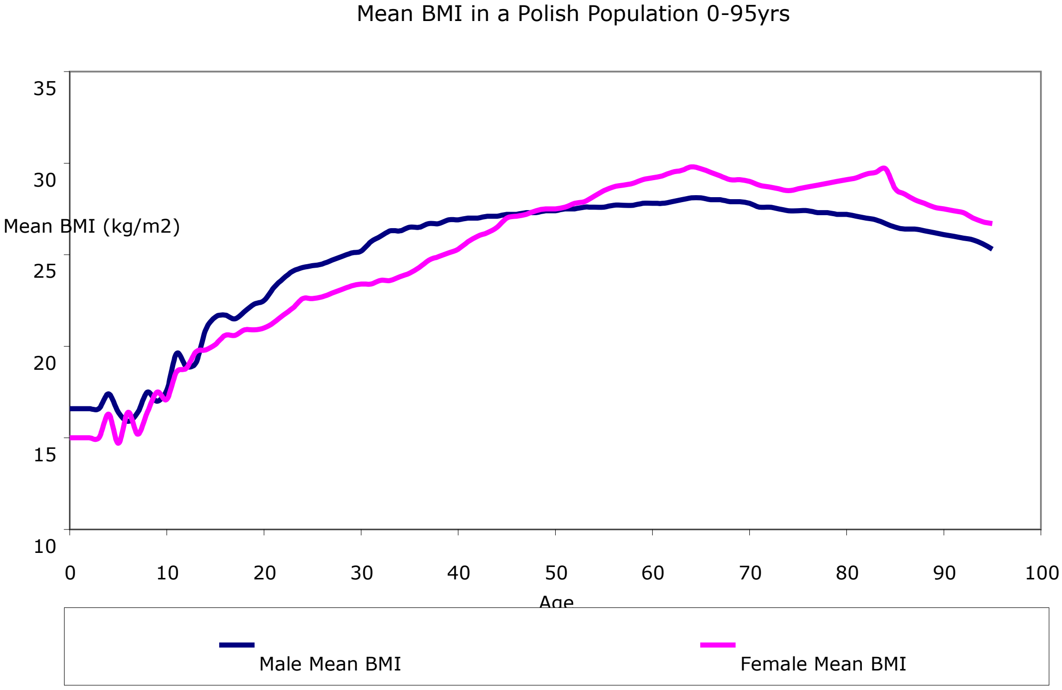
Overweight & obesity in an Italian Population 0-95yrs
% Percent
70
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Age
Males% Overweight (BMI 25-29.9 kg/m2)
Males % Obese
Females % Overweight (BMI 25-29.9 kg/m2)
Females % Obese

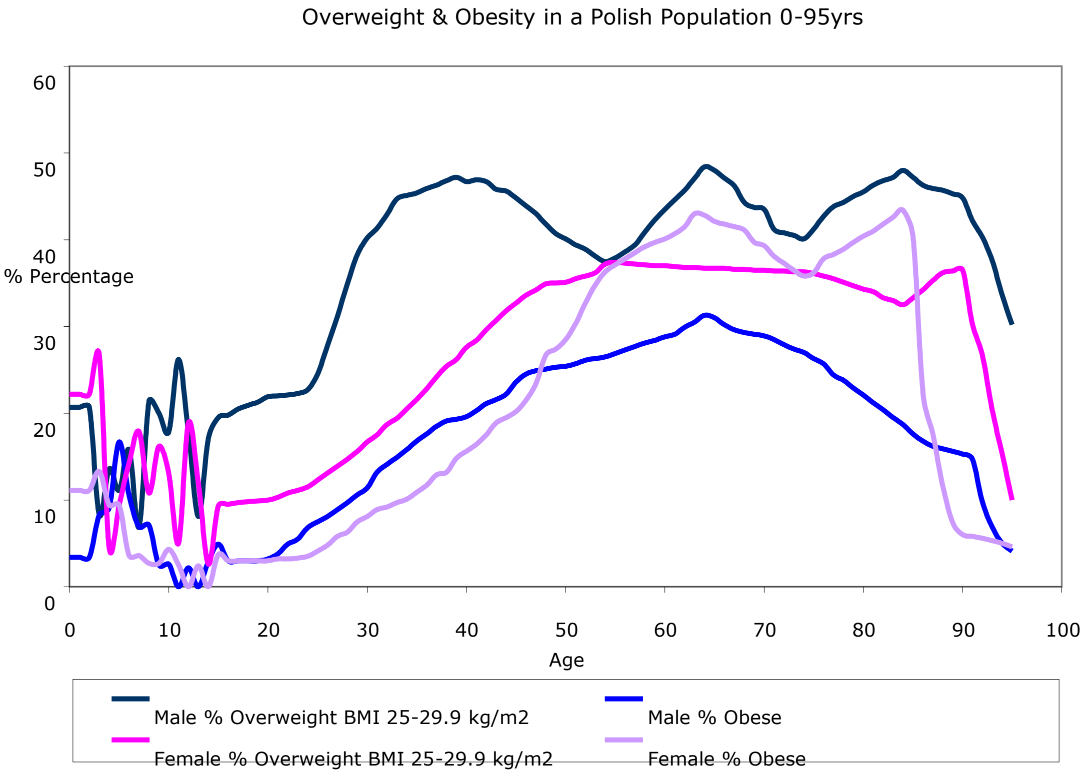
Netherlands



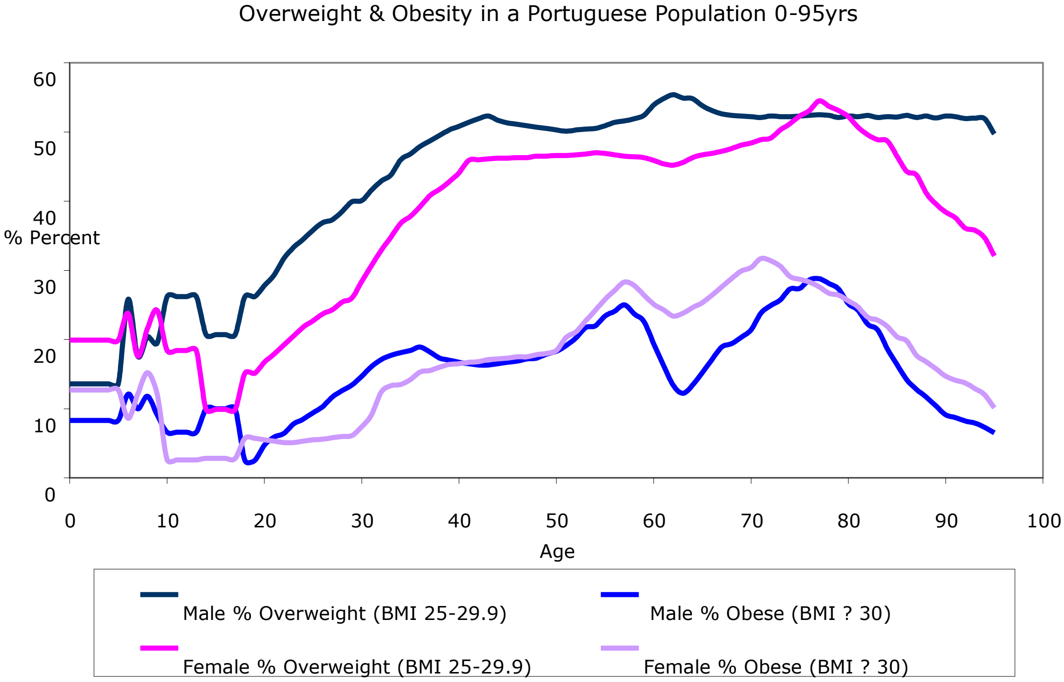


Poland

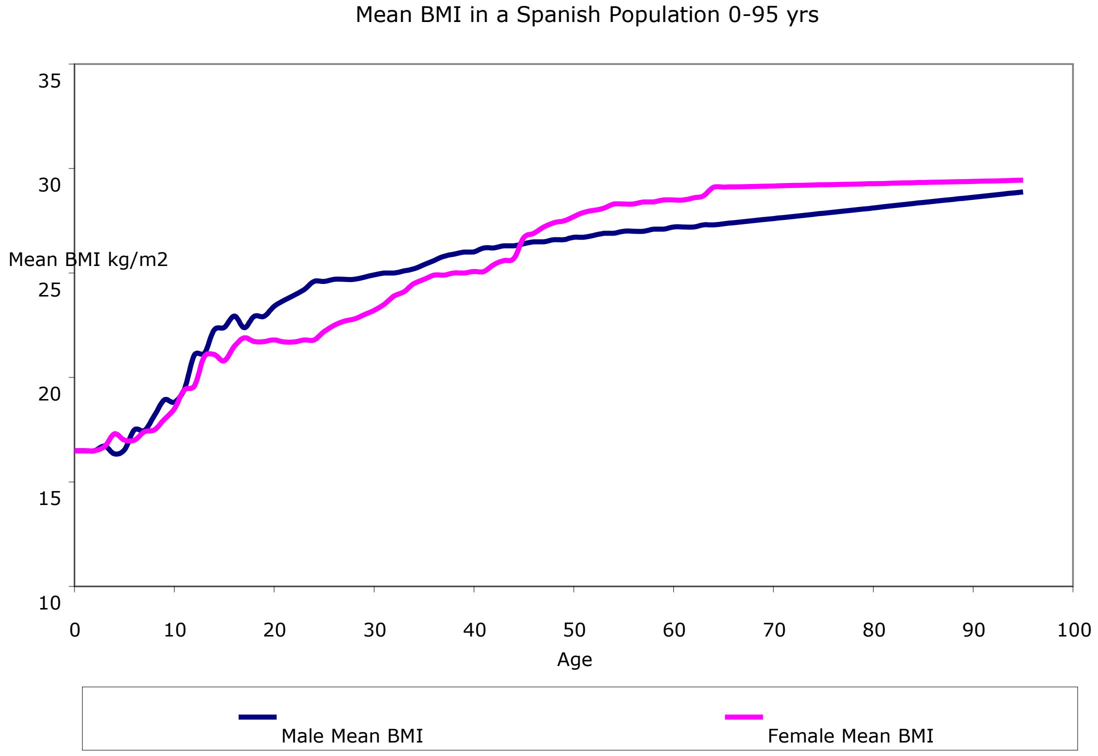

Mean BMI in a Polish Population 0-95yrs
Mean BMI (kg/m2)
35
30
25
20
15
10
0
10
20
30
40
50
60
70
80
90
100
Age
Male Mean BMI
Female Mean BMI

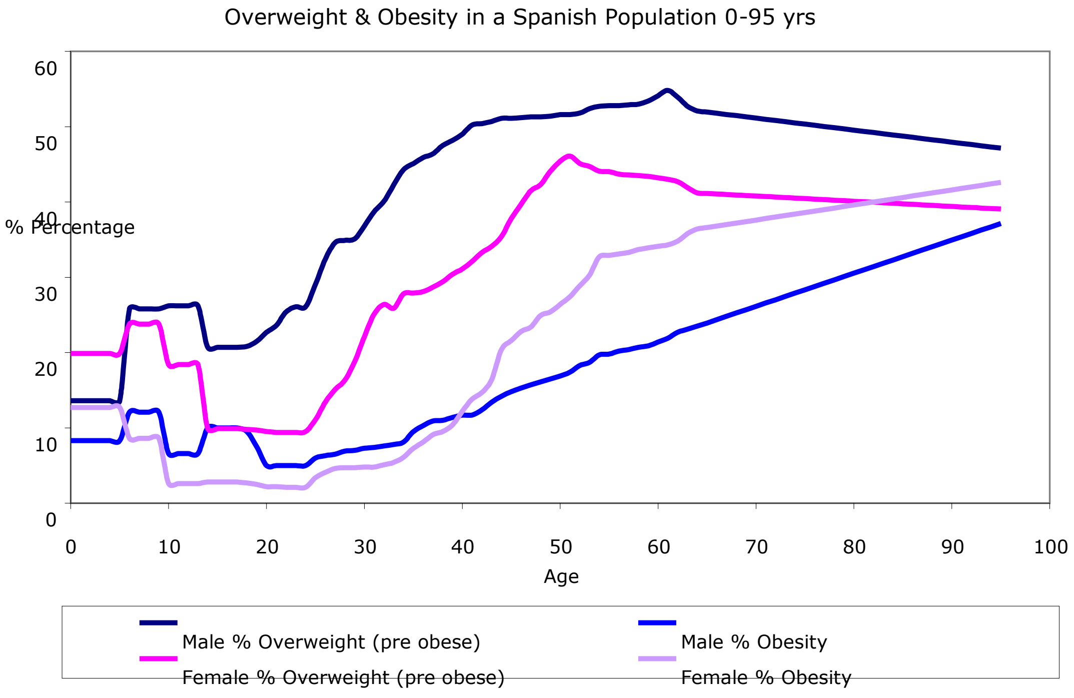

Overweight & Obesity in a Polish Population 0-95yrs
% Percentage
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Age
Male % Overweight BMI 25-29.9 kg/m2
Male % Obese
Female % Overweight BMI 25-29.9 kg/m2
Female % Obese

Portugal

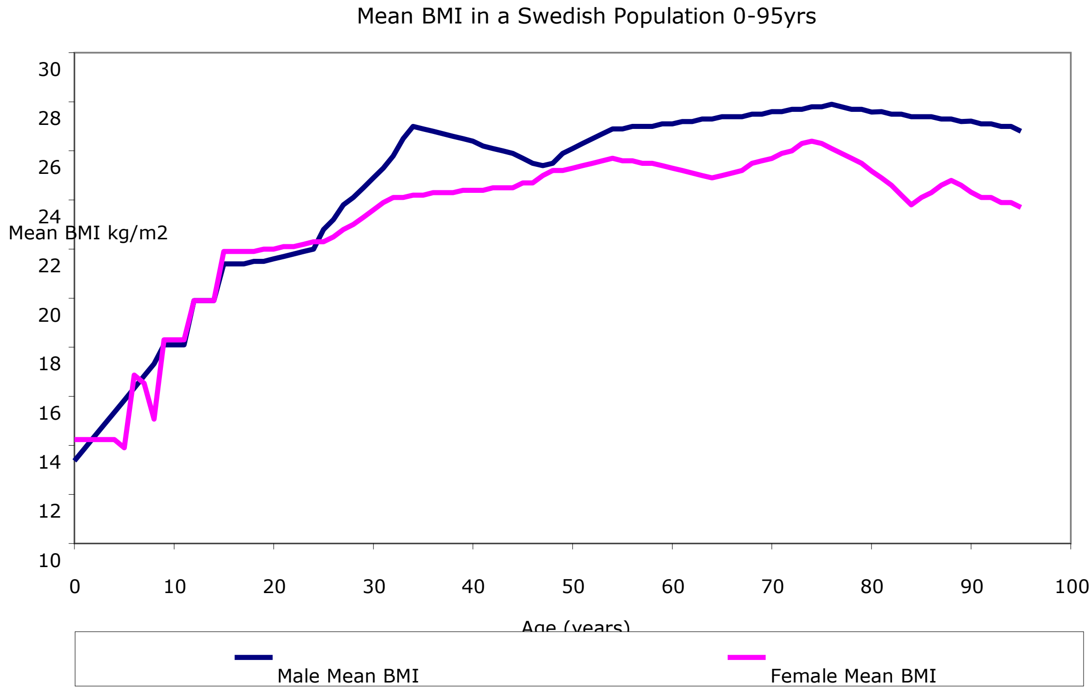

Overweight & Obesity in a Portuguese Population 0-95yrs
% Percent
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Age
Male % Overweight (BMI 25-29.9)
Male % Obese (BMI ? 30)
Female % Overweight (BMI 25-29.9)
Female % Obese (BMI ? 30)

Spain

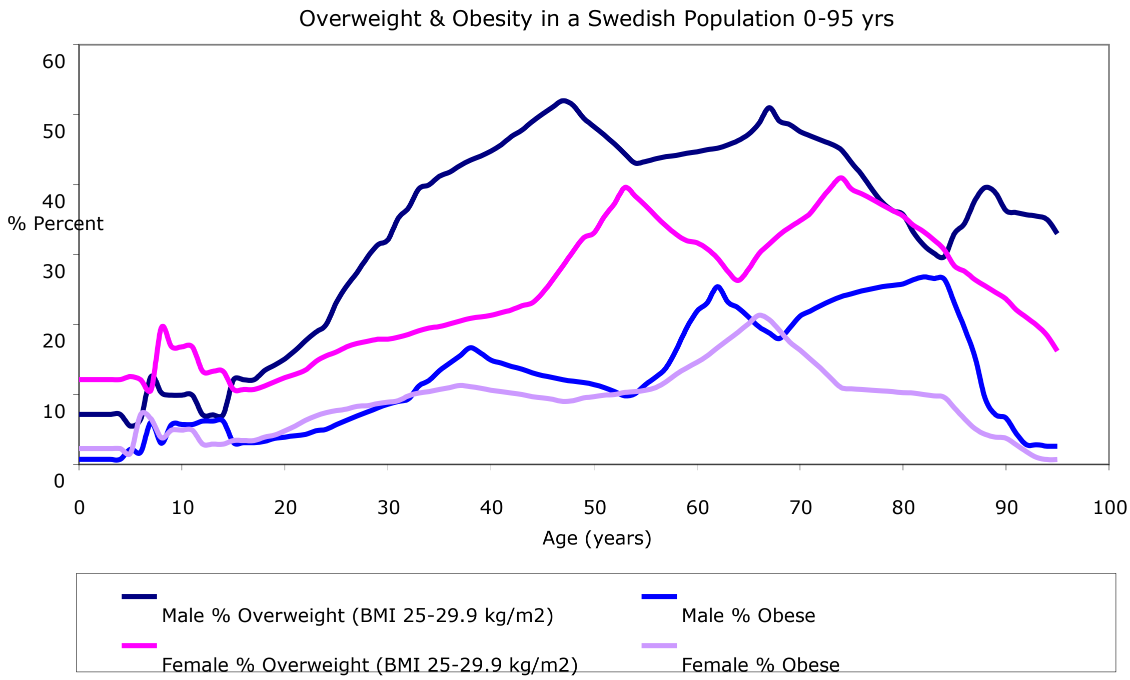

Mean BMI in a Spanish Population 0-95 yrs
35
30
25
20
15
10
Mean BMI kg/m2
0
10
20
30
40
50
60
70
80
90
100
Age
Male Mean BMI
Female Mean BMI


Overweight & Obesity in a Spanish Population 0-95 yrs
60
50
40
30
20
10
0
% Percentage
0
10
20
30
40
50
60
70
80
90
100
Age
Male % Overweight (pre obese)
Male % Obesity
Female % Overweight (pre obese)
Female % Obesity

Sweden

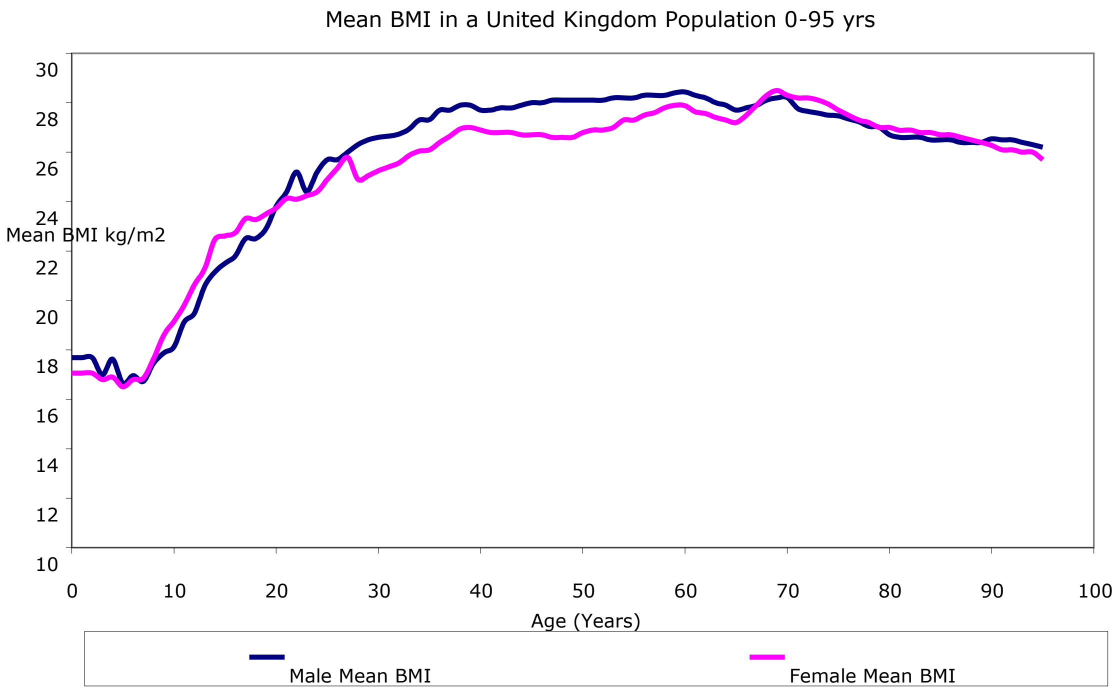


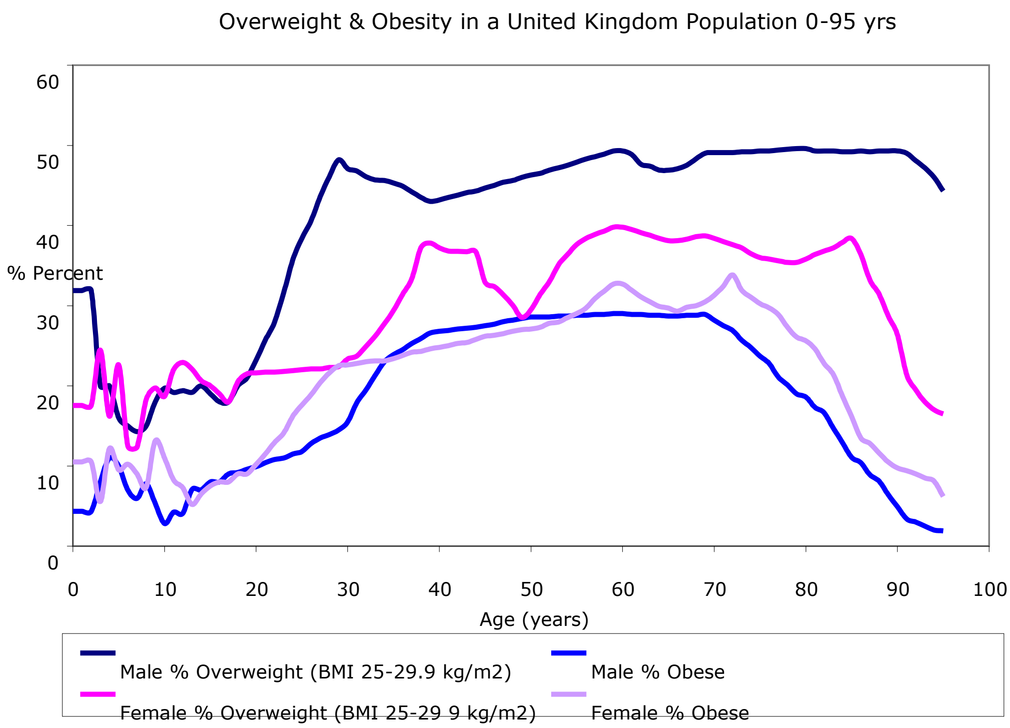
Mean BMI in a Swedish Population 0-95yrs
Mean BMI kg/m2
30
28
26
24
22
20
18
16
14
12
10
0
10
20
30
40
50
60
70
80
90
100
Age (years)
Male Mean BMI
Female Mean BMI



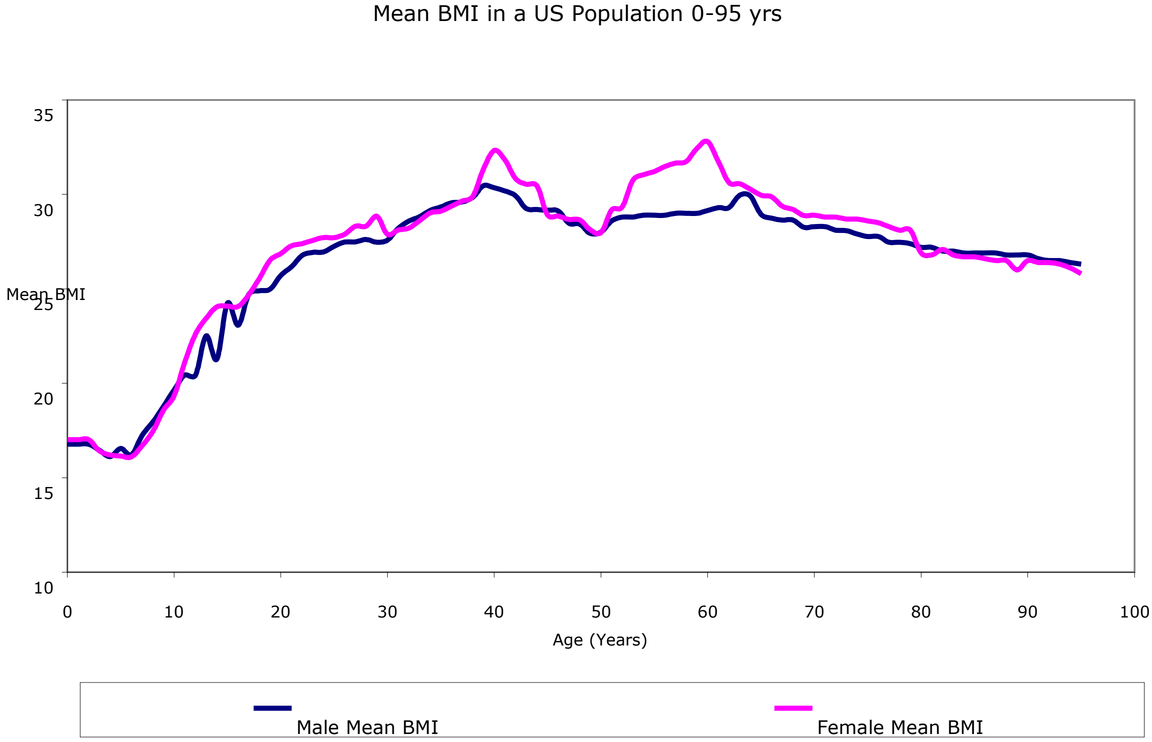
Overweight & Obesity in a Swedish Population 0-95 yrs
% Percent
60
50
40
30
20
10
0
0
10
20
30
40
50
60
70
80
90
100
Age (years)
Male % Overweight (BMI 25-29.9 kg/m2)
Male % Obese
Female % Overweight (BMI 25-29.9 kg/m2)
Female % Obese

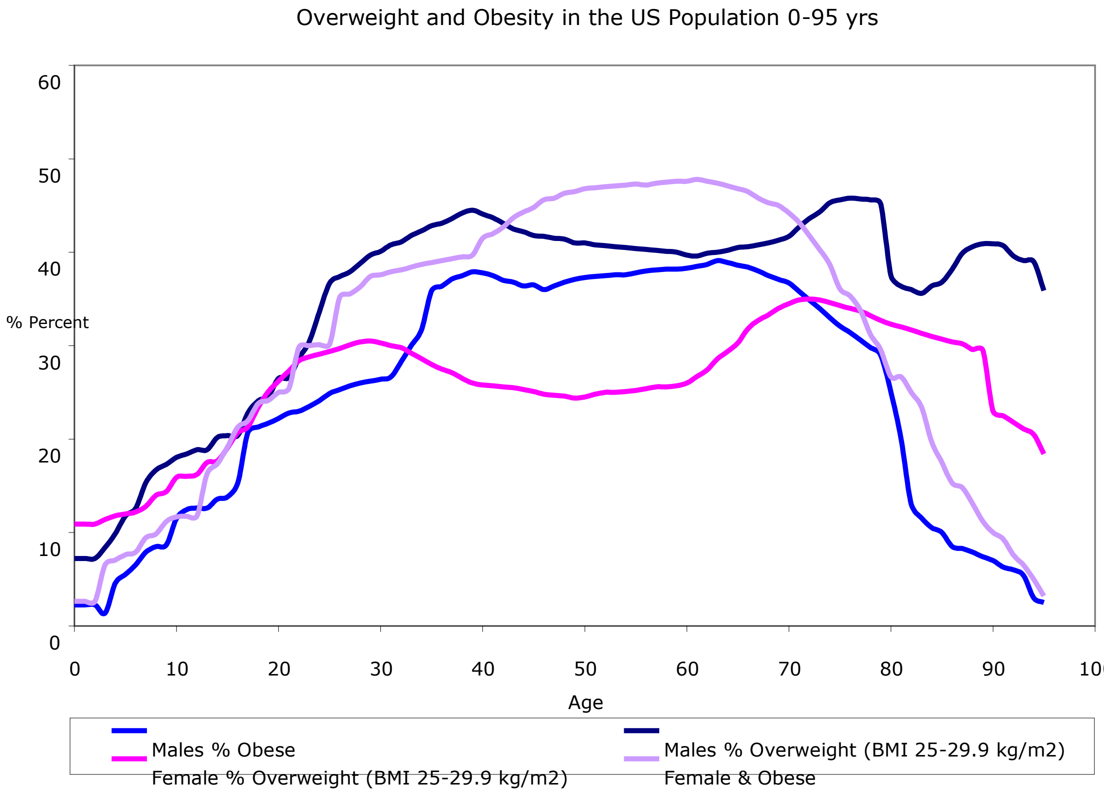
United Kingdom





USA


Mean BMI in a US Population 0-95 yrs
35
30
25
20
15
10
Mean BMI
0
10
20
30
40
50
60
70
80
90
100
Age (Years)
Male Mean BMI
Female Mean BMI


Overweight and Obesity in the US Population 0-95 yrs
60
50
40
30
20
10
0
% Percent
0
10
20
30
40
50
60
70
80
90
100
Age
Males % Obese
Males % Overweight (BMI 25-29.9 kg/m2)
Female % Overweight (BMI 25-29.9 kg/m2)
Female & Obese

5 Discussion of the data provided on BMI mean, and prevalence of overweight and obesity

This section summarises the nature of the data used for the estimates of mean BMI, and the prevalence of overweight and obesity. Further information is given in Annex 2.

Belgium

In children no appropriate data were available. In adults although the data came from a large survey they were regional not national. Therefore it would appropriate to replace the data when a large national survey becomes available.

Bulgaria

Good nationally representative data were available for both adults and children.

Czech Republic

Good nationally representative data were available for both adults and children.

Denmark

The data provided were older than desirable and should be replaced as soon as alternative more suitable data become available.

Finland
There were very limited child data. The adult data are old and when more representative data become available they should be replaced. High quality trend data are available in Finland between 1982 and 1997.

France

Good recent, national surveys are available for children and adults.

Germany

Good recent, national surveys are available for children and adults.

Ireland

Good national fairly recent (2002) surveys are available for children. Good data are available for adults, though it included Northern Ireland as well as the Republic of Ireland.

Italy

There is only limited data coverage. National survey are available but these are not representative. These data should be replaced as soon as a more appropriate national survey becomes available.

Netherlands

The data are acceptable should be replaced when alternative measured nationally representative data become available.

Poland

National data for 2003-7 has been provided by personal communication for the purpose of this report.

Portugal

Very limited categorical data for children and adults are available: but no continuous data. These data should be replaced as soon as better data become available.

Spain

Good national survey data are available for children and adults. More recent data should become available during 2010.

Sweden

Few childhood data are available apart from children around 10 years old.

United Kingdom

Good data are available for both children and adults in England and Scotland. Measured data do not exist for Wales but it is generally considered acceptable to use English data in lieu.

For a more detailed discussion of the quality of the data used in each country and the sources of alternative data used for the DYNAMO-HIA estimates, see Annex 2.

5.1 Potential sources of uncertainty related to the data sources

There is a remarkable shortage of high quality information on the prevalence of excess bodyweight in European member states. The data obtained comes from a variety of sources, each using its own approach. For the data used in DYNAMO-HIA all surveys in which height and weight information were collected through questionnaire or other self-reporting procedures were eliminated, and only data collected using professionally measured heights and weights were used.

Data collected in different member states not only use different approaches and methods, but are also collected at different times. Given the rapidly changing prevalence of obesity being recorded in several member states, the year of collection of survey data can make a significant difference to the estimated prevalence levels. Ideally, a multi-national survey should be conducted which collects data in a single time period from across all populations.

In addition, member state population profiles are changing over time, with changing birth rates, ageing populations, extended life expectancy, immigration from non-EU regions and shifting patterns of migration within the EU.

Data on child obesity is more limited than that for adult obesity, as interest in obesity among children is very recent. Trends data are very difficult to obtain for children especially, as comparable surveys conducted several years apart have been undertaken in only very few member states.

5.2 Comparabiltiy

Data were estimated for each member state using the best data available from surveys of measured weights and heights. Where data were missing, interpolated data or data from countries deemed sufficiently similar were used. These estimations are discussed in Annex 2.

Part 2 Estimating risk factor-disease relationships

1. Choice of outcomes

Within the DYNAMO-HIA project, a limited number of diseases were modelled separately. The user can extend this list. These diseases already included in DYNAMO were selected based on two criteria: 1) best evidence of a risk factor-disease relationship for most risk factors examined in the project, i.e. for alcohol consumption, smoking and overweight/obesity, and 2) prevalence of the disease. Effects of the risk factor through diseases not modelled separately can be included in the DYNAMO by using RRs for all-cause mortality and all-cause disability. Estimating the association between the risk factor and all-cause disability involved a separate approach and is documented elsewhere [ref]. The selected disease outcomes presented here are:

- all-cause mortality;
- ischaemic heart disease (IHD);
- stroke;
- diabetes mellitus;
- chronic obstructive pulmonary disease (COPD);
- cancer of the lung;
- cancer of the breast;
- cancer of the colon and rectum;
- colon of the mouth and oropharynx;
- cancer of the oesophagus;
- cancer of the endometrium (uterus, womb);
- cancer of the kidney;
- cancer of the gallbladder.

Additional data for further diseases can be added subsequently. For example, based on published literature, diseases which would merit further investigation include

- metabolic syndrome;
- non-alcoholic fatty liver disease / steatosis;
- cancer of the liver;
- benign prostate hyperplasia;
- cancer of the prostate;
- pulmonary embolism;
- deep vein thrombosis;
- hyperuricaemia / gout;
- gallstones;
- reproductive disorders / infertility;
- polycystic ovary syndrome;
- osteoarthritis;
- lower back pain;
- psychiatric disorders;
- complications in pregnancy;
- complications in surgery.

2. General approach for obtaining data on relative risks

The associations provided in this report were based on a comprehensive review of the literature. This provided evidence for the direction and size of the relationship between BMI and the selected health outcomes. A number of meta-analyses and systematic reviews have been conducted and these are included in the tables in Annex 3 (summary of literature search findings).

From these reviews and from large-scale individual studies a value was derived for use in the DYNAMO study. The value chosen was a judgement based on a number of factors:

- The findings of relevant and large-scale studies, shown in the tables;
- The findings of systematic reviews and meta-analyses, shown in the tables;
- Higher priority to data which represented European populations;
- Higher priority to data derived from surveys which used measured, rather than self-reported, heights and weights to obtain BMI;
- Higher priority to reviews conducted in most recent decades, referring to more studies;
- Choosing a conservative approach (i.e. 'the actual risk is likely to be greater than this') rather than a 'worst case' approach (i.e. 'the actual risk could be as high as this').

3. Data collection and estimation methods

3.1 Criteria for selecting sources of RRs

There are many ways of assessing adiposity, e.g. waist circumference, waist-to-hip ratio, skin-fold thickness and Body Mass Index (using height and weight). In the present report, the search was restricted to studies and meta-analyses that used BMI as a way of categorising adiposity, and which reported the risk in comparison with a 'normal' BMI of between 18 kg/m^2 and 24.9 kg/m^2.

3.2 Search strategy

Computerised databases, library and internet searches

The PubMed database (http://www.ncbi.nlm.nih.gov/sites/entrez) was searched using the free search terms 'Obesity', 'Overweight', 'BMI', 'adiposity', 'bodyweight', 'lifestyle', in conjunction with the disease of interest, in order to identify relevant studies and researchers who could be contacted to obtain data or further information about the studies described.

Examples of meta-analyses included in the present review are:

- *Bogers et al. Association of overweight with increased risk of CHD partly independent of blood pressure and cholesterol levels. Arch Intern Med, 2007; 167:1720-1728.*
- *McGee et al. Body Mass Index and mortality: a meta-analysis based on person level data from twenty-six observational studies. Ann Epidemiol, 2005; 15:87-97.*
- *McTigue et al. Obesity in older adults: a systematic review of the evidence for diagnosis and treatment. Obesity 2006; 14:1485-1497.*
- *Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*
- *Renehan et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Vazquez G et al. Comparison of BMI, WC, WHR in predicting incident diabetes: a meta-analysis. Epd Revs 2007; doi:10.1093/epirev/mxm008.*

Examples of large surveys also referred to in the present review are:

- *Adams et al. Overweight, obesity and mortality in a large prospective cohort of persons 50-71 years old. NEJM 2006; 355:763-778.*

- *Baker et al. Childhood BMI and the risk of CHD in adulthood. NEJM 2007; 357:2329-2337.*
- *Banegas et al Mortality attributable to obesity in Europe, EJCN, 2003; 57:201-208.*
- *Calle et al BMI and mortality in a prospective cohort of US adults. NEJM 1999; 341:1097-1105.*
- *Carey VJ et al. Body fat distribution and risk of NIDDM in women. Am J Epid. 1997;145:614-619.*
- *Chen et al. BMI and mortality from IHD in a lean population: 10 year prospective study of 220,000 adult men. Int J Epidemiol, 2006; 35:141-150.*
- *Engeland A et al. Height and body mass index in relation to colorectal and gallbladder cancer in two million Norwegian men and women. Cancer Causes Control. 2005 Oct;16(8):987-96.*
- *Engeland A, Tretli S, Bjørge T. Height and body mass index in relation to esophageal cancer; 23-year follow-up of two million Norwegian men and women. Cancer Causes Control. 2004;15:837-43.*
- *Freedman DM et al. The mortality risk of smoking and obesity combined. Am J Prev Med, 2006; 31: 355-362*.
- *Hippisley-Cox et al. Predicting risk of type 2 diabetes in England and Wales: prospective derivation and validation of QDScore. BMJ 2009;338:b880. doi:10.1136/bmj.b880.*
- *Pischon T et al General and abdominal obesity and risk of death in Europe. NEJM 2008;359:2105-2120.*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*
- *Schienkiewitz A et al. BMI history and risk of type 2 diabetes: results from the EPIC-Potdsdam Study. Am J Clin Nutr 2006; 84:427-433.*
- *Stevens et al, The effect of age on the association between BMI and mortality. NEJM 1998; 338:1-7..*
- *Wang Y et al. Comparison of abdominal adiposity and overall obesity in predicting risk of type 2 diabetes among men. Am J Clin Nutr 2005;81:555-563.*

Additional studies were found using known sources of expertise, such as the UK Foresight study *Tackling Obesities: Future Choices* published by the UK government in 2007 (http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp), and the World Cancer Research Fund series of background meta-analyses conducted for the report *Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report* (2007) (http://www.dietandcancerreport.org/).

Contacts with experts

Contacts were made with experts in the field for references to published or unpublished data sources or for the identification of appropriate contact persons. Experts were defined as contact authors for large studies that examined the association between BMI and the selected outcomes, or authors of meta-analyses in the same field of research.

3.3 Characteristics of excluded studies of relative risks

Studies or meta-analyses were normally excluded if any one of the following criteria was satisfied:

- The measurement of exposure differed from that used for this project;

- The outcome measure was prognosis, pre-cancerous lesions or pre-disease markers rather than incident cases or mortality;
- The statistical analyses of the study did not examine any major confounding factors such as age, sex or smoking.

3.4 Characteristics of included studies of relative risks

Relative risk estimates for all-cause mortality, IHD, stroke, diabetes mellitus, lung cancer, colorectal cancer, mouth/oropharynx cancer, oesophagal cancer, breast cancer, endometrial cancer, kidney cancer and gallbladder cancer were obtained from literature searches and additional material described above.

No convincing data were found for a relationship between BMI and COPD and so it was assumed for the present analysis that there is no association (RR=1 for both genders and all age groups). Subsequent evidence may lead to a revision of this assumption.

3.5 Approach for selecting age and sex specific relative risks

When reporting the relative risk estimates for this specific workpackage, the following assumptions were made:

a) For each outcome, the same relative risk estimates were applied to all countries, assuming no interaction between an individual's BMI and that individual's country of residence on the associations. However, it is not possible to verify whether this assumption is true, as the study populations covered by the literature reviews were from limited numbers of countries, which did not allow comparisons between countries, although some evidence for differential relative risks may be found for some diseases when comparing Asian and Far Eastern population groups with European population groups;

b) Due to the limited evidence available for children, it was decided to apply a relative risk of one (1.0) for individuals under the age of 20 years; and

c) For the other age groups, we assumed that the relative risk estimates are the same for all age groups, except where we were able to obtain data by age group. In these cases the relative risks were adjusted to conform with the known effects of age on the association between BMI and disease outcome. The adjustments are shown in the tables in the next section.

4. Provided data on risk factor-disease relationships

Table of estimated relative risks of disease linked to overweight and obesity

Disease	**RR overweight** BMI 25-29.9 Normal weight = 1.0		**RR obesity** BMI 30 or more Normal weight = 1.0		**Age adjustments*** (multiplier of differential risk)	**Smoking adjustments*** (never smoker =1.0)
	men	**women**	**men**	**women**		
All cause mortality	1.20	1.15	1.55	1.50	x 0.98 from age 50 x 0.95 from age 60 x 0.90 from age 70	inconsistent
Ischaemic Heart Disease	1.35	1.35	2.00	2.00	x 0.70 age over 65	x 2.50 for current smokers

Stroke	1.20	1.20	1.50	1.55	x 0.75 from age 65	
Diabetes	2.25	2.30	5.50	7.00	x 0.92 from age 60 x 0.90 from age 75	
COPD	1.00	1.00	1.00	1.00		
Cancer – Lung	0.80	0.88	0.65	0.70		
Cancer – Breast	1.00	1.00 1.12 over age 50	1.00	1.00 1.25 over age 50		
Cancer - Oral	0.80	0.88	0.65	0.70		
Cancer - Colorectal	1.20	1.08	1.40	1.10	x 0.90 from age 45	
Cancer – Oesophagal (all forms combined)	1.00	1.00	1.00	1.00		
Cancer- Oesophagal (Adenocarcinoma)	*1.60*	*1.50*	*2.45*	*2.15*		
Cancer – Oesophagal (Squamous cell)	*0.72*	*0.53*	*0.55*	*0.30*		
Cancer – Kidney (renal)	1.24	1.32	1.55	1.80		x 0.60 for current smokers
Cancer - Gallbladder	1.05	1.35	1.25	1.85	x 1.17 from age 45 men x 0.80 from age 45 women	
Cancer – Womb (endometrial)	---	1.50	---	2.50		

* Adjustments for age and smoking are given as multipliers of the differential risk from the base (1.0). Thus an adjustment multiplier of x0.95 applied to an RR of 1.20 would lead to an RR of 1.19
(calculated as RR′ = 1 + A(RR-1) where RR is the given relative risk, RR′ is the adjusted relative risk and A is the adjustment multiplier).

Table of estimated relative risks of disease linked to BMI above 22 kg/m²

Disease	**RR per unit BMI** above BMI 22		**Age adjustments *** (x = multiplier of differential risk)	**Smoking status adjustments *** (Never smoker =1.00)
	men	**women**		
All cause mortality	1.07	1.03	x 0.98 from age 50 x 0.95 from age 60 x 0.90 from age 70	inconsistent
Ischaemic Heart Disease	1.07	1.10	x 0.70 from age 65	x 2.50 for current smokers
Stroke	1.04	1.04	x 0.75 from age 65	
Diabetes	1.18	1.22	x 0.92 from age 60 x 0.90 from age 75	
COPD	1.00	1.00		
Cancer – Lung	0.97	0.98		
Cancer – Breast	1.00	1.00 1.02 from age 50		
Cancer - Oral				
Cancer - Colorectal	1.04	1.02	x 0.90 over age 45	
Cancer – Oesophagal (all forms combined)	1.00	1.00		
Cancer- Oesophagal (Adenocarcinoma)	*1.10*	*1.08*		
Cancer – Oesophagal (Squamous cell)	*0.96*	*0.89*		
Cancer – Kidney (renal)	1.05	1.05		x 0.60 for current smokers
Cancer - Gallbladder	1.02	1.06	x 1.17 from age 45 men x 0.80 from age 45 women	
Cancer – Womb (endometrial)	---	1.10		

* Adjustments for age and smoking are given as multipliers of the differential risk from the base (1.0). Thus an adjustment multiplier of x0.95 applied to an RR of 1.20 would lead to an RR of 1.19
(calculated as RR’ = 1 + A(RR-1) where RR is the given relative risk, RR’ is the adjusted relative risk and A is the adjustment multiplier).

5. Sources of uncertainty in risk factor-disease relationships

5.1 Potential sources of uncertainty related to the choice of data sources used

A potential source of uncertainty in the data used to derive the estimates of relative risk shown above was the inconsistency in reporting of how BMI was obtained. In most individual studies the source of BMI was usually stated, and allowed the reader to assess the findings in terms of whether the BMI was based on measured or self-reported heights and weights. In the reviews and meta-analyses there was some inconsistency in reporting, and some mixing of data from surveys using different approaches to obtaining BMI.

A second potential uncertainty was the underlying population ethnicity. There is evidence that some ethnic groups – such as populations predominantly in Asia – are more sensitive to the health effects of adiposity than others[15,16] possibly because they tend to show higher abdominal fat deposits for a given BMI than non-Asian populations.[17] In addition, differences in health status associated with BMI may also be found among immigrants to Europe from non-European regions, compared with indigenous Europeans.[18]

5.2 Other potential sources of uncertainty

In the present report, the same relative risk relationships have been assumed for all EU member state population groups. The paucity of data on levels of obesity and the relationships between obesity and health in the various member states makes it impossible to assess whether this assumption is justified. When further evidence becomes available it can be used to refine the present model and improve the accuracy of the relative risk estimates.

In the present report a relative risk of 1.0 has been given to all people under the age of 20 years. There is a severe lack of information on the relationship between obesity and health outcomes for younger people, not least because most of the diseases of interest take several years to develop. There are many papers that indicate that children even under the age of 10 years have evidence of early signs of disease associated with increased BMI[19], but there is no clear evidence of relative risk of actual disease for these younger age groups. In the last decade a few children have been diagnosed with Type II diabetes, a disease previously so rare in this age groups that it was referred to as 'adult onset diabetes'. The new cases of Type II diabetes in children are closely associated with excess body weight, but there are inadequate data to establish a relative risk estimate for these age groups. It is to be hoped that better evidence will be accumulated that can allow more accurate relative risks estimates to be applied to people under age 20 years.

Annex 1 – Self report vs measured BMI

Table. Examples of comparisons between self-reported and measured BMI

Sample Size	Age Range	Area	Main Findings	Refer-ence
1528 men 1514 women	18+	ATTICA region of Greece	Women were nine times more likely to under-report their weight than men. Men were 7.5 times more likely to over-report their height than women.	20
7772 men 8801 women	20+	National USA NHANES	Statistically significant differences were found for the mean error of the measured *versus* self report values for height and BMI. These were notably larger in older adults. In adults over the age of 70years BMI was 1 unit lower in self report than in measured. The study concluded that self report could be used for younger adults but that self report in older adults $\geq$ 60years resulted in misclassification	21
4808	35-76	Oxford, UK	22.4% men and 18% of women were misclassified with self reported height and weight. The authors noted that if you develop predicative equations from a small representative sample, these equations can be used to improve the accuracy of self reported estimates; in this case misclassification was reduced to 15.2% in men and 13.8% in women.	22
5445 men 1905 women	40-50yrs men 35-50yrs women	Workplace cohort in France	13% men and 17% of women were misclassified using self report data. They identified 5 factors that was associated with the bias, overweight, end digit preference, age, educational level and occupation.	23
3208 adults	18-84yrs	Region Stockholm, Sweden	19% men and 12% women were misclassified according to self reported weight and height.	24
865 men 971 women	25-64yrs	Glasgow, Scotland	Author found that this population was fairly unique and as they under reported height and weight. As a result under estimates of BMI was only found in 55-64 year old women.	25
262 men 310 women		Leon, Spain	Prevalence of obesity based on measured weight and height was 1.8 times that of self reported data in men and 2.5 times for women. Authors also found that the difference between measured and self report increases with age.	26
4253 men 1148 women	35-64 yrs	Workplace, Japan	Prevalence of obesity was 23.6% using self report and 24.9% using measured data in men. Obesity prevalence was 11.5% using self report and 12.4% using measured data in women. Authors also found that those with higher measured BMI significantly underestimated weight compared with those with lower BMI. Presence of diabetes was also notes as a factor.	27
1140 adults	18-78yrs	Adelaide, Australia	Inclusion of waist circumferences increases the validity of self reported BMI.	28
15,025 adults	20+ yrs	NHANES, USA	All women and Mexican American men underestimated true obesity prevalence. Ethnicity had a significant difference that could not be explained by sociodemographic, smoking or other health variables.	29
820 adults telephone interview 1318 adults,		Vaud, Switzerlan d	It must be noted that the surveys were based on different population samples. However the author noted that this difference is unlikely to explain the systematic bias observed between self report and measured values. Prevalence of obesity in the measured survey was	30

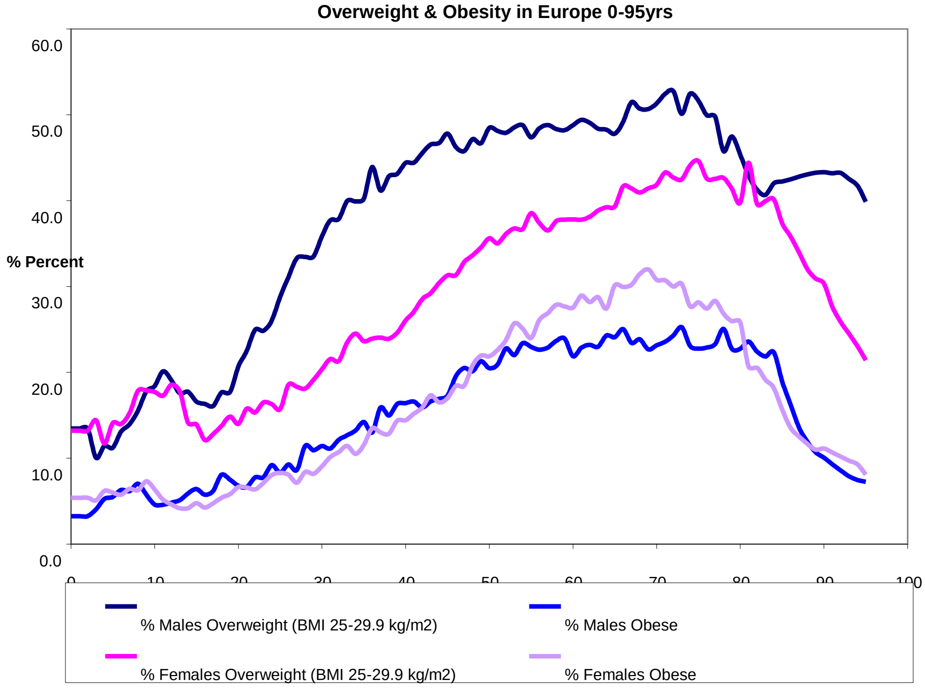
Sample Size	Age Range	Area	Main Findings	Refer-ence
physical examination			double that of self reported survey.	
1622 adults	18-64yrs	Wales	The prevalence of overweight and obesity was underestimated by 4.5% in men and 6.7% in women. The authors also noted that reporting was more biased in older and overweight groups. (Although not mentioned in the paper it is likely that the extent of the underestimate of obesity rather than combined overweight would be higher).	31
836 males 871 females		Mexico	"Self report height and weight is an acceptable method but its precision reduces with age."	32
4619 adolescents	Grade 9-12 (14-17yrs approx)	USA	BMIs based on self reported height and weight underestimate the prevalence of overweight in adolescent populations.	33
376 children	1st Grade and 4th Grade	Japan	The results indicated that reported data by parents provided a reliable assessment of childhood obesity. Error in estimating obesity was between -1.2 to 1%.	34
3400 adults			Reliance on self report data will result in considerable underestimation of the prevalence of obesity. In this instances only 55% of obese women and 60% obese men were classified as such according to the measured values.	35
7455 adults			The author suggests that substantial misclassification can occur when self report data are used to define BMI categories.	36
15,483 baseline 11,495 follow up	Grade 7-12 (12-17yrs approx)	USA	Author found that parental report is a better indicator than adolescent report, however using self reported BMI correctly classified 96% in the obese category.	37
2860 children/adolescents	9-21	Jeddah City, Saudi Arabia	The author found high levels of inaccuracy using self reported height and weight in classifying obesity by BMI. Approx 60% of children were unaware of their weight and/or height and could therefore not be classified.	38
3244 adolescents	15-18	Madrid, Spain	The author reports that the analysis of BMI as a categorical variable involves a considerable underestimate of high BMI. In this instance high BMI was underestimated by 34%.	39
418 adolescents	Year 11 (15/16yrs)	Wales	The author suggests that self report bias had significant consequences for the accuracy of overweight and obese classification. Actual and perceived body size each contributed to underreporting of body weight. 25% of overweight students were misclassified and >30% of obese students were misclassified when using self report data.	40
143	Teenagers	Siena, Italy	The author identified overestimation of height and underestimation of weight in both genders. They suggest using conversion factors to correct the reported BMI.	41
	Teenagers	London, UK	Self reported height and weights resulted in underestimation of overweight. Self assessment of body fatness was influential on the height and weight reporting of females. The author suggests that self reported data from teenagers should only be used with caution.	42
294	56-78	UK	The author suggests that overweight individuals tended to under report and the short and underweight tended to over report. Studies investigating associations of	43

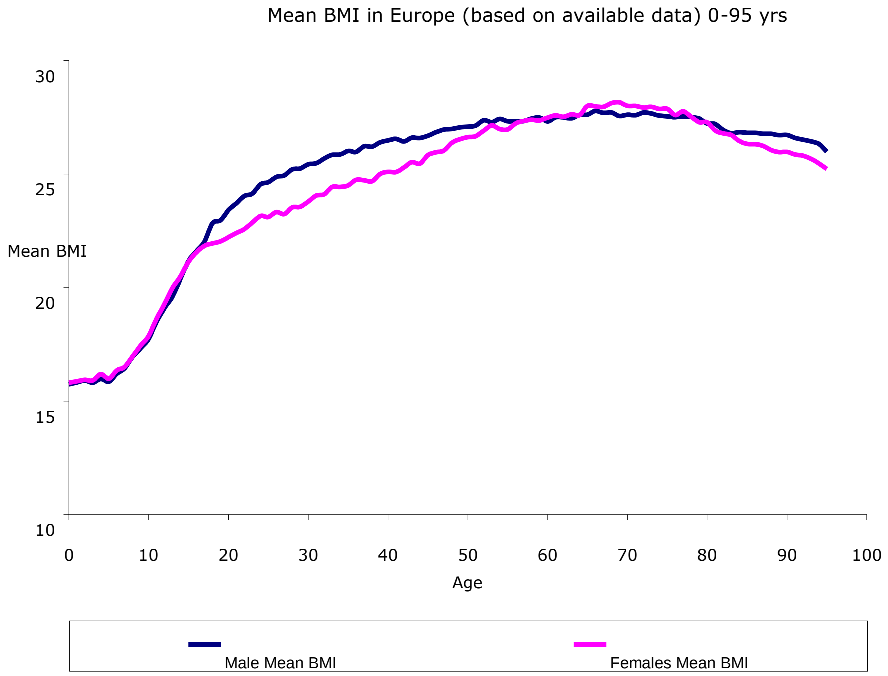
Sample Size	Age Range	Area	Main Findings	Refer-ence
			disease with height and weight using self reported measures will underestimate effects.	
11,284	20-74	NHANES, USA	The author suggested that on average errors in self report with measured were small, however these were directly related to the individuals' weight status, the more overweight the greater the error. Race, age and end digit preference were also a factors.	44
1381	60-79	UK	Generally well correlated but again suggests that obese individuals were more likely underestimate their weight.	45
2046 men 2393 women		USA	Underreporting was significantly related to weight, height and participation in current weight reduction programme. However, generally self reported weight correlated well with actual weight across the range of the population.	46
1932	12-16yrs	NHANES, USA	The author found that the influence of gender and race bias was small. Self reported heights and weights were extremely reliable for predicting obesity related morbidities and behaviours.	47
683	11-18yrs	Australia	The author suggested that students with high BMI and high weight values were more likely to underreport weight. Younger, early pubertal and premenarcheal students were more likely to underestimate height and older, postmenarcheal (>3yrs) more likely to overestimate height. They also found the more exercise they partook the greater the accuracy of height estimate.	48
Review of literature			26 studies were examined reviewing self reported height, 21 of these found that women overestimate height. 34 studies were found reviewing self reported weight and all 34 studies found that women underestimate weight. The author noted that although the mean variations of error was small, a significant percentage of the women in the groups had very large errors resulting in misclassification	49

Annex 2 – Details of the exposure data identified

European Estimates

Countries included in analysis. Austria, Belgium, Bulgaria, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Poland, Portugal, Spain, Sweden, UK - Weighted to UN Popin 2009 country estimates. The estimates cannot be considered as truly representative of the European region as the data are lacking in Eastern Europe. However, as more data become available, these estimates will be improved.





Austria

In Children and adolescents 0-17 years, no appropriate data for children were available. The most appropriate data to use were deemed to be from Germany. The reference used was: Kurth and Schaffrath Rosario, The prevalence of overweight and obese children and adolescents living in Germany. Results of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), Bundesgesundheitsblatt 2007. This Nationally representative survey took place between 2003 and 2007.

In adults aged 18-95yrs we had separate sources of data for continuous and categorical data. For continuous data (Mean BMI, SD) we used a small, sub national sample (832 individuals), the data ranged from 25-64 years. There are concerns with using these data (Mean BMI) and we feel using the much larger German or Hungarian surveys would be more appropriate, with German data being the most recent. These data were obtained from the WHO Infobase and originated from Ulmer H et al. Recent trends and sociodemographic distribution of cardiovascular risk factors: results from two population surveys in the Austrian WHO CINDI demonstration area *Wiener Klinische Wochenschrift*, 2001, 113:573-579, Additional data from personal communication: Hanno Ulmer, Institute of Biostatistics, University Innsbruck.

The categorical data (% Overweight and Obesity) originated from Schwarz B. Abdominal Obesity and cardiometabolic risk factors in Austria, Central Europe. RdM O&G 2007. This national survey included over 1,000 participants (1054) and was implemented in 2006. It should be made clear though that the author of the above survey noted that although the survey population was well balance and fairly representative, as they were based in a primary care setting, selection bias towards higher morbidity risk could exist. In contrast though volunteers to health screening programs may lead to a selection bias the other way. The author could not determine which effect dominated. The data covered adults between 30-74 years.

As with the continuous data the alternative Germany or Hungarian data could be used, the German data are more recent. No data were available for older age categories, data were extrapolated using the method as outlined previously outlined.

For both categorical and continuous data, older adults were not accounted for. Data was determined as in methodology already outlined previously in the document.

We provided data from following references to supply historic/trend data. Reference: WHO Infobase – original data from Countrywide Integrated Noncommunicable Diseases Intervention (CINDI) programme. Year 1986, Regional Data.

We did not use the Telephone survey from 1992 as it was self report and we did not have access to data in correct format.

In comparison with Eurocadet, they also found few data. They used the self reported survey from 1999 - Microzensus 1999. They did not use Global Database on BMI, WHO estimates (Ono T et al 2005), OECD, PAN EU Survey (1999), Vienna Health examinations from 1986 as they were non representative, nor did they use CINDI data.

We would like to acknowledge special contributions from the following. The Austrian MOH (Herta Marie Rack, Quality Management and Health Care System Research, Federal Ministry of Health, Family and Youth, Vienna, Austria) who very kindly provided us with 2006/7 National Survey unfortunately we were unable to use this as it was based on self reported heights and weights.

Belgium

In Children and adolescents 0-17 years, no appropriate data for children were available. The most appropriate data to use were deemed to be from Germany. The reference used was: Kurth and Schaffrath Rosario, The prevalence of overweight and obese children and adolescents living in Germany. Results of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), Bundesgesundheitsblatt 2007. This Nationally representative survey took place between 2003 and 2007.

In adults aged 18-74 years a large regional survey involving 5066 participants was used. The survey was performed between 2002-4. The reference for this survey is as follows: Duvigneaud N, Wijndaele K, Matton L, Deriemaeker P, Philippaerts R, Lefebre J, Thomis M, Duquet W. Prevalence of overweight, obesity and abdominal obesity in Flemish adults. Arch Public Health 2006;64:123-142. Data for older adults was not available. Adults aged 75-95 were determined using methodology outlined previously.

Data excluded from the DYNAMO study included the BELSTRESS survey and HIS Surveys. The BELSTRESS survey although large it was only a workplace survey. De Backer Guy. Overview on the prevalence and problem of obesity in Belgium. De Eetbrief 2000;70. The HIS Surveys (Health Interview Surveys) based on 'reported' heights and weights. Please note that when HIS surveys were compared with other measured figures and they were not dissimilar, the measured data were predictably slightly higher.

In terms of historical data, data from a survey carried out between 1979-1984 were considered appropriate. The Survey was considered to be national representative. The reference for the surveys is as follows:
Stam-Morga MC. Sociodemographic and nutritional determinants of obesity in Belgium. International Journal of Obesity. 1999;23;Suppl 1:S1-S9

Surveys not used for historic data included the following references:

- Hulens M, Beunen G, Claessens AL et al. Trends in BMI among Belgian children, adolescents and adults from 1969 to 1996. IJO 2001;25:395-99
- Guillaume M, Lapidus L, Beckers F et al. Familiar trends of obesity through three generations: the Belgian-Luxembourg Child Study. IJO 1995;19: (Suppl 3)S5-S9
- Lorant V, Tonglet R. Obesity; trend in inequality. J Epidemiol Community Health 2000;54:637-638 - Only used armed forces subjects 18-25 yrs
- Stam-Moraga MC, Kolanaowski J, Framaix M et al. Trends in the prevalence of obesity among Belgian men at work, 1977-1992. IJO 1998:22:988-992

When compared with Eurocadet they used the national HIS surveys from 1997, 2001 & 2004. Eurocadet did not use the Global Database on BMI nor the WHO estimates Ono T et al.

Bulgaria

In children and adolescents aged 0-17 years data were provided from National representative sample a cross sectional survey. The survey took place in 2004 and included 1326 children. The data were reanalysed and sent to IASO as personal communication, published reference provided S. Petrova (2005) Current problems in nutrition of children in Bulgaria, GP News, 12, 5-8. Although data were provided for 2007 in 3 age groups but it was felt that we should continue to use the data from one survey as the data were available by individual year of age.

In adults aged 18-95 years, a 2004 nationally representative, cross sectional survey representing 1031 adults was considered the most appropriate. The data had been reanalysed and sent as personal communication to IASO. The published reference provided was S. Petrova, K. Angelova (2006) Scientific background of Food-Based Dietary Guidelines for Bulgarians. Advances in Bulgarian Science, 4, pp.19-33. Only very limited data were available for the final age category (90-95 years) and it was not appropriate to use it. Instead a polynomial trend line was applied and figures adjusted accordingly.

This project did not use the Bulgarian Health Survey from 2001 as it was based on self reported heights and weights

In historic terms data were available for adults and children from a 1998 survey analysed and provided via personal communication by S Petrova.

The EUROCADET study used the Bulgarian Survey of the health status of the population from 2001 but they did not have methodology. They also chose not to use the CINDI data.

We would like to acknowledge special contributions from Svetoslav Handjiev the President of the Association for the Study of Obesity and Related Diseases for his kind assistance with this project and Assoc.Prof. Stefka Petrova.

Croatia

Dr Maja Baretic from the Croatian society on obesity and Prof. Koršić (President of Society) very kindly provided data from the 2003 National survey, however, Croatia was not one of the countries within the final remit of this study and was for this reason excluded.

Cyprus

Currently Insufficient measured appropriate data available.

Czech Rep

In children and adolescents aged 0-5 years data was provided by members of the HOPE project, further details of survey methodology were not available at this time. For children 5-17years, the data were provided from 2001. This was as a personal communication from Prof. Marie Kunesova. The survey was a large national survey involving 35,953 children. The reference is Vignerová J., Bláha P., Kobzová J., Krejčovský L., Riedlová J: 6th Nationwide Anthropological Survey of Children and Adolescents 2001, Czech Republic. Grant report for Internal Grant Agency, Ministry of Health, CR, grant No. NJ/6792-3. National Institute of Public Health, Prague, 2002.

The following survey was not used as anthropometric measurements were taken but not published. The reference was Parizkova J. Dietary habits and nutritional status in adolescents in Central and Eastern Europe. European Journal of Clinical Nutrition 2000;54:/(Suppl 1) S36-S40.

In addition a 2005 survey was excluded as the data breakdown was limited. Overweight and Obesity data. Kunesova M, Vignerova J, Steflova A et al. Overweight and obesity in Czech children and adolescents – association with parental obesity and socioeconomical factors. J Publ Health, 2007, vol. 15 (3), p. 163-170. Overweight and obesity % was only available in 3 age categories. We had more comprehensive child data from a survey carried out in 2001.

In adults aged 18-84 years a large national survey from 2008 was considered the most appropriate. The reference: Svacina, S., Matoulek, M, Horak, P, Lajka J. The Czech monitoring of Overweight and Obesity, provided by STEM/MARK agency during Campaign: Live healthy. In older adults aged 85-95 were estimated using methodology outlined earlier in the report.

The HIS Surveys were excluded as based on self reported height and weights.

In terms of historic data. Data were available from a survey from the year 1997 – 1998 involving 1536 males, 1670 females from 9 districts of Czech Republic. These were provided by a personal communication by Prof. V Hainer (collated by Dr Cifkova and Dr Lanska). Survey data from 1985-92 were also available in terms of continuous data. This was restricted though as it is a regional MONICA survey.

In comparison with EUROCADET they used the HIS Survey on Czech Population (HIS surveys are based on 'self reported' heights and weights). EUROCADET did not use the WHO Comparable estimates Ono T et al (2005).

We would like to acknowledge special contributions from Prof. Fried, the president of the Czech Society for Study of Obesity and Prof. Dana Mullerova the Vice president of the Czech Society for Study of Obesity, Prof. Svacina and Prof Kunesova for assisting us with the data in this project. Thanks also to Prof. V Hainer, Dr Cifkova and Dr Lanska for providing the historic data.

Denmark

In children and adolescents aged 0-17 years a survey from 1996-97 was deemed most appropriate. The Reference : Nielson A, National Institute of Public Health, Copenhagen. Personal communication data re-analysed. It should be noted that adolescents aged 17 was not used as the sample size too small. We had no data for 0-4yrs. In the absence of alternative suitable data we had to use the figures from 5 years olds as we had insufficient evidence to further extrapolate from.

In adults aged 19-64 years data were provided through a personal communication by WHO Europe for an earlier Global Burden of Disease project (GBD). The survey is understood to be nationally representative though further survey details were not available. The survey took place in 1995 involving a sample of 1316 adults. Data for older age categories were estimated using methodology already previously outlined in this report.

The following survey provided by personal communication was excluded. The original reference: Tjoenneland A, Overvad OK. Diet, cancer and health, a population study and establishment of a biological bank in Denmark. In Danish Ugeskr Laeger 2000;162:350-354. The survey was excluded as only involved 50-64yrs. Another survey the national SUSY 2005/6 survey was also excluded as it was based on self reported weight and heights.

Historic data was available from a survey based on a MONICA Design. This is a sub - national survey from Copenhagen, though considered reasonably representative of Danish population. The survey took place during the years 1982/83. The data were provided as personal communication in 2000 for GBD Project.

Surveys not used to provide trend data included:

- Heitmann BL. 10 year trends in overweight and obesity among Danish men and women aged 30-60 years. Ugeskr Laeger 1999;161:4380-4 - Data not provided by age. Only supplied as total for males and females in 1982 – 1992.
- Males only - Sorensen HT, Sabroe S, Gillman M et al. Continued increase in prevalence of obesity in Danish young men. IJO 1997;21:712-714
- Males only - Thomsen BL, Ekstrom CT, Sorensen TIA. Development of the obesity epidemic in Denmark: Cohort, time and age effects among boys born 1930-1975. IJO 1999;23:693-701

In comparison with EUROCADET they used the HIS Survey. They did not use WHO Comparable estimates Ono T et al (2005)

Special Contributions: Thanks go to Prof. Søren Toubro Danish Association for the Study of Obesity who kindly provided background data for this project.

Estonia

Insufficient data were available 0-95 years. Very limited continuous data were available but not in format required for DYNAMO project.

Finland

In children and adolescents aged 0-17 years the only data available was for 5 and 12 year olds. Due to a lack of alternative data the figures for 5 years had to be used for 0-10 year olds. The 12 year figures were subsequently used from 11-17.

For reasons already outlined the self reported data were not used. Vuorella N et al found that on average adolescents reported a BMI 2.5kg/m2 lower compared to clinically measured values. Reference: Vuorela N, Saha MT, Salo M. Prevalence of overweight and obesity in 5 - and 12- year-old Finnish children in 1986 and 2006. Acta Paediatrica 2009;98:507-512 (n = 4016, sub regional but from a wide range of municipalities.)

In adults aged 25-64 years the survey used was the National FINRISK Survey. The survey took place in 1997 with a sample size of 4394. Reference: Lahti-Koski M et al. Age, education and occupation as determinants of trends in body mass index in Finland from 1982-1997. International Journal of Obesity. 2000;24;12:1669-76.

The younger age categories are interpolated between children to middle aged adults. The older age categories were estimated using methodology clearly outlined elsewhere.

Alternative data supplied but not used are from the WHO Infobase 102584a1 - Helakorpi S, Patja K, Prättälä R, Uutela A. Health behaviour and health among the Finnish adult population, spring 2005. Helsinki, KTL-National Public Health Institute, 2005.
The data have been supplied but do not provided estimates for the data from 25-95 as it is understood that the alternative data although older has high quality associated trend data.

In terms of historic data high quality trend data are available. Reference: Lahti-Koski M et al. Age, education and occupation as determinants of trends in body mass index in Finland from 1982-1997. International Journal of Obesity. 2000;24;12:1669-76

The following trend data were not used - Overweight among men (30-59yrs) in East Finland, 1972-1987. National Public Health Institute. Overweight was BMI 27-30 not BMI 25-29.9kg/m2

Further data for Eastern Finland from 1972 and 1977 (mean BMI and % Obesity are also available on request) - Lahti-Koski M et al. Secular trends in body mass index by birth cohort in Eastern Finland from 1972 - 1997. IJO 2001;25:724-734

Further data for Finland (by Region) available for 1972, 1977, 1982, 1987, 1992. Pietinen P Vartiainen E, Mannisto S. Trends in body mass index and obesity among adults in Finland from 1972 to 1992

In comparison with EUROCADET, they used 2004 EUROSTAT survey based on self reported data. EUROCADET did not use, Rissanen A, Heliövaara M, Aromaa A. Overweight and anthropometric changes in adulthood: a prospective study of 17000 Finns. International Journal of Obesity,1988 12:391-401. Ono et al WHO Global Comparable Estimates. Ono T, Guthold R, Strong K. WHO Global Comparable Estimates, 2005 (unpublished report).

France

For children and adolescents age 2-17 years a large national survey took place 2006/7. These data were provided as a personal communication. Reference: Results are in press. French food safety agency (in press). Report of the second French INCA dietary survey, 2006-7 and Lioret S, Touvier M, Dubisson C, Dufour A, Calamassi-Tran G, Lafay L, Volatier JL, Marie B. Trends in child overweight rates and energy intake in France from 1999 to 2007 and socio-econmic status.

Surveys not used: Rolland-Cachera MR, Castetbon K, Arnault N et al. Body mass index in 7-9yr old French children: frequency of obesity, overweight and thinnness. IJO 2000;26: 1610-1616 - only data for 7-9 year olds, so alternative data more appropriate.

For adults aged 18-79 years data were derived from large national survey from 2006. These data were provided by personal communication. Reference: Étude nationale nutrition santé ENNS, 2006. Personal Communication from Lioret S. French food safety agency (in press). Report of the second French INCA (Individuelle Nationale des Consommations alimentaires) dietary survey, 2006-07.

ObEpi surveys were not uses as these are based on 'reported' weights and heights. In addition the French National Institute of Statistics surveys from 1980 and 1991 were exluded as these were also based on 'reported' heights and weights (reference is Maillard G et al - shown in full in EUROCADET section). Finally the GAZEL cohort was excluded as again based on self report anthropometry and based only on those individuals in selected employment.

Historic data were available in children based on continuous data but only available for regional survey during the years 2000 and 2006. The reference: Heude B, Lafay L, Borys JM, Thibult N, Lommez A, Romon M, Ducimetiere P, Charles MA. Time trend in height, weight, and obesity prevalence in school children from Northern France, 1992-2000. Diabetes Metabolism 2003;29:235-40

In children on a categorical basis, regional level trend data were available for 5 Year olds. Romon M, Duhamel A, Collinet N, Weill J. Influence of social class on time trends in BMI distribution in 5-year old French children from 1989 to 1999. IJO 2005;29:54-59

The following sources were not used.

- Laurier D, Guiguet M, Phong Chau N et al. Prevalence of obesity: a comparative survey in France, the UK and the USA. IJO 1992;16: 565-572 as based on self reported data.
- Maillard G et al. Trends in the prevalence of obesity in the French adult population between 1980 and 1991. IJO 1999;23:389-39 again self reported survey

In comparison with EUROCADET they used the self reported ObEpi Surveys. EUROCADET also used Maillard G et al. Trends in the prevalence of obesity in the French adult population between 1980 and 1991. IJO 1999;23:389-394. The heights and weights were 'reported' with no measurements being taken.

EUROCADET did not use Enquete decennale de la Sante INSEE as information not compatable with WHO cut off points and limited. They did not use Ono T et al, WHO Global Comparable Estimates 2005.

Special Contributions: Special thanks go to Dr Sandrine Lioret of the French Food Safety Agency (AFSSA) who very kindly provided data for this project.

Germany

In children and adolescents aged 2-17 years a large national survey carried out between 2003-2006 was used. Reference: Kurth and Schaffrath Rosario, The prevalence of overweight and obese children and adolescents living in Germany. Results of the German Health Interview and Examination Survey for Children and Adolescents (KiGGS), Bundesgesundheitsblatt 2007; 50:736-743.

The following survey was not used. Schaefer F, Georgi M, Wuhl E, Scharer K. Body mass index and percentage fat mass in healthy German schoolchildren and adolescents. IJO 1998;22:461-469. It should be noted however that LMS data were available and have been provided to the DYNAMO team.

In adults aged 18-79 years of age, we made use of a large national survey between 2005-7. The data were reanalysed and provided by personal communication from Prof.Dr.M.J.Müller, President of the German Obesity Society. Reference: Federal Ministry of Food, Agriculture and Consumer Protection and Federal Research Institute of Nutrition and Food, Germany, Report of Results 2008 (http://www.bmelv.de/cln_045/nn_1196770/SharedDocs/downloads/03-Ernaehrung/NVS2/NVS__Ergebnisbericht, templateId=raw,property=publicationFile.pdf/NVS_Ergebnisbericht.pdf)

Surveys we did not use included the Microsensus surveys from 1999,2003 and 2005 as these are based on 'self reported' surveys.

Historic data was available from several sources. Firstly a large national survey carried out in 1998. Reference - Bergmann KE, Mensink GBM (1999) Korpermasse und Ubergewicht. Gesundheitswesen:62:S115-S120, Personal communication provided by Prof G Mensk

Secondly continuous data & obesity were also available from the MONICA surveys. % overweight was not available. 1984/5 and 1994/5. Regional MONICA Survey. Filipiak B, Schneider A, Doring A, Stieber J, Keil U. Trends in cardiovascular risk factors from Survey 1984/5 to Survey 1994/5

Finally Mean BMI, SD and % Obesity data were available from National Surveys in 1985, 1988 and 1990. Hoffmeister H, Mensink GBM, Stolzenberg H. National trends in risk factors for Cardiovascular Disease in Germany. Preventive Medicine 1994;23:197-2005

Trend surveys not used in adults**.** Hessia Study - Hoffmeister H. Epidemiologische Feldntersuchungen in Hessen. SozEp-Berichte 2, Dietrich Reimer Verlag, 1978 - could not obtain data.

In children the following survey was not used as regional survey and national surveys were already available.

> Kromeyer-Hauschild K, Zellner K, Jaeger U, Hoyer H. Prevalence of overweight among school children in Jena. International Journal of Obesity 1999 Vol. 23, No. 11 p1143-50
>
> Alexy U, Sichert-Hellert W, Kersting M. Fifteen year time trends in energy and macronutrient intake in German children and adolescents: results of the DONALD study. British Journal of Nutrition 2002;87:595-604 - did not supply detail over time, only provided combined estimates for the entire duration of the survey 1985-2000.

Barth N, Siegler A, Himmelmann GW et al. Significant weight gains in a clinical sample of obese chldren and adolescents between 1985-1995. IJO 1997:21:122-126. Clinical sample therefore not appropriate.

In comparison with the EUROCADET they used the Microsensus and these were based on 'self reported' height and weights. They did not use Ono T, Guthold R, Strong K. WHO Global Comparable Estimates, 2005 (unpublished report).

Special Contributions. Special thanks go to Prof. Manfred J. Müller, President of the German Obesity Society (Deutsche Adipositasgesellschaft) for kindly providing data for this project.

Greece

Insufficient appropriate measured data available at this time.
It should be noted however that thanks go to Dr E Kapantais of the Hellenic Medical Association for Obesity (HMAO) for providing background information for this project.

Hungary

Insufficient measured appropriate data available at this time.

Ireland

In children a national survey for 4-16 year olds was considered the most appropriate. Reference: Whelton H, Harrington J, Crowley E, Kelleer V, Cronin M, Perry IJ. Prevalence of overweight and obesity on the island of Ireland: results from the North South Survey of Children's Height, Weight and Body Mass Index, 2002. BMC Public Health 2007;7:187. Republic of Ireland data only used (Northern Ireland data also available).

0-4 years missing - in absence of more suitable data, data for 4yrs were used to represent 0-3yrs and should be replaced when more appropriate data become available. Age 10yrs missing - data were interpolated. Age 17 years - data were interpolated

Surveys not used included the National Children's Food Survey 2004/5, though more recent it did not have appropriate age breakdown. Additionally the Northern Ireland Health and Social Wellbeing Survey 2005/6 were excluded as only included Northern Ireland not Republic of Ireland. It was considered more appropriate to use older data.

In adults aged 18-64 years the North/South Ireland Food Consumption Survey a large measured survey covering both Northern Ireland AND Republic of Ireland was considered most appropriate. Reference: McCarthy SN, Harrington KE, Kiely M et al. Analyses of the anthropometric data from the North/South Ireland Food Consumption Survey. Public Health Nutrition 2001;4 (5(A):1099-1106

The SLAN 1998 and 2002 surveys were not used. They were based on Self Report height and weight. National Nutrition Surveillance Centre. www.healthpromotion.ie/research, http://www.healthpromotion.ie/uploaded_docs/Dietary_Habits_Slan_Results.pdf

Historic data were available for adults and children. In adults a large national measured survey, carried out between 1988-89. Irish Universities Nutrition Alliance Summary Report was available. In children the 1990 Irish National nutrition survey was available based on measured heights and weights.

In comparison with EUROCADET they used the SLAN Survey, the national nutrition surveillance Centre, based on self reported heights and weights. They did not use the Irish Nutrition and Dietetic Institute, Irish national nutrition survey 1990.

Italy

On a categorical basis data were available for 2yr old infants. Figures were given as combined boys and girls, however in the absense of any more comprehensive data this has been selected. Cattaneo A, Monasta L, Stamatakis E et al. Overweight and obesity in infants and pre-school children in the European Union: a review of existing data. Obesity Reviews 2009 published online ahead of print. The survey was subnational and involved 1230 infants.

Again on a categorical basis data were also available for 3-17 years. A sub national survey covering three regions from 1993-1999. Reference:Celi F, Bini V, De Giorgi G, Molinari D, Faraoni F, Di Stefano G, Bacosi ML, Berioli MG, Contessa G, Falorni A. Epidemiology of overweight and obesity among school children and adolescents in three provinces of central Italy, 1993-2001: study of potential influencing variables. EJCN 2003; 57:1045-1051

In children no mean data available. Median data have been used for 0-17years. Data for 0-5 years were estimated by creating a formula for change in BMI with age using actual data for 5-17yrs and then applying this formula to 0-5years. When actual survey data become available these data should be replaced. LMS data were also been provided as available.

In adults continuous data were available for aged 35-74 years. This was a national survey from 1998. Reference: Reference Who infobase. Andrea Gaggioli, Ministry of Health. The measurements are taken by medical practitioners so are not truly representative of the populations but it is considered that these measurements are more accurate than relying on self reported data. We requested further information regarding the survey but as yet further information has not been forthcoming. The younger adults overweight and obesity were interpolated between children and 35yrs. Categorical data were only available for % obesity. A formula to estimated between overweight and obesity was calculated from all the data available across Europe. This was applied to provide the % overweight estimates. These data should be replaced as soon as alternative measured data becomes available.

The National Institute of Statistics also provided details of early surveys but again these are based on self reported heights and weights and had to be excluded.

Trend data available were based on self reported weight and heights and therefore had to be excluded. Reference:Gallus S, Colombo P, Scarpino V, Zuccaro P, Negri E, Apolone G, Vecchia CL. Overweight and obesity in Italian adults 2004, and an overview of trends since 1983 *European Journal of Clinical Nutrition*, 2006, 60:1174-1179

In comparison the EUROCADET study used the self reported ISTAT surveys. They did not use Ono T, Guthold R, Strong K. WHO Global Comparable Estimates, 2005 (unpublished report).

Latvia

Insufficient measured survey data available at this time.

Lithuania

Insufficient measured survey data available at this time.

Luxembourg

Insufficient measured survey data available at this time.

Netherlands

In children aged 2-3 years continuous data were available. Reference: A M Fredriks, S van Buuren, J M Wit, S P Verloove-Vanhorick. Body index measurements in 1996–7 compared with 1980. Arch Dis Child 2000;82:107–112.

In children aged 2-3 years categorical data were available from the following reference. R. A.Hirasing, A.M. Fredriks, S.Van Buuren, S. P.Verloove-Vanhorick en J.M.Wit. Toegenomen prevalentie van overgewicht en obesitas bij Nederlandse kinderenen signalering daarvan aan de hand van internationale normen en nieuwe referentiediagrammen.Ned Tijdschr Geneeskd 2001 7 juli;145(27)1303-1308

In children and adolescents continuous data were available for 4-17 years. Reference: Katja van den Hurk, Paula van Dommelen, Stef van Buuren, Paul H Verkerk, Remy A HiraSing. Prevalence of overweight and obesity in the Netherlands in 2003 compared to 1980 and 1997' Arch Dis Child 2007;92:992-995. Additional mean BMI data provided by personal communication Stef Van Buuren. The survey was a national and involved 90,071 children in total.

In children and adolescents categorical data were also available. Reference: R. A.Hirasing, A.M. Fredriks, S.Van Buuren, S. P.Verloove-Vanhorick en J.M.Wit. Toegenomen prevalentie van overgewicht en obesitas bij Nederlandse kinderenen signalering daarvan aan de hand van internationale normen en nieuwe referentiediagrammen.Ned Tijdschr Geneeskd 2001 7 juli;145(27)1303-1308. This was a national survey that took place in 1996/7. LMS data are also available. These were based on 7482 boys and 7018 girls of Dutch origin, measured in 1996–7.

In adults continuous data were available for adults aged 18-65 years. The data were provided by personal communication from Lucie Viet, RIVM, Centre for prevention and Health Services Research. The data were based on a national survey, carried out during 1998-2001 involving approx 5200 subjects.

Categorical data were provided by a personal communication. Reference: Visscher TLS Personal Communication. National Institute of Public Health and the Environment. Data from the MORGEN Study. (Netherlands). This was a national survey performed during 1993-7. It provided both self report and measure height and weights in adults 18-65 years of age.

In both categorical and continuous data for older age categories, data were determined using methodology outlined earlier in the report.

A regular nationally representative survey is carried out by Statistics Netherlands (CBS), unfortunately this is based on self reported height and weight and therefore had to be excluded. This survey is also known as the POLS survey.

Historic data were available from the survey outlined below.   .

Mean BMI and SD, % obesity. Reference: Seidell JC,Verschuren WMM, Kromhout D. Prevalence and trends of obesity in The Netherlands 1987–1991. International Journal of Obesity and Related Metabolic Disorders 1995;19:924-927. Survey carried out between 1987-91.

Surveys not used for trend data

Amsterdam Growth and Health Longitudinal Study (AGAHLS). Kemper H, Post G, Twisk J, van Mechelen W. Lifestyle and obesity in adolescence and young adulthood: results from the Amsterdam Growth and Health Longitudinal Study. IJO 1999;23 (S3):S34-S40. These data were not presented in appropriate format.

Twisk JWR et al. Body mass index and sum of skinfolds. IJO 1998;22:915-922. Again these data were not presented in appropriate format.

Mean BMI, overweight and Obesity data available from 1976-1980 but unfortunately the data were not broken down by age so could not be used. Data originally from the Consultation Bureau Heart Project. Visscher T, Kromhout D, Seidell J. Long term and recent time trends in the prevalence of obesity among Dutch men and women. IJO 2002;26(9):1218-24

In comparison with EUROCADET they used data from the self reported POLS survey and a self reported HIS Survey.

Poland

In children and adolescents aged 2-17 years the national survey details were provided by personal communication. Overweight and obesity (IOTF cut off) 2-15yrs. Mean BMI 3-17yrs. The survey involved 609 boys and 607 girls (2-18yrs) in 2000. Reference: Szponar L, Sekuła W, Rychlik E.: Badania indywidualnego spożycia żywności i stanu odżywienia w gospodarstwach domowych (*Survey of Individual Food Consumption and Nutritional Status at Households*). Warszawa, IŻŻ. 2003.

Data were missing for overweight and obesity in 16-18 year olds. Figures were interpolated between figures for 15yrs and 19yrs, when more appropriate data become available these should be replaced.

For adults data from the 2003-3007 National WOBASZ survey was made available.   This provided good quality, recent, national data for adults.

NATPOL II and III it was unclear if actual body measurements were taken.   The paperwork implied that survey was an interview survey with only blood pressure being measured (the survey was primarily looking at hypertension). Therefore these surveys had to be excluded.

For adults aged 35-64 years, very limited historic data were available from 1992/3. Personal communication by Prof W B Szostak, data from MONICA.   Data collected by Prof Stefan Rywik.

Adult surveys not included, Welon Z, Jankowska EA. Overweight and obesity in urban population of Poland in 1983-1999 yrs (in Polish). Pol. Merk. Lek. 2002:295-298.

Data were presented by gender and age and social status, but not used as survey years too far apart to be useful in this context.

In children historic continuous data were available between 1971 and 2000. Reference:Chrzanowska M, Koziel S, Ulijaszek SJ. Changes in BMI and the prevalence of overweight and obesity in children and adolescents in Cracow, Poland, 1971-2000. Economics and Human Biology 2007;5:370-378

Also available were mean BMI, overweight and obesity, regional, measured survey carried out in 1996/9 involving around 3000 children. Reference: Personally communication to IASO. Originally published in Palczewska I, Niedzwiecka Z (1999). Siatki centrylowe do oceny rozwoju somatycznego dzieci I mlodziezy, Instytut Matki I Dziecka, Warszawa.

Surveys not used**.** Lipowicz A. Fatness of children and adolescents from various socio-economic groups between 1978 and 1988. Anthropological Review 1999;62:35-40. The paper only provided data on skinfold thickness not BMI

In comparison EUROCADET used the self report HIS surveys.

Special Contributions: Special thanks go to Dr Grazyna Broda and Dr Powel Jurakfor kindly reanalysing data from the WOBAZ survey specifically for the purpose of this study.

Portugal

In children and adolescents very limited data were available for % overweight and % obesity. Reference: Padez C, Fernandes T, Mourao I, Moreira P, Rosado V. Prevalence of overweight and obesity in 7-9 year old Portuguese Children:Trends in body mass index from 1970-2002. American Journal of Human Biology 2004;16:670-678. These data were from a national Survey carried out 2002/3. All data except 7-10 years derived from Spanish data (See Spain Annex 2 for full details).

In children and adolescents no appropriate continuous data were available and therefore Spanish data were used. This should be replaced when more appropriate alternative data become available.

In adults categorical data were available for 18-64 years. These were based on a national survey between carried out 2003/4. Reference: Carmo do I, Santos dos O, Camolas J et al. Overweight and obesity in Portugal: national prevalence in 2003-5. Obesity Reviews 2008;9:11-19

In adults no continuous data were available and data for Spain were used in place. These data should be replaced when appropriate measured data becomes available.

Surveys not used included the self reported Eurostat data.

In adults historic data were available on a categorical basis for adults only. These were provided by personal communication. Age specific overweight and obesity were presented in the following paper as a chart - Carmo do I, Santos dos O, Camolas J et al. Overweight and obesity in Portugal: national prevalence in 2003-5. Obesity Reviews 2008;9:11-19
In adults continuous data were available from 1985/7 regional survey. Dyer AR, Elliott P, on behalf of the Intersalt Co-operative Research Group. The Intersalt study: relations of body mass index to blood pressure. Journal of Human Hypertension 1989;3:299-208

The survey presented by Jacome de Castro et al could not be used as the data were limited. Jacome de Castro J, Dias JA, Baptista F, Costa JG, Glvao-Teles A, Camilo-Alves

A. Secular trends of weight, height and obesity in cohorts of young Portuguese males in the District of Lisbon: 1960 to 1990. European Journal of Epidemiology 1998;14:299-303 - Limited to Males aged 20yrs. Mean BMI and % overweight and obesity are available in 5 year intervals between 1960-1990.

In children continuous data were provided from a National survey carried out between 1970-2003. Reference: Padez C, Fernandes T, Mourao I, Moreira P, Rosado V. Prevalence of overweight an dobesity in 7-9 year old Portuguese Children:Trends in body mass index from 1970-2002. American Journal of Human Biology 2004;16:670-678

Surveys not used included:

> Reference: Cardoso HFV, Padez C. Changes in height, weight, BMI and in the prevalence of obesity among 9 to 11 year old affluent Portuguese schoolboys, between 1960 and 2000. Annals of Human Biology 2008;35:624-638 - did not use as limited age range and not at all representative of Portuguese population.
>
> Cardoso HF, Caninas M. Secular trends in social class differences of height, weight and BMI of boys from two schools in Lisbon, Portugal (1910-2000). Econ Human Biol 2009;advanced online publication

EUROCADET used the Carmo do I et al 2005 as shown above.

The EUROCADET survey did not use.

> Dias CM, de Jesus Graca M. O inquérito nacional de saúde em Portugal; história, métodos e alguns resultados. Maria Daniel Vaz de Almeida, Pedro Graça1, Cláudia Afonso, Amleto D'Amicis, Raimo Lappalainen and Soren Damkjaer. Physical activity levels and body weight in a nationally representative sample in the European Union, Public Health Nutrition: 2(1a), 105-113
>
> The INTERSALT Co-operative Research Group. Appendix Tables, Centre-specific results by age and sex, Journal of Human Hypertension; 3:331-407
>
> INSA/INE, INS 1998/1999 and 2005/2006.

Romania

No appropriate measured data available at this time.

Slovakia

Insufficient measured data available at this time.

Special thanks are given to Dr Barakova from the National Health Information Center, established by the Ministry of Health of the Slovak Republic for providing background data for the project.

Slovenia

Insufficient measured data available at this time.

Spain

In children and adolescents aged 2-17 years categorical data were provided from the following reference. Serra-Majem L. Aranceta Bartrina J. Pérez-Rodrigo C. Ribas-Barba L. Delgado-Rubio A. Prevalence and deteminants of obesity in Spanish children and young people. Br J Nutr. 2006 Aug;96 Suppl 1:S67-72.

In children and adolscents age 2-17 years continous data were provided from the following reference. Serra Majem L. Ribas Barba L. Aranceta Bartrina J. Pérez Rodrigo C. Saavedra Santana P. Peña Quintana L. Obesidad infantil y juvenil en España. Resultados del estudio enKid (1998-2000). Med Clin (Barc). 2003 Nov 29;121(19):725-32.

The national survey took place between 1998-2000, and was based on measured weights and heights. Three references were supplied.

> Serra Majem L, Ribas Barba L, Aranceta Bartrina J, Pérez Rodrigo C, Saavedra Santana P, Peña Quintana L. Obesidad infantil y juvenil en España. Resultados del estudio enKid (1998-2000). Med Clin (Barc). 2003 Nov 29;121(19):725-32.
>
> Aranceta-Bartrina J, Serra-Majem L, Foz-Sala M, Moreno-Esteban B; Grupo Colaborativo SEEDO. Prevalencia de obesidad en España. Med Clin (Barc). 2005 Oct 8;125(12):460-6.
>
> Gutierrez-Fisac JL, López E, Banegas JR, Graciani A, Rodríguez-Artalejo F (2004). Prevalence of overweight and obesity in elderly people in Spain. Obesity Research; 12 (4): 710-715

The surveys in total involved around 20,000 participants.

Surveys not used were the HIS Surveys 1987, 1995 and 1997, 2001 and 2003 as they were based on self reported height and weight.

Historic data were provided in adults by the reference, Aranceta J, Perez Rodrigo C, Serra Majem Li, Ribas L, Quiles Izquierdo J, Vioque J, Foz M. Prevalence of Obesity in Spain: the SEEDO'97 study. Spanish Collaborative Group for the Study of Obesity. Med Clin (Barc) 1998 Vol 111(12):441-5

In children trends were avaiable in 6, 7, 13 and 14 yrs old children. Reference: Moreno LA, Sarria A, Fleta J, Rodriguez G, Bueno M (2000) Trends in body mass index and overweight prevalence among children and adolescents in the region of Aragon (Spain) from 1985-1995. IJO 2000;24:925-931. Please note while this reference appeared in print and on pubmed this pdf cannot be found on the IJO nature website?

Surveys not used

> Moreno LA, Fleta J, Sarria A et al. Secular changes in body fat patterning in children and adolescents of Zaragoza (Spain), 1980-1995. IJO 2001;25:1636-1660. This provided only regional data and no BMI data provided only height and weights.
>
> The regional survey Plans P, Pardell H, Salleras Li. Epidemiology of Cardiovascular disease risk factors in Catalonia (Spain). European Journal of Epidemiology 1993;9:381-389. Data from 1989, Mean BMI and Obesity by age and gender was also excluded.
>
> Rodrigues Artalejo F, Lopez Garcia E, Gutierrez-Fisac JL et al. Changes in the prevalence of Overweight and Obesity and their risk factors in Spain 1987-1997.

Preventive Medicine 2002;34:72-81. Excluded as based on self reported height and weights.

Gutierrez-Fisac JL, Regidor E, Garcia EL et al. The obesity epidemic and related factors: the case of Spain. Cad. Saude Publica, Rio de Janeiro 2003;19 (suppl 1) S101-S110. Excluded as based on self reported height and weights.

In children the following reference was excluded as it did not use the IOTF Cut off. Rios M, Fluiters E, Perez Mendez LF et al. Prevalence of childhood overweight in Northwestern Spain: a comparative study of two periods with a ten year interval. IJO 1999;23:1095-1098

In comparison EUROCADET used the self report HIS Surveys published by the Ministry of Health.

Special thanks go to Dr. Xavier Formiguera, President of the Spanish Society for the Study of Obesity (SEEDO) and Dr. Javier Aranceta who provided data used within this project. Thanks also go to Prof. Fernando Rodríguez Artalejo for providing background data and information regarding future sources of data.

Sweden

In children continuous data 0-8 years had to be based on a linear change in 9-17 year olds, 0-3 years were based on data of 4 year old Norwegian children in the absence of anything more appropriate. All these data should be replaced as soon as new data available. In children, categorical data 0-8 years based on Norwegian data. 0-3 yrs based on 4 year old data in the absence of anything more suitable. Data for 9, 11, 12,14, 15 and 17 yrs from Ekblom OB et al 2004. Data were presented for 10 yrs, 13yrs and 16yrs. 10 year old data were applied to 9 and 11 year olds. 13 year old data applied for 12 and 14 year olds. 16 year olds data applied for 15 and 17 year olds. No SD data available.

Reference for Norwegian data: Juliusson PB, Roelandts M, Eide GE et al. Overweight and obesity in Norwegian children: Secular trends in weight for height and skinfolds. Acta Paediatrica 2007;96:1333-1337.

Reference for Swedish data: Ekblom OB, Oddsson K, Ekblom BT. Prevalence and regional differences in overweight in 2001 and trends in BMI distribution in Swedish children from 1987-2001. Scandinavian Journal of Public Health 2004;32:257-263

Surveys not used

Lager ACJ, Fossum B, Rorvall G and Bremberg SG. Children's overweight and obesity: Local and national monitoring using electronic health records. Scandinavian Journal of Public Health 2009;37:201-5 as data were not available in useable format. Contacted author and we were advised that further data will be available in the future.

Holmback U, Fridman J, Gustafsson J,roos L, Sundelin C, Forslund A. Overweight more prevalent among children than among adolescents. Acta Paediatrica 2006;96:577-581. The survey sample size was too small to present data by individual year of age

In adults data for 25-64 year olds were provided from a regional survey from 2002 involving 1036 subjects. Reference: Berg C, Rosengren A, Aires N et al. Trends in overweight and obesity from 1985-2002 in Goteborg, West Sweden. IJO 2005;8:916-924. Data for older adults were determined by using methodology outlined earlier in the report.

Surveys not used in this report included:

EUROSTAT survey as based self reported heights and weights.

Swedish Survey of Living conditions 2002/3 as based on self reported height and weights.

Historic data were provided for adults in the following references.

Berg C, Rosengren A, Aires N et al. Trends in overweight and obesity from 1985-2002 in Goteborg, West Sweden. IJO 2005;8:916-924. This was a sub national survey.

Lahmann PH, Lissner L, Gullberg B, Berglund G. Sociodemographic factors associated with long-term weigh gain, current body fatness and cetral adiposity in Swedish women. IJO 2000;24:685-694 - data limited to women from 45-73 years of age. This was a sub national survey, part of the Malmo Diet and Cancer Study.

The following surveys were excluded from providing either historic or trend data.

Swedish annual survey of living conditions had to be excluded from providing trend data as it was based on self reported height and weight. Example references: Sundquist J, Johansson SE. The inflence of socioeconomic stts, ethinicity and lifestyle on body mass index in a longitudinal study. International Journal of Epidemiology 1998:27:57-63. Lissner L Johansson SE, Qvist J, Rossner S, Wolk A. Social mapping of the obesity epidemic in Sweden. IJO 2000;24:801-805.

Kuskowska- Wolk A, Rossner S. Body mass distribution of a represetnative adult population in Sweden. Diabetes Research and Clinical Practice 1990;10:S37-s41. Once again this survey was based on reported heights and weights.

DiPietro Loretta, Mossberg HO, Stunkard AJ. A 40 year history of overweight children in Stockholm: life-time overweight, morbidity and mortality. IJO 1994;18:585-590. This data could not be used as data were not presented in usable format.

Rasmussen F, Johansson M, Hansen HO. Trends in overweight and obesity among 18 year old makes in Sweden between 1971 and 1995. Acta Paediatricia 1999;88:431-7. Limited to 18 year old males and therefore could not be included.

Historic/trend data in children were limited to mean BMI, overweight and Obesity in 9-11 year olds. These were based on a sub national survey, data were taken from the following reference:

Marild S, Bondestam M, Bergstrom R et al. Prevalence trends of obesity and overweight among 10 year old children in Western Sweden and relationship with parental body mass index. Acta Paediatricia 2004;93:1588-95

Surveys not used

> Ekblom OB, Oddsson K, Ekblom BT. Prevalence and regional differences in overweight in 2001 and trends in BMI distribution in Swedish children from 1987-2001. Scandinavian Journal of Public Health 2004;32:257-263. 1987 data not presented in usable format.
>
> Petersen S, Brulin C, Bergstrom E. Increasing prevalence of overweight in young schoolchildren in Umea, Sweden, from 1986 to 2001. Acta Paediatricia 2003;92:848-853
> Sundblom E, Petzold M, Rasmussen F, Callmer E, Lissner L. Childhood overweight and obesity prevalences levelling off in Stockholm but socioeconomic differences persist. IJO 2008;32:1525-1530, excluded as data limited to 10 year olds.

In comparison EUROCADET used the self report EUROSTAT survey. They did not use either the National Public Health Report 2001. Scandinavian Journal of Public Health,2001 29:1-239.

Or Lissner L, Johansson S-E, Qvist J, Rössner S, Wolk A. Social mapping of the obesity epidemic in Sweden. International Journal of Obesity and Related Metabolic Disorders,2000 24:801-805

Switzerland

No appropriate measured data available at this time.

Special thanks go to Dr. Yves Schutz from Lausanne, and Dr. Josef Laimbacher from the Children Hospital St. Gallen.- and Prof Ulrich Keller provided background data.

United Kingdom

In children aged 0-2 years not available. Figures for 2 years were used. Figures were based on the Health Survey for England 2005, Dept of Health. Data were obtained and analysed by IASO.

Surveys not used to supply child data were the Scottish Health Survey as these used different cut off points and were not comparable.

In Adults 18-95 years the following references were utilised.

Health Survey for England 2005, Dept of Health. National to England, large, measured survey.

Scottish Health Survey, national to Scotland, large, measured survey.

In order to supply a UK wide figure the data were weighted according to the 2001 Census. England 83.6%, Scotland 8.6%, Wales 4.9%, Northern Ireland 2.9%. No measured data available in Wales therefore it was considered after discussion that the England figures should be used.

Historic data were available for both adults and children in the following references.

Health Survey for England (every year from 1992)

OPCS, 1981 - in Royal College of Physicians. OBESITY. Reprinted from the Journal of the Royal College of Physicians of London 1983;17:

Surveys not used

Laurier D, Guiguet M, Chau NP et al. Prevalence of obesity: a comparative survey in France, the UK and the USA. IJO 1992;16:565-572 -Survey took place in 1988 on a representative population aged 16-50 yrs but insufficient detail given in the paper

In children historic/trend data available from:

Health Surveys for England - National, Measured, Annual Survey

Chinn S, Rona RJ. Prevalence and trends in overweight and obesity in three cross sectional studies of British Children, 1974-1994. BMJ 2001;322:24-26
n=8007 (1974), n= 6267 (1984), n= 5874 (1994) - England only

Of interest is the following reference though it is not based on IOTF Child cut off points. The National 1946 Birth Cohort. However only data for the percentage above average weight for height - in Royal College of Physicians. OBESITY. Reprinted from the Journal of the Royal College of Physicians of London 1983;17:

Surveys not used

Bundred P, Kitchiner D, Buchan I. Prevalence of overweight and obese children between 1989 and 1998: population based series of cross sectional studies. BMJ 2001;322:326-8. In this instance data were not presented by gender and used different cut off points.

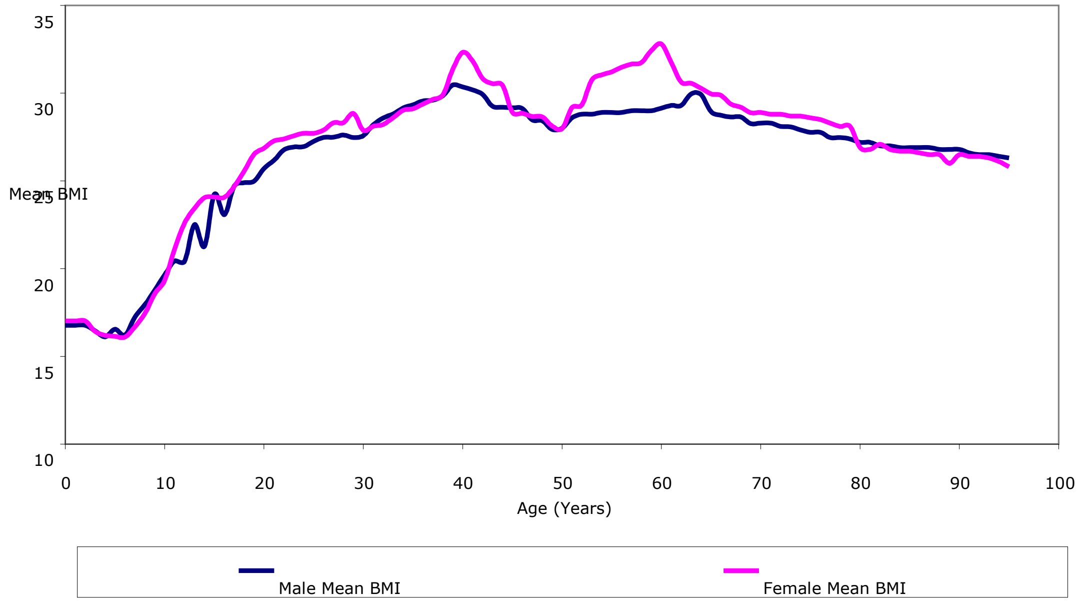
In comparison EUROCADET used the regional MONICA Survey. They did not use
The Health Survey for England. Neither did they use Wadsworth M, Kuh D, Richards M, Hardy R. Cohort profile: The 1946 National Birth cohort. Int J Epidemiology.

USA

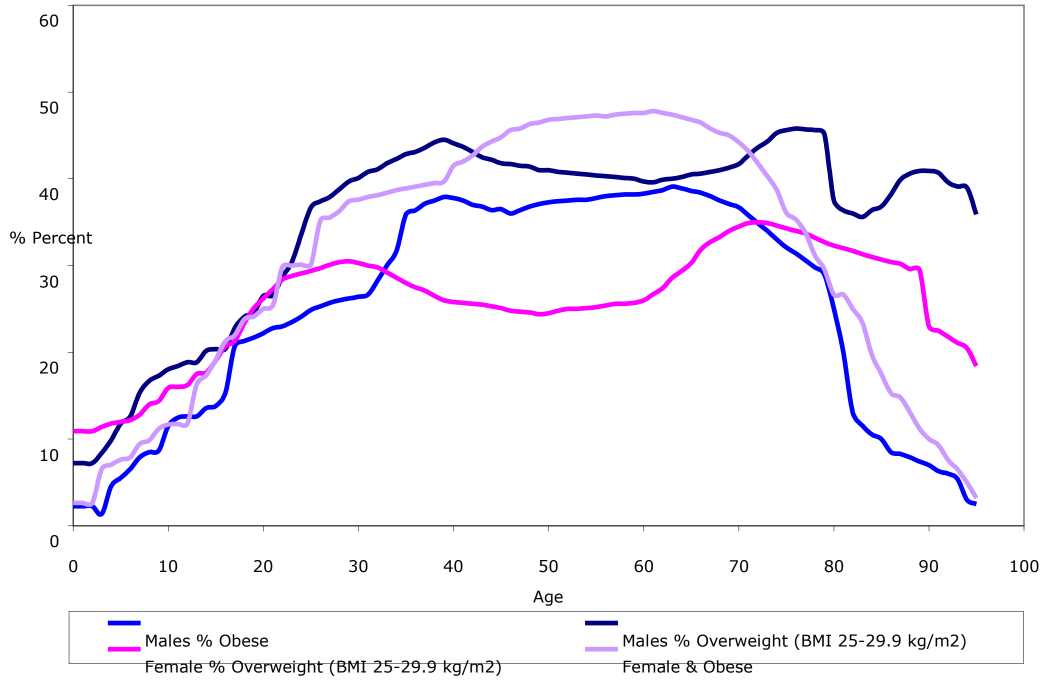
Children 0-17yrs
NHANES 05/06. Large national (n=3554), measured survey, Raw data supplied, IASO reanalyzed and smoothed

Adults 18-95yrs
NHANES 05/06 Large national (n=5242), measured survey, Raw data supplied, IASO reanalyzed and smoothed

Mean BMI in a US Population 0-95 yrs



Overweight and Obesity in the US Population 0-95 yrs



Annex 3 Relative Risk assessments

Sources and estimates of the Relative Risk (RR) of defined diseases according to BMI status (given as per BMI unit increase from BMI 22 = 1.0; and per BMI category of Overweight and Obese relative to normal weight). The RR used for the DYNAMO study is given in the last line of each table.

Adjustments for age and smoking are given as multipliers of the differential risk, i.e. as a multiplier of the difference in relative risk from the base (1.0). Thus an adjustment multiplier of x0.95 applied to an RR of 1.20 would lead to an RR of 1.19 (calculated as RR' = 1 + A(RR-1) where RR is the given relative risk, RR' is the adjusted relative risk and A is the adjustment multiplier).

Assumptions:

The value chosen for the DYNAMO-HIA project was a judgement based on a number of factors:

- The findings of relevant and large-scale studies, shown in the tables;
- The findings of systematic reviews and meta-analyses, shown in the tables;
- Higher priority to data which represented European populations;
- Higher priority to data derived from surveys which used measured, rather than self-reported, heights and weights to obtain BMI;
- Higher priority to reviews conducted in most recent decades, referring to more studies;
- Choosing a conservative approach (i.e. 'the actual risk is likely to be greater than this') rather than a 'worst case' approach (i.e. 'the actual risk could be as high as this').

Due to the limited evidence available for children, a relative risk of one (1.0) is recommended for individuals under the age of 20 years.

For the other age groups, we assumed that the relative risk estimates are the same for all age groups, except where we were able to obtain data by age group. In these cases the relative risks were adjusted to conform with the known effects of age on the association between BMI and disease outcome. The adjustments are shown in the tables and should be used as follows:

Adjustments for age and smoking are given as multipliers of the differential risk, i.e. as a multiplier of the difference in relative risk from the base (1.0). Thus an adjustment multiplier of x0.95 applied to an RR of 1.20 would lead to an RR of 1.19 (calculated as RR' = 1 + A(RR-1) where RR is the given relative risk, RR' is the adjusted relative risk and A is the adjustment multiplier).

Excel files containing relative risks for males and females aged 1 to 95 years have been constructed for the DYNAMO-HIA project.

Summary tables

Tables show the RRs for:

All-Cause Mortality

Incident risk from Ischaemic (Coronary) Heart Disease

Incident risk from Stroke

Incident risk from Diabetes

Incident risk from Lung Cancer

Incident risk from Breast Cancer

Incident risk from Endometrial Cancer

Incident risk from Oesophagal Cancer

Incident risk from Kidney Cancer

Incident risk from Oral Cancer

Incident risk from Colorectal Cancer

Incident risk from Gallbladder Cancer

Incident risk from COPD: PLEASE NOTE there was insufficient information on which to construct a table of relative risks.

RR All-Cause Mortality
***Per unit BMI** above BMI 22*

Source	BMI	RR	RR	age	current smoking	notes
	sr=self rep m=measured	men	women	multipliers	multipliers (never smoked = 1.0)	
Moore	m		1.05	x 0.95 from age 65		
Lawlor	m	1.08	1.03			
Rosengren	m	1.09	--			
PSC meta	m + sr	1.06	1.05	x 0.95 from age 60 x 0.85 from age 75	x 0.92 men x 0.99 women	
McGee meta	?	1.02	1.02			
Banegas	sr	1.04			x 0.87	
Adams	sr	1.03	1.04	x 0.95 from age 55 x 0.90 from age 65	x 0.72 men x 0.80 women	
Freedman	sr	1.07	1.03		x 1.67 men x 3.97 women	
Calle	sr	1.04	1.06	x 0.96 from age 65 x 0.90 from age 75		
Stevens	sr	1.07	1.03	x 0.99 per decade		
Yarnell	sr	1.07	-			
DYNAMO		**1.07**	**1.03**	**x 0.98 from age 50 x 0.95 from age 60 x 0.90 from age 70**	**inconsistent**	

- *Moore et al. Past BMI and risk of mortality among women. Int J Obesiy, 2008; 32:730-739.*
- *Lawlor et al. Reverse causality and confounding and the associations of overweight and obesity with mortality. Obesity. 2006; 14: 2294-2304.*
- *Rosengren et al. Body weight and weight gain during adult life in men in relation to CHD and mortality. Eur Heart J. 1999; 20:268-277.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*
- *McGee et al. Body Mass Index and mortality: a meta-analysis based on person level data from twenty-six observational studies. Ann Epidemiol, 2005; 15:87-97.*
- *Banegas et al Mortality attributable to obesity in Europe, EJCN, 2003; 57:201-208.*
- *Adams et al. Overweight, obesity and mortality in a large prospective cohort of persons 50-71 years old. NEJM 2006; 355:763-778.*

- Freedman et al. The mortality risk of smoking and obesity combined. Am J Prev Med, 2006; 31: 355-362.
- Calle et al BMI and mortality in a prospective cohort of US adults. NEJM 1999; 341:1097-1105.
- Stevens et al, The effect of age on the association between BMI and mortality. NEJM 1998; 338:1-7.
- Yarnell et al. Comparison of weight in middle age, weight at 18 and weight change between, in predicting subsequent 14-year mortality and coronary events: Caerphilly Prospective Study. J Epidemiol Community Health 2000; 54: 344-348.

RR All-Cause Mortality
By BMI category (BMI 22=1.0)

Source	BMI	RR BMI 25-29.9		RR BMI 30+		age	current smoking
	sr=self rep m=measured	men	women	men	women	multipliers	multipliers (never smoked = 1.0)
Moore	m		1.22		1.60	x 0.95 from age 65	
Lawlor	m	1.38	1.20	2.10	1.76		
Rosengren	m	1.0	1.10	1.39	1.55		
PSC meta	m + sr	1.44	1.27	2.07	1.61	x 0.95 from age 60 x 0.85 from age 75	x 0.92 men x 0.99 women
McGee meta	?	1.0	1.0	1.20	1.28		
Banegas	sr	1.10		1.54			x 0.87
Adams	sr	1.0	1.06	1.35	1.18	x 0.95 from age 55 x 0.90 from age 65	x 0.72 men x 0.80 women
Freedman	sr	0.80	1.20	1.20	1.20		x 1.67 men x 3.97 women
Calle	sr	1.15	1.33	2.05	1.53	x 0.96 from age 65 x 0.90 from age 75	
Stevens	sr	1.28	1.18	1.64	1.35	x 0.99 per decade from age 30	
Yarnell	sr	1.44	-	2.03	-		
DYNAMO		***1.20***	***1.15***	***1.55***	***1.50***	***x 0.98 from age 50 x 0.95 from age 60 x 0.90 from age 70***	***inconsistent***

- Moore et al. Past BMI and risk of mortality among women. Int J Obesiy, 2008; 32:730-739.
- Lawlor et al. Reverse causality and confounding and the associations of overweight and obesity with mortality. Obesity. 2006; 14: 2294-2304.

- *Rosengren et al. Body weight and weight gain during adult life in men in relation to CHD and mortality. Eur Heart J. 1999; 20:268-277.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*
- *McGee et al. Body Mass Index and mortality: a meta-analysis based on person level data from twenty-six observational studies. Ann Epidemiol, 2005; 15:87-97.*
- *Banegas et al Mortality attributable to obesity in Europe, EJCN, 2003; 57:201-208.*
- *Adams et al. Overweight, obesity and mortality in a large prospective cohort of persons 50-71 years old. NEJM 2006; 355:763-778.*
- *Freedman et al. The mortality risk of smoking and obesity combined. Am J Prev Med, 2006; 31: 355-362.*
- *Calle et al BMI and mortality in a prospective cohort of US adults. NEJM 1999; 341:1097-1105.*
- *Stevens et al, The effect of age on the association between BMI and mortality. NEJM 1998; 338:1-7.*
- *Yarnell et al. Comparison of weight in middle age, weight at 18 and weight change between, in predicting subsequent 14-year mortality and coronary events: Caerphilly Prospective Study. J Epidemiol Community Health 2000; 54: 344-348.*

RR Ischaemic (Coronary) Heart Disease
***Per unit BMI** above BMI 22*

Source	BMI	RR	RR	age	current smoking	notes
	sr=self rep m=measured	men	women	multipliers	multipliers (never smoked = 1.0)	
Morbidity						
Bogers	*m*	*1.05*				
Rosengren	*m*	*1.08*	*-*			
Guh meta	*?*	*1.06*	*1.12*			
UK NAO	*?*	*1.04*	*1.12*			
UK Foresight	*?*	*1.06*	*1.07*	*x 0.70 age over 65*		
Yarnell	*sr*	*1.08*	*-*			
Mortality						
Lawlor1	*m*	*1.11*	*1.04*			
Lawlor2	*m*	*1.04*	*-*			
Chen	*m*	*1.06*	*-*			
Rosengren	*m*	*1.07*	*-*			
McGee	*?*	*1.04*	*1.05*			
PSC meta	*m + sr*	*1.07*				
Freedman	*sr*	*1.07*	*1.07*	*x 0.70 age over 65*	*x 2.50 for current smoker*	
DYNAMO		***1.07***	***1.10***	***x 0.70 over age 65***	***x 2.50 for current smoker***	

- *Bogers et al. Association of overweight with increased risk of CHD partly independent of blood pressure and cholesterol levels. Arch Intern Med, 2007; 167:1720-1728.*
- *Rosengren et al. Body weight and weight gain during adult life in men in relation to CHD and mortality. Eur Heart J. 1999; 20:268-277.*
- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *UK National Audit Office. Tackling Obesity in England. 2001. http://www.nao.org.uk/publications/0001/tackling_obesity_in_england.aspx*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Yarnell et al. Comparison of weight in middle age, weight at 18 and weight change between, in predicting subsequent 14-year mortality and coronary events: Caerphilly Prospective Study. J Epidemiol Community Health 2000; 54: 344-348.*
- *Lawlor et al. Reverse causality and confounding and the associations of overweight and obesity with mortality. Obesity. 2006; 14: 2294-2304.*

- *Chen et al. BMI and mortality from IHD in a lean population: 10 year prospective study of 220,000 adult men. Int J Epidemiol, 2006; 35:141-150.*
- *McGee et al. Body Mass Index and mortality: a meta-analysis based on person level data from twenty-six observational studies. Ann Epidemiol, 2005; 15:87-97.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*
- *Freedman et al. The mortality risk of smoking and obesity combined. Am J Prev Med, 2006; 31: 355-362.*

RR Ischaemic (Coronary) Heart Disease
By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	*current smoking*
	sr=self rep m=measured	*men*	*women*	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*
Morbidity							
Bogers	*m*	*1.29*		*1.72*			
Rosengren	*m*	*1.44*	*-*	*2.07*	*-*		
Guh meta	*?*	*1.29*	*1.72*	*1.80*	*3.10*		
UK NAO	*?*	*-*	*-*	*1.50*	*3.20*		
UK Foresight	*?*	*1.35*	*1.40*	*1.80*	*2.00*	*x 0.70 age over 65*	
Yarnell	*sr*	*1.54*	*-*	*2.17*	*-*		
Mortality							
Lawlor1	*m*	*1.73*	*1.23*	*2.84*	*1.93*		
Lawlor2	*m*	*1.24*	*-*	*3.88*	*-*		
Chen	*m*	*1.44*	*-*	*-*	*-*		
Rosengren	*m*	*1.13*	*-*	*2.05*	*-*		
McGee	*--*	*1.16*	*1.10*	*1.51*	*1.62*		
PSC meta	*m + sr*	*1.39*		*1.73*			
Freedman	*sr*	*1.39*	*1.37*	*3.76*	*1.70*	*x 0.70 age over 65*	*x 2.50 for current smoker*
DYNAMO		***1.35***	***1.35***	***2.00***	***2.00***	***x 0.70 age over 65***	***x 2.50 for current smoker***

- *Bogers et al. Association of overweight with increased risk of CHD partly independent of blood pressure and cholesterol levels. Arch Intern Med, 2007; 167:1720-1728.*
- *Rosengren et al. Body weight and weight gain during adult life in men in relation to CHD and mortality. Eur Heart J. 1999; 20:268-277.*

- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *UK National Audit Office. Tackling Obesity in England. 2001. http://www.nao.org.uk/publications/0001/tackling_obesity_in_england.aspx*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Yarnell et al. Comparison of weight in middle age, weight at 18 and weight change between, in predicting subsequent 14-year mortality and coronary events: Caerphilly Prospective Study. J Epidemiol Community Health 2000; 54: 344-348.*
- *Lawlor et al. Reverse causality and confounding and the associations of overweight and obesity with mortality. Obesity. 2006; 14: 2294-2304.*
- *Chen et al. BMI and mortality from IHD in a lean population: 10 year prospective study of 220,000 adult men. Int J Epidemiol, 2006; 35:141-150.*
- *McGee et al. Body Mass Index and mortality: a meta-analysis based on person level data from twenty-six observational studies. Ann Epidemiol, 2005; 15:87-97.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*
- *Freedman et al. The mortality risk of smoking and obesity combined. Am J Prev Med, 2006; 31: 355-362.*

RR Stroke
***Per unit BMI** above BMI 22*

Source	BMI	RR	RR	age	current smoking	notes
	sr=self rep m=measured	men	women	multipliers	multipliers (never smoked = 1.0)	
Morbidity						
Guh meta	*?*	*1.04*	*1.09*			
UK Foresight	*?*	*1.05*	*1.04*	*x 0.75 over age 65*		
UK NAO	*?*	*1.03*	*1.03*			
Mortality						
Lawlor 1	*m*	*1.04*	*1.04*			
Lawlor 2	*m*	*1.07*				
PSC	*m + sr*	*1.07*				
DYNAMO		***1.04***	***1.04***	***x 0.75 over age 65***		

- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *UK National Audit Office. Tackling Obesity in England. 2001. http://www.nao.org.uk/publications/0001/tackling_obesity_in_england.aspx*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Lawlor et al. Reverse causality and confounding and the associations of overweight and obesity with mortality. Obesity. 2006; 14: 2294-2304.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*

RR Stroke
By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	*current smoking*
	sr=self rep m=measured	*men*	*women*	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*
Morbidity							
Guh meta	*?*	*1.23*	*1.15*	*1.51*	*1.49*		
UK Foresight	*?*	*1.35*	*1.25*	*1.50*	*1.60*	*x 0.75 over age 65*	
UK NAO	*?*			*1.30*	*1.30*		
Mortality							
Lawlor 1	*m*	*0.90*	*0.90*	*1,48*	*1.52*		
Lawlor 2	*m*	*0.94*		*2.06*			
PSC	*m + sr*	*1.39*		*1.93*			
DYNAMO		***1.20***	***1.20***	***1.50***	***1.55***	***x 0.75 over age 65***	

- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *UK National Audit Office. Tackling Obesity in England. 2001. http://www.nao.org.uk/publications/0001/tackling_obesity_in_england.aspx*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Lawlor et al. Reverse causality and confounding and the associations of overweight and obesity with mortality. Obesity. 2006; 14: 2294-2304.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*

RR Diabetes
Per unit BMI *above BMI 22*

Source	BMI	RR	RR	age	current smoking	notes
	sr=self rep m=measured	men	women		multipliers	multipliers (never smoked = 1.0)
Morbidity						
Decoda Study	m	1.11	1.12			Asian population groups
Meigs	m	1.18				
Hippisley-Cox	m	1.29	1.27	x 0.92 from age 60 x 0.90 from age 75		
Meisinger	m	1.15	1.26			
Guh meta	?	1.20	1.29			
UK Foresight	?	1.20	1.20			
UK NAO	?	1.18	1.29			
Vazquez meta	m + sr	1.13				
Schienkiewitz	sr	1.15	1.11	x 1.04 over age 35		
Carey	sr	-	1.28			
Wang	sr	1.20	-			
Mortality						
PSC	m + sr	1.16				
DYNAMO		***1.18***	***1.22***	***x 0.92 from age 60 x 0.90 from age 75***		

- *Decoda Study Group (Nyamdorj R, et al). BMI compared with central obesity indicators in elation to diabetes and hypertension in Asians. Obesity 2008;16:1622-1635.*
- *Meigs JB et al. BMI, metabolic syndrome and risk of type 2 diabetes or CVD. J Clin Endocrinol Metab 2006; 91:2906-2912.*
- *Hippisley-Cox et al. Predicting risk of type 2 diabetes in England and Wales: prospective derivation and validation of QDScore. BMJ 2009;338:b880. doi:10.1136/bmj.b880.*
- *Meisinger C et al. Body fat distribution and risk of type 2 diabetes in the general population: are there difference between men and women. The MONICA/KORA Augsburg Cohort Study. Am J Clin Nutr. 2006;84:483-489.*
- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *UK National Audit Office. Tackling Obesity in England. 2001. http://www.nao.org.uk/publications/0001/tackling_obesity_in_england.aspx*

- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Vazquez G et al. Comparison of BMI, WC, WHR in predicting incident diabetes: a meta-analysis. Epd Revs 2007; doi:10.1093/epirev/mxm008.*
- *Schienkiewitz A et al. BMI history and risk of type 2 diabetes: results from the EPIC-Potdsdam Study. Am J Clin Nutr 2006; 84:427-433.*
- *Carey VJ et al. Body fat distribution and risk of NIDDM in women. Am J Epid. 1997;145:614-619.*
- *Wang Y et al. Comparison of abdominal adiposity and overall obesity in predicting risk of type 2 diabetes among men. Am J Clin Nutr 2005;81:555-563.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*

RR Diabetes
By BMI category (BMI 22=1.0)

Source		RR BMI 25-29.9		RR BMI 30+		age	notes
	sr=self rep m=measured	men	women	men	women	multipliers	
Morbidity							
Decoda Study	m	1.69	1.78	2.86	3.17		Asian population groups
Meigs	m	2.12		5.28			
Hippisley-Cox	m	2.33	2.33	7.17	6.50	x 0.92 from age 60 x 0.90 from age 75	
Meisinger	m	-	-	4.15	10.48		
Guh meta	?	2.40	3.92	6.74	12.41		
UK Foresight	?	2.20	1.65	40.00	14.50		
UK NAO	?	-	-	5.2	12.7		
Vazquez meta	m + sr	1.87		3.50			
Schienkiewitz	sr	2.01	1.69	4.05	2.86		
Carey	sr	-	3.35	-	11.20		
Wang	sr	2.55	-	6.50	-		
Mortality							
PSC	m + sr	2.16		4.67			
DYNAMO		**2.25**	**2.30**	**5.50**	**7.00**	**x 0.92 from age 60 x 0.90 from age 75**	

- *Decoda Study Group (Nyamdorj R, et al). BMI compared with central obesity indicators in elation to diabetes and hypertension in Asians. Obesity 2008;16:1622-1635.*
- *Meigs JB et al. BMI, metabolic syndrome and risk of type 2 diabetes or CVD. J Clin Endocrinol Metab 2006; 91:2906-2912.*
- *Hippisley-Cox et al. Predicting risk of type 2 diabetes in England and Wales: prospective derivation and validation of QDScore. BMJ 2009;338:b880. doi:10.1136/bmj.b880.*
- *Meisinger C et al. Body fat distribution and risk of type 2 diabetes in the general population: are there difference between men and women. The MONICA/KORA Augsburg Cohort Study. Am J Clin Nutr. 2006;84:483-489.*
- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *UK National Audit Office. Tackling Obesity in England. 2001. http://www.nao.org.uk/publications/0001/tackling_obesity_in_england.aspx*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Vazquez G et al. Comparison of BMI, WC, WHR in predicting incident diabetes: a meta-analysis. Epd Revs 2007; doi:10.1093/epirev/mxm008.*
- *Schienkiewitz A et al. BMI history and risk of type 2 diabetes: results from the EPIC-Potdsdam Study. Am J Clin Nutr 2006; 84:427-433.*
- *Carey VJ et al. Body fat distribution and risk of NIDDM in women. Am J Epid. 1997;145:614-619.*
- *Wang Y et al. Comparison of abdominal adiposity and overall obesity in predicting risk of type 2 diabetes among men. Am J Clin Nutr 2005;81:555-563.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*

RR Cancer - Lung

***Per unit BMI** above BMI 22*

Source	*BMI*	*RR*	*RR*	*age*	*current smoking*	*notes*
	sr=self rep m=measured	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*	
Morbidity						
Renehan meta	*m + sr*	*0.96*	*0.97*			
Reeves	*sr*	*-*	*0.98*			
WCRF meta	*m + sr*	*0.98*			*RR not affected*	
Mortality						
PSC meta	*m + sr*	*0.99*				
Reeves	*sr*	*-*	*0.97*			
DYNAMO		***0.97***	***0.98***			

- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*
- *WCRF: Meta-analyses conducted for the 2007 report Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report. (http://www.dietandcancerreport.org/)*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*

RR Cancer - Lung

By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	*current smoking*
	sr=self rep m=measured	*men*	*women*	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*
Morbidity							
Renehan meta	*m + sr*	*0.76*	*0.80*	*0.58*	*0.64*		
Reeves	*sr*	*-*	*0.88*	*-*	*0.77*		
Mortality							
PSC meta	*m + sr*	*0.98*		*0.96*			
Reeves	*sr*	*-*	*0.85*	*-*	*0.72*		
DYNAMO		***0.80***	***0.88***	***0.65***	***0.70***		

- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*
- *PSC = Prospective Studies Collaboration. BMI and cause-specific mortality in 900,000 adults: collaborative analyses of 57 prospective studies. Lancet, 2009; 373:1083-1096.*

RR Cancer - Breast
***Per unit BMI** above BMI 22*

Source	BMI	RR	RR	age	current smoking	notes
	sr=self rep m=measured	men	women	multipliers	multipliers (never smoked = 1.0)	
Morbidity						
Guh meta	*?*	*1.00*	*1.01*	*Post-menopausal*		
Renehan meta	*m + sr*	*1.00*	*1.02*	"		
UK Foresight	*?*	*1.00*	*1.02*	"		
Reeves	*sr*	*1.00*	*1.03*	"		
WCRF meta		*1.00*	*0.98ns* *1.02*	*Pre-menopause* *Post-menopause*		
Mortality						
Reeves	*sr*	*1.00*	*1.03*	"		
DYNAMO		***1.00***	***1.00 before age 50*** ***1.02 over age 50***			

- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*
- *WCRF: Meta-analyses conducted for the 2007 report Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report. (http://www.dietandcancerreport.org/)*

RR Cancer - Breast

By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	
	sr=self rep m=measured	*men*	*women*	*men*	*women*	*multipliers*	
Morbidity							
Guh meta	*?*	*1.00*	*1.08*	*1.00*	*1.13*	*Post-menopausal*	
Renehan meta	*m + sr*	*1.00*	*1.12*	*1.00*	*1.25*	*"*	
UK Foresight	*?*	*1.00*	*1.12*	*1.00*	*1.25*	*"*	
Reeves	*sr*	*1.00*	*1.17*	*1.00*	*1.37*	*"*	
Mortality							
Reeves	*sr*	*1.00*	*1.17*	*1.00*	*1.36*	*"*	
DYNAMO		***1.00***	***1.00 before age 50 1.12 over age 50***	***1.00***	***1.00 before age 50 1.25 over age 50***		

- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*

RR Cancer - Endometrium / uterus / womb

***Per unit BMI** above BMI 22*

Source	*BMI*	*RR*	*RR*	*age*	*current smoking*	*notes*
	sr=self rep m=measured	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*	
Morbidity						
Bjorge 2007	*m*		*1.08*			
Guh meta	*?*		*1.10*			
Renehan meta	*m + sr*		*1.10*			
Bergstrom meta	*m + sr*		*1.10*			
UK Foresight	*?*		*1.10*			
Reeves	*sr*		*1.12*			
Mortality						
Reeves	*sr*		*1.09*			
DYNAMO			***1.10***			

- *Bjørge T et al size in relation to cancer of the uterine corpus in 1 million Norwegian women. Int J Cancer. 2007; 120:378-83.*
- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Bergstrom et al. Overweight as an avoidable cause of cancer in Europe. Int J Cancer 2001; 91:421-430.*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*

RR Cancer - Endometrium / uterus / womb

By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	*current smoking*
	sr=self rep m=measured	*Men*	*women*	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*
Morbidity							
Bjorge 2007	*m*		*1.36*		*2.51*		
Guh meta	*?*		*1.53*		*3.22*		
Renehan meta	*m + sr*		*1.59*		*2.53*		
Bergstrom meta	*m + sr*		*1.59*		*2.52*		
UK Foresight	*?*		*1.59*		*2.52*		
Reeves	*sr*		*1.72*		*2.97*		
Mortality							
Reeves	*sr*		*1.57*		*2.46*		
DYNAMO			***1.50***		***2.50***		

- *Bjørge T et al size in relation to cancer of the uterine corpus in 1 million Norwegian women. Int J Cancer. 2007; 120:378-83.*
- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Bergstrom et al. Overweight as an avoidable cause of cancer in Europe. Int J Cancer 2001; 91:421-430.*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*

RR Cancer - Oesophagus
***Per unit BMI** above BMI 22*

Source	*BMI*	*RR*	*RR*	*age*	*current smoking*	*notes*
	sr=self rep m=measured	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*	
Morbidity						
Engeland 2004	*m*	*Ad 1.12 Sq 0.96*	*Ad 1.08 Sq 0.90*			
Renehan meta	*m + sr*	*Ad 1.09 Sq 0.96*	*Ad 1.09 Sq 0.88*			
Reeves	*sr*	*-*	*Ad 1.08 Sq 0.88*			
WCRF meta	*m + sr*	*Ad 1.11 Sq 0.98*				
Mortality						
Reeves	*sr*	*-*	*Ad 1.08 Sq 0.86*			
DYNAMO		***Ad 1.10 Sq 0.96***	***Ad 1.08 Sq 0.89***			

Ad = Adenocarcinoma of the oesophagus
Sq = Squaemous cell cancer of the oesophagus

- *Engeland A, Tretli S, Bjørge T. Height and body mass index in relation to esophageal cancer; 23-year follow-up of two million Norwegian men and women. Cancer Causes Control. 2004;15:837-43.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*
- *WCRF: Meta-analyses conducted for the 2007 report Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report. (http://www.dietandcancerreport.org/)*

RR Cancer - Oesophagus
By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	*current smoking*
	sr=self rep m=measured	*men*	*women*	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*
Morbidity							
Engeland 2004	*m*	*Ad 1.80 Sq 0.72*	*Ad 1.64 Sq 0.52*	*Ad 2.58 Sq 0.68*	*Ad 2.06 Sq 0.43*		
Renehan meta	*m + sr*	*Ad 1.52 Sq 0.71*	*Ad 1.51 Sq 0.57*	*Ad 2.31 Sq 0.50*	*Ad 2.28 Sq 0.32*		
Reeves	*sr*		*Ad 1.44 Sq 0.56*		*Ad 2.09 Sq 0.31*		
Mortality							
Reeves	*sr*		*Ad 1.50 Sq 0.47*		*Ad 2.46 Sq 0.22*		
DYNAMO		***Ad 1.60 Sq 0.72***	***Ad 1.50 Sq 0.53***	***Ad 2.45 Sq 0.55***	***Ad 2.15 Sq 0.30***		

Ad = Adenocarcinoma of the oesophagus
Sq = Squaemous cell cancer of the oesophagus

- *Engeland A, Tretli S, Bjørge T. Height and body mass index in relation to esophageal cancer; 23-year follow-up of two million Norwegian men and women. Cancer Causes Control. 2004;15:837-43.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*
- *WCRF: Meta-analyses conducted for the 2007 report Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report. (http://www.dietandcancerreport.org/)*

RR Cancer - Kidney
***Per unit BMI** above BMI 22*

Source	BMI	RR	RR	age	current smoking	notes
	sr=self rep m=measured	men	women	multipliers	multipliers (never smoked = 1.0)	
Morbidity						
Bjorge 2004	m	1.05	1.05		Current smoker lower risk, x 0.60	
Bergstrom meta	m + sr	1.06				
Renehan meta	m + sr	1.04	1-.06			
UK Foresight	?	1.06	1.06			
Reeves	sr	-	1.05			
Mortality						
Reeves	sr	-	1.05			
DYNAMO		***1.05***	***1.05***		***Smokers x 0.60***	

- *Bjørge T, Tretli S, Engeland A. Relation of height and body mass index to renal cell carcinoma in two million Norwegian men and women. Am J Epidemiol. 2004;160:1168-76.*
- *Bergstrom et al. Overweight as an avoidable cause of cancer in Europe. Int J Cancer 2001; 91:421-430.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*

RR Cancer - Kidney

By BMI category (BMI 22=1.0)

Source		RR BMI 25-29.9		RR BMI 30+		age	current smoking
	sr=self rep m=measured	men	women	men	women	multipliers	multipliers (never smoked = 1.0)
Morbidity							
Bjorge 2004	m	1.18	1.32	1.55	1.85		Current smoker lower risk, x 0.60
Bergstrom meta	m + sr	1.36		1.84			
Renehan meta	m + sr	1.24	1.34	1.54	1.80		
UK Foresight	?	1.36	1.36	1.84	1.84		
Reeves	sr	-	1.25	-	1.56		
Mortality							
Reeves	sr	-	1.28	-	1.65		
DYNAMO		***1.24***	***1.32***	***1.55***	***1.80***		***Smokers x 0.60***

- *Bjørge T, Tretli S, Engeland A. Relation of height and body mass index to renal cell carcinoma in two million Norwegian men and women. Am J Epidemiol. 2004;160:1168-76.*
- *Bergstrom et al. Overweight as an avoidable cause of cancer in Europe. Int J Cancer 2001; 91:421-430.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*

RR Cancer - Oral
***Per unit BMI** above BMI 22*

Source	*BMI*	*RR*	*RR*	*age*	*current smoking*	*notes*
	sr=self rep m=measured	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*	
Morbidity						
WCRF meta	*m + sr*	*0.89*				
Mortality						
DYNAMO		***0.97***	***0.98***			

- *WCRF: Meta-analyses conducted for the 2007 report Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report. (http://www.dietandcancerreport.org/)*

RR Cancer - Oral

By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	*current smoking*
	sr=self rep m=measured	*men*	*women*	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*
Morbidity							
WCRF meta	*m + sr*	*0.56*		*0.31*			
Mortality							
DYNAMO		***0.80***	***0.88***	***0.65***	***0.70***		

- *WCRF: Meta-analyses conducted for the 2007 report Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report. (http://www.dietandcancerreport.org/)*

RR Cancer - Colorectal
***Per unit BMI** above BMI 22*

Source	*BMI*	*RR*	*RR*	*age*	*current smoking*	*notes*
	sr=self rep m=measured	*men*	*women*		*multipliers*	
Morbidity						
Engeland 2005	*m*	*1.04*	*1.01*	*x 0.90 over age 45*		
Guh meta	*?*	*1.07*	*1.05*			
Renehan meta	*m + sr*	*1.04*	*1.02*			
UK Foresight	*?*	*1.05*	*1.05*			
Reeves	*sr*	*-*	*0.99*	*All over age 50*		
WCRF meta	*m + sr*	*1.04*	*1.02*			
Mortality						
Reeves	*sr*	*-*	*0.99*	*All over age 50*		
WCRF meta	*m + sr*	*1.02*	*1.02*			
DYNAMO		***1.04***	***1.02***	***x 0.90 over age 45***		

- *Engeland A et al. Height and body mass index in relation to colorectal and gallbladder cancer in two million Norwegian men and women. Cancer Causes Control. 2005 Oct;16(8):987-96.*
- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*
- *WCRF: Meta-analyses conducted for the 2007 report Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report. (http://www.dietandcancerreport.org/)*

RR Cancer - Colorectal
By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	*current smoking*
	sr=self rep m=measured	*men*	*women*	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*
Morbidity							
Engeland 2005	*m*	*1.21*	*1.03*	*1.49*	*1.07*	*x 0.90 over age 45*	
Guh meta	*?*	*1.51*	*1.45*	*1.95*	*1.66*		
Renehan meta colon	*m + sr*	*1.24*	*1.09*	*1.54*	*1.19*		
Renehan meta rectal only	*m + sr*	*1.09*	*1.00*	*1.19*	*1.0*		
UK Foresight	*?*	*1.15*	*1.33*	*1.15*	*1.33*		
Reeves	*sr*	*-*	*0.99*	*-*	*0.99*	*All over age 50*	
WCRF meta	*m + sr*	*-*	*-*	*1.46*	*1.19*		
Mortality							
Reeves	*sr*	*-*	*0.99*	*-*	*0.99*	*All over age 50*	
WCRF meta	*m + sr*			*1.65*	*1.43*		
DYNAMO		***1.20***	***1.08***	***1.40***	***1.10***	***x 0.90 over age 45***	

- *Engeland A et al. Height and body mass index in relation to colorectal and gallbladder cancer in two million Norwegian men and women. Cancer Causes Control. 2005 Oct;16(8):987-96.*
- *Guh et al. The incidence of co-morbidities related to obesity and overweight : a systematic review of the literature. BMC Public Health 2009; 9:88 doi:10.1186/1471-2458-9-88.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *UK Foresight Project. Tackling Obeseties: Future Choices. Dept of Innovation, Universities and Skills. 2007. http://www.foresight.gov.uk/OurWork/ActiveProjects/Obesity/Obesity.asp*
- *Reeves et al. Cancer incidence and mortality in relation to BMI in the Million Women Study. BMJ 2007; 335:1134-1144.*
- *WCRF: Meta-analyses conducted for the 2007 report Food, Nutrition, Physical Activity, and the Prevention of Cancer: a Global Perspective. Second Expert Report. (http://www.dietandcancerreport.org/)*

RR Cancer - Gallbladder

Per unit BMI *above BMI 22*

Source	*BMI*	*RR*	*RR*	*age*	*current smoking*	*notes*
	sr=self rep m=measured	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*	
Morbidity						
Engeland 2005	*m*	*1.03*	*1.06*	*x 1.17 age over 45 men x 0.80 age over 45 women*		
Rehenan meta	*m + sr*	*1.02*	*1.10*			
Bergstrom meta	*m + sr*	*1.06*				
Mortality						
DYNAMO		***1.02***	***1.06***	***x 1.17 age over 45 men x 0.80 age over 45 women***		

- *Engeland A et al. Height and body mass index in relation to colorectal and gallbladder cancer in two million Norwegian men and women. Cancer Causes Control. 2005 Oct;16(8):987-96.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Bergstrom et al. Overweight as an avoidable cause of cancer in Europe. Int J Cancer 2001; 91:421-430.*

RR Cancer - Gallbladder

By BMI category (BMI 22=1.0)

Source		*RR BMI 25-29.9*		*RR BMI 30+*		*age*	*current smoking*
	sr=self rep m=measured	*men*	*women*	*men*	*women*	*multipliers*	*multipliers (never smoked = 1.0)*
Morbidity							
Engeland 2005	*m*	*1.00*	*1.38*	*1.27*	*1.88*	*x 1.17 age over 45 men* *x 0.80 age over 45 women*	
Rehenan meta	*m + sr*	*1.09*	*1.59*	*1.19*	*2.53*		
Bergstrom	*m + sr*	*1.34*		*1.78*			
Mortality							
DYNAMO		***1.05***	***1.35***	***1.25***	***1.85***	***x 1.17 age over 45 men*** ***x 0.80 age over 45 women***	

- *Engeland A et al. Height and body mass index in relation to colorectal and gallbladder cancer in two million Norwegian men and women. Cancer Causes Control. 2005 Oct;16(8):987-96.*
- *Renehan A, et al. BMI and incidence of cancer: a systematic review and meta-analysis of prospective observational studies. The Lancet 2008; 371:569-578.*
- *Bergstrom et al. Overweight as an avoidable cause of cancer in Europe. Int J Cancer 2001; 91:421-430.*

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