OECD Health Working Papers No. 45

The Obesity Epidemic: Analysis of Past and Projected Future Trends in Selected OECD Countries

Franco Sassi,
Marion Devaux,
Michele Cecchini,
Elena Rusticelli

https://dx.doi.org/10.1787/225215402672

OECD

Unclassified **DELSA/HEA/WD/HWP(2009)3**

Organisation de Coopération et de Développement Économiques
Organisation for Economic Co-operation and Development **20-Mar-2009**

English - Or. English

DIRECTORATE FOR EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS
HEALTH COMMITTEE

DELSA/HEA/WD/HWP(2009)3
Unclassified

Health Working Papers

OECD HEALTH WORKING PAPERS NO. 45

THE OBESITY EPIDEMIC: ANALYSIS OF PAST AND PROJECTED FUTURE TRENDS IN SELECTED OECD COUNTRIES

Franco Sassi, Marion Devaux, Michele Cecchini and Elena Rusticelli

JEL Classification : I12, I32, D12

JT03261624

Document complet disponible sur OLIS dans son format d'origine
Complete document available on OLIS in its original format

English - Or. English

DIRECTORATE FOR EMPLOYMENT, LABOUR AND SOCIAL AFFAIRS

OECD HEALTH WORKING PAPERS

This series is designed to make available to a wider readership health studies prepared for use within the OECD. Authorship is usually collective, but principal writers are named. The papers are generally available only in their original language – English or French – with a summary in the other.

Comment on the series is welcome, and should be sent to the Directorate for Employment, Labour and Social Affairs, 2, rue André-Pascal, 75775 PARIS CEDEX 16, France.

The opinions expressed and arguments employed here are the responsibility of the author(s) and do not necessarily reflect those of the OECD

Applications for permission to reproduce or translate all or part of this material should be made to:

Head of Publications Service
OECD
2, rue André-Pascal
75775 Paris, CEDEX 16
France

Copyright OECD 2009

ACKNOWLEDGEMENTS

The authors would like to thank Mike Murphy, Tim Lobstein and Tomas Philipson for comments on the ideas developed in this paper. The authors would also like to thank all the experts who participated in the Expert Group meeting held in Paris in April 2008 on behalf of OECD member countries. Finally, they are grateful to Mark Pearson, Peter Scherer, Elizabeth Docteur, John Martin and Martine Durand for comments provided on various drafts, and Gabrielle Luthy and Aidan Curran for editorial assistance. The authors remain responsible for any errors and omissions.

The Economics of Prevention project is partly funded through regular contributions from OECD member countries. Additional voluntary contributions to the project were made by the following member countries: Australia, Denmark, Mexico, Netherlands, Sweden and Switzerland.

The project is also partly supported by a grant from the Directorate General for Public Health and Consumer Affairs of the European Commission. The contents of this paper do not necessarily reflect the views of the Commission.

ABSTRACT

Analysis of past and future trends in lifestyle risks factors and their determinants

This paper provides an overview of past and projected future trends in adult overweight and obesity in OECD countries. Using individual-level data from repeated cross-sectional national surveys, some of the main determinants and pathways underlying the current obesity epidemic are explored, and possible policy levers for tackling the negative health effect of these trends are identified. First, projected future trends show a tendency towards a progressive stabilisation or slight shrinkage of pre-obesity rates, with a projected continued increase in obesity rates. Second, results suggest that diverging forces are at play, which have been pushing overweight and obesity rates into opposite directions. On one hand, the powerful influences of obesogenic environments (aspects of physical, social and economic environments that favour obesity) have been consolidating over the course of the past 20-30 years. On the other hand, the long term influences of changing education and socio-economic conditions have made successive generations increasingly aware of the health risks associated with lifestyle choices, and sometimes more able to handle environmental pressures. Third, the distribution of overweight and obesity in OECD countries consistently shows pronounced disparities by education and socio-economic condition in women (with more educated and higher socio-economic status women displaying substantially lower rates), while mixed patterns are observed in men. Fourth, the findings highlight the spread of overweight and obesity within households, suggesting that health-related behaviours, particularly those concerning diet and physical activity, are likely to play a larger role than genetic factors in determining the convergence of BMI levels within households.

JEL Classification codes: I12, I32, D12

Key words: obesity, socio-economic inequality, obesogenic environment, household

RESUME

Analyses des tendances passées et futures des facteurs de risque liés au mode de vie et de leurs déterminants

Ce document fournit une vue d'ensemble des tendances passées et futures des taux de surpoids et d'obésité dans les pays de l'OCDE. L'utilisation de données individuelles issues d'enquêtes transversales nationales a permis d'explorer les déterminants principaux et les cheminements sous-jacents à l'épidémie d'obésité, et d'identifier de possibles leviers politiques pour contrer les effets négatifs de ces tendances sur la santé. Premièrement, les projections futures confirment la tendance vers une stabilisation progressive voire une faible baisse des taux de pré-obésité, accompagnée d'une augmentation continuelle des taux d'obésité. Deuxièmement, les résultats suggèrent que des forces divergentes sont en jeu, poussant les taux de surpoids et d'obésité dans deux directions opposées. D'une part, la forte influence d'un environnement obésogène (les aspects de l'environnement physique, social et économique qui favorisent l'obésité) a été confirmée au cours des 20-30 dernières années. D'autre part, l'influence sur le long terme de l'évolution de l'éducation et des conditions socio-économiques a rendu les générations successives de plus en plus conscientes des risques pour la santé liés aux choix de vie, et parfois plus aptes à gérer la pression de l'environnement. Troisièmement, les distributions des taux de surpoids et d'obésité dans les pays de l'OCDE montrent de façon cohérente des disparités marquées selon l'éducation et les conditions socio-économiques chez les femmes (plus éduquées et ayant un statut socio-économique plus élevé, les femmes ont des taux considérablement plus faibles), alors que des résultats variés sont observés chez les hommes. Quatrièmement, les résultats soulignent l'étendu du surpoids et de l'obésité au sein des ménages, et suggèrent que les comportements liés à la santé en particulier ceux concernant l'alimentation et l'activité physique, jouent probablement un rôle plus important que les facteurs génétiques dans la détermination du niveau de l'IMC au sein des ménages.

TABLE OF CONTENTS

SECTION I 8

1.1. International trends in obesity, diet, physical activity, and their determinants 8
1.2 Aims of the study 11

SECTION II 12

Data and methods 12
2.1. Data sources 12
2.2. Analytical models 14

SECTION III 18

Results 18
3.1. Descriptive statistics 18
3.2. Age, period and cohort effects 23
3.3. Disparities in overweight and obesity across socio-economic groups 26
3.4. Future projections of overweight and obesity rates 34
3.5. Multilevel models 40

SECTION IV 42

DISCUSSION OF FINDINGS AND CONCLUSIONS 42

4.1. The driving forces behind the epidemic: individual attitudes and environmental influences. 43
4.2. Unequal lifestyles, unequal health: disparities in obesity across social groups 44
4.3. The spread of obesity within families and social networks. 45

ANNEXES 47

ANNEX 1 – DETAILS OF HEALTH SURVEY DATA AND SAMPLE CHARACTERISTICS 47

ANNEX 2 – VARIABLES EXTRACTED FROM HEALTH SURVEY DATASETS 60

ANNEX 3 – DETAILS OF STATISTICAL MODELS USED IN THE ANALYSIS 62

ANNEX 4 –INEQUALITIES IN OBESITY AND OVERWEIGHT BY LEVEL OF EDUCATION 65

ANNEX 5 – INEQUALITIES IN OBESITY AND OVERWEIGHT BY SOCIO-ECONOMIC CONDITION 68

ANNEX 6 – ESTIMATES AND STANDARD ERRORS FROM SINGLE-LEVEL AND MULTILEVEL LOGISTIC MODELS 71

REFERENCES 75

Tables

Table 1. Strength of the intra-class correlation in diet and physical activity within households. 40
Table 2. Strength of the pairwise correlation in overweight, obesity and BMI between spouses and between mother and children. 41

SECTION I

1.1. International trends in obesity, diet, physical activity, and their determinants

1. Lifestyles have visibly changed in the OECD area over the course of recent decades. Some changes have been associated with improvements in health status and life expectancy, as in the case of tobacco consumption, which has been dropping in many countries since the 1950s (OECD, 2007). In other cases, lifestyles have become a threat to individual health. For instance, changing diets and increasingly sedentary lifestyles, particularly in the last thirty years, have contributed to a generalised increase in body weight. Spreading obesity has been associated with growing rates of chronic diseases, possibly affecting longevity (Foresight, 2007; Fontaine *et al.*, 2003; Olshansky *et al.,* 2005).

2. The effects of unhealthy diets and sedentary lifestyles show up in the current epidemic of overweight and obesity both among children and among adults in OECD countries. But there is also a less visible, but no less important, epidemic of 'lack of cardio-respiratory fitness' associated with sedentary behaviour. Longitudinal research between 1970 and 1993 on a cohort of about 25 thousand American adult males suggests that poor cardio-respiratory fitness (measured by administering a maximal exercise test on a treadmill) is an independent predictor of all-cause and cardio-vascular disease (CVD) mortality in all body-mass groups (normal weight, pre-obese and obese) after adjustment for other mortality predictors (Wei *et al*., 1999). Moreover, studies have shown that lack of cardio-respiratory fitness is of comparable importance to other independent predictors of mortality such as smoking, hypertension and diabetes, respectively, all body-mass groups, including men of normal weight. Lack of musculoskeletal fitness, also associated with sedentary behaviour, is likely to be a precipitating cause of loss of some activities of daily living (ADLs) and frailty among elderly people. There are also other diseases associated with unhealthy diets. For example, many people are consuming too much salt, which is one of the determinants of rising levels of hypertension.

3. In the remainder of this section we present a review of aspects of the distribution across social groups, and changes over time, of the prevalence of overweight and obesity. Lifestyle choices about nutrition and physical activity are the most direct determinants of overweight and obesity. However, the former are influenced by a wide range of factors, which must be taken into consideration when assessing the causes of trends over time in population rates of overweight and obesity. Comprehensive reviews of the determinants of trends in overweight, obesity, aspects of diet and physical activity have been presented in recent years (Branca *et al.*, 2007; Foresight, 2007; Bhargava, 2008). These point to a wide range of interconnected factors over the life-course of individuals, from genetic background to early nutrition, to education, to exposure to *obesogenic* environments in many aspects of the lives of individuals. Existing evidence of the determinants of body mass, diet and physical activity helped to focus the analyses presented in this paper and informed our choices of data, analytical approaches and statistical models.

1.1.1. Gender

4. There does not appear to be a uniform gender pattern in obesity across countries. Worldwide, obesity rates tend to be higher in women than in men, other things being equal, and the same is true, on average, in the OECD area. However, this is not the case in all countries. Men display higher non-

standardised obesity rates in half of OECD countries (with Greece, Ireland, Norway, Germany and Korea showing proportionally larger disadvantages for men). Male obesity rates have also been growing faster than female rates in most OECD countries, although the latter have been growing marginally faster in countries such as Denmark, Canada and Italy in recent years.

5. Unlike obesity, pre-obesity (defined as a body mass index – BMI – equal to or higher than 25, but lower than 30) is overwhelmingly more prevalent in men than in women in all OECD countries. Trends over time show pre-obesity rates increasing at a faster pace in women than men in countries such as Australia, Switzerland, United States or United Kingdom, while the opposite is true in countries such as Finland, Japan or Spain.

6. A number of possible explanations have been proposed for the higher prevalence of obesity in women in many countries. In a study based on US data, Chou *et al.* (2003) identified women as one of a number of groups, along with low-wage earners and ethnic minorities, in which declining real incomes, coupled with increasing numbers of hours devoted to work, have been associated with escalating obesity rates since the 1970s. A suggestion has also been made, supported by some biological evidence, that women who suffer nutritional deprivation in childhood are prone to becoming obese in adult life, whereas this effect does not appear to be present in men (Case *et al.*, 2007).

7. Gender differences in obesity are important *per se*, because they may suggest possible pathways through which obesity is generated. However, the gender dimension is perhaps even more important because of its significant interactions with other individual characteristics, such as socio-economic condition or ethnicity. Evidence from a number of countries shows that socio-economic gradients in obesity are steeper in women than in men (Wardle *et al.*, 2002; Branca *et al.*, 2007). In some cases they can be observed only in women (Wardle *et al.*, 2002). Women in certain ethnic minority groups are substantially more likely to be obese than other women, even after controlling for differences in socio-economic conditions, while this is not true for men in the same minority groups. Such interactions underscore the complexity of some of the causal mechanisms that shape body characteristics in modern industrialised societies.

1.1.2. Age

8. Evidence from a range of countries shows that the relationship between body mass index and age generally follows a bell-shaped pattern. Weight tends to increase slightly but progressively as individuals age, until it reaches a peak and begins to drop, while height remains relatively constant in adulthood. The age at which population rates of obesity start to decline varies in different countries, ranging from the late sixties to the late seventies in industrialised countries. However, there is little evidence that the bell-shaped pattern shown by most of the available statistics reflects a true relationship between age and BMI or overweight and obesity rates. Particularly when age-specific rates are derived from cross-sectional data, or even from pooled cross-sections, the individuals observed in a given age-group were born in a specific birth cohort, and their weights were observed at a particular point in time. Both of these time-related factors, birth cohort and period of observation, may have an influence on individual BMI and likelihood to be overweight or obese. Efforts to disentangle different temporal effects are not commonly made. This shortfall of most existing analyses makes it difficult not only to interpret the observed relationship between BMI and age, but also to extrapolate observed time-trends into the future.

1.1.3. Education and socio-economic condition

9. A complex relationship exists between socio-economic condition and obesity. At the population level, the relationship changes sign as countries increase their wealth. In low-income countries obesity is generally more prevalent among the better-off, while disadvantaged groups are increasingly affected as

countries grow richer. Many studies have shown an overall socio-economic gradient in obesity in modern industrialised societies. Rates tend to decrease progressively with increasing socio-economic status, whether the latter is measured by income, education, or occupation-based social class. Levels of obesity decrease roughly in a linear fashion with increasing education. There is some evidence that this association is, at least in part, causal. Natural experiments where policy changes are implemented that directly affect the number of years of mandatory schooling, can provide an indication of the causal nature of the link between education and obesity. Arendt (2005) used changes in compulsory education laws in Denmark and found inconclusive results regarding the effect of education on BMI. On the other hand, Spasojevic (2003) using a similar estimation strategy for Sweden found that additional years of education have a causal effect on maintaining a healthy BMI. However, the socio-economic gradient in obesity does not appear to be as steep as that observed in general health status and in the prevalence of a number of chronic diseases (Lobstein *et al.*, 2007). This finding may be linked to substantial gender differences in the relationship between socio-economic condition and obesity. In fact, the overall socio-economic gradient in obesity observed in many countries is an average of a strong gradient in women and a substantially milder, or even lacking, gradient in men. This difference has been reported in a number of studies, but hypotheses about possible explanations remain largely unexplored.

10. It has been suggested that men and women in poor socio-economic conditions may differ in their lifestyle choices. For instance, rates of smoking, or alcohol abuse, are higher among men at the bottom of the social ladder, and there is at least some evidence that both of these behaviours are inversely related to obesity. Men and women in poor socio-economic circumstances may also differ with regard to their patterns of physical activity. Low-paid jobs typically reserved to men tend to be more physically demanding than those more often taken up by women. Additionally, the two-way link between unemployment and obesity seems stronger in women than in men (Morris, 2006), and evidence from a longitudinal study has shown that overweight women are more likely to be unmarried, have lower education and lower incomes, while these effects are weaker in men (Gortmaker *et al.*, 1993).

11. The implications of the gender difference in socio-economic gradients are of course important. Among other things, the higher prevalence of obesity in women belonging to disadvantaged socio-economic groups means that these women are more likely to give birth to and raise children who will themselves be overweight or obese, and in turn will have fewer chances of moving up the social ladder, perpetuating the link between obesity and socio-economic disadvantage.

1.1.4. Ethnicity

12. Ethnic origin and migrant status are important dimensions along which variations in health and health-related behaviours have been shown in a wide range of empirical studies. Such variations exist also in relation to overweight and obesity, even after accounting for the socio-economic differences often associated with ethnic minority and migrant status. Not all minority groups, however, display higher than average rates of overweight and obesity. Moreover, as evidence from the US and England shows, when minorities do have higher obesity rates these may be unevenly distributed across gender groups, with minority women displaying substantially higher than average obesity rates and minority men broadly in line with the average. However, a mechanistic application of the BMI thresholds used for populations of Caucasian background to ethnic minorities, particularly those of African, Caribbean or Asian origin, may be misleading, as the levels of BMI at which the risk of chronic diseases starts to increase substantially may be lower than that measured in individuals of Caucasian background.

1.2 Aims of the study

13. The OECD undertook a detailed analysis of individual-level health interview and health examination survey data from a selection of member countries, with a view to exploring the progression of the obesity epidemic in a comparative perspective. The analysis had the following main aims:

1. To describe changes over time in the prevalence of overweight and obesity, as measured by health interview or health examination surveys, and the key factors associated with such changes.

2. To assess possible social gradients in the above trends along a number of relevant dimensions (*e.g.* socio-economic condition, age, gender), and whether these have changed over time.

3. To assess the effects of the clustering of individuals into households on the uptake of unhealthy lifestyles and the likely implications in terms of spread of obesity and effectiveness of prevention strategies.

4. To project trends in overweight and obesity into the future, based on the observation of recent changes in the distribution of the body mass index in national populations.

14. The data analysis undertaken as part of the Economics of Prevention project was primarily intended to enhance existing knowledge by investigating potentially important neglected areas and to apply analytical methods not previously used to investigate the issues in question, in order to identify critical and policy relevant questions for further investigation.

SECTION II

Data and methods

2.1. Data sources

15. The analyses undertaken as part of the OECD Economics of Prevention project have been based on national health interview and health examination surveys. These two types of surveys are important components of national health monitoring systems. Health interview surveys rely on personal interviews to gather information on individual socio-demographic characteristics, living and working conditions, perceived and objective health status (*e.g.* acute and chronic conditions), health-related behaviours (*e.g.* smoking, drinking, physical activity, aspects of diet), utilisation of health services, such as hospital admissions and primary care consultations, including some preventive services (*e.g.* cancer screening). In addition, health examination surveys include a direct examination component, which may take the form of a home visit by a nurse, or may entail a more thorough set of clinical investigations undertaken in a health care setting. The latter surveys provide an opportunity to gather additional and more accurate information about anthropometric measures, individual health status, functional limitations and disability. However, health examination surveys are particularly expensive and logistically more complex than health interview surveys, and the representativeness of the resulting samples may be affected by high non-participation and non-response rates. Health surveys are generally cross-sectional, and without follow-up. In most cases they are household-based and select participant households through multistage probability sampling, stratified by geographic area. In a number of countries, additional information about aspects of health and health-related behaviours may be derived from specific modules within surveys of living and working conditions, disability surveys or lifestyle and health education surveys.

16. We obtained access to health interview and health examination survey data from a number of OECD countries, including Australia, Austria, Canada, France, Germany, Hungary, Italy, Korea, Spain, Sweden, Turkey, United Kingdom (England), United States. However, the data obtained from the Turkey Demographic and Health Survey carried out by the Hacettepe University Institute of Population Studies, in collaboration with the General Directorate of Mother and Child Health/Family Planning, Ministry of Health, are not used in the main analysis because they are drawn from a selected population (mainly women of childbearing age) and are not nationally representative. However, national estimates of the prevalence of obesity by age group, gender and region in Turkey were recently published in a study based on a representative sample of 4,205 individuals (Iseri *et al.*, 2008). Data for Germany were not analyzed because the earlier of the two available editions of the relevant survey was restricted to the former West Germany and therefore not representative for the entire Germany. Analyses were carried out for eleven countries Australia, Austria, Canada, England, France, Hungary, Italy, Korea, Spain, Sweden and the United States. These eleven countries provide a relatively wide geographical spread as well as a varied selection, both in terms of population rates of obesity and in terms of survey characteristics. However for Hungary and Sweden, only descriptive analyses could be carried out because relevant data were available in only two waves of the surveys (the Hungarian National Health Survey and the Swedish Level of Living Survey).

17. We performed in-depth analyses on nine countries. The detailed characteristics of the samples for these countries, including percentages of individuals by socio-demographic characteristics, are shown in tables 1 to 10 in Annex 1. Most of the analyses presented in this paper were limited to the age range 16-65 (except for forecast analyses where age groups are in the range 15-75). Four waves of the Australian National Health Survey were analyzed (1989, 1995, 2001, 2005) including 80,215 individuals. The Austrian dataset covered a total of 91,271 individuals from three waves of the *Mikrozensus* (1983, 1991, 1999) and from the latest edition of the Health Interview Survey 2006/07 carried out by Statistics Austria using the same infrastructure as the *Mikrozensus*. For Canada, one edition of the National Population Health Survey (NPHS 1994/95) and three editions of the Canadian Community Health Survey (CCHS 2000/01, 2003, 2005) were used in the analysis, including a total of 245,639 individuals. Fifteen annual waves of the Health Survey for England (HSE) were used, covering the period 1991-2005, with a total of over 122,034 individuals. Ten editions of the French survey *Enquête Santé et Protection Sociale* were used (1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 2000, 2002, 2004) with 77,319 individuals. Three waves of the Italian survey *Condizioni di Salute* were analyzed (1994-95, 2000, 2005) with 200,312 individuals. Three waves of the Korean National Health and Nutrition Examination Survey (KNAHNES) were available (1998, 2001 and 2005) including a total of 18,077 individuals. Six were the waves used of the Spanish survey *Encuesta National de Salud de España*, covering the period 1987-2003, with a total of 71,515 individuals. Twenty-six annual waves of the US National Health Interview Survey (NHIS) were used (from 1980 to 2005) with 2,510,126 individuals, but restricted to 1997-2005 with 211,177 individuals in regression analyses for consistency of regression covariates. As different cross-sectional surveys were pooled in the analysis for each country, we devised appropriate weights to account for sample size differences across surveys. Where sampling weights are provided with the data, these were used in the relevant analyses (Australia, Canada and the US). Finally, it should be noted that the English and Korean surveys are health examination surveys with data on height and weight clinically measured, whereas other surveys are entirely questionnaire based and therefore collect self-reported information on height and weight.

2.1.1. Data heterogeneity and solutions adopted

18. Health interview and examination surveys may vary substantially across countries, both in terms of health topics covered and survey methodologies. Differences in questionnaire design, measurements protocols, sampling frames, may limit the comparability of the results of different surveys. Heterogeneity may exist within countries, over time and across geographical areas, as well as across countries.

19. Several sources of heterogeneity were identified in the data obtained for this study. A number of these were dealt with by applying international standard classifications, such as ISCED for educational attainment, or ISCO for occupation. In some cases, the values of certain variables were converted into common measurement units. For instance, whenever possible, income figures were aggregated at the household level and equivalised using McClemens scores. An attempt was also made to standardise different occupation-based socio-economic classifications, broadly following the model of the English socio-economic classification (SEC). Five-level occupation-based social class variable were available or could be derived in Austria, England, Italy and Spain, and a 6-level variable in France. In countries for which an occupation-based social class variable could not be derived, equivalised household income was instead used as an indicator of socio-economic condition. These include Australia, Canada, Korea, and the US. The least tractable heterogeneity problems were those arising from differences in the definitions adopted for certain variables; differences in measurement approaches, *e.g.* self-reported vs. measured height and weight; differences in the wording of survey questions and in the categorisation of responses.

2.1.2. Description of trends in overweight and obesity

20. Descriptive statistics were devised to give an overview of the rates of overweight and obesity separated for men and women aged 15-64 years old. Age-standardisation was applied using the 2005 OECD standard population to make the results comparable across countries. A description of the distribution of BMI across years was carried out countries by countries. For these, gender- and age-standardised values were employed.

2.2. Analytical models

2.2.1. Disentangling temporal effects: age-period-cohort models

21. Average levels of body weight and the prevalence of overweight and obesity increased rapidly over recent decades. While this upward trend is confirmed by both empirical and analytical evidence, the causes of increasing obesity rates as well as their trend components are not completely known. Several hypotheses attempt to identify multiple time-related effects by considering, for example, processes of cultural change influencing individual lifestyles, as well as metabolic changes combined with different activity and dietary patterns over the life course. Moreover, cohorts of individuals born in different decades will not necessarily share the same life experiences and be exposed to similar social, civil or natural events. For these reasons, when evaluating the influence of time on obesity trends it is desirable to treat separately the three temporal dimensions represented by age, birth cohort and period of observation. These three components interact with each other, but they are also likely to have independent effects on lifestyle choices and body weight.

22. *Age effects* are generally associated with the variation given by life changes (*e.g.* physiological modifications, accumulation of social experience, shifts in social status) which are common within different age groups. *Period effects* identify the variation over time periods, *i.e.* calendar years, and determined by environmental factors (*e.g.* technology, culture, the economy, the physical environment, etc.) that affect all age groups simultaneously. *Cohort effects* reflect the variation associated with factors to which all individuals born in a given time period are exposed at critical stages in their lives (*e.g.* characteristics of the education system, attitudes towards breastfeeding, etc).

23. A*ge-period-cohort* (*APC*) models have been used in social and demographic research (Glenn, 1976; Fienberg and Mason, 1985; Robertson and Ecob, 1999; O'Brien, 2000; Yang, Fu and Land, 2003; Kerr *et al.*, 2007; etc.) as well as biostatistics and epidemiology (Moolgavkar *et al.*, 1979; Osmond and Gardner, 1982; Kupper *et al.*, 1985, Oberaigner *et al.*, 2006; etc) as a general methodology to analyze trends in disease and mortality rates. Initially developed by Mason (1973), APC models have been mainly used to assess the effect of one of the three time-related factors on given outcomes, net of the influences of the other two time-related dimensions.

24. Disentangling age, period and cohort effects is a statistically challenging undertaking, mainly because of an identification problem. The exact linear dependency between age, period and cohort (period = cohort + age) represents a special case of collinear regressors, preventing the inversion of the design matrix (X^TX) which becomes singular by construction so to create an infinite number of possible solutions of the regression model. The identification problem has been traditionally addressed in the literature in three ways: 1) identifying one or more constraints on the parameters vectors (*e.g.* equalizing some regression coefficients for the age, period and cohort variables, aggregating categories following check-mark patterns) in order to make the matrix (X^TX) non-singular and the estimator viable; 2) including in the regression model a nonlinear transformation of one of the temporal effects (usually a squared function of age) so to remove the linear relationships existing between the three effects; 3) using a correlated "proxy" variable substituting one of the three effects. One common limitation in applying any of the three previous

techniques depends on the prior theoretical and empirical knowledge required to set restrictions on the coefficients or to specify "proxy" variables. The selection of constraints introduces arbitrariness in the estimation, which can lead to biased conclusions.

25. The model used in our analyses is one proposed by Yang, Fu and Land (2004), based on a robust estimator (intrinsic estimator) which does not require the identification of constraints on the parameter vectors by using prior information. The intrinsic estimator method (Fu, 2000; Knight and Fu, 2000; Fu and Hall, 2004 and Fu and Rohan, 2004) considers an orthogonal decomposition of the parameter space into a null space for the singular design matrix and a non-null space, where the intrinsic estimator is obtained by the Moore-Penrose generalized inverse. We were unable to perform the APC analysis on Australian data for which direct access at the individual level was not possible. Given the characteristics of the analytical approach selected, the APC analysis could be carried out for countries which have equal period and age groups intervals. So we were able to compute the APC model only on six countries: Canada (5-year intervals), England (single year intervals), France (2-year intervals), Italy (5-year intervals), Korea (4-year intervals), and the US (single year intervals). All analyses were undertaken using Stata 10.

2.2.2. Social gradient in obesity and overweight: logistic models

26. Disparities in obesity and overweight rates among population groups were first analyzed with logistic models adjusting for a range of covariates. In particular, we controlled for gender, age (assuming a non-linear relationship with obesity and overweight), marital status, ethnicity (when available, *i.e.* in England and the US), smoking status, occupation status, education attainment, socio-economic condition and interaction terms between the latter and gender and between education and gender. These analyses were restricted to the last decade (1995-2005) in order to have comparable results across countries.

27. The advantage of the logistic model lies in providing odds ratios that are easily interpretable as the impact of one specific characteristic (*e.g.* a category of socio-economic condition or education level) to the reference characteristic category. The odds ratio is indeed the relative odds of an event (being obese or overweight) comparing individuals for whom a given covariate takes different values (*e.g.* high vs. low educational attainment).

28. Estimated rates of obesity and overweight were obtained according to education and gender, and socio-economic status and gender after fitting the statistical models. All rates were adjusted for age 40 and for the mean values of marital status, smoking status and occupational status estimated in the nine countries to reflect the mean population of the relevant countries.

29. In addition, to make an assessment of time-trends in social inequalities in overweight and obesity, we measure the difference over time in rates of overweight and obesity among different socio-economic groups by introducing into the regression model an interaction term between socio-economic condition variable and the squared effect of the survey year.

2.2.3. Comparison across countries: Indexes of Inequality

30. The use of logistic regressions described above provides an accurate picture of inequalities within countries. However that approach is less useful in comparisons across countries, and over time, because of differences in the size and nature of socio-economic groups in different settings and time periods. Therefore, further analyses were undertaken using indexes of inequalities which overcome, at least in part, the problems just described.

31. The relative index of inequality was used to compare the size of relative inequalities in obesity and overweight across countries along two dimensions: education level and socio-economic group. The relative index of inequality has been employed in several studies analyzing socio-economic inequalities in

health across different regions. The index is the ratio between the estimated rate for the worst off in the bottom socio-economic group and the rate for the best off in the top group (Pamuk 1985; Mackenbach *et al*., 1997). To obtain the relative index of inequality, we fitted a regression line of the obesity/overweight rates of the socio-economic groups (and by education level) on their relative position in the social hierarchy (the proportion of population that has a higher position in the social hierarchy). Then we took the estimated rates for the top and the bottom of the hierarchy to compute the ratio. This index assumes that the socio-economic groups are ranking in a hierarchical way.

32. The slope index of inequality was derived from the relative index of inequality as a means of gauging the absolute size of inequalities in different countries. To obtain the slope index, instead of computing the ratio as for the relative index, we computed the difference between the rate for the worst off in the bottom socio-economic group and the rate for the best off in the top group. The slope index of inequality can be interpreted as the absolute effect on rates in moving from the lowest to the highest ends of the socio-economic scale. It is worth noting that the slope index of inequality depends on the difference in overweight or obesity rate in the population and it is sensitive to the mean value of the prevalence of obesity (or overweight) of the population. For example, if the prevalence of obesity doubled in each category of the socio-economic dimension, the slope index would double but the relative index of inequality would be unchanged (Wagstaff *et al*., 1991). This means that absolute and relative indexes of inequality may vary in opposite ways, and so it is important to present both indicators.

2.2.4. Projection of future trends: quantile regression models

33. We have explored a range of approaches for projecting overweight and obesity trends into the future, including those used in research directly commissioned by governments (*e.g.* United Kingdom) and an in-depth analysis carried out by Mills (2009) using the implicit simplex restrictions in the proportions forecast. However, we selected quantile regression as the most appropriate technique for the prediction of future rates. Quantile regression is a semi-parametric regression approach aimed at modelling changes in individual quantiles of the distribution of a continuous outcome variable.

34. Quantile regression is particularly useful when individual quantiles in the distribution of an outcome variable behave differently along a given dimension, in our case the time dimension. Although initially applied to the study of economic inequalities (Eide 1999; Kahn, 1998; Gosling, 2000), the quantile regression approach was subsequently applied in the context of biological and epidemiological studies, including the study of BMI variations (Hao, 2007; Guntupalli, 2006; Ruhm, 2007). Quantile regression can accurately estimate the patterns of stratification of each covariate while controlling for others and it can indicate whether and how a given covariate has different effect on different quantiles of the distribution of BMI. When used for projecting time trends into the future, quantile regression does not rest on any assumptions, or impose any constraints, on the future distribution of the outcome variable. This feature is particularly valuable in the wake of substantial variations over time and across countries in the rates of change of BMI.

35. A range of covariates and interaction terms between individual covariates were selected for inclusion in the final model, based on the correlations observed between such covariates and BMI, and on the changes observed over time in the distribution of those covariates in the populations in question. More precisely, the model is adjusted for gender, age, marital status, ethnicity (only available in England and the US), educational attainment and its interaction with gender, socio-economic condition and its interaction with gender, year and its interaction with age. Regressions were estimated for each percentile of the BMI distribution. The projected values of BMI at each percentile of the BMI distribution were obtained by setting the value of the time period (year) variable to the appropriate value in the forecast (2009, 2014 and 2019, respectively). Population distributions by age and gender in 2009, 2014 and 2019 were derived from official projections provided by national statistical agencies. These data for Canada were only available for

the years 2011, 2016 and 2021, so the forecast were calculated for these corresponding years. Other covariates were set at the mean values observed in the latest available survey years. Projected population rates of overweight and obesity were then calculated by linear interpolation between the percentile exceeding the respective BMI thresholds and the preceding one. All analyses were undertaken using SAS 9.1 and the experimental QUANTREG procedure, which permits the use of sampling weights.

2.2.5. The effects of household and geographic aggregation: multilevel models

36. A number of studies have shown significant variations in overweight and obesity rates across geographical areas and have investigated some of the factors associated with such variations (Ellaway *et al.*, 1997; Kahn *et al.*, 1998; Abdul-Ramin *et al.*, 2003; Rami *et al.*, 2004; Sobngwi *et al.*, 2004; Chaix *et al.*, 2003; Dollman *et al.*, 2005; van Lenthe *et al.*, 2002; Willms *et al.*, 2003; Moon *et al.*, 2007). In particular, characteristics of the areas where individuals live, housing conditions or the broader physical environment (*e.g.* urban settings, deprived neighbourhoods, upper-floor apartments, scarce lighting, and excessive traffic) have been associated with higher obesity levels and decreased physical activity. Additionally, obesity and overweight have been linked with economic and social area-level factors such as regional income inequality, unemployment rates, availability of fast food outlets in the neighbourhood, availability and price of healthy food, social capital and gross domestic product per capita.

37. In addition to individual behavioural determinants, family environments and habits have also been shown to play a fundamental role in the development of dietary preferences and eating behaviours. Many studies have found that certain household habits (e.g. television watching, lack of family meals at home, eating out, childhood neglect, maternal smoking during pregnancy, non-stimulating home environments) are significantly associated with a higher risk of obesity, particularly for children (Ebbeling *et al.*, 2002; Skidmore *et al.*, 2004; Snethen *et al.*, 2007; Savage *et al.*, 2007; Rice *et al.*, 1998). Socio-economic characteristics, or employment status, of household members have a direct impact on income levels and food purchasing patterns. A higher educational level of parents is associated with a greater awareness of nutrition-related issues.

38. The effects of the clustering of individuals into households or geographical areas are best studied using multilevel statistical models, also known as hierarchical linear models, random effects models or nested models. These models are a generalization of regression methods developed in the 1980s in order to treat hierarchical and clustered data. The seminal work of Aitkin *et al.* (1981) introduced multilevel modelling in the framework of educational sciences. Further developed in the work of Aitkin and Longford (1986), multilevel methods currently represent the method of choice to handle social data in which individual behaviours are assumed to be influenced by some group membership.

39. Multilevel models consider base-level units (*individuals*) as organized into hierarchies of successive higher-levels units (*groups*), (*e.g.* households, towns, regions or countries), by allowing for residual components at any level of the hierarchy. One consequence of failing to recognize hierarchical structures is that the standards errors of the regression coefficients would be underestimated, and in particular those relative to higher level explanatory variables. Multilevel models allow decomposing the overall variance observed in a sample into a “within-variance” component, reflecting variation among individuals within higher-level groups, and a “between-variance” component, reflecting variation among higher-level groups.

40. Some of the analyses presented in this paper are based on linear or logistic multilevel models, depending on the outcome variables used. These are two-level, random-intercept models, using households or geographical area as higher-level units of aggregation. The sampling structures of the surveys undertaken in England, France, Italy, and Korea are household-based surveys whereas surveys undertaken in Austria, Australia, Canada and Spain have a regional structure.

SECTION III

Results

3.1. Descriptive statistics

41. Age-standardised rates of obesity show significant differences across countries in obesity levels and in trends over time. Figures 1 and 2 show trends over the survey years in men and women, respectively. Obesity rates have been increasing in all countries in men. A similar increase has been observed in women in Australia, Austria, Canada, England, France, Hungary, Sweden, and the US whereas the corresponding curves for Italy, Korea and Spain in figure 2 are virtually flat or show minimal increases over time. Obesity rates in England and the US are substantially higher than in the other countries, and over five times those observed in Korea. It should be noted, however, that the same BMI thresholds were used in all countries to define overweight (BMI of 25 and over) and obesity (BMI of 30 and over), while there are suggestions that lower thresholds should be used in Asian populations (WHO/IOTF 2004). Figures 1 and 2 report trend lines based on two different surveys undertaken in the US, the National Health and Nutrition Examination Survey (NHANES) and the National Health Interview Survey (NHIS). The former provides information on measured BMI, while the latter presents self-reported figures. Self-reported rates from the NHIS appear to under-estimate obesity compared to actual rates reported in NHANES, but the time trends are the same. Corresponding results for overweight rates are presented in figures 3 and 4. Overweight rates have been increasing in all countries in men except in Canada and France where rates appear to level off. Overweight rates display less variation than obesity rates: US rates are twice as high as Korean rates, while the difference in obesity between the two countries is roughly nine fold. Overweight rates in women in figure 4, show an increasing trend over years except for Italy, Korea, and Spain, where the curves seem virtually flat.

Figure 1. Obesity rates in men aged 15-64 (age-standardized)

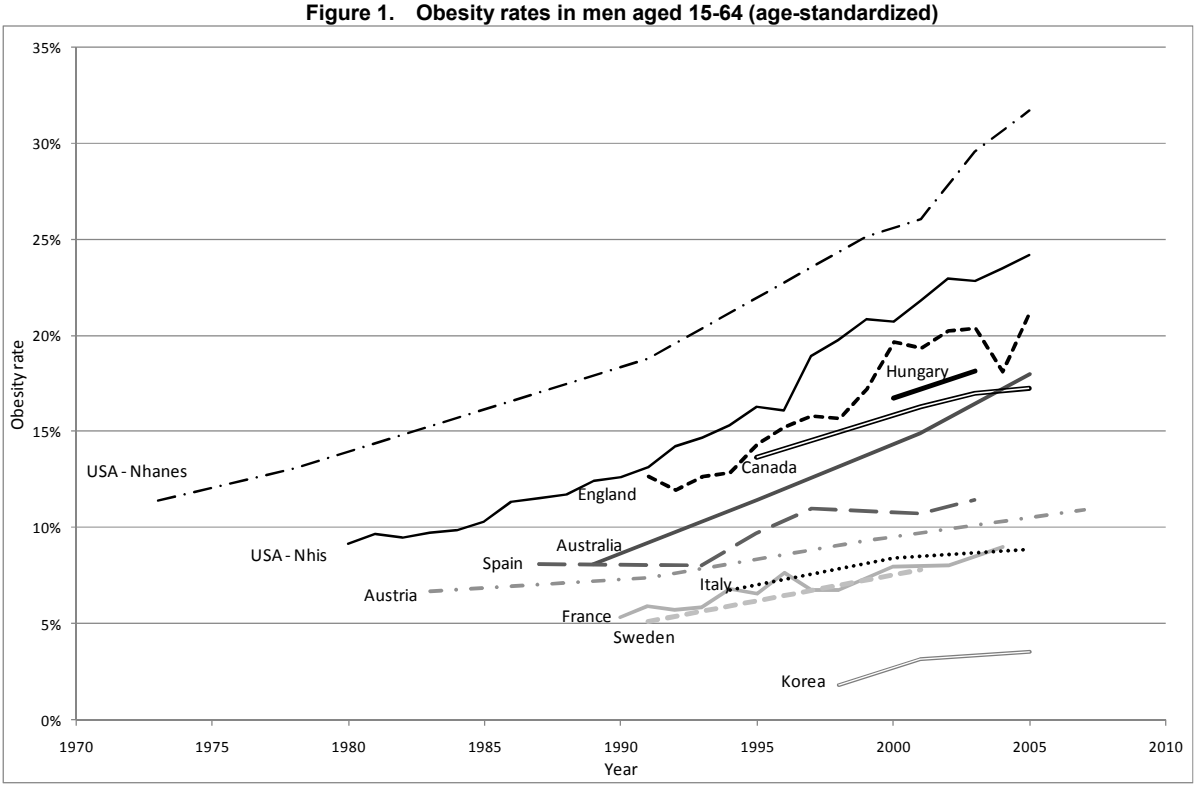


Figure 2. Obesity rates in women aged 15-64 (age-standardized)

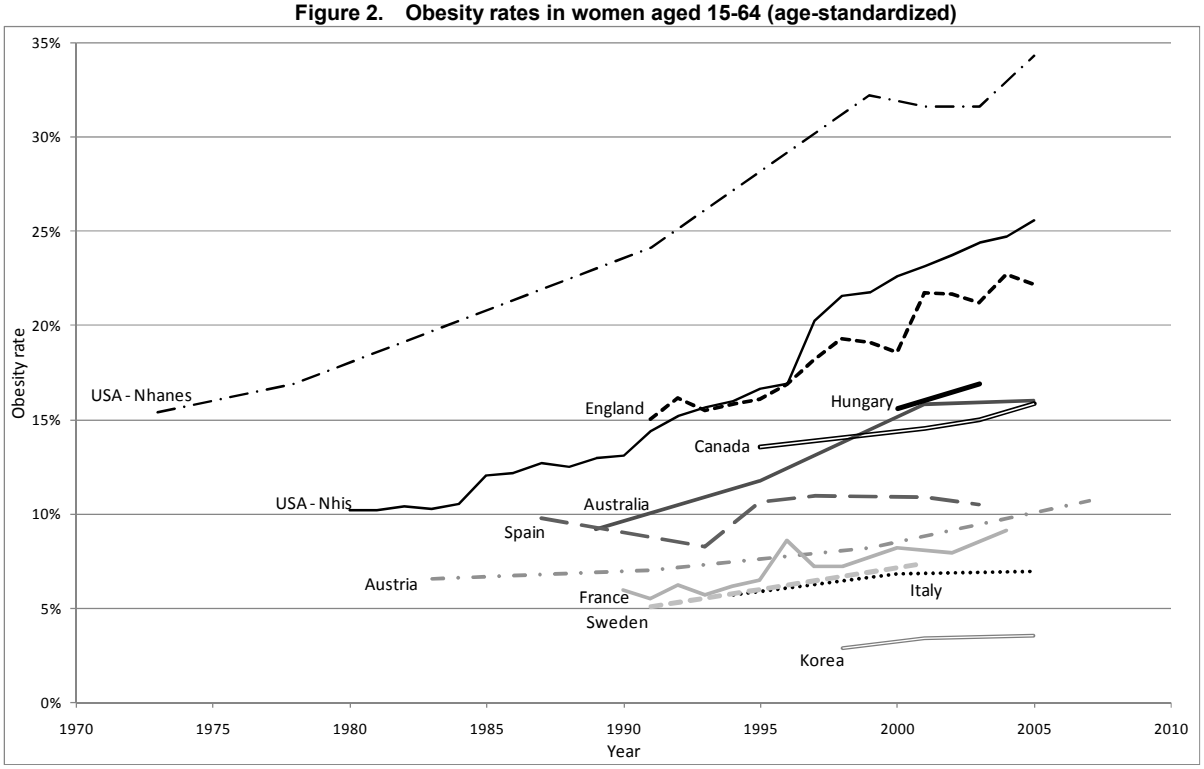


Figure 3. Overweight rates in men aged 15-64 (age-standardized)

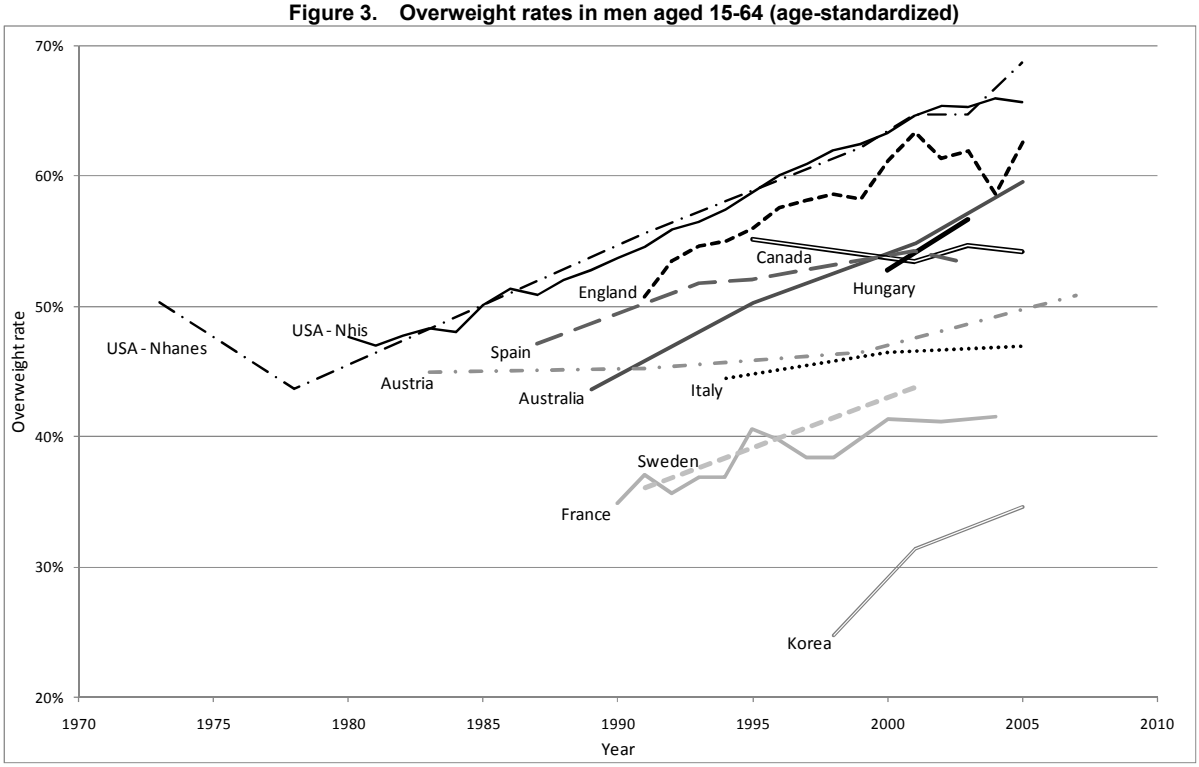
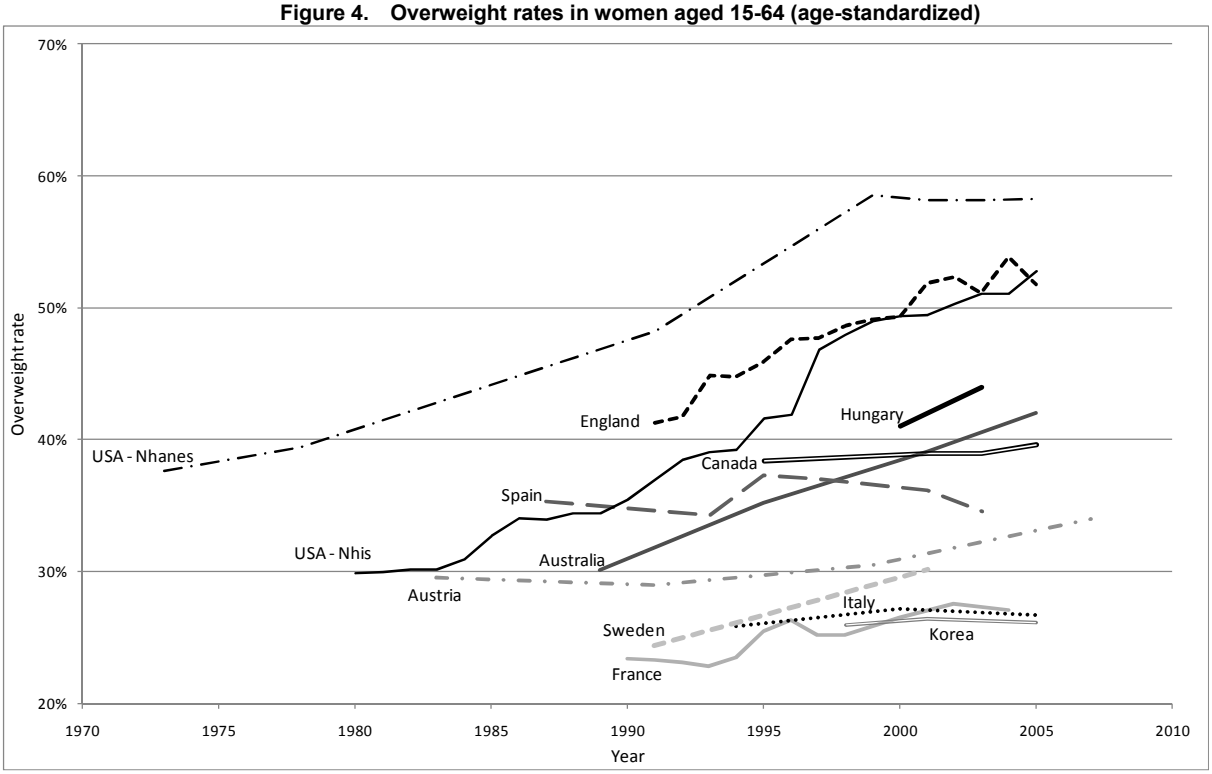


Figure 4. Overweight rates in women aged 15-64 (age-standardized)



42. Figures 5 to 13 show the age- and gender-standardized distribution of BMI in individual countries for several years for people aged 15-74 (20-64 for Canada). BMI distributions have been shifting over time in all countries, but the shift is more marked in Australia, England and the US.

Figure 5. BMI distribution in Australia

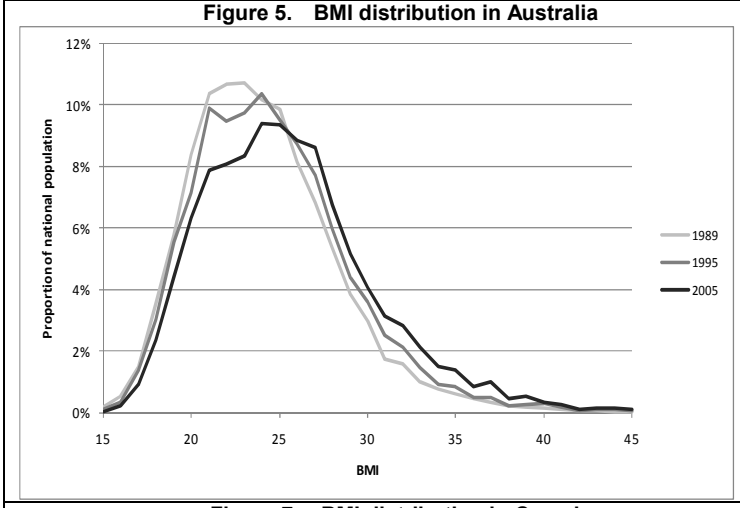


Figure 6. BMI distribution in Austria

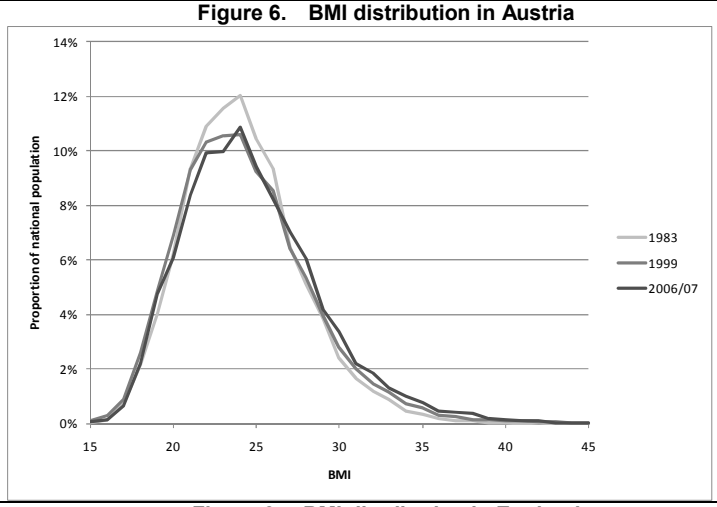


Figure 7. BMI distribution in Canada

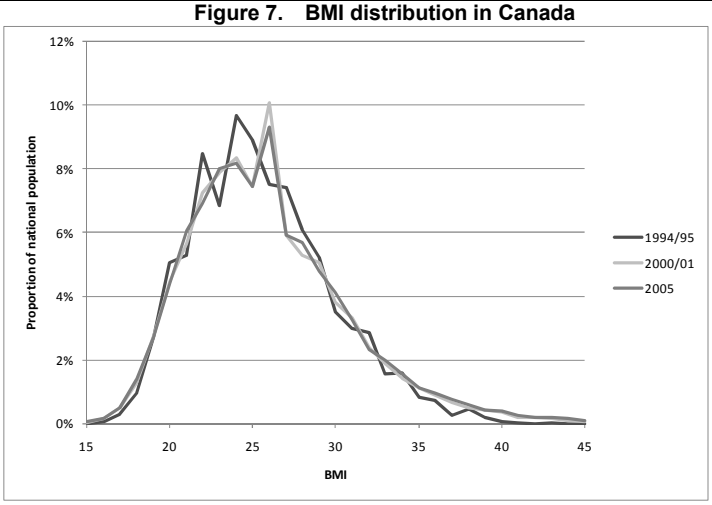


Figure 8. BMI distribution in England

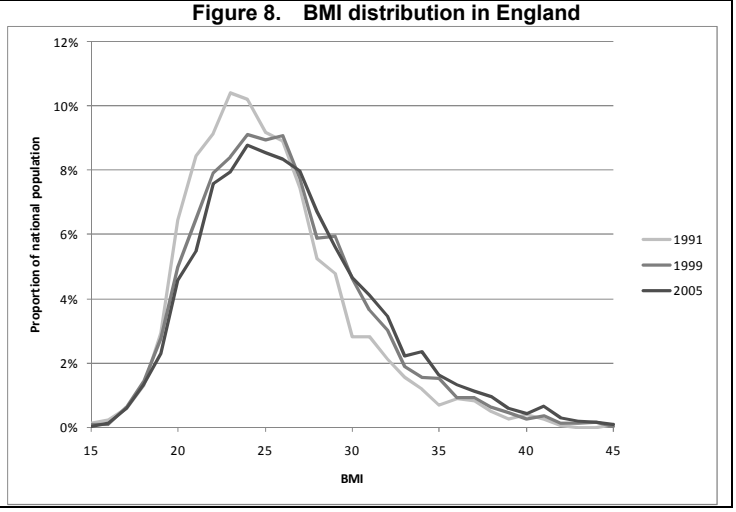


Figure 9. BMI distribution in France

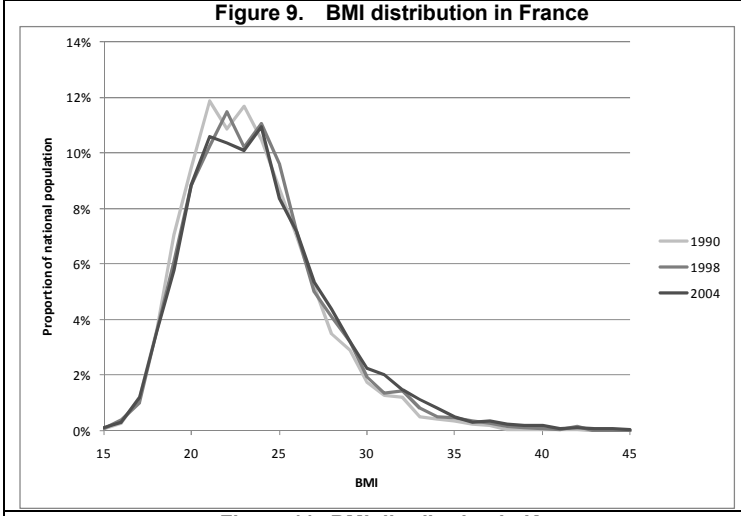


Figure 10. BMI distribution in Italy

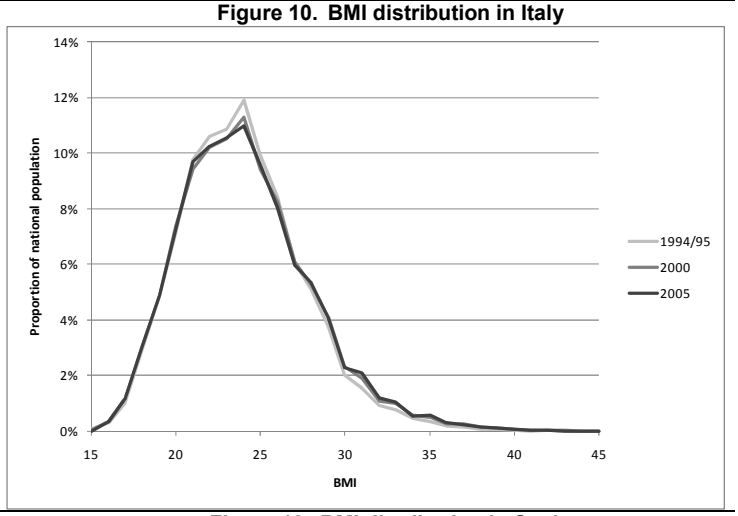


Figure 11. BMI distribution in Korea

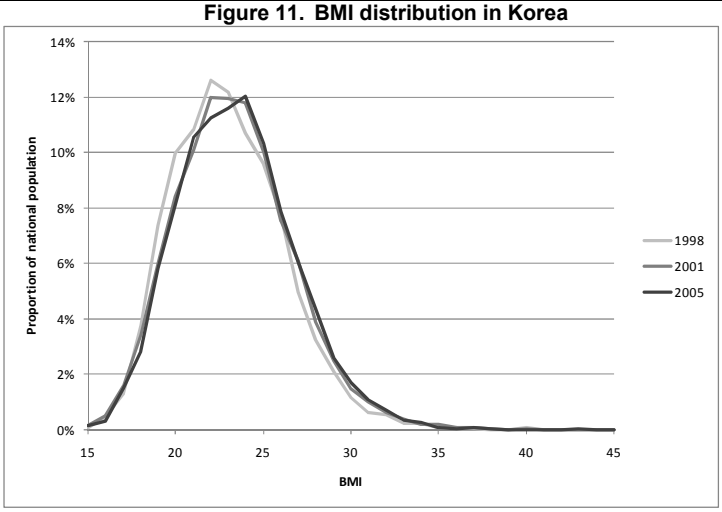


Figure 12. BMI distribution in Spain

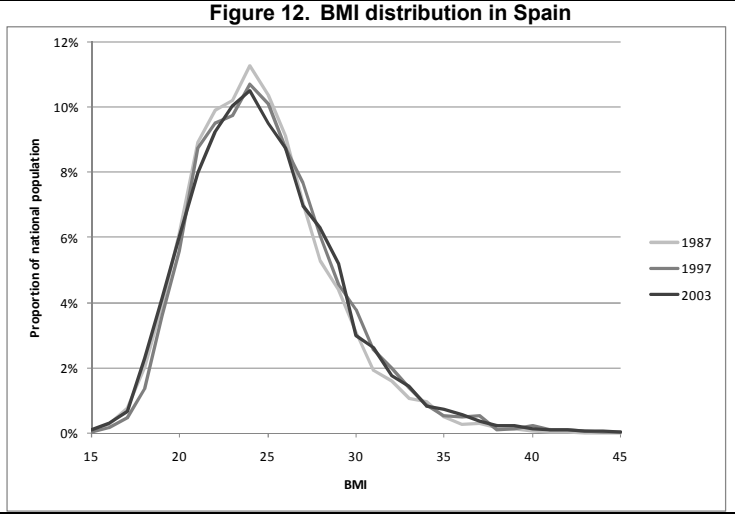
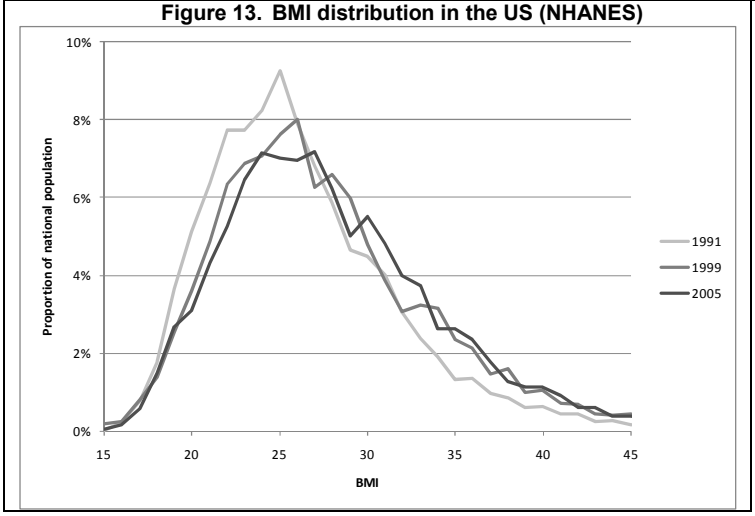


Figure 13. BMI distribution in the US (NHANES)



3.2. Age, period and cohort effects

43. By using the APC model described in section II, we estimated the net effects of age, birth cohort and period of observation on a number of relevant outcomes. It should be noted, however, that the statistical approach selected to conduct the APC analysis could not be applied to datasets including surveys undertaken at irregular intervals. Therefore, it was not possible to apply the model to data from Austria and Spain. Moreover Australian data, for which direct access at the individual level was not possible, were not suitable for this analysis. So, the analysis was limited to six countries: Canada, England, France, Italy, Korea, and the US (NHIS). The Italian and Korean data comprised only three periods of observation, at a relatively short distance from one to another. Figures 14 and 17 show time-trends in obesity and overweight rates in the six countries. The figures show that period effects have been increasing over time in all the countries.

44. The age effects are illustrated in figures 15 and 18 for obesity and overweight respectively. The curve for obesity rates appears to reflect the bell-shaped pattern discussed in section I with the possible exception of Korea, which shows a relatively flat pattern for obesity. Generally, it would seem that obesity rates tend to increase more rapidly with age and then start to decline at earlier ages, compared to what ordinary regressions show. The age curve for overweight appears to increase with age and then to level off, except for Canada, where the effect is eventually declining. The bell-shaped pattern for the age effect due to declining obesity rates at older ages could be explained by the fact that older people are more often ill and that may cause a loss of weight and, obese people may have a shorter life expectancy and so they are less likely to appear among individuals in the right hand tail of the curve. However, the APC analysis was carried out for the age range 16-65 which is expected to prevent most of the potential bias arising from the censoring of obese individuals dying earlier than average.

45. Cohort effects are shown in figure 16 and 19, respectively, for obesity and overweight. The resulting picture seems to point consistently to relatively sustained negative cohort effects at least since the 1930s. The effects appear to be steadily declining but, for obesity, they show signs of an upturn in France, the US and Canada starting from the 1960s. These findings would seem to suggest that the underlying probability of obesity of successive birth cohorts, linked to factors that must have had an influence at critical stages in the life of the individuals concerned, has been declining over time, but has been increasing again since the 1960s in France, the US and Canada. In the next section we shall briefly explore a number of possible explanations that may at least partially account for the negative cohort effect identified in the APC analysis.

Figure 14. Period effects for obesity rates

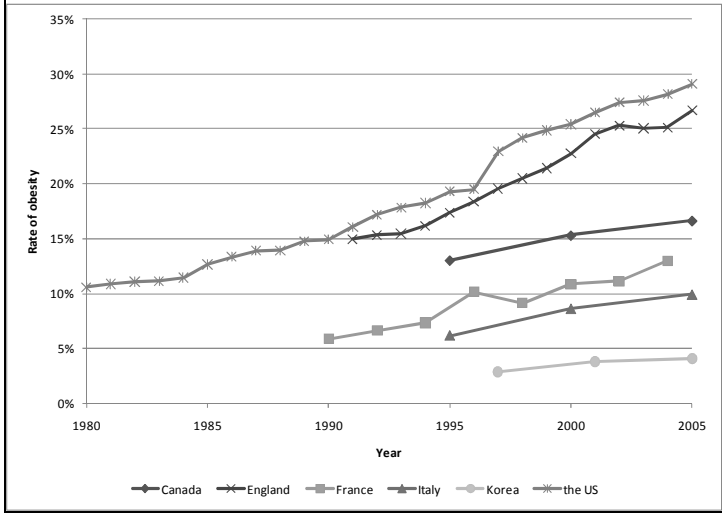


Figure 15. Age effects for obesity rates

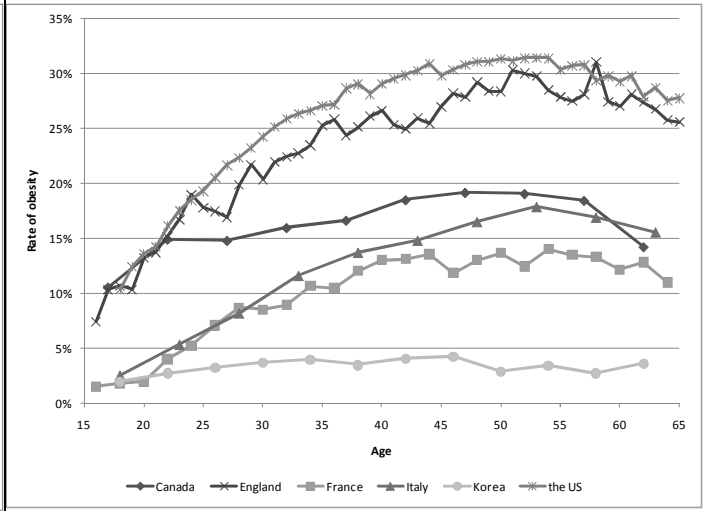
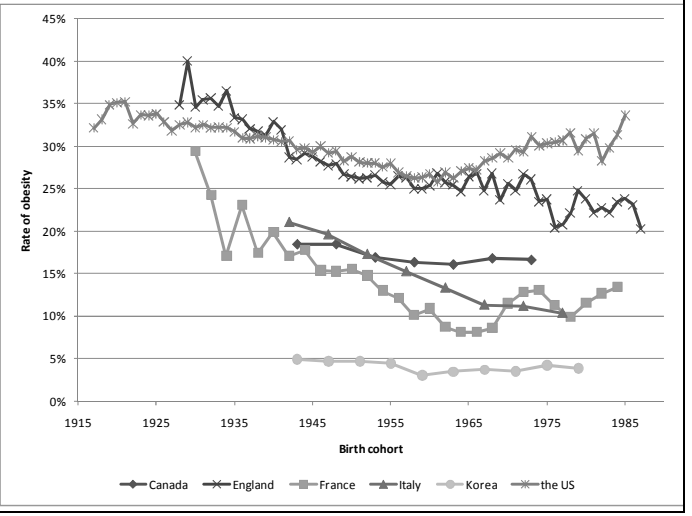


Figure 16. Cohort effects for obesity rates



Note Figure 14: Constant cohort mix, Age assumed constant: in England, USA: age=40, Canada: age group=40-44, France age group=40-41; Italy age group= 41-45; Korea age group=40-44

Note Figure 15: Constant cohort mix, Period effect assumed constant: in England, USA, Canada, Italy, Korea: period=2005, France: period=2004.

Note Figure 16: Age and Period effect are assumed constant: in England, USA age=40 period=2005, in Canada age group=40-44 period=2005, in France age group=40-41 period=2004, in Italy age group=41-45 period=2005, in Korea age group=40-44 period=2005

Figure 17. Period effects for overweight rates

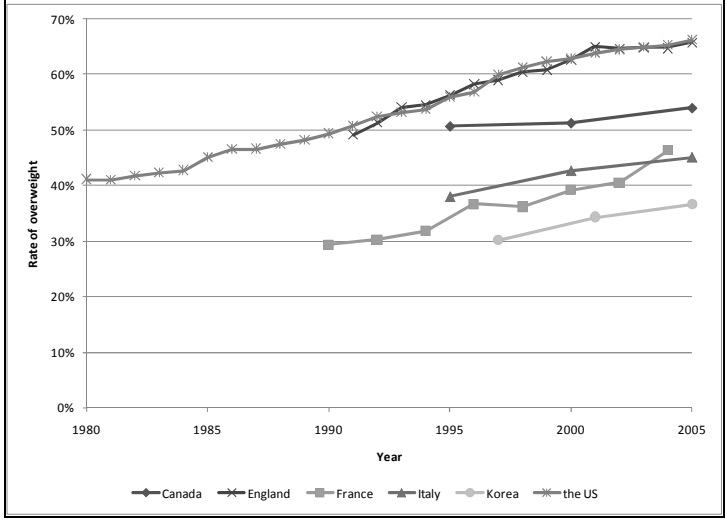


Figure 18. Age effects for overweight rates

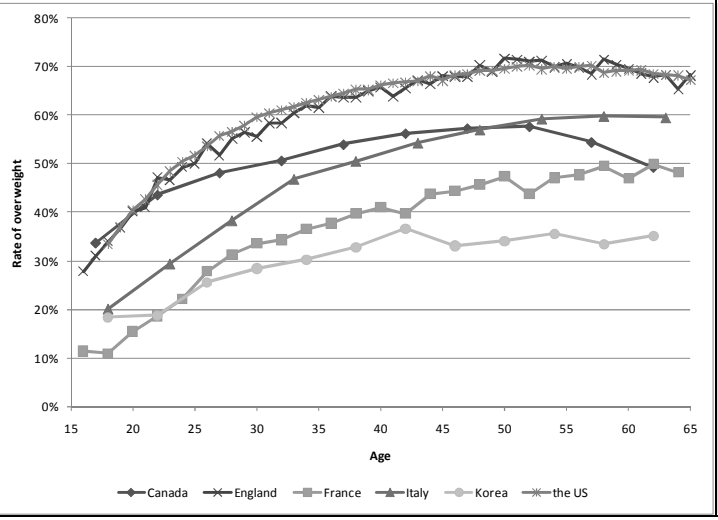


Figure 19. Cohort effects for overweight rates

Note Figure 17: Constant cohort mix, Age assumed constant: in England, USA: age=40, Canada: age group=40-44, France: age group=40-41; Italy age group= 41-45; Korea age group=40-44

Note Figure 18: Constant cohort mix, Period effect assumed constant: in England, USA, Canada, Italy, Korea: period=2005, France: period=2004.

Note Figure 19: Age and Period effect are assumed constant: in England, USA age=40 period=2005, in Canada age group=40-44 period=2005, in France age group=40-41 period=2004, in Italy age group=41-45 period=2005, in Korea age group=40-44 period=2005

3.3. Disparities in overweight and obesity across socio-economic groups

3.3.1 Social gradients in overweight and obesity within individual countries

46. Correlations between socio-demographic characteristics and the likelihood of individuals being overweight and obese are shown in figures 20 to 27. The interaction terms between gender and socio-economic condition (respectively, gender and education level) were significant in most of the countries indicating how gender patterns differ in correlations between socio-economic indicators and overweight and obesity. Therefore separated results are presented by gender. Differences in overweight and obesity among individuals with different levels of education are remarkably consistent across countries. In most of the countries a gradient is observed: the lower the education attainment, the higher the likelihood of being obese or overweight. For men, lower education is strongly associated with a higher likelihood of being overweight except in Korea where the gradient seems in the opposite direction. The correlation is even stronger for obesity but still in the opposite direction in Korea. For women, figures 21 and 23 show a clear strong gradient in the likelihood of obesity and overweight according to the level of education. Generally, gradients observed in women are substantially stronger than those observed in men.

47. However, the correlations observed in relation to occupation-based measures of socio-economic condition, or household income, do not always appear as clear-cut as those described for education. Figure 24 shows an unclear relationship between socio-economic condition and likelihood of overweight for men. Some significant positive correlations between low socio-economic condition and high probability of overweight for men are observed in Austria and in England, whereas significant correlations of the opposite sign are observed in Australia, Canada, Italy, Korea, Spain and the US. The correlation between low socio-economic condition and high likelihood of obesity is apparently positive at least in some of the socio-economic condition groups in most of the countries except Canada and Korea. In women, the probability of overweight or obesity is strongly associated with a low socio-economic condition with significant correlations in most of the countries except Korea. Social gradients are remarkable and stronger for obesity than for overweight in most of the countries.

48. Regarding heterogeneity in the data, we considered the method proposed by Cawley (2000) and Lakdawalla and Philipson (2002) to correct the US data from the reporting bias using the measured data on height and weight from the National Health and Nutrition Examination Surveys (NHANES). This leads to the same results in terms of impact of the factors, but the rates of obesity and overweight are higher, that corresponds to the under reporting bias in reporting weight for overweight and obese people.

Figure 20. Odds ratios for overweight in men by education level

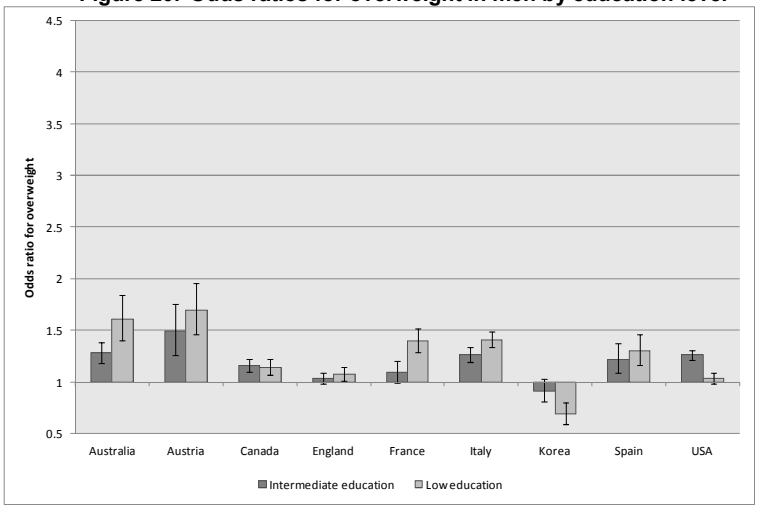
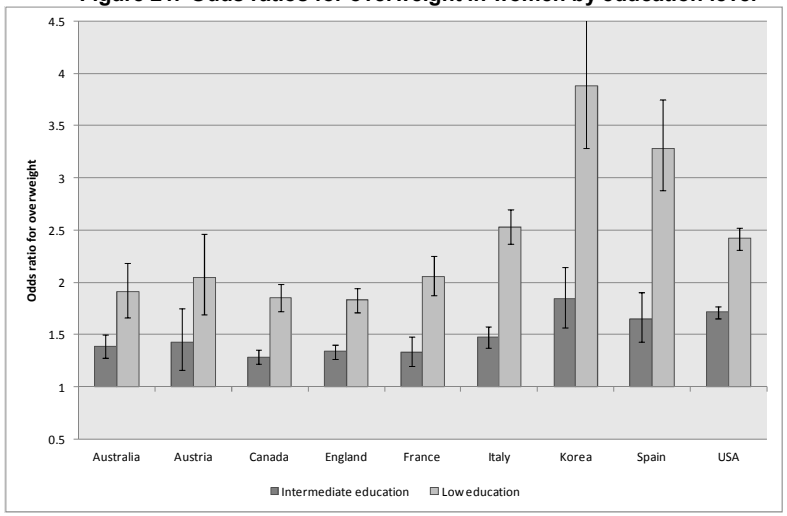


Figure 21. Odds ratios for overweight in women by education level



Note: Upper confidence intervals were truncated for Korea (value 4.59).

Figure 22. Odds ratios for obesity in men by education level

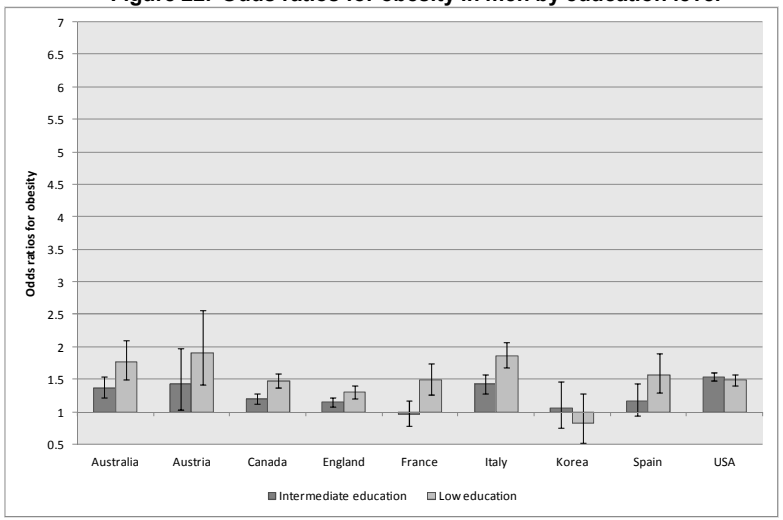
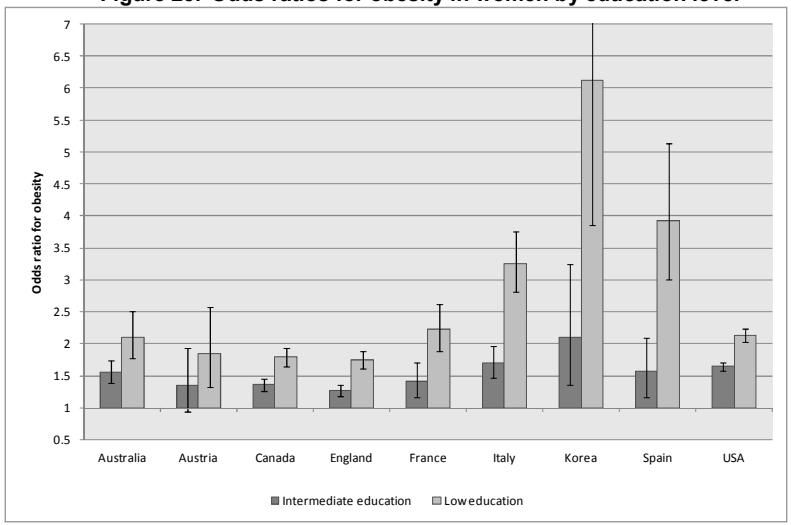


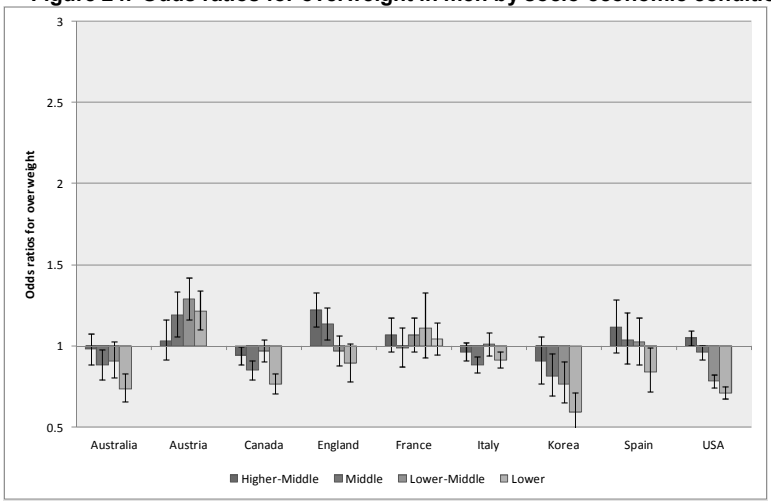
Figure 23. Odds ratios for obesity in women by education level



Note: Upper confidence intervals were truncated for Korea (value 9.68).

Note Figure 20 to 23: The lighter the vertical bar, the lower the education level. Education level is a three-group variable: Low education (ISCED 0/1/2), Intermediate education (ISCED 3/4) and High education (ISCED 5/6). The reference category for comparisons is the highest education level. Confidence intervals containing 1 mean that corresponding odds ratios are not significant.

Figure 24. Odds ratios for overweight in men by socio-economic condition



Note: Lower confidence interval was truncated for Korea (value 0.49).

Figure 25. Odds ratios for overweight in women by socio-economic condition

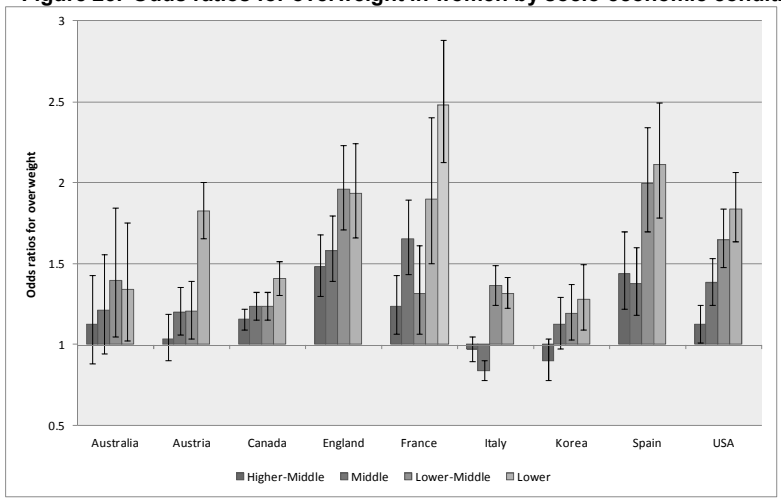
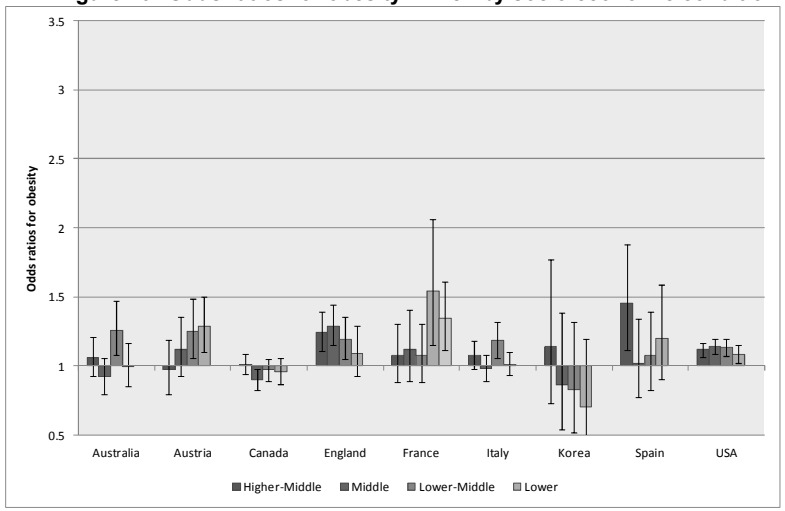
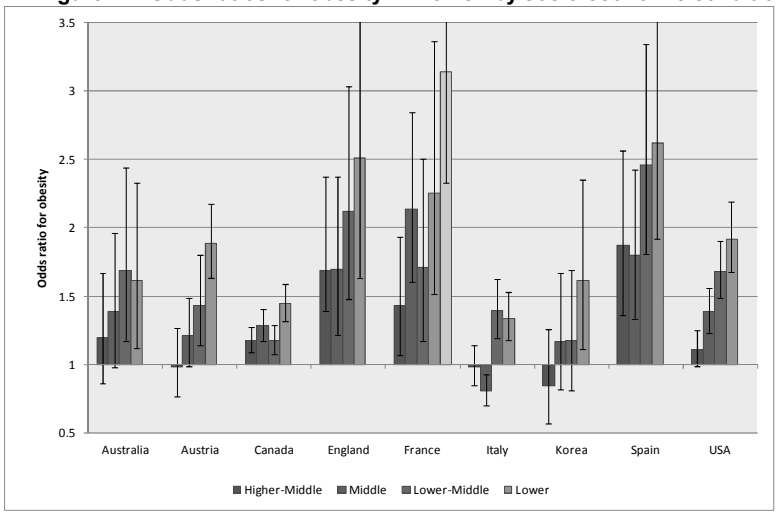


Figure 26. Odds ratios for obesity in men by socio-economic condition



Note: Lower confidence interval was truncated for Korea (value 0.42).

Figure 27. Odds ratios for obesity in women by socio-economic condition



Note: Upper confidence intervals were truncated for England (value 3.85), France (4.22) and Spain (3.58).

Note Figure 24 to 27: The lighter the vertical bar, the lower the socio-economic condition. The reference category for comparisons is the highest socio-economic condition group. Confidence intervals containing 1 mean that corresponding odds ratios are not significant. In France, there are 6 groups of socio-economic condition instead of 5 (Professionals, managers / Skilled white collars / Clerks / Self-employed / Farmers / Unskilled workers).

3.3.2 Cross-country comparisons of disparities in overweight and obesity

49. Using appropriate inequality indexes, the scale of socio-economic disparities in overweight and obesity was examined in comparative perspective (across countries and overtime). Figures 28 and 29 show relative indexes of inequality in the prevalences of overweight and obesity according to education level for men and women, respectively. Figures 30 and 31 show the corresponding absolute indexes of inequality for men and women respectively. Indexes are calculated from rates corresponding to those of 40-year old individuals with mean characteristics calculated on the nine countries.

50. The relative indexes of inequality for men are greater than 1 in all countries, meaning that obesity and overweight are higher among men with lower educational attainment, except for Korea. The magnitude of these inequalities varies substantially among countries. France, Austria, Spain, Italy and the US present the largest inequalities in obesity with rates in least educated individuals more than twice as large as in most educated individuals. Relative indexes of inequalities in overweight are substantially lower, the largest value being 1.5 in France and Austria.

51. The absolute index of inequality by education in obesity for men displayed in figure 30 reaches a value of 20 in France and Austria, which means that there is a 20-percentage point difference in obesity rates between people with the lowest education and those with the highest. This makes these two countries the least egalitarian in terms of absolute inequalities. The absolute index of inequality is greater in overweight than in obesity in most countries. However, larger inequalities in obesity are observed in Canada, England and the US, which are countries that display relatively large obesity rates.

52. The relative index of inequality by education for women is greater than 1 in all countries, indicating that obesity and overweight are higher among those with less education. The extent of inequalities varies among countries (Figure 29). For example, in Australia, Austria, Canada, England and the US, the relative index of inequality in obesity and overweight for women takes values of 3 or less, indicating that overweight and obesity rates among those with the least education are up to three times higher than among those with the most education. On the other hand, in France, Italy, Korea and Spain, the relative index of inequality for women takes values of 3 or higher, indicating that obesity and overweight differ by a factor of more than 3 between the lower and upper ends of the education scale.

53. The absolute index of inequality by education for women (Figure 31) is larger in overweight than in obesity. The absolute index in obesity varies from 7 to 24 across countries, while the absolute index in overweight varies between 14 and 45. Spain and the US have the largest absolute inequalities in both overweight and obesity.

54. Comparing results between both genders, larger education-related inequalities are seen among women than those in men in all countries; that confirms the findings reported in section 3.3.1 and those available from other studies. In countries where inequalities in obesity are the largest, there is also a greater difference in inequalities between men and women.

55. Corresponding charts for the relative index of inequality according to socio-economic condition are presented in figures 32 and 33. In both men and women, rates in obesity and overweight are higher among those with lower socio-economic condition in all countries. In men, the relative index of inequality in overweight according to socio-economic condition ranges between values of 1 and 1.5. The index of inequality in obesity also varies within a narrow range (1.1 to 1.7) except for France and Korea where the index takes values above 3. In women, the variation in relative inequalities is slightly larger across countries. Inequalities in obesity are larger in France, Korea, Spain and the US with obesity rates 2.5 times higher in the lowest socio-economic condition group than in the highest. Inequalities in overweight are

highest in France and Spain, with an index value larger than 2. A comparison between genders also shows larger inequalities in women.

56. The absolute index of inequality in men according to socio-economic condition is generally higher in overweight than in obesity, except for England and the US (Figure 34). The absolute index of inequality in overweight and obesity is highest in France, followed by Korea, Austria and the US, consistently with what was shown in relation to the relative index. Figure 35 shows that the absolute index of inequality in overweight in women is larger in Spain, the US, France and England and the absolute index in obesity is largest in the US and England.

Figure 28. Relative index of inequality for men by education level

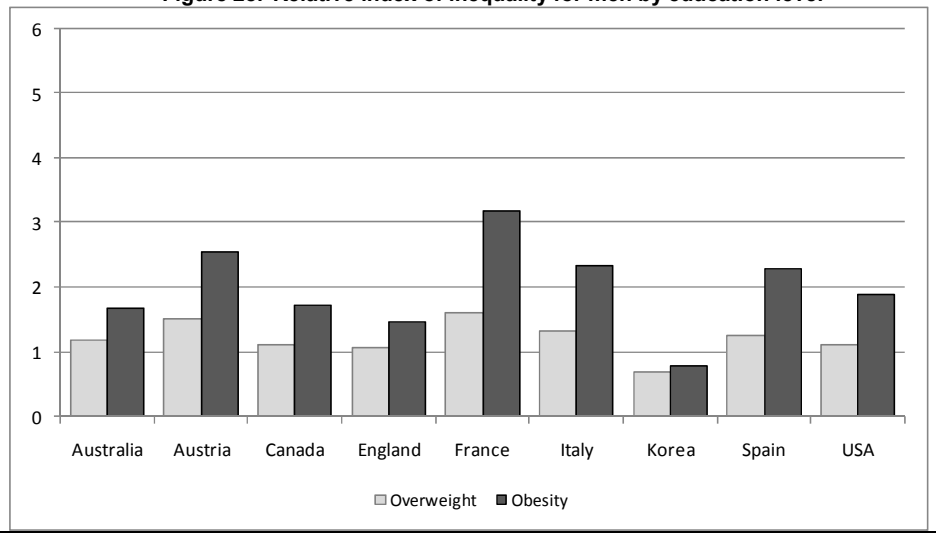
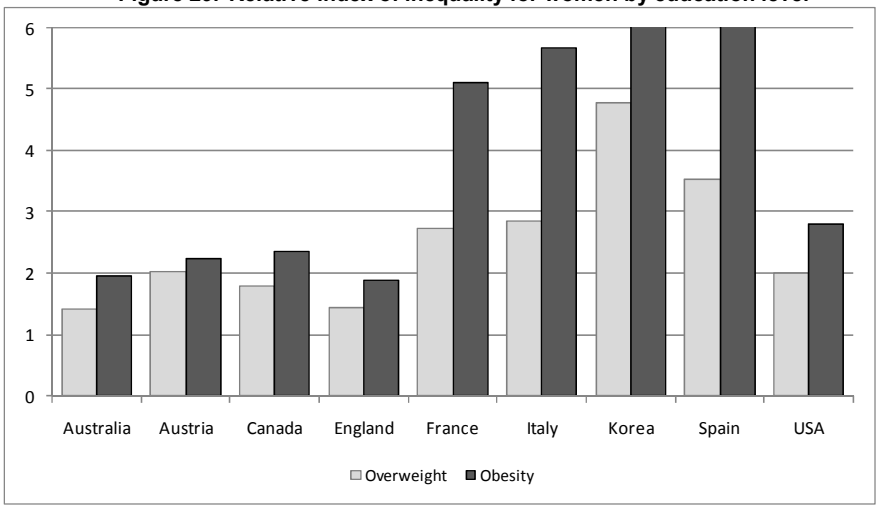


Figure 29. Relative index of inequality for women by education level



Note: Indexes for obesity were truncated for Korea (value 34.9) and Spain (14.5).

Figure 30. Absolute index of inequality for men by education level

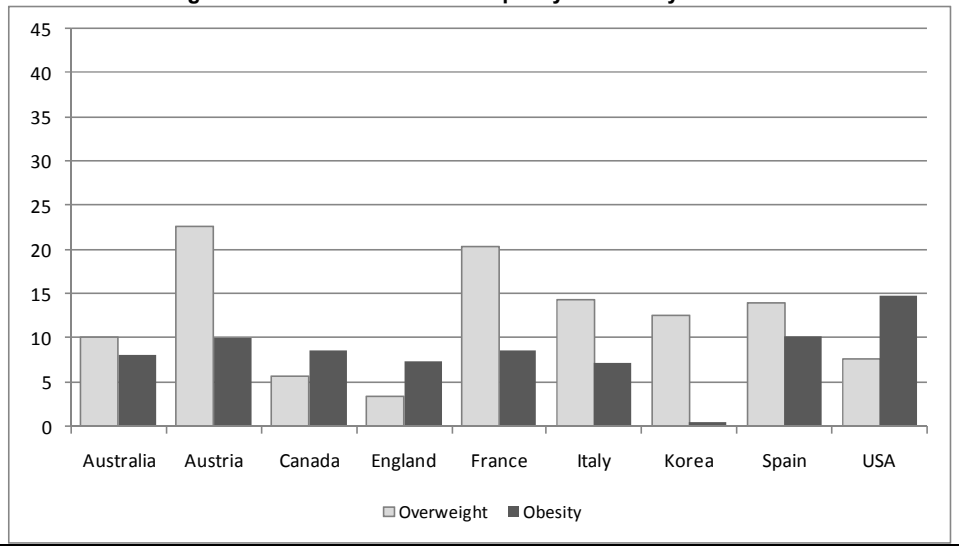


Figure 31. Absolute index of inequality for women by education level

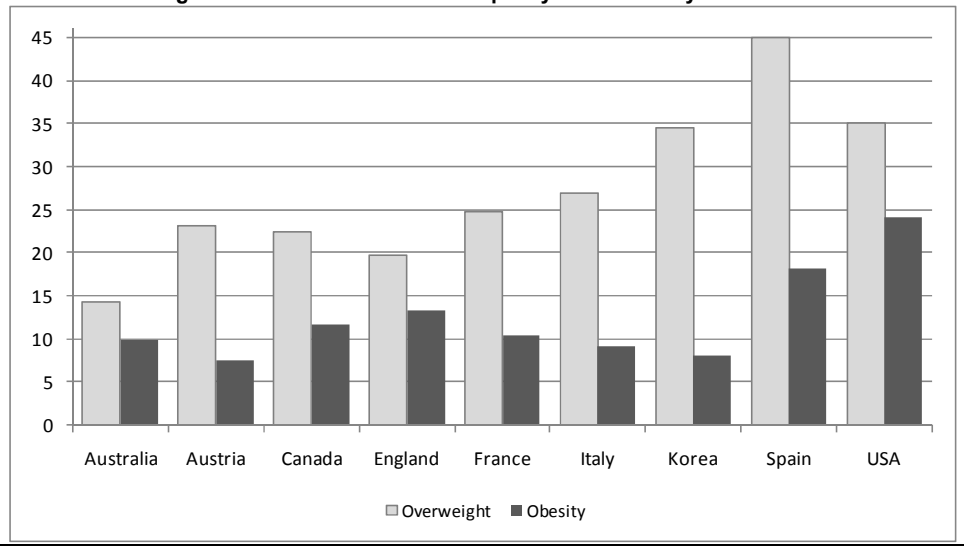


Figure 32. Relative index of inequality for men by socio-economic condition

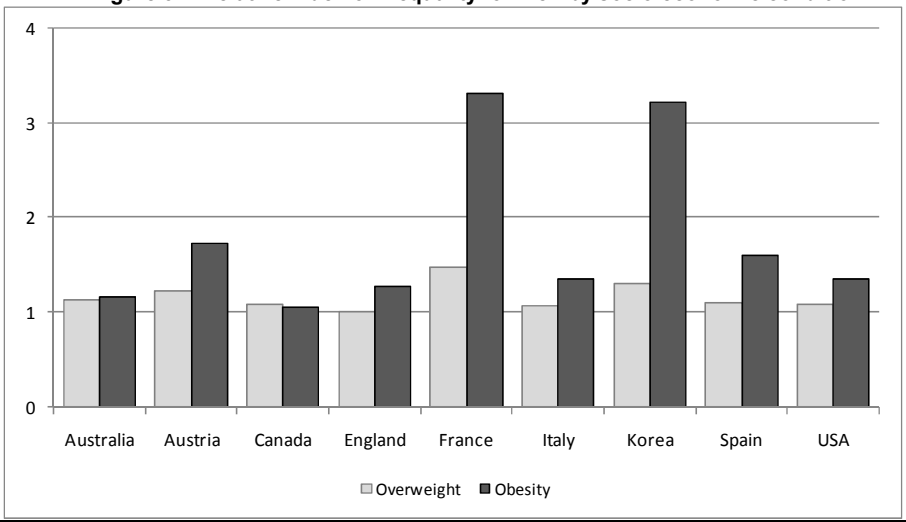


Figure 33. Relative index of inequality for women by socio-economic condition

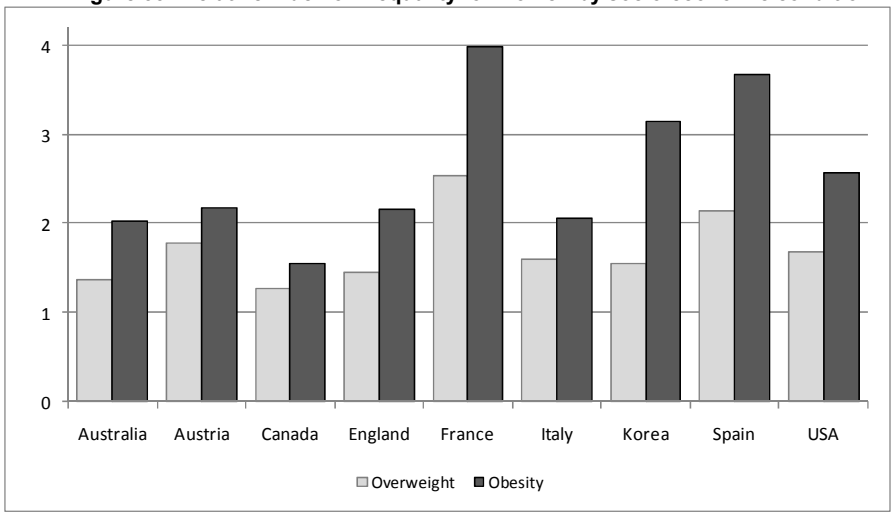


Figure 34. Absolute index of inequality for men by socio-economic condition

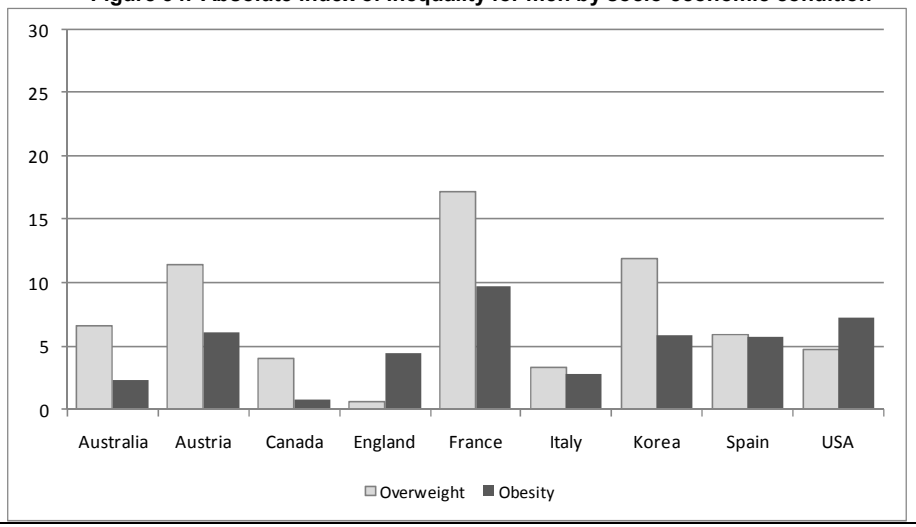
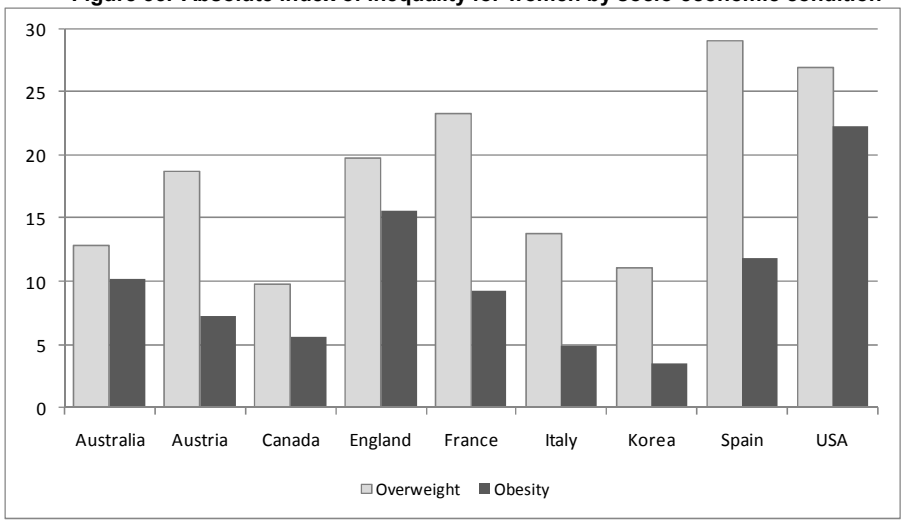


Figure 35. Absolute index of inequality for women by socio-economic condition



57. In addition, we analyzed time-trends in social inequalities in overweight and obesity. Charts illustrating time-trends in inequalities by education and socio-economic condition in obesity and overweight are presented in appendixes 4 and 5. In most countries, inequalities in both men and women do not display any particular trends over time. However, inequalities in obesity according to education in women do seem to increase in Italy and Australia, while they seem to diminish in Spain. Concerning socio-economic condition inequalities in obesity, they appear to rise in women in Austria, England and Italy and in men in Spain, whereas they seem to decrease in women in Canada.

58. Time-trends of inequalities by education in overweight seem to increase in men in Italy and Austria, and in women in England, while they look like decreasing in men in England and in women in Austria. Socio-economic condition inequalities in overweight somewhat rose in both men and women in Italy, in women in England and Korea, in men in France and Canada, whereas they appear to diminish in Austria in both genders and in the US in women.

3.4. Future projections of overweight and obesity rates

59. Quantile regression models were used to project overweight and obesity rates to 2009, 2014 and 2019. The covariates included in the analyses, in addition to a time period (year) variable required for the projection of rates into the future, were age, gender, ethnicity (when available), education and its interaction with gender, occupation-based socio-economic condition and its interaction with gender, working status, marital status. At a second stage of the analysis interaction terms between age groups and year were added.

60. The projections made allow for a possible non linearity of time trends in overweight and obesity rates. However, these projections should be read as extrapolations of past trends into the future. As such, they are implicitly based on the assumption that the factors that have determined the rate changes observed in recent years, including policies adopted by governments to tackle emerging trends, will continue to exert the same influence on future trends. The projections made so far should be seen as a basis for further analyses of likely future trends that take into account possible future modifications of the factors that have been shown to be most closely correlated with changes in overweight and obesity rates over time.

61. The results of the projections made for the nine countries are illustrated in figures 36 to 44. The emerging patterns present important differences between Australia, Canada, England and the US on one hand, and Austria, France, Italy and Spain on the other. In particular, a substantial further increase in obesity rates is projected in the former group of countries, with stable or slightly declining rates of overweight. Numbers of individuals in the lower section of the overweight range have been decreasing sharply in these countries, while numbers of individuals in the upper section of the overweight range have been increasing. The latter two changes are projected to broadly offset each other, leading to stable or slightly decreasing overweight rates. Conversely, obesity rates are projected to grow at a relatively slow pace in Austria, France, Italy and Spain over the next ten years, while overweight rates in the same countries are projected to grow at a faster rate, especially in Korea. It is conceivable, although not necessarily proven by the data, that the pattern observed in Australia, Canada, England and the US is simply a later stage in a progression that Austria, France, Italy, Korea and Spain may experience further down the line, unless key determinants of such progression are effectively acted upon in the near future.

62. The gender- and age-standardized rates are presented on the same charts. They correspond to obesity and overweight rates for a constant population structure over time (2005 OECD standard population). In most countries, the standardized rates projected in the future overlap non-standardized rates. However, in Austria, France, Italy and Spain, the standardized projected rates of obesity and overweight are slightly lower than non-standardized rates, indicating that overweight and obesity will partly grow in those countries due to projected changes in national population structures by age and gender.

63. Ruhm (2007) has previously employed this method to calculate the future prevalence of obesity in the US in 2010 and 2020 using the NHANES data. We replicated this work by complementing the model with covariates and using one more survey wave 2005/06. Results obtained for projected rates in 2009, 2014 and 2019, were similar and varied slightly due to adjustments and additional data.

Figure 36. Future projections - Australia

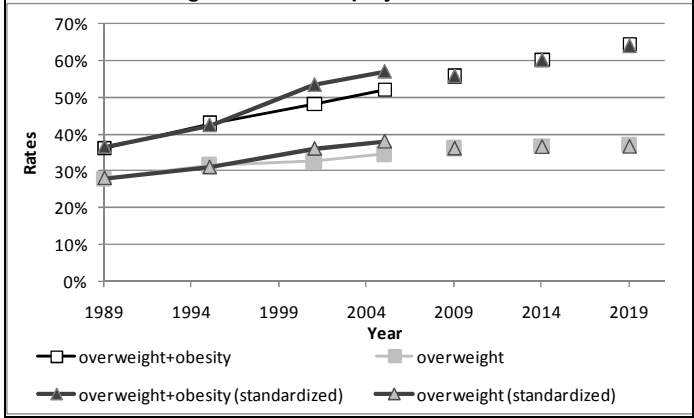


Figure 37. Future projections - Austria

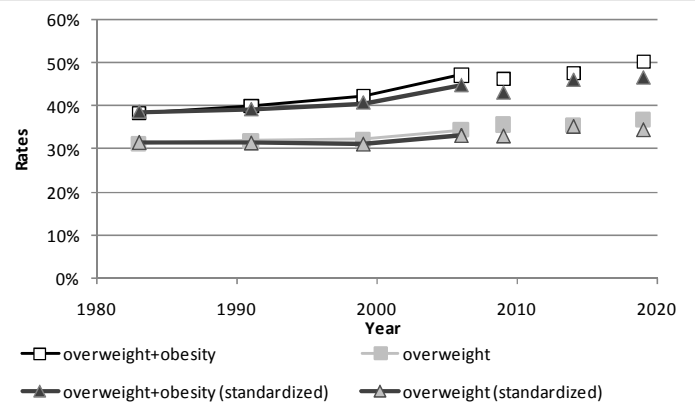


Figure 38. Future projections - Canada

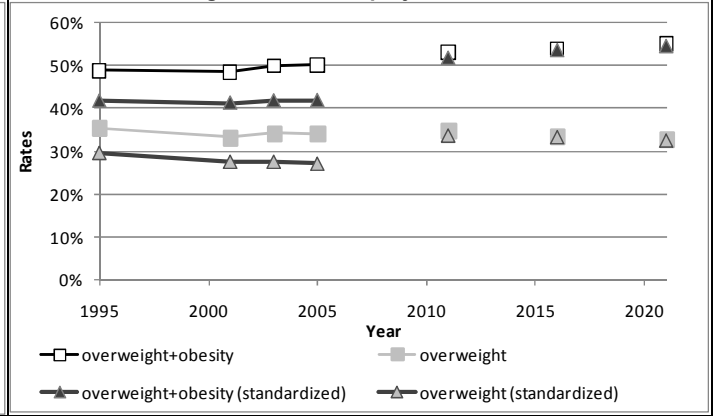


Figure 39. Future projections - England

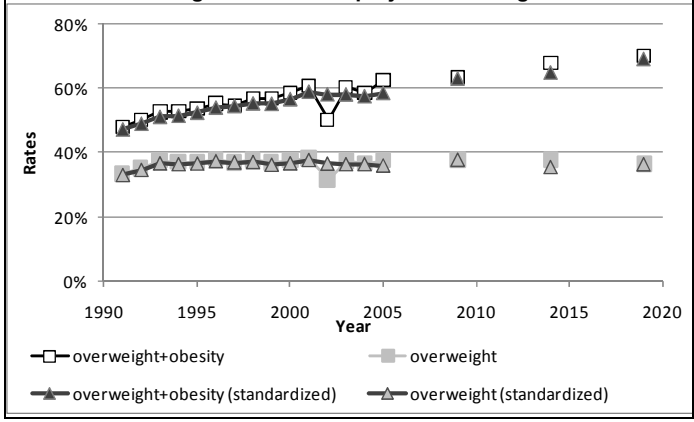


Figure 40. Future projections - France

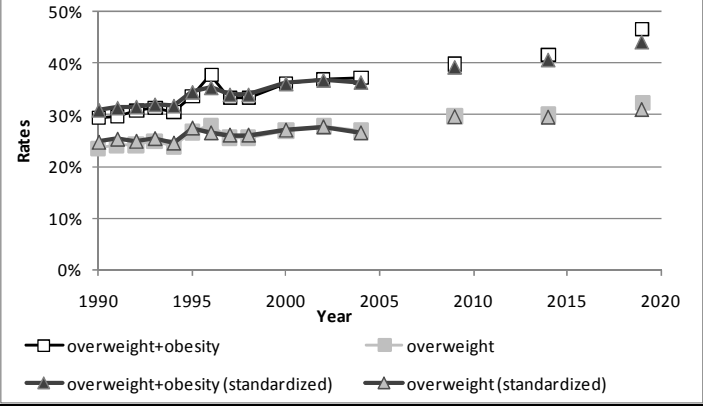


Figure 41. Future projections - Italy

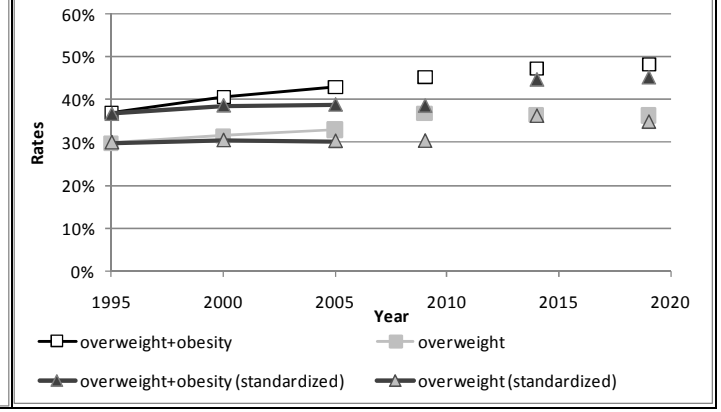


Figure 42. Future projections - Korea

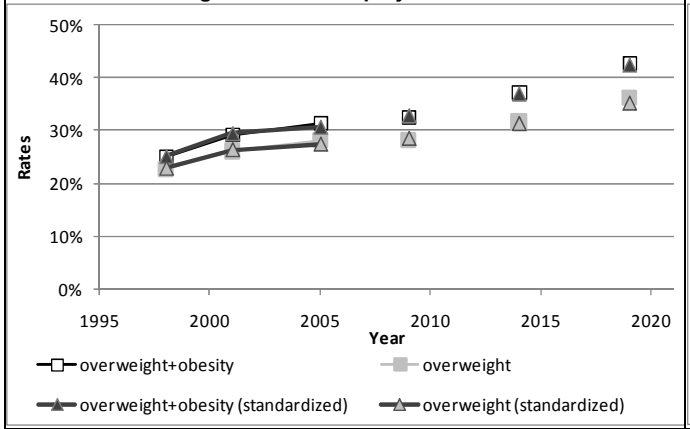


Figure 43. Future projections - Spain

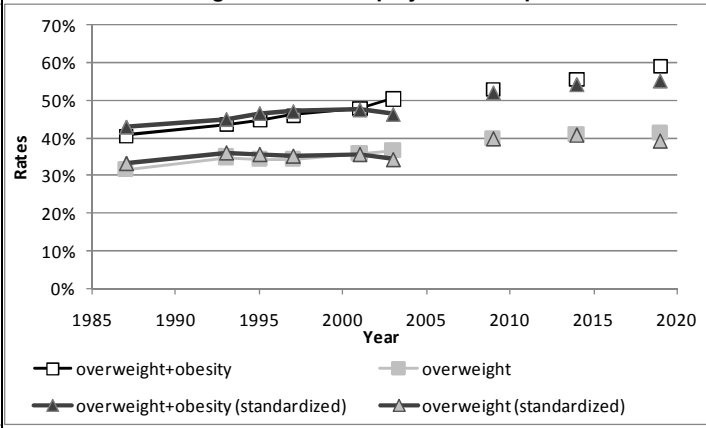
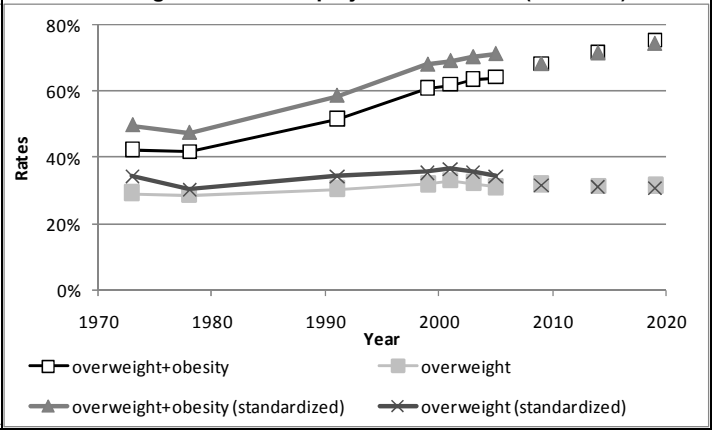


Figure 44. Future projections - the US (NHANES)



Note to figures 36-44: Past rates are crude weighted rates estimated from health survey data. Past standardized rates are gender- and age-standardized, based on the 2005 OECD population. Future rates are calculated from quantile regression estimates by using projected population structures by age and gender in each country. Future standardized rates are also calculated from quantile regression estimates but using the 2005 OECD population structure.
Quantile regressions for Australia were performed with the Stata qreg command without using weights but controlling for the main socio-economic characteristics.

64. At a second stage of the analysis, we devised future projections of obesity rates by age group, by introducing into the quantile regression model interaction terms between age groups and year. Figures 45 to 53 present the findings of this analysis: age-standardized rates of obesity for past years and estimations from quantile regressions for the future. It appears that obesity is increasing with age until a certain point, at which it levels off, that confirms our previous findings in the descriptive statistics section. Data for Canada are less suitable for comparisons across countries since they are only available for the age range 20-64. It is worth noting that different patterns are observed in Australia, England and the US on one hand, and Austria, France, Italy and Spain on the other. Future projections for Australia, England and the US show a strong increase of obesity rates for all age groups over 25, with at least a 10-point growth between 2005 and 2019. In Austria, France and Spain, rates increases concern mostly the older groups (65-74) with at least a 7-point increase in France and Spain and a 4-point increase in Austria. In Italy, the increase appears weaker than in other countries and the most affected age group is the 45-54 group.

Figure 45. Future projections by age group- Australia

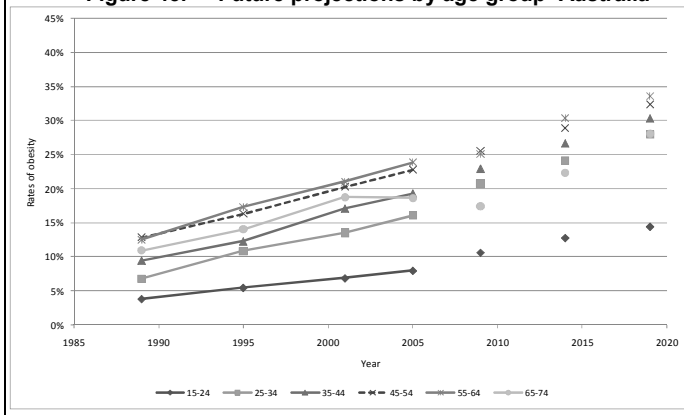


Figure 46. Future projections by age group - Austria

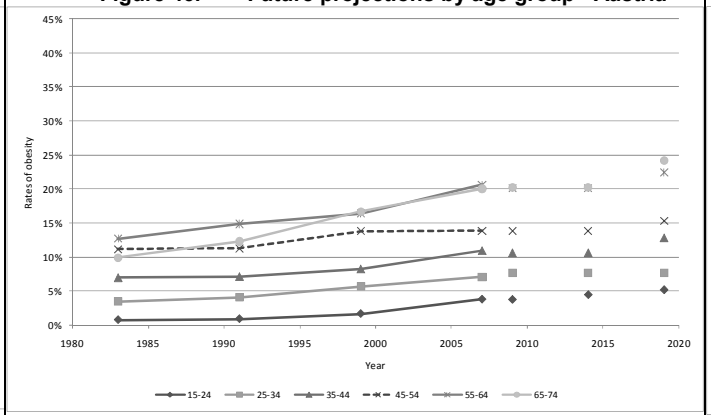


Figure 47. Future projections by age group- Canada

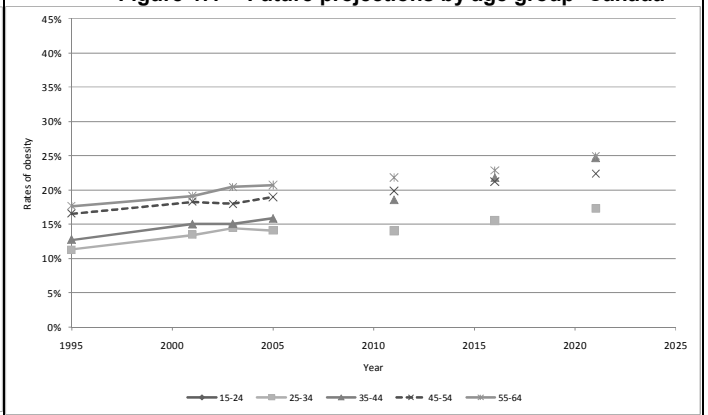


Figure 48. Future projections by age group- England

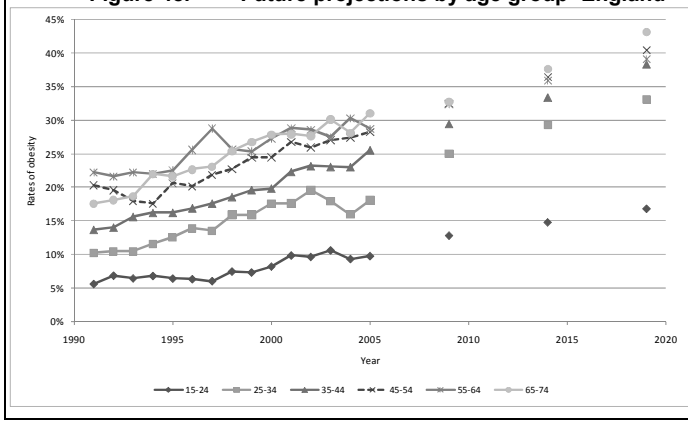


Figure 49. Future projections by age group- France

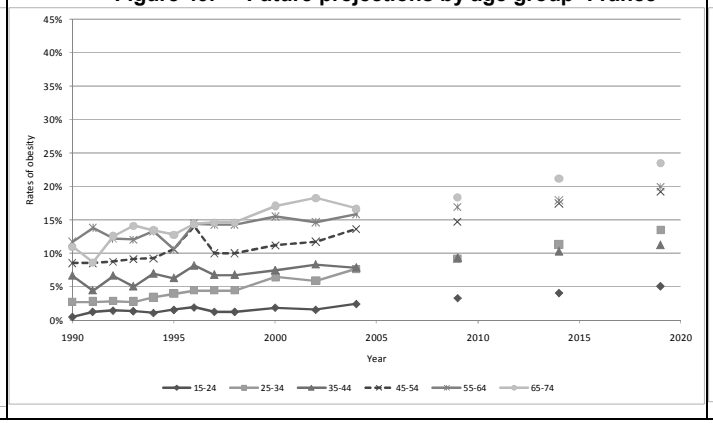


Figure 50. Future projections by age group- Italy

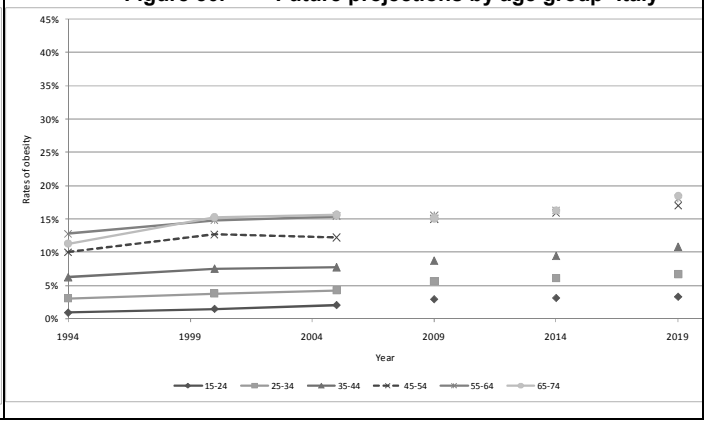


Figure 51. Future projections by age group- Korea

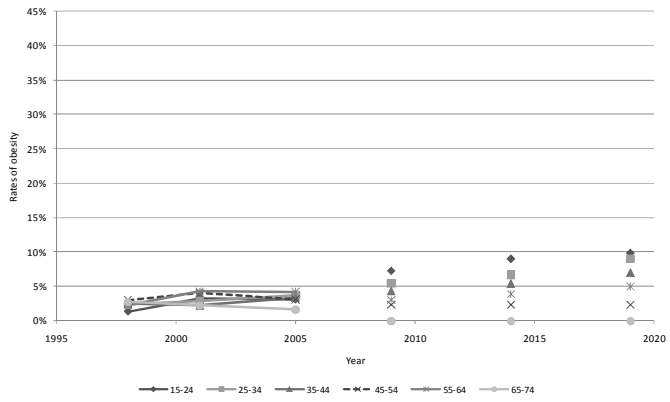


Figure 52. Future projections by age group- Spain

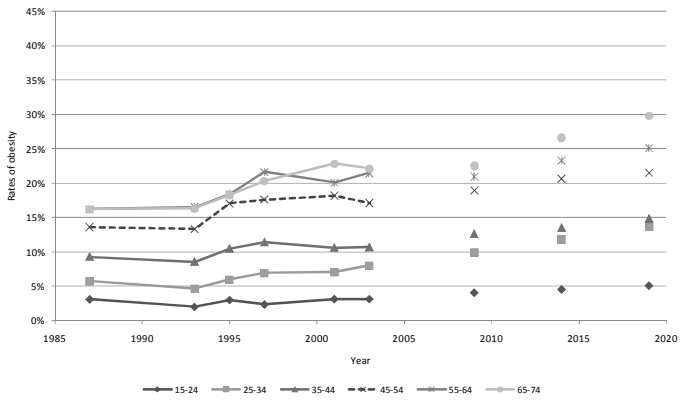
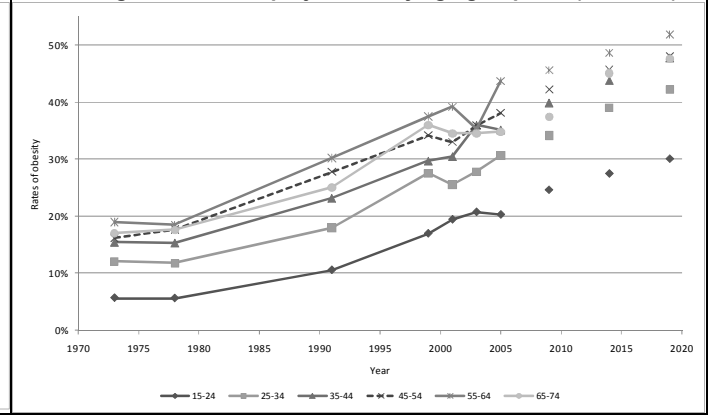


Figure 53. Future projections by age group- US (NHANES)



3.5. Multilevel models

65. Multilevel models of overweight and obesity rates, aspects of diet and physical activity were developed using households as higher-level units using data from England, France, Italy and Korea. Other surveys did not provide complete information on all household members, therefore they were not suitable for this analysis. Some of the surveys (Austria, Australia, Canada and Spain) provided information on sampled individuals' regions of residence, and these were used to design multilevel models with a regional clustering of observations. However, the results obtained with the regional aggregation are not presented here because the geographic levels correspond to large areas (states in Australia, health regions in Canada and administrative regions in Spain and Austria) and correlation in rates of obesity and overweight among people living in those areas are very low.

66. Intercept-only multilevel models with no covariates were first devised for the purpose of making a baseline assessment of variance components, *i.e.* for determining what proportion of the overall variance observed in each sample for different outcomes (*e.g.* obesity or health-related behaviours) may be attributed to variation *within* households, and what proportion may be attributed to variation *between* households. The stronger the correlation in obesity or health related behaviours among members of a household, the larger is the proportion of the total variance that may be attributed to variation between households, and therefore the larger is the coefficient named *rho* (ρ) that represents the ratio of *between* variance over total variance. Such coefficients are shown in table 4 for a range of outcome variables in the countries. In order to avoid a biased estimation of the baseline ρ coefficients in household level analyses, single-member households were excluded when intercept-only models were run, while they were included in subsequent multilevel analyses. The values of the ρ coefficients suggest remarkable degrees of correlation within households in overweight and obesity as well as in dietary habits and physical activity.

Table 1. Strength of the intra-class correlation in diet and physical activity within households.

	England	Korea	France	Italy
Probability of overweight	15.3%	6.5%	11.32%	6.07%
Probability of obesity	24.7%	16.3%	26.68%	22.23%
Physical activity (not being inactive)	32%	15.2%	24.78%	55.45%
Daily consumption of fruits and vegetables	51.2%	-	-	-
5 serves/day of fruits and vegetables	40.4%	-	56.16%	-
Daily fiber intake (milligrams)	-	33.4%	-	-
Daily fat intake (score in England/grams in Korea)	33.7%	30.2%	-	-

Note: Values in the table show the proportion of the total variance observed in the national samples for the variables listed which is due to differences between households. The higher these values, the stronger the correlation within households.

67. To determine whether the clustering within household is due to genetic or household factors, we analyzed the correlation in overweight, obesity and BMI between spouses (not genetically related) and compared this to the correlation between mother and children (genetically related, with the expectation of adopted children and step-children, which we were not able to exclude from the analysis). The correlations in overweight, obesity and BMI between mother and children are always higher than those between spouses, except in France, where the correlation in overweight between spouses is higher than that between mother and children, and in Korea, where some correlations are not significant, possibly due to a smaller sample size. These results support the view that both genetic and behavioural factors contribute to explaining the prevalence of overweight and obesity within households. The role of genetic factors is more important in countries where the difference between the two correlation coefficients is large (*e.g.* England).

In France and Italy, the correlation between spouses is very close to that between mother and children, suggesting that behavioural factors play a larger role.

Table 2. Strength of the pairwise correlation in overweight, obesity and BMI between spouses and between mother and children.

Pairwise correlation	England	France	Italy	Korea
Overweight				
Spouses	13.1% ***	16.75% ***	15.21% ***	-1.2%
Mother and Children	21.27% ***	15.49% ***	17.14% ***	12.23% ***
Obesity				
Spouses	13.51% ***	11.78% ***	11.14% ***	-1.04%
Mother and Children	20.4% ***	13.11% ***	12.37% ***	-1.23%
BMI				
Spouses	20.74% ***	23.58% ***	22.38% ***	2.27% *
Mother and Children	31.39% ***	28.3% ***	26.38% ***	21.14% ***

Note: Values in the table show the correlation in overweight, obesity and BMI between members of individual households. (***) means that values are statistically significant at 1%, (**) significant at 5% and (*) significant at 10%.

68. In Korea, the low correlation in BMI between spouses may reflect cultural specificities in partner selection, possibly leading men with a higher BMI to prefer engaging in partnerships and marriage with women with a lower BMI. We tested the extent to which the correlation in BMI between spouses may be affected by behavioural factors, as opposed to partner selection, by exploring the variation in correlation coefficients for couples of different ages (from under 30 to over 65 years old). No correlation in BMI was observed in younger couples (correlation= -0.01, not significant), whereas a correlation coefficient of 0.09 ($p<0.01$) was observed in older couples. The degree of correlation is still lower than in other countries, and Korea remains an exception in this respect.

69. At a second stage of the multilevel analysis, we introduced a range of covariates at the individual and household levels, and also interaction terms between selected covariates. This was done for the purpose of controlling for the effects of multiple factors and to improve the estimates of the determinants of the likelihood of being overweight and obese. The estimates and their standard errors from the multilevel models are displayed in appendix 6 and compared to the outputs of the single-level models. As expected, the standard errors are higher in the multilevel models. However, estimates of the effects of most independent variables present only minor changes. When multilevel models accounting for the clustering of individuals into households are used to estimate overweight and obesity rates, the resulting estimates tend to be lower than those provided by single-level models (up to 3 percentage points lower in Italy). Also, disparities in overweight and obesity are often larger than previously estimated (especially in women in England and Korea, and in both genders in France).

SECTION IV

DISCUSSION OF FINDINGS AND CONCLUSIONS

70. Virtually all OECD governments have expressed serious concerns in recent years about unhealthy diets and sedentary lifestyles, which are seen as the immediate causes of a rising epidemic of overweight and obesity. There is little doubt that such concerns are legitimate. A large body of empirical evidence shows that overweight and obesity rates have been increasing relentlessly over recent decades in all industrialised countries, as well as in many lower income countries. A detailed analysis of individual-level national health examination and health interview survey data was undertaken, using surveys from the following 11 OECD countries: Australia, Austria, Canada, England, France, Hungary, Italy, Korea, Spain, Sweden, and the US. These surveys provide the most accurate and detailed information currently available on overweight and obesity for national OECD populations, assessed with reference to the body mass index. Our analyses of trends over time support the grim picture drawn in the international literature and so do our projections of overweight and obesity rates over the next ten years. Our analyses of changes in the distribution of BMI over time and across countries show that patterns observed today in countries with relatively low rates of overweight and obesity are strikingly similar to those observed in the past in countries that have now reached substantially higher rates. It may not take a long time before the former countries catch up with the latter.

71. Obesity has been increasing at a faster pace in countries with historically higher rates, leading to a widening gap among countries over time. Conversely, pre-obesity appears to have been growing faster in countries with historically lower rates. This picture is consistent with a progressive shift of relatively large groups within national populations from normal weight to pre-obesity first, and subsequently from pre-obesity to obesity.

72. Projected trends in adult overweight and obesity (age 15-74) over the next 10 years, based on the assumption that the entire distribution of BMI in national populations would continue to evolve following the patterns observed in the past, predict a progressive stabilisation or slight shrinkage of pre-obesity rates in many countries (*e.g.* Australia, England, US), with a continued increase in obesity rates. Increases in overweight and obesity are expected to happen at a progressively faster pace in countries (*e.g.* Korea, France) where rates of obesity were historically lower. In the absence of effective interventions, countries with historically low rates of overweight and obesity, such as Korea, may expect within the next 10 years to reach the same proportions of pre-obese population (BMI between 25 and 30) as countries that currently rank near the top of the BMI league table, such as England. Obesity is more common in older age groups, within the age-range examined, and appears to be growing at slightly faster rates than in younger age groups in several countries. However, changes in the age structures of national populations in the OECD area are unlikely to have contributed in a major way to past increases in overweight and obesity, or to contribute to expected future increases.

73. While it seems clear that recent increases in overweight and obesity will continue to have impact on the prevalence of chronic diseases, particularly diabetes, it is much less clear whether they will have a substantial impact on mortality. Comprehensive studies have failed to demonstrate a large overall impact of obesity on longevity, even when taking a very long time perspective (McPherson *et al*, 2007). For certain conditions, a higher weight does not lead to an increased mortality, and individuals who are overweight in old age appear to have slightly reduced mortality rates than normal weight individuals of the same age.

4.1. The driving forces behind the epidemic: individual attitudes and environmental influences.

74. While weight gain is fundamentally determined by an energy imbalance (energy intake greater than energy expenditure), the relative roles played by changing diets (intake) and sedentary lifestyles (expenditure) on the recent spread of overweight and obesity remain somewhat uncertain. However, it seems clear that the circumstances in which people have been leading their lives over the past 20-30 years, including aspects of physical, social and economic environments, have exerted powerful influences on their overall calorie intake, on the composition of their diets and on the frequency and intensity of physical activity at work, at home and during leisure time. The environmental influences described here were shown to have been even stronger than suggested by many existing empirical analyses. Indeed, they are so strong that they have more than offset an apparent declining underlying trend in the likelihood of overweight and obesity for successive birth cohorts.

75. Our findings suggest that diverging forces are at play, which have been pushing overweight and obesity rates into opposite directions. On one hand, the powerful influences of *obesogenic* environments that have been consolidating over the course of recent decades. On the other, the long term influences of changing education and socio-economic conditions which have made successive generations increasingly aware of the health risks associated with lifestyle choices, and sometimes more able to handle environmental pressures. Analyses based on age-period-cohort models have shown, possibly for the first time, important negatively sloped cohort effects. The presence of such cohort effects suggests that the large increases in overweight and obesity rates observed over recent decades may be attributed primarily to factors and dynamics that have characterised the latter time period, and that have sharply increased everyone's likelihood of becoming overweight or obese, regardless of their age or birth cohort.

76. Negative cohort effects mean that, everything else being equal, younger generations are less likely than older ones to become overweight or obese, although these effects alone do not appear to have been sufficiently strong to compensate period effects pushing overweight and obesity rates in the opposite direction. There are a number of possible explanations for the negative cohort effects identified in this paper, which may help devising policy strategies to make such effects even stronger in the future. First, education and socio-economic status have changed substantially over time since World War II. However, when we accounted for individual level education and occupation-based social class, cohort effects were somewhat attenuated but remained clearly negatively sloped. The effects of changing levels of education and socio-economic circumstances are probably to be measured at the aggregate level, as all individuals born and grown up in a certain time period benefit from the general levels of education and socio-economic status of the overall population, as well as their own. In addition, the availability of information on the health risks and benefits associated with diet and physical activity and the awareness of such risks at critical times in the development of individual habits and personality have been increasing over time, possibly contributing to the negative cohort effects. Finally, the role of material deprivation, particularly food deprivation, during childhood as a factor that may increase the likelihood of obesity in later life has been highlighted in a number of studies (Lobstein *et al.*, 2007), and there are suggestions that this effect is stronger in women than in men (Case *et al.*, 2007). This factor might also help explaining the negative cohort effects.

77. Nevertheless, we observe signs of an upturn, starting from the 1960s, in the cohort effects curves for Canada, France, and the US. These findings are consistent with those of a study based on Australian data from the same survey used by the OECD for some of the analyses reported in this paper. The study used three survey waves (1990,1995 and 2000) and a log-linear Poisson model to assess age, period and cohort effects, reaching the conclusion that cohort effects become positively sloped since the 1960s, at least for overweight (Allman-Farinelli *et al.*, 2008). A further study on a selected Korean population of 28-59 year old male government employees showed steadily increasing cohort effects for obesity (Kwon *et al.*, 2008). However, both the Australian and the Korean studies were based on statistical approaches requiring the setting of specific constraints based on assumptions concerning some of the effects, an approach which we rejected in the present study due to the lack of prior knowledge that would justify such assumptions.

78. In a policy perspective, countries wishing to implement interventions aimed at curtailing the growth of overweight and obesity should take account of both of these major forces. If interventions are deemed to be justified, these should counter the influences of *obesogenic* environments on individual lifestyle choices, and should aim at modifying such environments in ways that would make healthy choices easier. At the same time, interventions should promote a further decline in the underlying probability of overweight and obesity for new generations. However, our analysis of policies and interventions adopted by OECD and other EU countries seems to indicate that governments have been making great efforts in the latter direction, but have shown a lesser propensity to tackle aspects of the *obesogenic* environments in which people have been leading their lives in recent years. For instance, there appears to be a limited awareness of, or willingness to intervene on, features of the political and economic environments which have contributed to the growth in overweight and obesity. Limited attention has been paid to dynamics in price and availability of different types of foods. Changes in physical environments and transport systems are contemplated only in relatively few instances. There might be good reasons for not intervening in these areas. In some cases, potential interventions may be ineffective, or they may eventually lead to welfare losses. It should not be forgotten that *obesogenic* environments have often developed through changes that were perceived to enhance individual or social welfare. Any reasons for and against intervention should be made explicit and open to challenge.

4.2. Unequal lifestyles, unequal health: disparities in obesity across social groups

79. Many OECD countries have been concerned not only about the pace of the increase in overweight and obesity, but also about inequalities in their distribution across social groups, particularly by socio-economic status and by ethnic background. After exploring trends over time and across countries in rates of overweight and obesity, we turned to the distribution of the latter across social groups within national populations. A range of analyses were conducted to assess the extent to which socio-economic groups differ from one another in terms of body mass, after controlling for a number of individual characteristics. Inequality indexes were used to make comparisons of disparities over time and across countries.

80. Significant disparities exist among social groups in OECD countries, both in relation to lifestyle choices and health outcomes. This is true along several dimensions, including age, gender, social class, level of education, and ethnicity. Overweight and obesity are at the same time markers reflecting aspects of individual lifestyles and important risk factors for health and longevity. Disparities across social groups in overweight and obesity matter not just because of their impact on the distribution of income and health, but also because of their potential impact on overall social welfare.

81. The distribution of overweight and obesity among the population in OECD countries consistently shows pronounced disparities by education and socio-economic status among women (with more educated and higher socio-economic status women displaying substantially lower rates), while mixed patterns are

observed among men. In some countries, men display a similar but markedly less pronounced gradient than women, in others no clear gradient is detectable, and in at least one country (Korea) a reverse gradient is observed among men, both by education and socio-economic status. Part of the difference between genders may be explained by a reverse causal link (obesity generates unemployment and low socio-economic status) which has been shown elsewhere to be significantly stronger in women than in men. Differences in lifestyles are also likely to contribute to explaining gender differences in socio-economic and ethnic inequalities. Acting on the mechanisms that make women in poor socio-economic circumstances so vulnerable to obesity, and women at the other end of the socio-economic spectrum much more able to handle *obesogenic* environments, is of great importance not just as a way of redressing existing inequalities, but also because of its potential effect on overall social welfare. The current distribution of obesity appears particularly undesirable, as it is likely to perpetuate the vicious circle linking obesity and disadvantage by intergenerational transmission.

82. Countries where the largest (relative) disparities exist are not necessarily those where overweight and obesity rates are highest. Least educated women are at greatest disadvantage in Korea, Spain, Italy and France, where their chances of being overweight or obese are many times higher than those of their most educated counterparts. Conversely, disparities are least in England and Australia, where women at the two extremes of the education spectrum differ in their overweight and obesity rates by a factor of less than two. Disparities in obesity by education among men are largest in France, Austria, Spain and Italy, but still substantially smaller than among women, and are relatively minor in other countries. Disparities in obesity by socio-economic status follow a similar pattern, and are largest in France, Spain and Korea for both men and women.

83. In most countries, disparities have not significantly changed over the period of time for which data are available, although widening disparities were observed at least in Spain, Australia (by education level), England and Italy (by socio-economic status). In those countries, more disadvantaged population groups have been increasing their rates of obesity at a faster pace than their better-off counterparts, over the last 15 years.

4.3. The spread of obesity within families and social networks.

84. Overweight and obesity are social phenomena. The lifestyle choices leading to overweight and obesity, typically those concerning nutrition and physical activity, as well as the outcomes of those choices in terms of body weight, tend to be shared among members of the same families, social networks and peer groups. Research has shown that similarities within such groups exist when measured at a given point in time, but also when changes in individual behaviours are observed over time (Christakis *et al.*, 2007). This phenomenon may be at least partly responsible for the very fast pace at which overweight and obesity rates have been rising in recent years.

85. Data from countries which provided full information on all members of each surveyed household (England, France, Korea and Italy), show that one sixth to one fourth of the overall variation in the probability of being obese is determined by differences among households, rather than differences among individuals (25% in England, 16% in Korea, 27% in France and 22% in Italy). The proportion was higher, up to 50% (similar to what is observed in smoking), for health-related behaviours such as consumption of fruit and vegetables and physical activity, and was about one third for fat consumption. When selecting pairs of spouses within households (*i.e.* individuals not sharing the same genetic background), the correlation of BMI levels in each couple was above 20% in all countries except Korea, where it was substantially smaller. The correlation was stronger in older age couples, suggesting that the effect is at least in part due to the adoption of common lifestyles, and not merely to partner selection.

86. Genetic factors may also play a part in determining a convergence of BMI levels within households. It has been argued that obesity is the lifestyle-related condition that is most influenced by genetic heritage (Cutler *et al.*, 2003). Studies comparing natural and adopted children with two, one or no obese parents showed that natural children are substantially more likely than adopted ones to resemble their parents in terms of body weight. However, when selecting only mothers and their children within households (*i.e.* members who share the same genetic background) in the above health survey data, the correlation was stronger than between spouses in all countries, but not so much stronger to suggest that similarities in BMI among household members may be mostly explained by genetic factors. Genetics alone cannot account for the rise in overweight and obesity experienced over the past 20-30 years by all OECD countries. Rather, *obesogenic* environments appear to have encouraged individuals, especially when culturally and socially vulnerable, to make less healthy lifestyle choices, and those genetically predisposed have tended to become overweight or obese as a result. This interaction between genetic factors and environment appears to be strongly supported by the findings of the analyses undertaken as part of this project.

87. The clustering of overweight and obesity within households, social networks, and possibly other levels of aggregation, provides important insights on the trends observed in recent years and on possible ways of tackling them. Project findings confirm the existence of what has been described elsewhere as a "social multiplier" effect, which is very likely to have contributed to the rapid spread of overweight and obesity throughout the OECD area. It has been calculated that a large proportion of the increase observed in child obesity in recent years is a direct effect of increases observed in adult obesity. In economic terms, this effect may be described as an externality, indicating that individual lifestyle choices are likely to have an influence on other individuals' lifestyles. The impact on other individuals' health may be less direct in this case than, for instance, in the case of passive smoking, but it is no less important. A strong indication emerges that actions targeting individuals outside the social context in which they lead their lives are unlikely to be very effective. A number of countries are increasingly promoting interventions involving peer groups (*e.g.* school-based, or workplace interventions) or family members (*e.g.* children and parents). These interventions may better exploit the "social multiplier" effect, turning it into a positive externality which generates favourable influences on health behaviours among members of families and social networks. In addition to providing better chances of interventions being effective in changing behaviours, exploiting the "social multiplier" effect in the way just described may produce faster reductions in overweight and obesity rates than interventions targeting individuals out of their social context.

ANNEXES

ANNEX 1 – DETAILS OF HEALTH SURVEY DATA AND SAMPLE CHARACTERISTICS

Table 1: Characteristics of the Surveys

	Name of survey	Organization undertaking the survey	Type of survey	Years used in the analyses
AUSTRALIA	Nartional Health Survey	Australian Bureau of Statistics	Health interview survey	1989, 1995, 2001, 2004/05
AUSTRIA	Mikrozensus + Health Interview Survey	Statistics Austria	Health interview survey	1983, 1991, 1999, 2006/07
CANADA	National Population Health Survey + Canadian Community Health Survey	Statistics Canada	Health interview survey	1994/95, 2000/01, 2003, 2005
ENGLAND	Health Survey for England	Office for Population Censuses and Surveys (1991-1993), then the Joint Survey Unit of the National Centre of Social Research and the Department of Epidemiology and Public Health at University College London (since 1994)	Health examination survey	1991 to 2005
FRANCE	Enquête Santé et Protection Sociale	Institute for Research and Information in Health Economics	Health interview survey	1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998,
ITALY	Condizioni di Salute	Instituto Nazionale di Statistica	Health interview survey	1994/95, 2000, 2005
KOREA	Korean National Health and Nutrition Examination Survey	jointly carried out by the Korea Institute for Health and Social Affairs and the Korea Health Industry Development Institute	Health examination survey	1998, 2001, 2005
SPAIN	Encuesta Nacional de Salud de Espana	Ministry of Health and Consumers in collaboration with the Centre of Sociological Investigations	Health interview survey	1993, 1995, 1997, 2001, 2003, 2006
US-NHIS	National Health Interview Survey	National Center for Health Statistics	Health interview survey	1997 to 2005
US-NHANES	National Health and Nutrition Examination Survey	National Center for Health Statistics	Health examination survey	NHANES I (1973), NHANES II (1978), NHANES III (1991), 1999/2000, 2001/02, 2003/04, 2005/06

Table 2: Sample characteristics (weighted percentages), Australia

		1989			1995			2001			2004/05		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		15,319	15,242	30,561	13,239	13,167	26,406	5,161	5,644	10,805	6,084	6,359	12,443
Age groups	15-19	7.3%	6.8%	7.1%	5.1%	4.7%	4.9%	3.3%	2.8%	3.1%	4.5%	4.6%	4.5%
	20-24	12.6%	12.7%	12.6%	13.4%	13.1%	13.3%	8.1%	7.9%	8.0%	10.3%	10.2%	10.3%
	25-29	13.2%	13.4%	13.3%	12.4%	12.8%	12.6%	10.1%	11.5%	10.8%	10.6%	11.0%	10.8%
	30-34	13.0%	13.3%	13.1%	12.9%	13.2%	13.1%	12.3%	13.4%	12.8%	12.3%	12.8%	12.5%
	35-39	12.1%	12.4%	12.2%	12.4%	12.8%	12.6%	13.2%	13.7%	13.5%	11.8%	12.3%	12.0%
	40-44	11.7%	11.7%	11.7%	11.4%	11.5%	11.4%	13.4%	12.8%	13.1%	12.3%	12.5%	12.4%
	45-49	9.4%	8.9%	9.2%	10.5%	10.7%	10.6%	11.7%	11.8%	11.7%	11.2%	11.2%	11.2%
	50-54	7.5%	7.4%	7.5%	8.8%	8.3%	8.5%	11.6%	10.8%	11.2%	9.9%	9.7%	9.8%
	55-59	6.6%	6.6%	6.6%	7.1%	6.6%	6.8%	9.0%	8.3%	8.7%	9.6%	8.8%	9.2%
	60-64	6.5%	6.8%	6.7%	6.0%	6.1%	6.0%	7.2%	6.9%	7.1%	7.5%	7.1%	7.3%
Marital status	single	28.8%	21.0%	25.0%	29.5%	23.5%	26.6%	28.0%	22.1%	25.1%	34.7%	28.3%	31.6%
	married	65.3%	67.6%	66.4%	63.1%	64.2%	63.6%	63.0%	63.3%	63.2%	55.6%	56.5%	56.0%
	div./ sep./ wid.	5.9%	11.3%	8.6%	7.4%	12.4%	9.8%	9.0%	14.6%	11.7%	9.7%	15.2%	12.4%
Occupation status	working	84.8%	60.2%	72.7%	81.3%	64.5%	73.2%	82.6%	66.2%	74.6%	84.4%	68.2%	76.6%
	not working	15.2%	39.8%	27.3%	18.7%	35.5%	26.8%	17.4%	33.8%	25.4%	15.6%	31.8%	23.4%
Education level	low	14.9%	15.0%	15.0%	11.8%	11.2%	11.5%	9.0%	7.5%	8.3%	6.1%	4.9%	5.6%
	middle	68.0%	71.5%	69.7%	67.3%	70.7%	68.9%	67.3%	70.7%	69.0%	43.5%	40.9%	42.2%
	high	17.1%	13.5%	15.3%	21.0%	18.1%	19.6%	23.7%	21.7%	22.7%	50.3%	54.2%	52.2%
Equivalised income quintiles	highest	28.1%	24.7%	26.4%	26.9%	23.6%	25.3%	29.6%	24.5%	27.2%	29.4%	23.9%	26.8%
	middle-high	24.5%	22.4%	23.5%	23.0%	21.4%	22.3%	22.8%	22.4%	22.6%	25.1%	22.0%	23.6%
	middle	21.6%	20.7%	21.1%	19.7%	19.6%	19.7%	20.1%	19.8%	19.9%	20.0%	21.0%	20.5%
	middle-low	14.5%	17.5%	16.0%	12.6%	16.7%	14.6%	13.0%	16.1%	14.5%	14.5%	17.5%	15.9%
	lowest	11.4%	14.7%	13.0%	17.8%	18.6%	18.2%	14.5%	17.2%	15.8%	11.0%	15.7%	13.3%
Obese	no	91.8%	90.9%	91.4%	87.9%	87.8%	87.9%	83.9%	83.1%	83.5%	80.4%	83.0%	81.6%
	yes	8.2%	9.1%	8.6%	12.1%	12.2%	12.1%	16.1%	16.9%	16.5%	19.6%	17.0%	18.4%
Over-weight	no	56.1%	70.6%	63.2%	48.8%	64.3%	56.3%	40.8%	58.3%	49.4%	37.0%	55.6%	46.1%
	yes	43.9%	29.4%	36.8%	51.2%	35.7%	43.7%	59.2%	41.7%	50.6%	63.0%	44.4%	53.9%

Table 3: Sample characteristics, Austria

		1983			1991			1999			2006/07		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		14,264	13,417	27,681	14,471	14,185	28,656	12,702	12,413	25,115	4,760	5,059	9,819
Age groups	15-19	13.6%	12.5%	13.1%	10.4%	10.3%	10.4%	11.7%	10.8%	11.2%	5.9%	3.6%	4.7%
	20-24	13.9%	12.4%	13.2%	11.7%	9.9%	10.8%	9.2%	8.5%	8.9%	8.4%	7.6%	8.0%
	25-29	9.5%	9.7%	9.6%	10.7%	9.7%	10.2%	9.1%	9.0%	9.0%	8.5%	8.5%	8.5%
	30-34	9.0%	10.1%	9.5%	10.4%	10.9%	10.6%	11.7%	13.2%	12.5%	9.9%	10.3%	10.1%
	35-39	10.0%	11.1%	10.5%	9.8%	11.0%	10.4%	14.2%	16.0%	15.1%	12.2%	12.8%	12.5%
	40-44	13.1%	14.1%	13.5%	10.8%	11.6%	11.2%	13.7%	14.4%	14.0%	13.8%	14.1%	13.9%
	45-49	10.3%	10.3%	10.3%	9.7%	9.9%	9.8%	11.8%	11.8%	11.8%	12.3%	12.6%	12.4%
	50-54	10.3%	9.9%	10.1%	10.9%	11.3%	11.1%	9.9%	9.7%	9.8%	9.2%	10.5%	9.9%
	55-59	8.1%	6.9%	7.5%	8.2%	8.0%	8.1%	7.4%	5.2%	6.3%	10.6%	10.8%	10.7%
	60-64	2.2%	3.1%	2.6%	7.5%	7.4%	7.5%	1.4%	1.5%	1.4%	9.2%	9.3%	9.3%
Marital status	single	36.4%	27.9%	32.3%	35.5%	28.6%	32.1%	39.1%	32.2%	35.7%	36.4%	28.6%	32.4%
	married	60.7%	65.6%	63.1%	60.2%	62.2%	61.2%	56.1%	59.1%	57.6%	62.0%	66.5%	64.3%
	div/sep/wid	2.9%	6.5%	4.7%	4.3%	9.1%	6.7%	4.7%	8.7%	6.7%	1.6%	4.9%	3.3%
Occupation status	working	90.2%	56.4%	73.9%	80.5%	54.3%	67.5%	88.3%	67.3%	77.9%	81.1%	63.4%	72.0%
	not working	9.8%	43.6%	26.1%	19.5%	45.7%	32.5%	11.7%	32.7%	22.1%	18.9%	36.6%	28.0%
Education level	low	87.3%	89.8%	88.5%	83.3%	85.3%	84.3%	83.7%	84.8%	84.2%	68.4%	58.9%	63.5%
	middle	9.4%	8.5%	8.9%	11.5%	10.9%	11.2%	10.4%	11.3%	10.8%	23.1%	31.7%	27.5%
	high	3.3%	1.7%	2.5%	5.3%	3.8%	4.5%	6.0%	3.9%	4.9%	8.4%	9.4%	9.0%
Socioeconomic status	highest	27.3%	39.1%	33.0%	24.7%	39.9%	32.2%	30.1%	45.8%	37.9%	37.7%	59.5%	48.9%
	middle-high	12.5%	10.2%	11.4%	14.6%	10.0%	12.3%	12.7%	11.4%	12.1%	8.8%	4.4%	6.6%
	middle	14.7%	16.0%	15.3%	14.0%	13.3%	13.6%	13.0%	11.7%	12.4%	12.6%	9.0%	10.8%
	middle-low	21.8%	11.1%	16.6%	24.7%	10.0%	17.4%	23.7%	9.9%	16.9%	0.0%	0.0%	0.0%
	lowest	23.6%	23.6%	23.6%	22.0%	26.8%	24.4%	20.5%	21.1%	20.8%	40.8%	27.0%	33.7%
Obese	no	93.7%	94.3%	94.0%	92.5%	93.2%	92.9%	91.2%	93.1%	92.1%	87.7%	87.9%	87.8%
	yes	6.3%	5.7%	6.0%	7.5%	6.8%	7.1%	8.8%	6.9%	7.9%	12.3%	12.1%	12.2%
Over-weight	no	57.0%	73.3%	64.9%	54.5%	71.1%	62.7%	54.1%	72.5%	63.2%	44.1%	62.8%	53.7%
	yes	43.0%	26.7%	35.1%	45.5%	28.9%	37.3%	45.9%	27.5%	36.8%	55.9%	37.2%	46.3%

Table 4: Sample characteristics (weighted percentages), Canada

		1994/95			2000/01			2003			2005		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		5,599	6,204	11,803	37,976	40,142	78,118	35,595	37,603	73,198	39,601	42,919	82,520
	20-24	9.6%	10.2%	9.9%	10.7%	10.5%	10.6%	10.6%	9.9%	10.2%	11.8%	10.9%	11.3%
	25-29	12.6%	11.2%	11.9%	10.8%	10.3%	10.5%	10.7%	10.3%	10.5%	10.5%	10.2%	10.4%
	30-34	14.7%	15.7%	15.2%	11.9%	11.2%	11.5%	10.7%	10.8%	10.8%	10.2%	10.2%	10.2%
	35-39	15.4%	14.7%	15.1%	13.9%	14.2%	14.1%	13.4%	13.3%	13.4%	11.4%	11.4%	11.4%
	40-44	13.4%	13.2%	13.3%	14.7%	14.8%	14.7%	14.8%	14.8%	14.8%	14.4%	14.0%	14.2%
	45-49	11.9%	10.8%	11.3%	12.5%	13.2%	12.8%	12.1%	12.8%	12.5%	12.7%	13.2%	12.9%
	50-54	9.2%	8.9%	9.0%	10.9%	11.1%	11.0%	11.1%	11.5%	11.3%	11.1%	11.8%	11.5%
	55-59	6.9%	7.9%	7.4%	8.4%	8.2%	8.3%	9.5%	9.6%	9.5%	9.9%	10.2%	10.1%
	60-64	6.4%	7.3%	6.8%	6.3%	6.6%	6.4%	7.0%	7.0%	7.0%	8.0%	8.1%	8.1%
Marital status	single	22.1%	18.4%	20.2%	24.7%	19.6%	22.2%	24.6%	19.6%	22.2%	25.5%	20.9%	23.2%
	married	71.0%	68.4%	69.7%	68.0%	67.5%	67.8%	68.6%	68.1%	68.4%	68.1%	67.5%	67.8%
	div/sep/wid	6.9%	13.2%	10.0%	7.4%	12.8%	10.0%	6.8%	12.2%	9.4%	6.4%	11.6%	8.9%
Occupation status	working	79.4%	63.6%	71.6%	83.7%	71.0%	77.5%	83.9%	72.3%	78.3%	84.1%	72.0%	78.2%
	not working	20.6%	36.4%	28.4%	16.3%	29.0%	22.5%	16.1%	27.7%	21.7%	15.9%	28.0%	21.8%
Education level	low	21.0%	20.3%	20.7%	17.7%	16.0%	16.8%	13.8%	12.7%	13.3%	12.4%	10.7%	11.5%
	middle	40.9%	45.2%	43.0%	27.7%	30.3%	28.9%	26.9%	27.9%	27.4%	25.1%	25.3%	25.2%
	high	38.1%	34.5%	36.3%	54.7%	53.8%	54.2%	59.3%	59.3%	59.3%	62.5%	64.0%	63.2%
Equivalised income groups	lowest	4.9%	6.4%	5.6%	3.5%	4.2%	3.9%	2.5%	3.1%	2.8%	18.6%	22.3%	20.4%
	middle-low	8.9%	12.0%	10.4%	5.1%	7.5%	6.3%	3.8%	6.1%	4.9%	32.2%	29.2%	30.8%
	middle	25.8%	28.3%	27.0%	17.6%	20.6%	19.1%	15.1%	18.0%	16.5%	10.0%	8.6%	9.3%
	middle-high	40.8%	37.1%	39.0%	36.7%	36.3%	36.5%	34.1%	35.5%	34.8%	6.4%	8.3%	7.3%
	highest	19.6%	16.3%	18.0%	37.1%	31.3%	34.2%	44.5%	37.3%	41.0%	32.8%	31.6%	32.2%
Obese	no	86.5%	86.6%	86.5%	83.4%	85.6%	84.5%	82.8%	85.0%	83.9%	82.3%	85.0%	83.6%
	yes	13.5%	13.4%	13.5%	16.6%	14.4%	15.5%	17.2%	15.0%	16.1%	17.7%	15.0%	16.4%
Over-weight	no	41.3%	60.8%	50.9%	43.0%	59.4%	51.0%	40.8%	59.2%	49.6%	40.8%	58.9%	49.6%
	yes	58.7%	39.2%	49.1%	57.0%	40.6%	49.0%	59.2%	40.8%	50.4%	59.2%	41.1%	50.4%

Table 5: Sample characteristics, England

		1991			1992			1993			1994			1995			1996			1997			1998		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		1,145	1,268	2,413	1,400	1,498	2,898	5,997	6,404	12,401	5,434	5,995	11,429	5,297	6,003	11,300	5,537	6,205	11,742	2,941	3,331	6,272	5,269	6,067	11,336
Age groups	15-19	7.2%	7.3%	7.2%	7.7%	7.9%	7.8%	7.0%	6.7%	6.8%	6.5%	5.9%	6.2%	6.0%	6.3%	6.2%	6.9%	6.3%	6.6%	6.7%	6.5%	6.6%	7.1%	6.7%	6.9%
	20-24	10.1%	9.8%	9.9%	8.9%	8.5%	8.7%	9.3%	9.2%	9.2%	9.8%	9.6%	9.7%	8.4%	8.6%	8.5%	7.6%	8.2%	7.9%	7.9%	7.5%	7.7%	7.8%	7.4%	7.6%
	25-29	12.3%	11.3%	11.8%	12.9%	13.0%	13.0%	11.9%	11.9%	11.9%	11.7%	12.1%	11.9%	10.4%	11.5%	11.0%	10.4%	10.9%	10.6%	11.2%	10.8%	11.0%	10.5%	10.6%	10.6%
	30-34	12.0%	12.9%	12.4%	10.1%	10.7%	10.4%	12.0%	12.2%	12.1%	12.8%	12.7%	12.7%	13.4%	12.9%	13.2%	12.3%	12.6%	12.4%	11.9%	12.8%	12.4%	12.5%	12.4%	12.4%
	35-39	10.8%	10.3%	10.6%	11.4%	11.8%	11.6%	10.9%	11.7%	11.3%	12.6%	12.4%	12.5%	12.9%	11.6%	12.2%	11.8%	12.6%	12.2%	11.9%	11.3%	11.6%	12.2%	12.6%	12.4%
	40-44	11.9%	12.5%	12.2%	11.9%	11.8%	11.9%	10.9%	11.1%	11.0%	10.4%	10.7%	10.6%	11.1%	11.0%	11.1%	11.9%	11.0%	11.4%	11.6%	11.6%	11.6%	10.4%	10.7%	10.6%
	45-49	10.2%	9.5%	9.8%	11.7%	10.0%	10.8%	12.0%	11.4%	11.7%	10.6%	11.4%	11.0%	10.6%	11.0%	10.8%	12.0%	11.7%	11.9%	11.6%	12.0%	11.8%	11.4%	10.8%	11.1%
	50-54	8.4%	8.8%	8.6%	9.1%	9.0%	9.0%	8.9%	9.1%	9.0%	8.7%	8.7%	8.7%	9.8%	9.9%	9.9%	10.2%	10.4%	10.3%	10.4%	10.8%	10.6%	10.9%	11.5%	11.2%
	55-59	8.4%	8.7%	8.5%	7.6%	7.8%	7.7%	8.9%	8.4%	8.7%	8.2%	8.1%	8.1%	8.7%	9.0%	8.9%	8.2%	8.0%	8.1%	8.6%	8.5%	8.5%	8.3%	8.4%	8.4%
	60-64	8.7%	9.1%	8.9%	8.6%	9.4%	9.0%	8.3%	8.3%	8.3%	8.7%	8.4%	8.5%	8.7%	8.1%	8.4%	8.6%	8.3%	8.5%	8.3%	8.1%	8.2%	8.8%	8.8%	8.8%
Ethnicity	White	95.8%	95.7%	95.7%	94.9%	95.7%	95.3%	94.7%	94.9%	94.8%	95.0%	95.0%	95.0%	95.0%	95.2%	95.1%	94.3%	94.5%	94.4%	94.2%	94.4%	94.3%	94.5%	94.9%	94.7%
	Black	2.2%	2.4%	2.3%	1.1%	1.7%	1.4%	1.9%	2.1%	2.0%	1.4%	2.0%	1.7%	1.5%	1.6%	1.6%	1.7%	2.2%	2.0%	1.7%	2.1%	1.9%	2.1%	2.1%	2.1%
	Asian	2.0%	2.0%	2.0%	4.0%	2.5%	3.2%	3.4%	3.0%	3.2%	3.6%	3.1%	3.3%	3.5%	3.2%	3.3%	4.0%	3.4%	3.7%	4.2%	3.5%	3.8%	3.4%	3.0%	3.2%
Marital status	single	25.4%	19.2%	22.2%	23.9%	18.1%	20.9%	25.9%	19.6%	22.7%	26.3%	19.9%	23.0%	23.4%	19.2%	21.2%	24.5%	19.5%	21.9%	24.3%	19.1%	21.5%	32.5%	26.3%	29.2%
	married	69.0%	66.3%	67.6%	69.8%	69.3%	69.5%	67.6%	68.2%	67.9%	67.6%	67.9%	67.8%	70.4%	68.9%	69.6%	69.1%	68.7%	68.9%	69.4%	68.7%	69.1%	58.0%	57.6%	57.8%
	div/sep/wid	5.6%	14.4%	10.2%	6.4%	12.6%	9.6%	6.5%	12.1%	9.4%	6.1%	12.1%	9.3%	6.2%	11.8%	9.2%	6.4%	11.8%	9.3%	6.3%	12.2%	9.4%	9.4%	16.1%	13.0%
Occupation status	working	79.0%	64.2%	71.2%	76.9%	63.6%	70.0%	76.0%	62.9%	69.2%	76.7%	62.6%	69.3%	75.8%	60.4%	67.6%	75.7%	61.5%	68.2%	77.5%	61.3%	68.9%	78.0%	62.6%	69.8%
	not working	21.0%	35.8%	28.8%	23.1%	36.4%	30.0%	24.0%	37.1%	30.8%	23.3%	37.4%	30.7%	24.2%	39.6%	32.4%	24.3%	38.5%	31.8%	22.5%	38.7%	31.1%	22.0%	37.4%	30.2%
Education level	low	30.9%	37.6%	34.4%	26.2%	31.2%	28.8%	27.2%	33.9%	30.7%	26.0%	31.5%	28.9%	24.4%	30.2%	27.5%	24.4%	27.5%	26.1%	22.2%	27.9%	25.3%	21.9%	26.0%	24.1%
	middle	47.4%	46.8%	47.1%	50.3%	52.1%	51.2%	47.2%	48.4%	47.8%	46.6%	49.3%	48.0%	46.5%	50.3%	48.5%	45.3%	51.8%	48.8%	45.6%	50.3%	48.1%	46.6%	52.4%	49.7%
	high	21.7%	15.5%	18.4%	23.5%	16.6%	19.9%	25.6%	17.7%	21.5%	27.4%	19.2%	23.1%	29.1%	19.4%	24.0%	30.3%	20.7%	25.2%	32.1%	21.8%	26.7%	31.5%	21.6%	26.2%
Socioeconomic status	highest	7.2%	2.0%	4.5%	7.7%	1.7%	4.6%	9.0%	2.3%	5.5%	7.7%	2.2%	4.8%	8.0%	2.2%	4.9%	7.2%	2.5%	4.7%	7.9%	2.5%	5.0%	6.6%	2.4%	4.4%
	middle-high	30.4%	24.8%	27.4%	27.5%	24.4%	25.9%	27.4%	24.4%	25.8%	27.7%	24.6%	26.1%	29.2%	24.6%	26.7%	30.5%	24.7%	27.4%	29.1%	24.5%	26.6%	29.0%	23.9%	26.3%
	middle	41.0%	44.6%	42.9%	44.9%	48.8%	46.9%	45.0%	46.0%	45.5%	44.0%	45.7%	44.9%	43.5%	47.0%	45.4%	43.4%	46.2%	44.9%	42.9%	46.0%	44.5%	43.3%	45.1%	44.3%
	middle-low	15.5%	19.2%	17.4%	14.6%	16.5%	15.6%	13.2%	19.9%	16.7%	15.0%	20.4%	17.8%	14.5%	19.5%	17.1%	13.7%	19.9%	17.0%	15.6%	20.4%	18.1%	15.4%	20.9%	18.3%
	lowest	5.9%	9.5%	7.7%	5.4%	8.5%	7.0%	5.4%	7.4%	6.4%	5.6%	7.1%	6.4%	4.9%	6.8%	5.9%	5.2%	6.7%	6.0%	4.5%	6.7%	5.7%	5.7%	7.7%	6.7%
Obese	no	87.0%	84.7%	85.8%	87.4%	83.7%	85.5%	86.9%	84.2%	85.5%	86.5%	83.9%	85.1%	84.7%	83.2%	83.9%	83.5%	82.4%	82.9%	83.0%	80.9%	81.9%	83.2%	79.8%	81.4%
	yes	13.0%	15.3%	14.2%	12.6%	16.3%	14.5%	13.1%	15.8%	14.5%	13.5%	16.1%	14.9%	15.3%	16.8%	16.1%	16.5%	17.6%	17.1%	17.0%	19.1%	18.1%	16.8%	20.2%	18.6%
Over-weight	no	48.3%	58.1%	53.5%	45.0%	57.5%	51.5%	44.0%	54.3%	49.3%	43.6%	54.4%	49.3%	41.5%	52.7%	47.4%	39.7%	50.7%	45.5%	39.1%	50.4%	45.1%	38.8%	49.2%	44.4%
	yes	51.7%	41.9%	46.5%	55.0%	42.5%	48.5%	56.0%	45.7%	50.7%	56.4%	45.6%	50.7%	58.5%	47.3%	52.6%	60.3%	49.3%	54.5%	60.9%	49.6%	54.9%	61.2%	50.8%	55.6%

Table 6 (continued): Sample characteristics, England

		1999			2000			2001			2002			2003			2004			2005		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		2,568	2,915	5,483	2,562	2,853	5,415	4,969	5,754	10,723	3,439	4,127	7,566	4,678	5,480	10,158	3,597	4,316	7,913	2,291	2,694	4,985
Age groups	15-19	7.3%	7.7%	7.5%	7.3%	5.6%	6.4%	6.5%	6.1%	6.3%	21.3%	18.6%	19.8%	6.5%	6.4%	6.4%	7.5%	6.6%	7.0%	7.3%	5.8%	6.5%
	20-24	7.4%	6.9%	7.1%	7.3%	6.2%	6.7%	7.8%	7.4%	7.6%	21.4%	20.1%	20.7%	7.5%	7.1%	7.2%	8.4%	7.9%	8.2%	7.6%	7.3%	7.4%
	25-29	9.7%	8.7%	9.2%	9.4%	10.2%	9.8%	8.9%	9.3%	9.1%	5.8%	7.1%	6.6%	8.2%	8.1%	8.1%	9.6%	10.6%	10.2%	7.5%	8.7%	8.1%
	30-34	11.8%	12.7%	12.3%	13.0%	12.7%	12.8%	11.5%	10.9%	11.2%	7.0%	8.5%	7.9%	11.0%	10.7%	10.8%	13.3%	11.6%	12.4%	11.5%	9.8%	10.6%
	35-39	13.0%	13.1%	13.1%	12.8%	14.0%	13.4%	12.7%	13.5%	13.1%	8.8%	10.9%	10.0%	11.9%	13.0%	12.5%	12.8%	13.1%	13.0%	11.0%	11.2%	11.1%
	40-44	10.6%	11.8%	11.2%	11.8%	12.4%	12.1%	11.4%	11.9%	11.7%	9.0%	8.2%	8.6%	12.3%	12.7%	12.5%	12.6%	13.4%	13.0%	10.2%	13.0%	11.7%
	45-49	11.0%	10.3%	10.6%	9.1%	10.5%	9.8%	10.4%	10.6%	10.5%	6.7%	6.8%	6.8%	10.3%	10.3%	10.3%	9.8%	10.6%	10.2%	11.6%	12.3%	12.0%
	50-54	11.2%	13.0%	12.1%	11.0%	11.2%	11.1%	11.8%	12.0%	11.9%	7.0%	7.2%	7.1%	10.9%	10.1%	10.5%	9.5%	9.2%	9.4%	11.4%	10.4%	10.9%
	55-59	9.8%	7.6%	8.6%	9.9%	9.4%	9.6%	10.4%	10.0%	10.2%	6.9%	7.1%	7.0%	12.0%	12.3%	12.1%	8.2%	8.4%	8.3%	11.6%	11.5%	11.6%
	60-64	8.3%	8.2%	8.3%	8.4%	8.0%	8.1%	8.7%	8.1%	8.4%	6.0%	5.3%	5.6%	9.4%	9.4%	9.4%	8.3%	8.5%	8.4%	10.3%	10.0%	10.2%
Ethnicity	White	94.0%	94.7%	94.4%	93.6%	93.7%	93.6%	94.5%	94.4%	94.5%	92.5%	92.7%	92.6%	93.2%	93.4%	93.3%	56.0%	58.4%	57.3%	93.6%	93.8%	93.7%
	Black	1.6%	1.7%	1.6%	1.4%	1.9%	1.6%	1.3%	1.9%	1.7%	2.0%	2.4%	2.2%	2.0%	2.2%	2.1%	13.1%	14.3%	13.8%	1.1%	1.8%	1.5%
	Asian	4.4%	3.6%	4.0%	5.0%	4.4%	4.7%	4.1%	3.7%	3.9%	5.5%	4.9%	5.2%	4.8%	4.4%	4.6%	30.9%	27.2%	28.9%	5.3%	4.5%	4.8%
Marital status	single	24.1%	19.5%	21.6%	25.6%	17.9%	21.5%	24.6%	19.1%	21.6%	46.2%	37.5%	41.5%	24.9%	20.6%	22.6%	28.1%	23.4%	25.6%	25.5%	19.3%	22.1%
	married	69.1%	68.0%	68.5%	67.5%	69.4%	68.5%	67.8%	68.1%	68.0%	48.4%	53.9%	51.4%	67.5%	66.3%	66.8%	65.2%	63.5%	64.3%	67.7%	68.8%	68.3%
	div/sep/wi	6.8%	12.6%	9.9%	6.9%	12.8%	10.0%	7.6%	12.8%	10.4%	5.3%	8.6%	7.1%	7.6%	13.1%	10.6%	6.7%	13.0%	10.1%	6.8%	11.9%	9.6%
Occupation status	working	76.8%	61.7%	68.8%	75.0%	64.1%	69.3%	77.2%	64.2%	70.3%	71.3%	56.7%	63.3%	77.7%	65.7%	71.2%	72.7%	56.5%	63.9%	77.0%	64.3%	70.1%
	not working	23.2%	38.3%	31.2%	25.0%	35.9%	30.7%	22.8%	35.8%	29.7%	28.7%	43.3%	36.7%	22.3%	34.3%	28.8%	27.3%	43.5%	36.1%	23.0%	35.7%	29.9%
Education level	low	21.0%	24.8%	23.0%	19.6%	21.3%	20.5%	17.8%	21.6%	19.9%	13.9%	15.2%	14.6%	17.8%	19.0%	18.5%	22.3%	24.7%	23.6%	17.2%	19.9%	18.7%
	middle	45.2%	53.2%	49.5%	46.2%	53.5%	50.0%	47.9%	53.5%	50.9%	56.5%	61.4%	59.1%	47.4%	53.6%	50.7%	41.0%	44.9%	43.1%	45.7%	50.2%	48.1%
	high	33.8%	22.0%	27.5%	34.2%	25.2%	29.4%	34.2%	24.9%	29.2%	29.6%	23.5%	26.3%	34.8%	27.4%	30.8%	36.7%	30.5%	33.3%	37.1%	29.9%	33.2%
Socioeconomic status	highest	8.8%	2.2%	5.3%	7.5%	2.0%	4.6%	7.3%	2.7%	4.8%	6.5%	3.3%	4.7%	7.6%	3.2%	5.2%	7.2%	3.8%	5.3%	7.9%	3.2%	5.4%
	middle-high	28.3%	25.1%	26.6%	29.5%	28.2%	28.8%	30.8%	27.8%	29.2%	26.0%	25.3%	25.6%	31.1%	30.3%	30.7%	30.0%	29.8%	29.9%	33.5%	32.0%	32.7%
	middle	44.5%	47.8%	46.2%	44.1%	44.1%	44.1%	41.9%	43.4%	42.7%	43.9%	46.0%	45.1%	42.3%	41.4%	41.8%	40.9%	39.7%	40.2%	40.5%	41.6%	41.1%
	middle-low	14.3%	19.0%	16.8%	14.5%	19.2%	17.0%	15.4%	20.6%	18.2%	19.2%	21.0%	20.2%	14.7%	20.1%	17.6%	17.8%	22.2%	20.2%	13.5%	18.3%	16.1%
	lowest	4.1%	5.9%	5.1%	4.4%	6.6%	5.5%	4.5%	5.5%	5.1%	4.5%	4.4%	4.5%	4.3%	5.0%	4.7%	4.2%	4.5%	4.3%	4.6%	4.9%	4.8%
Obese	no	81.9%	80.0%	80.8%	79.2%	80.3%	79.8%	79.1%	76.9%	77.9%	82.2%	80.8%	81.4%	77.9%	77.6%	77.7%	80.5%	76.2%	78.2%	76.8%	76.2%	76.5%
	yes	18.1%	20.0%	19.2%	20.8%	19.7%	20.2%	20.9%	23.1%	22.1%	17.8%	19.2%	18.6%	22.1%	22.4%	22.3%	19.5%	23.8%	21.8%	23.2%	23.8%	23.5%
Over-weight	no	38.9%	48.6%	44.1%	35.8%	48.7%	42.6%	33.6%	45.8%	40.1%	46.8%	52.1%	49.7%	34.4%	45.9%	40.6%	38.9%	43.6%	41.5%	34.3%	45.0%	40.1%
	yes	61.1%	51.4%	55.9%	64.2%	51.3%	0.0%	66.4%	54.2%	59.9%	53.2%	47.9%	50.3%	65.6%	54.1%	59.4%	61.1%	56.4%	58.5%	65.7%	55.0%	59.9%

Table 6: Sample characteristics, France

		1990			1991			1992			1993			1994			1995		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		2,922	2,818	5,740	2,746	2,738	5,484	2,883	2,888	5,771	3,583	3,493	7,076	2,595	2,514	5,109	2,513	2,439	4,952
Age groups	15-19	10.3%	9.7%	10.0%	9.4%	10.0%	9.7%	9.0%	8.4%	8.7%	9.2%	8.2%	8.7%	9.4%	8.8%	9.1%	7.8%	7.3%	7.5%
	20-24	14.6%	12.0%	13.4%	12.1%	11.2%	11.6%	13.3%	12.7%	13.0%	12.7%	11.4%	12.0%	14.7%	12.2%	13.5%	11.2%	11.1%	11.1%
	25-29	9.3%	9.5%	9.4%	12.9%	12.4%	12.7%	9.7%	8.4%	9.0%	12.1%	11.5%	11.8%	9.7%	9.2%	9.4%	12.3%	12.8%	12.6%
	30-34	11.2%	12.2%	11.7%	9.7%	9.6%	9.6%	10.9%	11.4%	11.1%	9.0%	10.1%	9.6%	10.4%	10.7%	10.5%	10.0%	10.0%	10.0%
	35-39	10.5%	10.6%	10.6%	13.3%	13.1%	13.2%	9.7%	10.2%	9.9%	12.6%	12.0%	12.3%	9.6%	10.1%	9.9%	13.2%	12.6%	12.9%
	40-44	12.3%	13.9%	13.1%	11.2%	11.3%	11.3%	13.4%	14.0%	13.7%	9.9%	11.0%	10.4%	12.8%	14.9%	13.8%	10.6%	11.1%	10.8%
	45-49	8.4%	8.4%	8.4%	10.3%	10.6%	10.5%	9.6%	10.1%	9.9%	11.5%	12.5%	12.0%	11.2%	12.1%	11.6%	13.3%	13.5%	13.4%
	50-54	8.8%	8.8%	8.8%	7.2%	7.2%	7.2%	9.9%	9.4%	9.7%	8.1%	8.0%	8.1%	8.7%	7.8%	8.3%	7.3%	7.7%	7.5%
	55-59	7.2%	7.8%	7.5%	8.3%	9.0%	8.7%	6.7%	7.8%	7.3%	8.7%	8.0%	8.4%	6.0%	6.6%	6.3%	8.2%	8.3%	8.3%
	60-64	7.4%	6.9%	7.2%	5.6%	5.7%	5.6%	7.8%	7.5%	7.6%	6.3%	7.2%	6.8%	7.6%	7.6%	7.6%	6.2%	5.6%	5.9%
Marital status	single	31.2%	24.8%	28.1%	30.2%	25.6%	27.9%	29.8%	24.5%	27.2%	30.3%	24.2%	27.3%	31.1%	24.9%	28.0%	28.8%	24.5%	26.7%
	married	66.7%	68.7%	67.6%	67.2%	67.3%	67.3%	68.5%	69.4%	68.9%	67.5%	69.6%	68.5%	65.4%	67.3%	66.3%	67.9%	68.9%	68.4%
	div/sep/wid	2.1%	6.5%	4.3%	2.5%	7.1%	4.8%	1.7%	6.1%	3.9%	2.2%	6.2%	4.2%	3.5%	7.9%	5.6%	3.3%	6.6%	4.9%
Occupation status	working	69.8%	52.7%	61.4%	71.5%	54.9%	63.2%	69.9%	54.3%	62.1%	67.5%	55.0%	61.3%	66.4%	52.9%	59.7%	71.3%	56.0%	63.8%
	not working	30.2%	47.3%	38.6%	28.5%	45.1%	36.8%	30.1%	45.7%	37.9%	32.5%	45.0%	38.7%	33.6%	47.1%	40.3%	28.7%	44.0%	36.2%
Education level	low	66.3%	63.0%	64.7%	63.9%	61.0%	62.5%	64.0%	61.5%	62.7%	60.3%	56.9%	58.6%	58.2%	54.5%	56.4%	59.2%	55.2%	57.2%
	middle	17.2%	22.5%	19.8%	16.9%	21.8%	19.3%	18.5%	21.3%	19.9%	19.3%	22.6%	21.0%	21.0%	25.2%	23.1%	19.0%	22.3%	20.6%
	high	16.5%	14.5%	15.5%	19.3%	17.2%	18.2%	17.6%	17.2%	17.4%	20.3%	20.5%	20.4%	20.8%	20.3%	20.6%	21.8%	22.5%	22.2%
Socioeconomic status	farmers	1.5%	0.8%	1.2%	1.5%	1.2%	1.3%	1.4%	1.0%	1.2%	0.9%	0.5%	0.7%	0.8%	0.6%	0.7%	1.4%	0.9%	1.2%
	self-employed	4.9%	2.9%	3.9%	5.8%	4.1%	4.9%	5.3%	3.3%	4.3%	5.6%	2.7%	4.2%	5.7%	3.8%	4.8%	7.5%	5.0%	6.3%
	professionals, managers	11.2%	7.2%	9.3%	11.9%	6.6%	9.3%	9.9%	5.7%	7.8%	9.3%	5.1%	7.2%	16.4%	9.7%	13.1%	16.2%	8.9%	12.6%
	skilled white collar	20.8%	16.5%	18.7%	25.4%	20.7%	23.0%	24.7%	21.6%	23.1%	25.3%	22.1%	23.7%	24.5%	20.1%	22.4%	22.6%	20.9%	21.7%
	clerks	13.9%	46.5%	29.9%	11.0%	44.9%	27.9%	12.0%	44.4%	28.2%	13.8%	47.0%	30.2%	11.5%	44.8%	27.9%	10.8%	44.1%	27.2%
	unskilled workers	47.6%	26.0%	37.0%	44.4%	22.5%	33.5%	46.8%	24.0%	35.3%	45.1%	22.6%	34.0%	41.0%	21.0%	31.2%	41.5%	20.3%	31.1%
Obese	no	94.8%	94.3%	94.5%	94.2%	94.8%	94.5%	94.3%	93.7%	94.0%	94.3%	94.4%	94.3%	93.3%	94.2%	93.8%	93.3%	93.8%	93.6%
	yes	5.2%	5.7%	5.5%	5.8%	5.2%	5.5%	5.7%	6.3%	6.0%	5.7%	5.6%	5.7%	6.7%	5.8%	6.2%	6.7%	6.2%	6.4%
Over-weight	no	66.4%	77.0%	71.6%	64.4%	77.7%	71.1%	64.9%	76.8%	70.9%	63.9%	77.3%	70.5%	64.2%	77.2%	70.6%	59.5%	75.4%	67.4%
	yes	33.6%	23.0%	28.4%	35.6%	22.3%	28.9%	35.1%	23.2%	29.1%	36.1%	22.7%	29.5%	35.8%	22.8%	29.4%	40.5%	24.6%	32.6%

Table 6 (continued): Sample characteristics, France

		1996			1997			1998			2000			2002			2004		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		2,030	2,385	4,415	2,710	2,707	5,417	2,710	2,707	5,417	4,548	4,517	9,065	4,313	4,288	8,601	5,079	5,193	10,272
Age groups	15-19	6.4%	7.0%	6.7%	9.7%	9.2%	9.5%	9.7%	9.2%	9.5%	9.3%	8.7%	9.0%	8.2%	7.9%	8.1%	9.5%	8.1%	8.8%
	20-24	10.0%	10.3%	10.1%	11.5%	10.8%	11.2%	11.5%	10.8%	11.2%	11.1%	10.3%	10.7%	11.9%	11.7%	11.8%	11.4%	10.8%	11.1%
	25-29	7.7%	8.2%	8.0%	11.1%	10.2%	10.7%	11.1%	10.2%	10.7%	9.8%	9.1%	9.5%	8.0%	7.0%	7.5%	7.6%	7.5%	7.5%
	30-34	10.6%	8.6%	9.5%	9.3%	9.7%	9.5%	9.3%	9.7%	9.5%	10.5%	10.7%	10.6%	12.5%	12.7%	12.6%	10.5%	10.9%	10.7%
	35-39	9.0%	10.3%	9.7%	11.9%	12.8%	12.4%	11.9%	12.8%	12.4%	11.0%	11.6%	11.3%	10.6%	10.8%	10.7%	10.8%	10.1%	10.5%
	40-44	12.0%	12.2%	12.1%	11.5%	11.5%	11.5%	11.5%	11.5%	11.5%	12.4%	13.2%	12.8%	12.2%	12.9%	12.5%	11.8%	12.5%	12.1%
	45-49	11.9%	12.7%	12.3%	13.1%	13.0%	13.1%	13.1%	13.0%	13.1%	11.5%	11.5%	11.5%	10.6%	11.3%	11.0%	10.1%	11.8%	11.0%
	50-54	13.3%	12.5%	12.8%	7.6%	8.8%	8.2%	7.6%	8.8%	8.2%	10.7%	10.8%	10.8%	12.7%	11.7%	12.2%	11.9%	11.7%	11.8%
	55-59	8.8%	8.0%	8.4%	7.7%	8.4%	8.1%	7.7%	8.4%	8.1%	7.2%	6.8%	7.0%	7.4%	7.6%	7.5%	8.8%	9.6%	9.2%
	60-64	10.3%	10.3%	10.3%	6.5%	5.6%	6.0%	6.5%	5.6%	6.0%	6.5%	7.1%	6.8%	5.8%	6.4%	6.1%	7.5%	7.1%	7.3%
Marital status	single	25.3%	23.0%	24.1%	31.8%	26.3%	29.0%	31.8%	26.3%	29.0%	30.2%	25.8%	28.0%	40.2%	34.2%	37.2%	26.0%	26.0%	26.0%
	married	72.3%	69.3%	70.7%	66.1%	67.6%	66.8%	66.1%	67.6%	66.8%	66.8%	67.6%	67.2%	55.2%	58.1%	56.6%	67.4%	67.6%	67.5%
	div/sep/wid	2.4%	7.7%	5.3%	2.1%	6.1%	4.1%	2.1%	6.1%	4.1%	3.0%	6.6%	4.8%	4.6%	7.7%	6.2%	6.6%	6.4%	6.5%
Occupation status	working	67.8%	54.0%	60.4%	67.6%	53.6%	60.6%	67.6%	53.6%	60.6%	71.3%	57.3%	64.3%	72.1%	58.6%	65.4%	69.9%	58.1%	64.0%
	not working	32.2%	46.0%	39.6%	32.4%	46.4%	39.4%	32.4%	46.4%	39.4%	28.7%	42.7%	35.7%	27.9%	41.4%	34.6%	30.1%	41.9%	36.0%
Education level	low	57.0%	53.8%	55.3%	56.4%	50.1%	53.2%	56.4%	50.1%	53.2%	52.1%	45.5%	48.8%	48.7%	43.2%	46.0%	51.1%	45.4%	48.2%
	middle	16.9%	20.8%	19.0%	17.8%	22.7%	20.3%	17.8%	22.7%	20.3%	19.1%	22.9%	21.0%	19.8%	23.5%	21.6%	19.4%	22.1%	20.8%
	high	26.1%	25.4%	25.7%	25.8%	27.3%	26.5%	25.8%	27.3%	26.5%	28.8%	31.6%	30.2%	31.5%	33.3%	32.4%	29.5%	32.5%	31.0%
Socioeconomic status	farmers	4.7%	4.7%	4.7%	3.2%	2.2%	2.7%	3.2%	2.2%	2.7%	3.6%	2.5%	3.1%	3.2%	2.4%	2.8%	3.2%	1.7%	2.5%
	self-employed	6.6%	5.1%	5.8%	7.7%	5.0%	6.3%	7.7%	5.0%	6.3%	6.5%	4.1%	5.3%	6.6%	3.4%	5.0%	7.2%	4.0%	5.6%
	professionals, managers	17.1%	8.3%	12.3%	13.9%	8.3%	11.1%	13.9%	8.3%	11.1%	19.5%	11.2%	15.4%	17.9%	10.0%	14.0%	18.1%	10.7%	14.4%
	skilled white collar	24.1%	21.6%	22.7%	23.3%	21.9%	22.6%	23.3%	21.9%	22.6%	20.4%	22.7%	21.5%	22.3%	23.0%	22.7%	19.8%	22.3%	21.0%
	clerks	10.0%	43.1%	27.9%	10.2%	41.2%	25.7%	10.2%	41.2%	25.7%	10.5%	41.8%	26.1%	10.3%	41.7%	26.0%	10.0%	43.5%	26.9%
	unskilled workers	37.4%	17.3%	26.5%	41.7%	21.5%	31.6%	41.7%	21.5%	31.6%	39.5%	17.6%	28.6%	39.7%	19.5%	29.6%	41.7%	17.8%	29.6%
Obese	no	91.1%	90.7%	90.9%	93.4%	93.0%	93.2%	93.4%	93.0%	93.2%	92.2%	91.9%	92.0%	91.8%	92.2%	92.0%	90.7%	90.7%	90.7%
	yes	8.9%	9.3%	9.1%	6.6%	7.0%	6.8%	6.6%	7.0%	6.8%	7.8%	8.1%	8.0%	8.2%	7.8%	8.0%	9.3%	9.3%	9.3%
Over-weight	no	57.4%	71.7%	65.1%	62.1%	75.1%	68.6%	62.1%	75.1%	68.6%	59.0%	73.8%	66.4%	58.7%	72.4%	65.6%	57.8%	72.2%	65.1%
	yes	42.6%	28.3%	34.9%	37.9%	24.9%	31.4%	37.9%	24.9%	31.4%	41.0%	26.2%	33.6%	41.3%	27.6%	34.4%	42.2%	27.8%	34.9%

Table 7: Sample characteristics, Italy

		1994/95			2000			2005		
		Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		19,010	18,513	37,523	44,642	43,056	87,698	37,801	37,290	75,091
Age groups	15-19	8.5%	7.9%	8.2%	7.0%	6.8%	6.9%	3.3%	3.0%	3.2%
	20-24	11.2%	11.5%	11.3%	9.9%	9.5%	9.7%	8.7%	8.6%	8.6%
	25-29	10.8%	11.8%	11.3%	10.5%	10.8%	10.6%	9.8%	10.0%	9.9%
	30-34	11.1%	11.9%	11.5%	11.1%	11.8%	11.5%	11.6%	11.8%	11.7%
	35-39	10.6%	11.3%	10.9%	11.8%	12.3%	12.1%	12.4%	12.8%	12.6%
	40-44	10.8%	10.8%	10.8%	10.7%	11.2%	11.0%	12.4%	13.0%	12.7%
	45-49	10.5%	10.5%	10.5%	10.5%	10.5%	10.5%	11.5%	11.7%	11.6%
	50-54	9.3%	9.4%	9.4%	10.5%	10.7%	10.6%	10.5%	10.7%	10.6%
	55-59	9.1%	8.6%	8.9%	9.0%	8.8%	8.9%	10.8%	10.9%	10.8%
	60-64	8.2%	6.3%	7.3%	9.1%	7.5%	8.3%	9.0%	7.5%	8.2%
Marital status	single	35.2%	28.3%	31.8%	37.0%	29.1%	33.1%	36.0%	28.3%	32.2%
	married	61.5%	65.4%	63.4%	58.5%	63.6%	61.0%	57.6%	62.3%	59.9%
	div/sep/wid	3.4%	6.3%	4.8%	4.5%	7.3%	5.9%	6.4%	9.5%	7.9%
Occupation status	working	69.8%	41.0%	55.6%	70.0%	43.3%	56.9%	76.4%	51.5%	64.0%
	not working	30.2%	59.0%	44.4%	30.0%	56.7%	43.1%	23.6%	48.5%	36.0%
Education level	low	31.8%	35.6%	33.6%	56.4%	54.9%	55.7%	51.0%	48.0%	49.5%
	middle	61.7%	58.8%	60.3%	36.2%	37.3%	36.7%	38.7%	40.0%	39.4%
	high	6.5%	5.6%	6.1%	7.4%	7.9%	7.6%	10.3%	12.0%	11.2%
Socioeconomic status	highest	11.1%	6.9%	9.0%	10.1%	6.1%	8.1%	9.7%	5.1%	7.4%
	middle-high	13.9%	12.0%	13.0%	19.8%	16.2%	18.0%	17.7%	12.1%	14.9%
	middle	19.8%	28.4%	24.0%	22.3%	31.0%	26.6%	23.0%	35.4%	29.2%
	middle-low	14.0%	13.3%	13.6%	3.4%	3.1%	3.2%	6.8%	5.9%	6.4%
	lowest	41.1%	39.5%	40.3%	44.4%	43.7%	44.1%	42.8%	41.5%	42.1%
Obese	no	93.0%	94.4%	93.7%	91.0%	93.1%	92.0%	90.2%	92.6%	91.4%
	yes	7.0%	5.6%	6.3%	9.0%	6.9%	8.0%	9.8%	7.4%	8.6%
Over-weight	no	55.1%	74.5%	64.7%	51.7%	72.2%	61.8%	49.4%	71.3%	60.2%
	yes	44.9%	25.5%	35.3%	48.3%	27.8%	38.2%	50.6%	28.7%	39.8%

Table 8: Sample characteristics, Korea

		1998			2001			2001		
		Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		3,523	4,100	7,623	2,552	3,153	5,705	2,064	2,685	4,749
Age groups	15-19	9.1%	8.8%	8.9%	7.2%	6.2%	6.7%	6.3%	4.0%	5.0%
	20-24	7.4%	8.4%	7.9%	7.4%	8.0%	7.7%	5.5%	6.7%	6.2%
	25-29	11.3%	11.9%	11.6%	10.0%	10.9%	10.5%	7.3%	8.1%	7.7%
	30-34	12.9%	12.7%	12.8%	13.1%	13.7%	13.5%	12.0%	13.5%	12.8%
	35-39	13.3%	12.7%	13.0%	13.9%	14.3%	14.1%	11.8%	13.3%	12.6%
	40-44	12.7%	11.8%	12.2%	14.0%	14.2%	14.1%	13.5%	14.6%	14.1%
	45-49	9.3%	9.0%	9.1%	11.4%	10.1%	10.6%	15.0%	12.7%	13.7%
	50-54	8.3%	7.9%	8.1%	7.3%	8.1%	7.7%	9.2%	10.0%	9.6%
	55-59	8.0%	8.8%	8.4%	8.6%	7.1%	7.8%	10.4%	8.7%	9.4%
	60-64	7.6%	7.9%	7.8%	7.0%	7.4%	7.2%	9.0%	8.4%	8.7%
Marital status	single	27.1%	20.4%	23.5%	25.5%	18.3%	21.6%	23.0%	17.0%	19.6%
	married	70.7%	71.0%	70.8%	71.8%	73.0%	72.5%	72.4%	72.7%	72.6%
	div/sep/wid	2.2%	8.6%	5.7%	2.6%	8.7%	6.0%	4.7%	10.2%	7.8%
Occupation status	working	73.0%	31.3%	50.6%	76.4%	34.2%	53.1%	77.6%	40.2%	56.5%
	not working	27.0%	68.7%	49.4%	23.6%	65.8%	46.9%	22.4%	59.8%	43.5%
Education level	low	27.4%	41.2%	34.8%	21.2%	31.5%	26.9%	20.1%	30.8%	26.1%
	middle	44.4%	40.1%	42.1%	40.8%	43.1%	42.1%	38.1%	39.4%	38.8%
	high	28.2%	18.8%	23.1%	38.0%	25.4%	31.0%	41.8%	29.9%	35.1%
Equivalised income quintiles	lowest	15.8%	15.6%	15.7%	15.7%	15.2%	15.4%	14.7%	15.4%	15.1%
	middle-low	21.8%	19.7%	20.7%	21.1%	19.1%	20.0%	21.1%	19.0%	19.9%
	middle	21.5%	19.9%	20.6%	23.0%	20.3%	21.5%	21.1%	19.9%	20.4%
	middle-high	21.8%	21.1%	21.4%	19.0%	18.9%	18.9%	21.1%	19.7%	20.3%
	highest	19.0%	23.8%	21.6%	21.2%	26.5%	24.2%	21.9%	26.0%	24.3%
Obese	no	98.2%	97.1%	97.6%	97.1%	96.7%	96.9%	96.5%	96.4%	96.4%
	yes	1.8%	2.9%	2.4%	2.9%	3.3%	3.1%	3.5%	3.6%	3.6%
Over-weight	no	74.5%	74.2%	74.4%	67.6%	73.4%	70.8%	63.5%	72.3%	68.4%
	yes	25.5%	25.8%	25.6%	32.4%	26.6%	29.2%	36.5%	27.7%	31.6%

Table 9: Sample characteristics, Spain

		1987			1993			1995			1997			2001			2003		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		10,303	8,879	19,182	7,309	6,620	13,929	2,374	2,129	4,503	2,362	2,124	4,486	7,192	7,058	14,250	7,393	7,772	15,165
Age groups	15-19	11.6%	12.7%	12.2%	11.6%	10.7%	11.1%	11.1%	10.2%	10.7%	10.4%	9.9%	10.2%	8.6%	7.9%	8.3%	5.8%	5.2%	5.5%
	20-24	13.6%	15.1%	14.3%	12.3%	13.6%	12.9%	12.8%	15.2%	13.9%	14.0%	13.0%	13.5%	11.0%	11.2%	11.1%	8.0%	7.7%	7.9%
	25-29	12.6%	13.5%	13.0%	12.6%	12.7%	12.7%	13.1%	12.1%	12.7%	12.4%	11.1%	11.8%	13.3%	11.7%	12.5%	9.1%	9.8%	9.4%
	30-34	10.0%	10.2%	10.1%	11.2%	12.2%	11.7%	11.0%	13.5%	12.1%	12.1%	14.2%	13.1%	12.0%	13.5%	12.8%	11.5%	11.5%	11.5%
	35-39	9.7%	9.7%	9.7%	10.1%	10.5%	10.3%	9.7%	10.1%	9.9%	10.7%	11.4%	11.0%	12.4%	11.8%	12.1%	14.2%	13.8%	14.0%
	40-44	8.8%	8.7%	8.7%	9.1%	9.1%	9.1%	9.9%	10.0%	9.9%	9.7%	9.6%	9.7%	10.6%	11.7%	11.2%	15.1%	12.9%	13.9%
	45-49	8.3%	8.1%	8.2%	9.2%	9.3%	9.2%	8.6%	8.2%	8.4%	7.7%	8.9%	8.3%	8.8%	9.0%	8.9%	11.3%	10.7%	11.0%
	50-54	10.6%	9.2%	10.0%	8.0%	7.8%	7.9%	7.7%	7.8%	7.8%	7.7%	7.2%	7.4%	9.4%	9.2%	9.3%	8.9%	9.2%	9.0%
	55-59	7.5%	6.9%	7.2%	7.4%	7.4%	7.4%	7.0%	6.4%	6.7%	6.1%	7.3%	6.7%	6.8%	7.2%	7.0%	8.0%	9.9%	9.0%
	60-64	7.3%	5.9%	6.6%	8.5%	6.8%	7.7%	9.1%	6.5%	7.8%	9.2%	7.3%	8.3%	7.0%	6.7%	6.9%	7.9%	9.6%	8.8%
Marital status	single	38.9%	33.5%	36.4%	40.2%	31.0%	35.8%	40.6%	33.1%	37.1%	43.6%	32.6%	38.4%	53.7%	60.2%	56.9%	38.4%	30.0%	34.1%
	married	59.3%	63.0%	61.0%	57.3%	64.4%	60.7%	57.5%	62.2%	59.7%	54.3%	60.8%	57.4%	42.5%	32.3%	37.4%	57.9%	59.7%	58.8%
	div/sep/wid	1.8%	3.5%	2.6%	2.4%	4.6%	3.5%	1.9%	4.7%	3.2%	2.1%	6.6%	4.2%	3.8%	7.5%	5.7%	3.8%	10.3%	7.1%
Occupation status	working	70.6%	27.9%	50.9%	67.3%	32.2%	50.6%	62.8%	30.0%	47.3%	61.9%	33.7%	48.5%	72.5%	41.3%	57.1%	76.2%	49.4%	62.5%
	not working	29.4%	72.1%	49.1%	32.7%	67.8%	49.4%	37.2%	70.0%	52.7%	38.1%	66.3%	51.5%	27.5%	58.7%	42.9%	23.8%	50.6%	37.5%
Education level	low	65.8%	69.9%	67.7%	54.8%	60.4%	57.5%	51.7%	54.8%	53.2%	52.8%	55.9%	54.3%	50.5%	53.7%	52.1%	55.7%	54.9%	55.3%
	middle	21.0%	18.5%	19.9%	24.3%	21.3%	22.9%	26.5%	24.9%	25.8%	31.9%	27.4%	29.8%	32.7%	30.1%	31.4%	28.4%	25.7%	27.0%
	high	13.2%	11.5%	12.4%	20.8%	18.3%	19.6%	21.7%	20.3%	21.1%	15.3%	16.7%	15.9%	16.8%	16.3%	16.5%	15.9%	19.5%	17.7%
Socioeconomic status	highest	3.2%	3.1%	3.2%	9.2%	9.5%	9.3%	10.7%	9.8%	10.3%	10.3%	11.3%	10.8%	10.7%	9.5%	10.1%	9.3%	12.0%	10.7%
	middle-high	29.4%	29.7%	29.5%	24.4%	23.3%	23.8%	24.1%	22.4%	23.3%	22.6%	22.2%	22.4%	13.8%	12.1%	13.0%	19.8%	18.2%	18.9%
	middle	16.1%	18.1%	17.0%	13.6%	16.0%	14.7%	10.8%	15.5%	13.0%	12.9%	13.7%	13.3%	23.3%	43.3%	33.2%	14.9%	30.0%	22.6%
	middle-low	24.8%	22.9%	23.9%	33.5%	29.0%	31.3%	35.8%	29.6%	32.9%	36.7%	30.9%	34.0%	37.9%	23.4%	30.7%	44.6%	22.0%	33.0%
	lowest	26.5%	26.3%	26.4%	19.4%	22.3%	20.8%	18.5%	22.7%	20.5%	17.4%	21.9%	19.5%	14.3%	11.7%	13.0%	11.4%	17.9%	14.8%
Obese	no	92.2%	91.4%	91.8%	92.2%	92.5%	92.3%	90.6%	90.8%	90.7%	89.5%	90.3%	89.9%	89.4%	89.6%	89.5%	87.6%	88.7%	88.2%
	yes	7.8%	8.6%	8.2%	7.8%	7.5%	7.7%	9.4%	9.2%	9.3%	10.5%	9.7%	10.1%	10.6%	10.4%	10.5%	12.4%	11.3%	11.8%
Over-weight	no	55.3%	68.7%	61.5%	50.0%	68.6%	58.9%	49.8%	66.2%	57.6%	49.4%	66.2%	57.3%	46.2%	64.9%	55.5%	43.9%	63.0%	53.7%
	yes	44.7%	31.3%	38.5%	50.0%	31.4%	41.1%	50.2%	33.8%	42.4%	50.6%	33.8%	42.7%	53.8%	35.1%	44.5%	56.1%	37.0%	46.3%

Table 10: Sample characteristics (weighted percentages), US - NHIS

		1997			1998			1999			2000			2001			2002			2003			2004			2005		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency		12,109	14,785	26,894	10,980	12,980	23,960	10,152	12,507	22,659	10,755	12,949	23,704	11,181	13,260	24,441	10,270	12,077	22,347	10,140	12,035	22,175	10,354	11,901	22,255	10,431	12,308	22,739
Age groups	15-19	3.2%	3.1%	3.2%	3.2%	2.9%	3.0%	3.2%	2.9%	3.1%	3.1%	3.2%	3.2%	3.4%	3.5%	3.4%	3.1%	3.6%	3.3%	3.5%	3.4%	3.5%	3.0%	3.3%	3.1%	2.6%	2.8%	2.7%
	20-24	9.7%	10.3%	10.0%	10.4%	9.2%	9.8%	10.8%	10.0%	10.4%	10.6%	10.2%	10.4%	10.4%	10.2%	10.3%	10.5%	10.6%	10.5%	10.3%	10.1%	10.2%	10.2%	10.6%	10.4%	10.2%	10.1%	10.1%
	25-29	12.1%	12.4%	12.3%	11.8%	11.9%	11.8%	11.4%	11.8%	11.6%	10.9%	11.5%	11.2%	10.9%	11.0%	10.9%	10.3%	10.5%	10.4%	10.7%	10.5%	10.6%	10.7%	10.6%	10.7%	11.1%	10.9%	11.0%
	30-34	13.5%	13.5%	13.5%	12.7%	13.0%	12.9%	11.8%	12.9%	12.4%	12.2%	12.2%	12.2%	12.1%	11.8%	11.9%	12.0%	12.3%	12.2%	11.8%	12.1%	12.0%	11.4%	11.1%	11.3%	11.2%	11.1%	11.2%
	35-39	14.2%	14.5%	14.3%	14.0%	13.7%	13.9%	13.9%	13.8%	13.8%	13.3%	13.7%	13.5%	12.6%	13.0%	12.8%	12.8%	12.9%	12.8%	12.1%	12.0%	12.0%	12.0%	11.9%	12.0%	11.6%	11.4%	11.5%
	40-44	13.0%	12.5%	12.8%	13.3%	12.9%	13.1%	13.1%	12.9%	13.0%	13.4%	12.8%	13.1%	13.5%	12.9%	13.2%	13.2%	12.4%	12.8%	13.2%	12.3%	12.7%	12.8%	12.1%	12.4%	12.1%	12.1%	12.1%
	45-49	11.1%	11.1%	11.1%	11.8%	11.7%	11.7%	11.7%	10.8%	11.2%	11.9%	11.4%	11.6%	11.7%	12.0%	11.9%	11.8%	11.5%	11.6%	11.8%	11.9%	11.8%	12.0%	11.6%	11.8%	12.3%	11.8%	12.1%
	50-54	9.1%	8.9%	9.0%	9.2%	9.8%	9.5%	9.8%	9.5%	9.6%	10.1%	10.0%	10.0%	10.7%	10.3%	10.5%	10.6%	10.0%	10.3%	10.5%	10.9%	10.7%	11.1%	11.2%	11.2%	10.8%	11.1%	11.0%
	55-59	7.2%	7.2%	7.2%	7.3%	7.9%	7.6%	7.7%	8.4%	8.1%	8.0%	8.1%	8.0%	8.2%	8.3%	8.3%	8.7%	9.1%	8.9%	9.1%	9.4%	9.3%	9.0%	9.4%	9.2%	10.0%	10.0%	10.0%
	60-64	6.7%	6.4%	6.5%	6.4%	7.0%	6.7%	6.7%	6.8%	6.8%	6.5%	7.0%	6.8%	6.3%	6.9%	6.7%	7.0%	7.2%	7.1%	7.1%	7.3%	7.2%	7.7%	8.1%	7.9%	8.1%	8.6%	8.4%
Ethnicity	Hispanic	8.8%	9.0%	8.9%	8.8%	9.1%	9.0%	8.8%	9.7%	9.3%	9.2%	9.7%	9.5%	9.3%	9.6%	9.5%	9.5%	9.5%	9.5%	10.8%	10.6%	10.7%	10.8%	10.8%	10.8%	11.2%	11.0%	11.1%
	Non-hispanic White	77.2%	73.6%	75.3%	77.1%	73.9%	75.4%	77.7%	73.0%	75.2%	76.5%	72.6%	74.4%	76.0%	72.9%	74.3%	75.7%	73.1%	74.3%	74.9%	71.7%	73.2%	73.7%	71.6%	72.6%	73.7%	71.3%	72.4%
	Non-hispanic Black	9.9%	13.4%	11.8%	10.0%	13.1%	11.6%	9.8%	13.6%	11.8%	10.0%	13.5%	11.9%	10.2%	13.4%	11.9%	10.2%	13.4%	11.9%	10.3%	13.2%	11.8%	10.6%	13.4%	12.1%	10.4%	13.5%	12.1%
	Other	4.1%	4.1%	4.1%	4.1%	3.9%	4.0%	3.7%	3.8%	3.7%	4.3%	4.2%	4.3%	4.5%	4.1%	4.3%	4.6%	4.0%	4.3%	4.0%	4.4%	4.2%	4.9%	4.2%	4.5%	4.7%	4.2%	4.4%
Marital status	single	27.8%	21.8%	24.6%	27.1%	21.0%	23.9%	28.7%	21.6%	24.9%	28.2%	22.0%	24.9%	28.7%	22.9%	25.6%	28.9%	23.5%	26.0%	29.1%	23.0%	25.9%	28.6%	23.3%	25.8%	29.3%	22.6%	25.7%
	married	56.7%	54.6%	55.6%	57.0%	56.6%	56.8%	54.7%	55.8%	55.3%	55.6%	55.6%	55.6%	55.3%	54.6%	54.9%	55.3%	54.1%	54.7%	54.7%	53.9%	54.3%	54.4%	53.7%	54.1%	54.4%	54.6%	54.5%
	div/sep/wid	15.5%	23.6%	19.8%	16.0%	22.4%	19.4%	16.6%	22.6%	19.8%	16.2%	22.5%	19.5%	16.0%	22.5%	19.5%	15.8%	22.4%	19.3%	16.2%	23.1%	19.9%	16.9%	22.9%	20.1%	16.3%	22.8%	19.8%
Occupation status	working	82.9%	69.5%	75.7%	83.9%	70.4%	76.7%	82.6%	71.1%	76.4%	83.3%	71.7%	77.1%	83.8%	71.9%	77.4%	81.2%	70.3%	75.4%	81.1%	68.6%	74.4%	81.2%	69.2%	74.9%	81.7%	70.0%	75.5%
	not working	17.1%	30.5%	24.3%	16.1%	29.6%	23.3%	17.4%	28.9%	23.6%	16.7%	28.3%	22.9%	16.2%	28.1%	22.6%	18.8%	29.7%	24.6%	18.9%	31.4%	25.6%	18.8%	30.8%	25.1%	18.3%	30.0%	24.5%
Education level	low	17.6%	17.6%	17.6%	16.5%	15.8%	16.1%	16.5%	15.3%	15.9%	16.5%	16.1%	16.3%	15.9%	15.1%	15.5%	15.5%	15.2%	15.3%	16.1%	15.3%	15.7%	15.5%	14.5%	15.0%	15.0%	14.8%	14.9%
	middle	52.8%	54.1%	53.5%	52.7%	54.6%	53.7%	53.0%	54.7%	53.9%	52.8%	53.7%	53.2%	52.4%	54.3%	53.4%	52.6%	53.2%	52.9%	52.4%	52.8%	52.6%	52.5%	52.5%	52.5%	51.9%	51.8%	51.8%
	high	29.5%	28.3%	28.9%	30.8%	29.6%	30.2%	30.5%	29.9%	30.2%	30.7%	30.2%	30.4%	31.6%	30.7%	31.1%	31.9%	31.7%	31.8%	31.5%	32.0%	31.7%	32.0%	33.0%	32.5%	33.1%	33.4%	33.2%
Equivalised income quintiles	lowest	11.2%	17.3%	14.5%	9.9%	15.6%	12.9%	13.2%	18.6%	16.1%	13.0%	18.3%	15.8%	13.5%	19.2%	16.5%	13.6%	18.9%	16.4%	13.4%	19.9%	16.9%	13.5%	18.9%	16.4%	12.9%	18.1%	15.7%
	middle-low	17.6%	18.0%	17.8%	18.7%	20.6%	19.7%	15.6%	17.5%	16.6%	15.1%	16.9%	16.1%	13.8%	15.5%	14.7%	15.5%	16.7%	16.1%	16.2%	16.2%	16.2%	15.5%	17.2%	16.4%	15.4%	16.2%	15.8%
	middle	19.2%	20.7%	20.0%	19.9%	19.6%	19.8%	20.6%	21.1%	20.9%	20.5%	20.8%	20.6%	22.3%	22.4%	22.4%	19.7%	20.6%	20.2%	18.6%	20.4%	19.6%	19.0%	19.5%	19.3%	21.7%	23.9%	22.9%
	middle-high	25.5%	23.8%	24.6%	22.6%	20.5%	21.5%	19.5%	18.1%	18.7%	19.1%	17.8%	18.4%	23.0%	21.1%	22.0%	24.2%	22.9%	23.5%	25.2%	22.8%	23.9%	23.8%	22.0%	22.9%	21.1%	18.5%	19.7%
	highest	26.5%	20.2%	23.1%	28.9%	23.7%	26.1%	31.2%	24.6%	27.7%	32.3%	26.3%	29.1%	27.4%	21.7%	24.4%	27.1%	20.9%	23.8%	26.6%	20.7%	23.4%	28.2%	22.3%	25.1%	28.9%	23.2%	25.9%
Obese	no	81.1%	80.4%	80.7%	80.1%	79.5%	79.8%	78.9%	78.9%	78.9%	79.0%	78.3%	78.6%	77.6%	77.0%	77.3%	76.1%	76.6%	76.4%	76.4%	76.2%	76.3%	76.0%	75.7%	75.8%	74.8%	74.6%	74.7%
	yes	18.9%	19.6%	19.3%	19.9%	20.5%	20.2%	21.1%	21.1%	21.1%	21.0%	21.7%	21.4%	22.4%	23.0%	22.7%	23.9%	23.4%	23.6%	23.6%	23.8%	23.7%	24.0%	24.3%	24.2%	25.2%	25.4%	25.3%
Over-weight	no	37.9%	55.0%	47.1%	37.1%	53.8%	46.0%	35.9%	52.3%	44.7%	35.5%	52.0%	44.3%	34.2%	51.2%	43.2%	33.1%	50.7%	42.5%	33.0%	49.7%	41.9%	32.3%	49.5%	41.3%	32.5%	47.9%	40.7%
	yes	62.1%	45.0%	52.9%	62.9%	46.2%	54.0%	64.1%	47.7%	55.3%	64.5%	48.0%	55.7%	65.8%	48.8%	56.8%	66.9%	49.3%	57.5%	67.0%	50.3%	58.1%	67.7%	50.5%	58.7%	67.5%	52.1%	59.3%

Table 11: Sample characteristics (weighted percentages), US - NHANES

		1973			1978			1991			1999			2001			2003			2005		
		Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total	Men	Women	Total
Total frequency																						
Age groups	15-19	16.0%	14.8%	15.3%	13.9%	19.2%	14.8%	10.7%	10.2%	10.5%	11.2%	9.9%	10.5%	11.3%	9.5%	10.4%	10.9%	10.2%	10.6%	11.0%	10.6%	10.8%
	20-24	13.1%	13.6%	13.3%	12.6%	20.3%	13.9%	11.6%	12.0%	11.8%	11.0%	11.6%	11.3%	10.5%	12.3%	11.4%	10.1%	10.6%	10.4%	11.1%	10.5%	10.8%
	25-29	12.0%	11.4%	11.7%	12.7%	12.7%	12.7%	12.6%	11.7%	12.1%	11.0%	10.0%	10.5%	9.7%	10.2%	9.9%	10.7%	9.3%	10.0%	9.5%	9.6%	9.5%
	30-34	9.1%	9.5%	9.3%	11.2%	8.1%	10.7%	13.9%	12.8%	13.3%	12.2%	12.1%	12.1%	9.5%	10.9%	10.2%	11.4%	11.0%	11.2%	9.6%	10.3%	9.9%
	35-39	8.3%	8.7%	8.5%	9.2%	7.6%	8.9%	12.1%	12.9%	12.5%	13.1%	12.8%	12.9%	11.6%	11.6%	11.6%	10.2%	10.6%	10.4%	11.2%	10.3%	10.7%
	40-44	9.0%	8.7%	8.9%	8.5%	5.7%	8.0%	11.5%	11.9%	11.7%	11.6%	11.2%	11.4%	12.9%	11.0%	11.9%	12.0%	12.1%	12.0%	10.5%	11.9%	11.2%
	45-49	9.2%	9.1%	9.1%	8.6%	5.0%	8.0%	8.7%	8.2%	8.4%	8.7%	10.8%	9.8%	12.0%	11.8%	11.9%	11.1%	11.6%	11.4%	12.4%	11.1%	11.7%
	50-54	9.0%	9.2%	9.1%	8.8%	7.1%	8.5%	6.7%	6.8%	6.8%	8.0%	9.2%	8.6%	10.6%	9.9%	10.3%	11.6%	10.4%	11.0%	11.1%	11.5%	11.3%
	55-59	8.4%	7.8%	8.1%	7.8%	6.7%	7.6%	6.6%	6.6%	6.6%	7.3%	5.7%	6.5%	6.8%	7.0%	6.9%	6.6%	7.5%	7.1%	7.5%	8.1%	7.8%
	60-64	6.1%	7.2%	6.7%	6.8%	7.6%	7.0%	5.5%	6.9%	6.2%	6.0%	6.5%	6.3%	5.0%	5.9%	5.5%	5.3%	6.6%	6.0%	6.1%	6.3%	6.2%
Ethnicity	Non-hispanic White							73.9%	73.0%	73.4%	68.9%	66.8%	67.8%	70.7%	68.3%	69.5%	70.5%	70.1%	70.3%	70.0%	67.5%	68.7%
	Non-hispanic Black							11.1%	12.7%	11.9%	11.0%	12.4%	11.7%	10.8%	12.8%	11.8%	11.4%	13.2%	12.3%	11.6%	13.3%	12.4%
	Mexican American							6.4%	5.5%	5.9%	7.7%	7.0%	7.3%	8.8%	7.8%	8.3%	9.7%	8.3%	9.0%	10.0%	8.5%	9.2%
	Other							8.6%	8.8%	8.7%	12.3%	13.8%	13.1%	9.7%	11.2%	10.4%	8.4%	8.4%	8.4%	8.5%	10.7%	9.6%
Marital status	single	27.1%	22.2%	24.6%	23.6%	50.1%	28.1%	29.3%	23.5%	26.3%	34.3%	27.3%	30.7%	30.2%	25.0%	27.6%	30.9%	25.9%	28.4%	27.8%	24.7%	26.3%
	married	67.6%	64.2%	65.8%	72.2%	3.9%	60.7%	62.6%	60.1%	61.3%	57.2%	54.6%	55.8%	60.5%	60.3%	60.4%	60.0%	57.3%	58.6%	61.6%	60.2%	60.9%
	div/sep/wid	5.3%	13.6%	9.6%	4.2%	46.0%	11.2%	8.1%	16.5%	12.4%	8.5%	18.1%	13.5%	9.3%	14.7%	12.0%	9.1%	16.8%	13.0%	10.5%	15.0%	12.8%
Occupation statu	working	80.9%	43.9%	61.7%	65.7%	58.3%	64.5%	85.6%	70.0%	77.6%	82.3%	64.9%	73.3%	80.5%	65.2%	72.8%	77.6%	66.2%	71.8%			
	not working	19.1%	56.1%	38.3%	34.3%	41.7%	35.5%	14.4%	30.0%	22.4%	17.7%	35.1%	26.7%	19.5%	34.8%	27.2%	22.4%	33.8%	28.2%			
Education level	low	20.8%	18.3%	19.5%	15.0%	16.3%	15.2%	15.1%	13.3%	14.2%	8.3%	8.0%	8.2%	8.9%	7.6%	8.2%	8.4%	6.3%	7.3%	8.8%	7.0%	7.9%
	middle	46.6%	57.0%	52.0%	50.9%	47.9%	50.4%	42.8%	47.6%	45.3%	44.6%	42.5%	43.5%	40.0%	38.5%	39.3%	41.4%	38.1%	39.8%	38.7%	35.1%	36.9%
	high	32.6%	24.7%	28.5%	34.1%	35.8%	34.4%	42.0%	39.1%	40.5%	47.1%	49.5%	48.3%	51.0%	53.9%	52.5%	50.2%	55.5%	52.9%	52.4%	57.9%	55.2%
Equivalised income quintiles	lowest	10.0%	12.6%	11.4%	8.4%	31.8%	12.4%	11.8%	15.0%	13.4%	12.3%	18.7%	15.5%	12.6%	15.4%	14.0%	12.1%	16.1%	14.2%	10.8%	12.0%	11.4%
	middle-low	23.9%	26.4%	25.2%	22.9%	30.9%	24.3%	19.3%	20.5%	20.0%	21.5%	19.4%	20.4%	17.5%	20.3%	18.9%	18.5%	19.6%	19.1%	17.4%	18.6%	18.0%
	middle	23.6%	23.5%	23.5%	25.4%	20.5%	24.5%	21.9%	20.5%	21.2%	16.0%	14.9%	15.4%	14.3%	14.6%	14.5%	15.5%	16.3%	15.9%	15.8%	14.6%	15.2%
	middle-high	18.5%	17.2%	17.8%	23.9%	7.2%	21.1%	19.1%	17.9%	18.5%	13.5%	12.3%	12.9%	15.5%	13.6%	14.5%	15.4%	13.8%	14.6%	17.5%	16.1%	16.8%
	highest	24.0%	20.3%	22.1%	19.4%	9.6%	17.8%	27.8%	26.0%	26.9%	36.7%	34.8%	35.8%	40.1%	36.1%	38.1%	38.5%	34.1%	36.3%	38.4%	38.7%	38.6%
Obese	no	89.3%	85.6%	87.4%	87.6%	86.6%	87.4%	82.0%	76.8%	79.3%	75.3%	68.4%	71.7%	74.0%	68.6%	71.3%	70.4%	67.7%	69.0%	68.4%	65.8%	67.1%
	yes	10.7%	14.4%	12.6%	12.4%	13.4%	12.6%	18.0%	23.2%	20.7%	24.7%	31.6%	28.3%	26.0%	31.4%	28.7%	29.6%	32.3%	31.0%	31.6%	34.2%	32.9%
Over-weight	no	53.0%	64.4%	58.9%	58.2%	66.9%	59.7%	45.7%	53.3%	49.6%	38.4%	42.1%	40.3%	35.2%	42.2%	38.8%	33.1%	41.6%	37.4%	31.4%	42.0%	36.8%
	yes	47.0%	35.6%	41.1%	41.8%	33.1%	40.3%	54.3%	46.7%	50.4%	61.6%	57.9%	59.7%	64.8%	57.8%	61.2%	66.9%	58.4%	62.6%	68.6%	58.0%	63.2%

ANNEX 2 – VARIABLES EXTRACTED FROM HEALTH SURVEY DATASETS

AREA	VARIABLE
INDIVIDUAL IDENTIFIERS	year of interview household identifier individual identifier concatenated identifier
SOCIO-DEMOGRAPHIC VARIABLES	age gender position as member of household marital status (single vs. married) detailed marital status ethnic minority status ethnic group migrant status (born in the country vs. born abroad) years spent in full-time education education, ISCED level annual gross household income (in current PPPs) deflated equivalised income in PPPs location size of household Government Office Region
WORK	occupational status situation if working situation if not working ISCO classification line of business mother\father houseworker social economic classification number of hours of work per week
HEALTH	self-assessed health presence of long-standing illness activities limited by long-standing illness diabetes reported as long-standing illness activities limited by diabetes cardio-vascular disease reported as long-standing illness activities limited by cardio-vascular disease Short Form 36 height in centimetres weight in kilograms body-mass index nature of BMI measurement

MENTAL HEALTH	GHQ12 (General Health Questionnaire)
DIET	salt added at table daily consumption of fruits and/or vegetables daily consumption of bread and/or pasta and/or rice daily consumption of soft drinks daily consumption of fast food and/or salty/sweet snacks fat used for cooking following a diet (medically prescribed or self-imposed) fat score
PHYSICAL ACTIVITY	regular physical activity intensity of physical activity intensity of physical activity during work intensity of physical activity during sport intensity of physical activity during walking intensity of physical activity during housework days/4 weeks active 30 mins days/4 weeks walking 30 mins days/4 weeks heavy manual 30 mins days/4 weeks heavy housework 30 mins
SMOKING	smoking status cigarettes smoked per annum (if current smoker)
ALCOHOL CONSUMPTION	drinking habits intensity of drinking alcoholism problem

ANNEX 3 – DETAILS OF STATISTICAL MODELS USED IN THE ANALYSIS

Logistic models

The logistic function is defined as the logarithm of the odds of being obese (or overweight) that is $\log it(p) = \ln(Odds) = \ln\{\frac{p}{1-p}\}$ where p is the probability of being obese (or overweight). The logistic regression model with the independent covariate x_i for the individual i can be expressed as:

$\log it(p_i) = \beta_0 + \beta_j x_{ij} + e_i$ where β_0 is the intercept, β_j the regression coefficient associated to the covariate x_{ij} (with j varying according to the number of factors), and residuals $e \sim N(0,\sigma^2)$. The model is transformed into a linear function using the cumulative density function $F(\alpha + \beta X) = 1/1 + e^{-\alpha-\beta X}$, and the parameters are estimated using the maximum likelihood method. The odds ratio is defined as: $OR = \frac{p_1/(1-p_1)}{p_0/(1-p_0)} = \exp(\beta_1)$ where p_1 is the probability of being obese (or overweight) when x_1 is present (e.g. having the highest education level) and p_2 the probability of being obese (or overweight) when x_1 is absent (e.g. having the lowest education level) and $\beta_1$is the coefficient associated to the covariate x_1.

Multilevel models

Let y_i be the value of the response variable Y for the individual i, and X_1 an independent covariate in a simple univariate model, the single-level regression equation for the individual i is given by

$$y_i = \beta_0 + \beta_1 x_{1i} + e_i \qquad (1)$$

where β_0 is the intercept, β_1 the regression coefficient and the individual-level residuals e_i with $e_i \sim N(0, \sigma_e^2)$.
In order to evaluate the significance of a higher order aggregation of individuals in n groups on the single values y_i, the regression model in (1) can be written as

$$y_{ij} = \beta_{0j} + \beta_{1j} x_{1ij} + e_{ij} \qquad (2)$$

where $j = 1,\ldots, n$ refers to the level-2 units (groups) and $i = 1,\ldots, N$, to the level-1 units (individuals).
Model in equation (2) is called *random intercept model* when the intercept β_0 in (1) becomes a random variable depending on the group j, that is

$$\beta_{0j} = \beta_0 + u_{0j} \qquad (3)$$

with $u_{0j} \sim N(0, \sigma_{u0}^2)$ as group-level residuals. When considering also the regression coefficient β_1 as a random variable such as

$$\beta_{1j} = \beta_1 + u_{1j} \tag{4}$$

with $u_{1j} \sim N(0, \sigma_{u1}^2)$ and $cov(u_{0j}, u_{1j}) = \sigma_{u01}$, the model in equation (2) is called *random coefficient model* and can be written in the form

$$y_{ij} = \beta_0 + \beta_1 x_{1ij} + (u_{0j} + u_{1j} x_{1ij} + e_{ij}) \tag{5}$$

In equation (5) the response variable y_{ij} has been expressed as the sum of a fixed part and a random part within the brackets, where the covariate x_{1ij} in the random part of the model is usually substituted by z_{1ij} to make the distinction with the covariates in the fixed part. In model (5) both intercept and regression coefficients vary from group to group, so to explain the effect of the group's aggregation on the *Y* variable. The individual-level residuals e_{ij} are assumed to be independent from the group-level residuals u_{0j} and u_{1j}.
The *intra level-2 unit correlation* in random intercept models is given by

$$\rho = \frac{\sigma_{u0}^2}{\sigma_{u0}^2 + \sigma_e^2} \tag{6}$$

and measures the proportion of the total variance which is between-groups. The same correlation index in case of random coefficient models equals

$$\rho = \frac{\sigma_{u0}^2 + 2\sigma_{01} z_{1ij} + \sigma_{u1}^2 z_{1ij}^2}{\sigma_{u0}^2 + 2\sigma_{01} z_{1ij} + \sigma_{u1}^2 z_{1ij}^2 + \sigma_e^2} \tag{7}$$

The existence of a non-zero intra-group correlation indicates that traditional estimation procedures used in multiple regressions, such as ordinary least square, are not correct. For this reason, estimation methods for multilevel models include generalized least square techniques (Goldstein, 1986), Fisher scoring algorithm (Longford, 1987) or the expectation-maximization algorithm (Raudenbush and Bryk, 1986). The simple 2-level random coefficient model in (5) can be further extended by introducing more explanatory variables at either the individual or the group levels. Moreover, the number of nested levels can be increased when considering more aggregation stages.
In the case y_{ij} is a discrete response, the model is a hierarchical logistic model and the random intercept model is

$$y_{ij} = \beta_0 + \beta_1 x_{1i} + (u_{0j} + e_{ij}) \tag{8}$$

with e_{ij} having logistic distribution and the individual-level variance σ^2_e is equal to $\pi^2/3$. So, the intra-class correlation is (with σ^2_{u0} the group-level variance)

$$\rho = \frac{\sigma_{u0}^2}{\sigma_{u0}^2 + \frac{\pi^2}{3}} \tag{9}$$

Quantile regression model

Quantile regression is a semi-parametric regression approach aimed at modelling changes in individual quantiles of the distribution of a continuous outcome variable. Quantiles are usually defined with τ. For instance, for τ=0.90, Qy(0.90|X) is the 90th percentile of the distribution of y conditional on the values of x. In other words, 90% of the values of y are less than or equal to the specified function of x.

The general model for quantile regression is expressed as:

$$y_i = \beta^{(\tau)} x_i + \varepsilon_i^{(\tau)}$$

where y_i is the BMI for individual *i*, x_i is a vector of individual characteristics including a constant term, and $\tau \in [0,1]$ indicates the cumulative proportion of the population, that is the quantiles.

The way quantile regression works may be illustrated in comparison with ordinary least square (OLS) regression. As standard regression minimizes the sum of squared residuals, QR minimizes the weighted sum of the absolute deviations of the error term (Koenker 1978; 2001). At a given percentile τ, the weights τ and (1-τ) are applied to positive residuals (i.e. observations above their respective predicted values) and negative residuals (i.e. observations below their respective predicted values). In the case of the median regression, τ and (1- τ) are both 0.5 and the estimation is obtained by minimizing the un-weighted sum of the absolute residuals.

Formally, the same concept may be expressed as:

$$\sum_{i=1}^{n} | y_i - x_i^{'} \beta(\tau) | \cdot \left[(\tau) I(y_i > x_i^{'} \beta(\tau)) + (1-\tau) I(y_i \leq x_i^{'} \beta(\tau)) \right]$$

Where y is the dependent variable, X is a matrix of covariates, β is the vector of coefficients depending on τ, i.e. the quantile that is being estimated, and I is an indicator function that takes the value of 1 if the condition in parentheses is true and 0 otherwise.

ANNEX 4 –INEQUALITIES IN OBESITY AND OVERWEIGHT BY LEVEL OF EDUCATION

Figure 1. Overweight rates in men in Australia

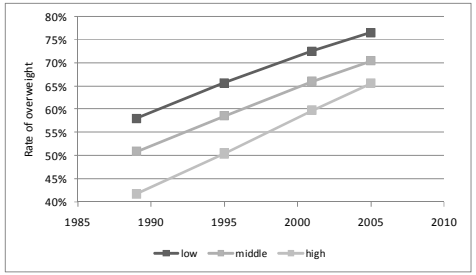


Figure 2. Overweight rates in women in Australia

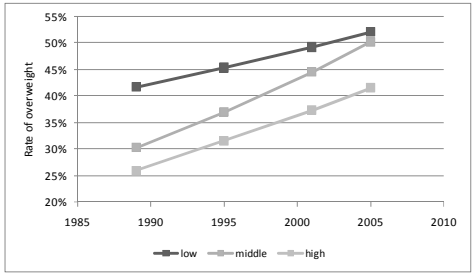


Figure 3. Obesity rates in men in Australia

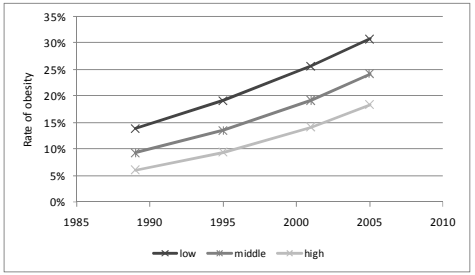


Figure 4. Obesity rates in women in Australia

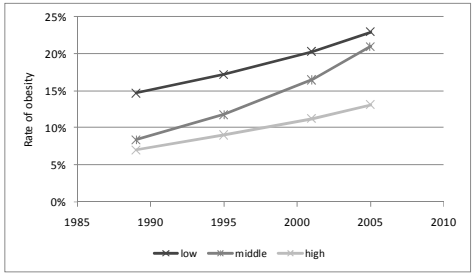


Figure 5. Overweight rates in men in Austria

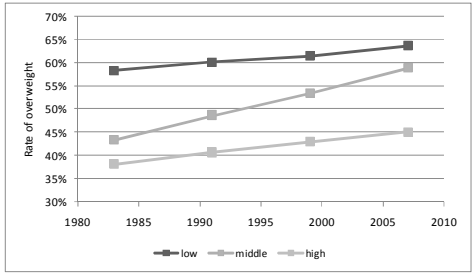


Figure 6. Overweight rates in women in Austria

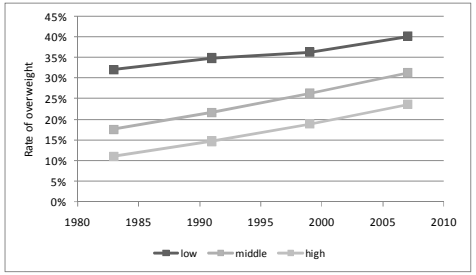


Figure 7. Obesity rates in men in Austria

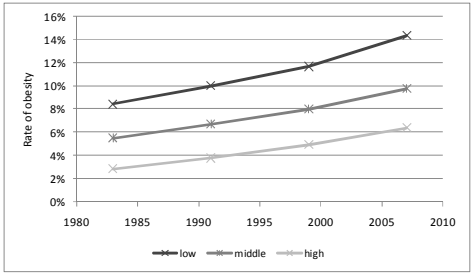


Figure 8. Obesity rates in women in Austria

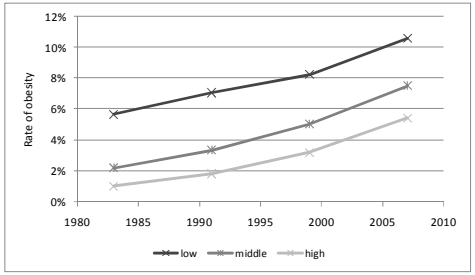


Figure 9. Overweight rates in men in Canada

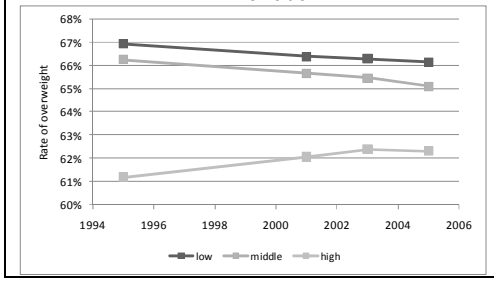


Figure 10. Overweight rates in women in Canada

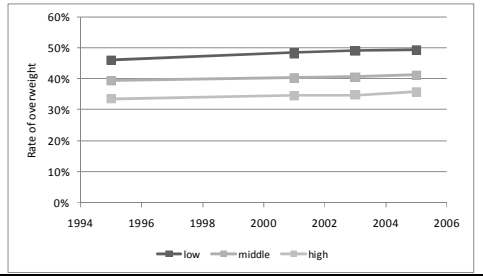


Figure 11. Obesity rates in men in Canada

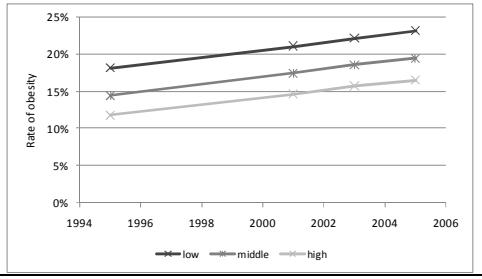
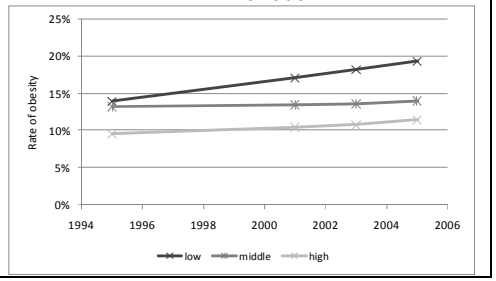


Figure 12. Obesity in women in Canada



Note: Estimated rates of obesity or overweight were calculated for 40-year old, married, non smoking and working individuals.

Figure 13. Overweight rates in men in England

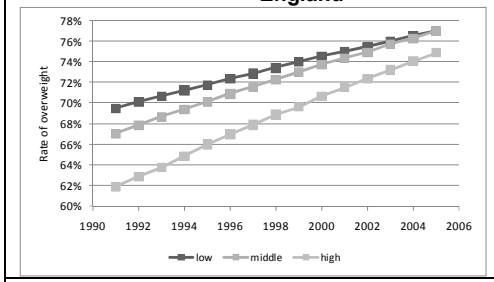


Figure 14. Overweight rates in women in England

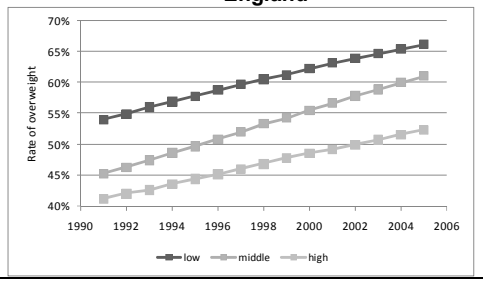


Figure 15. Obesity rates in men in England

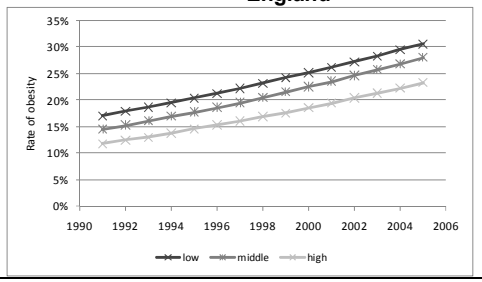


Figure 16. Obesity rates in women in England

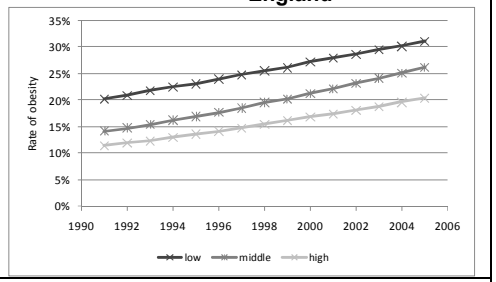


Figure 17. Overweight rates in men in France

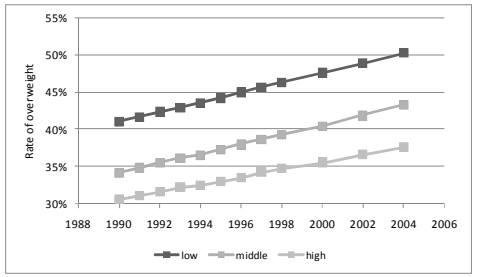


Figure 18. Overweight rates in women in France

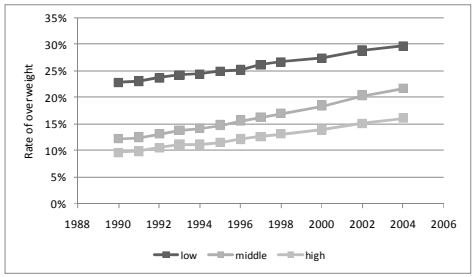


Figure 19. Obesity rates in men in France

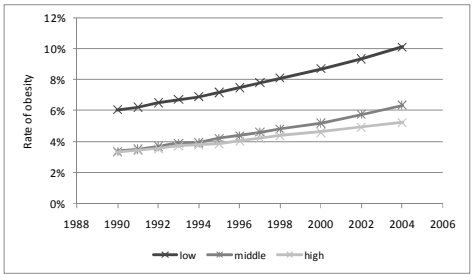


Figure 20. Obesity rates in women in France

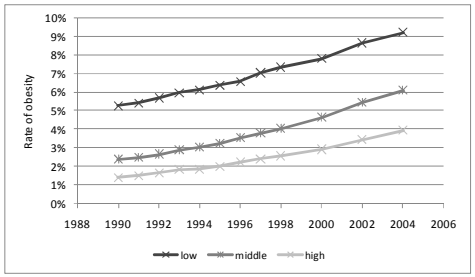


Figure 21. Overweight rates in men in Italy

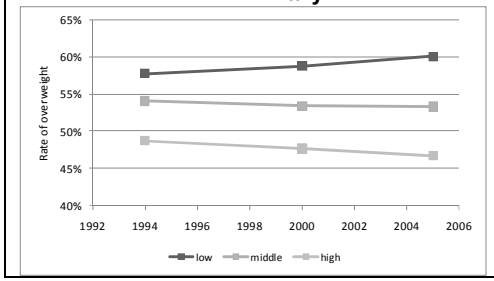


Figure 22. Overweight rates n women in Italy

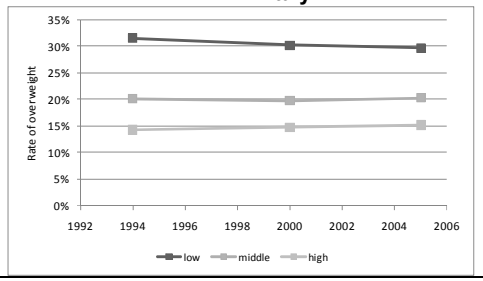


Figure 23. Obesity rates in men in Italy

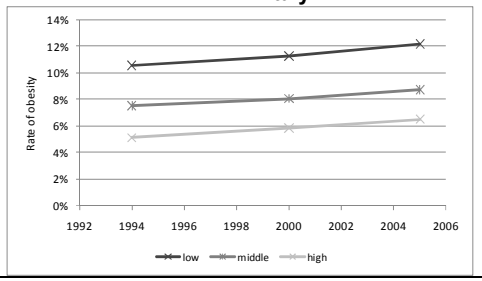
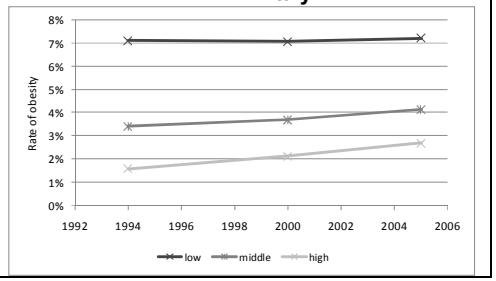


Figure 24. Obesity rates in women in Italy



Note: Estimated rates of obesity or overweight were calculated for 40-year old, married, non smoking and working individuals.

Figure 25. Overweight rates in men in Korea

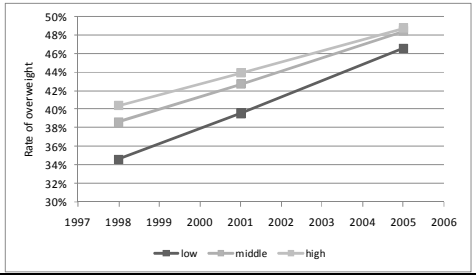


Figure 26. Overweight rates in women in Korea

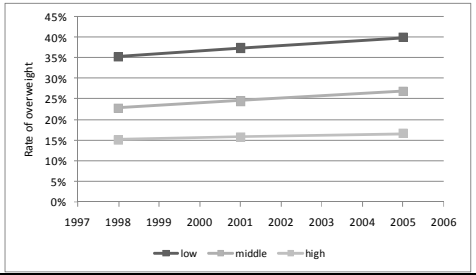


Figure 27. Obesity rates in men in Korea

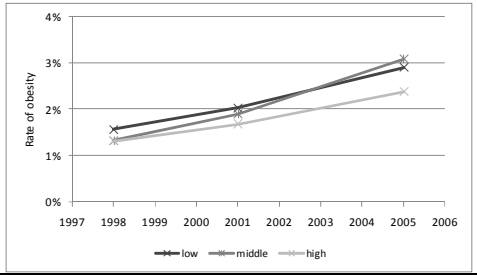


Figure 28. Obesity rates in women in Korea

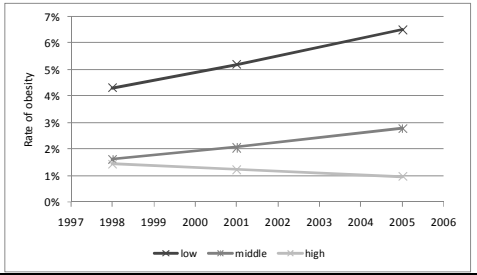


Figure 29. Overweight rates in men in Spain

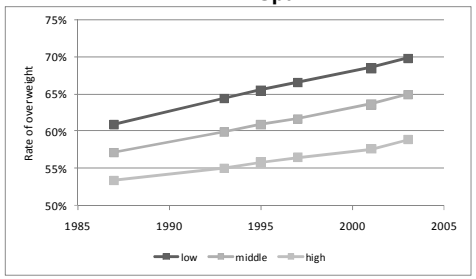


Figure 30. Overweight rates in women in Spain

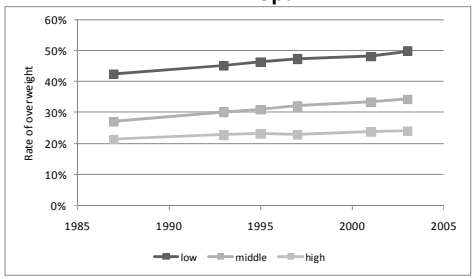


Figure 31. Obesity rates in men in Spain

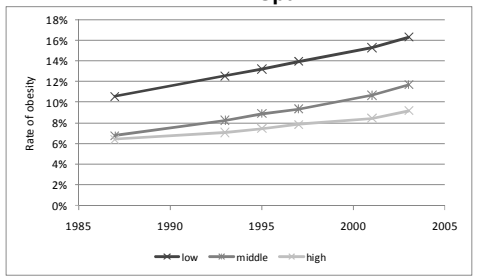


Figure 32. Obesity rates in women in Spain

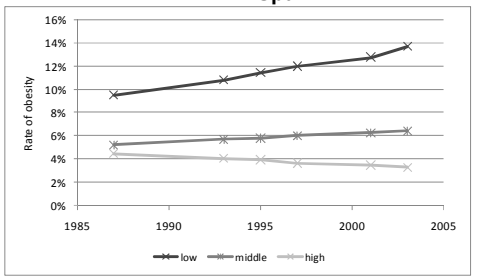


Figure 33. Overweight rates in men in the US

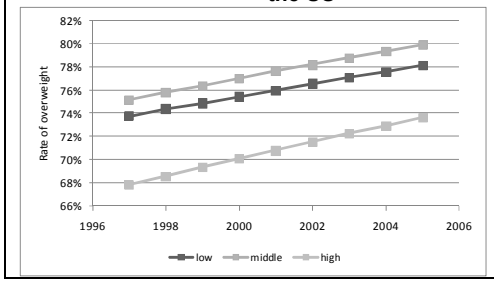


Figure 34. Overweight rates in women in the US

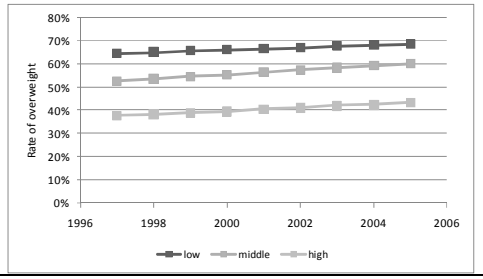


Figure 35. Obesity rates in men in the US

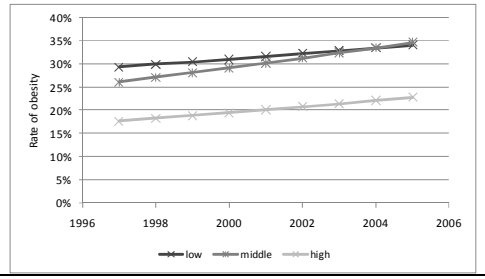
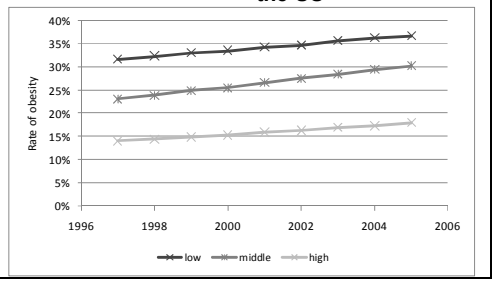


Figure 36. Obesity rates in women in the US



Note: Estimated rates of obesity or overweight were calculated for 40-year old, married, non smoking and working individuals.

ANNEX 5 – INEQUALITIES IN OBESITY AND OVERWEIGHT BY SOCIO-ECONOMIC CONDITION

Figure 1. Overweight rates in men in Australia

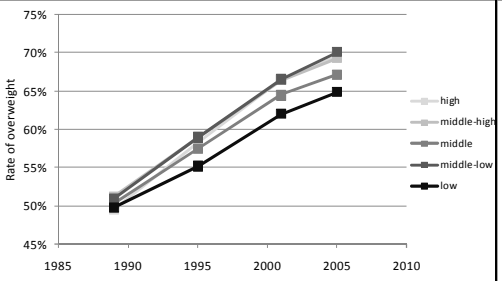


Figure 2. Overweight rates in women in Australia

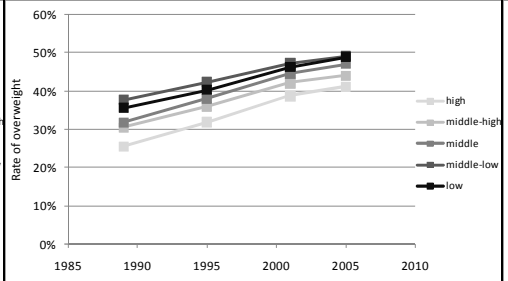


Figure 3. Obesity rates in men in Australia

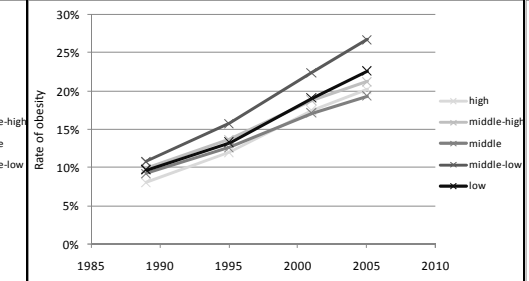


Figure 4. Obesity rates in women in Australia

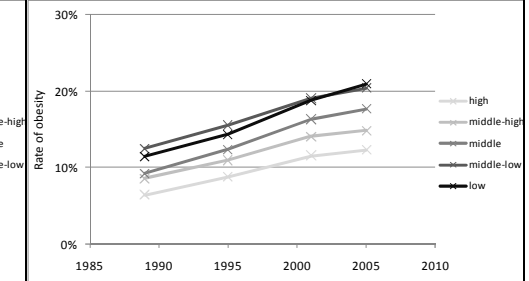


Figure 5. Overweight rates in men in Austria

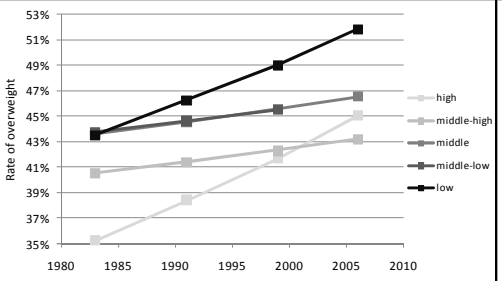


Figure 6. Overweight rates in women in Austria

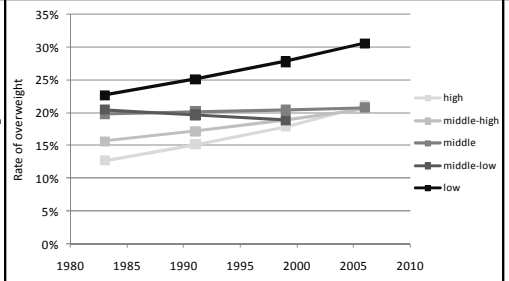


Figure 7. Obesity rates in men in Austria

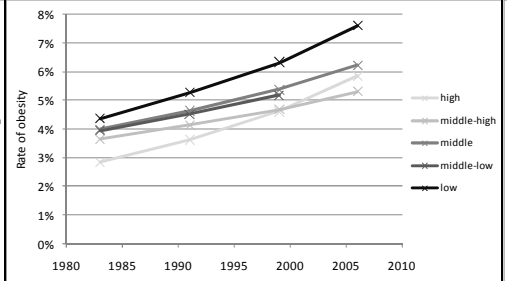


Figure 8. Obesity rates in women in Austria

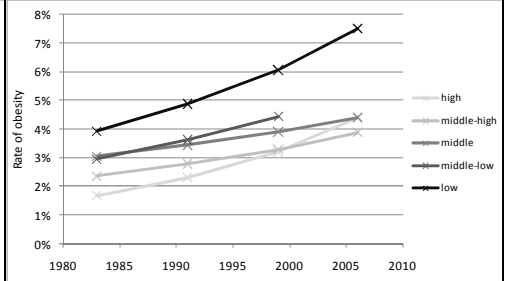


Figure 9. Overweight rates in men in Canada

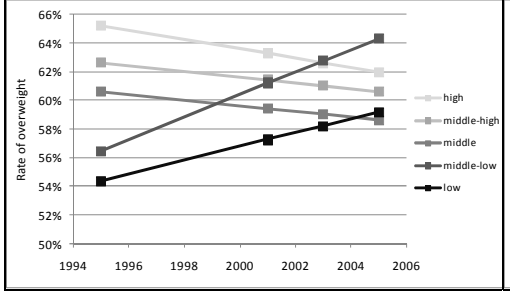


Figure 10. Overweight rates in women in Canada

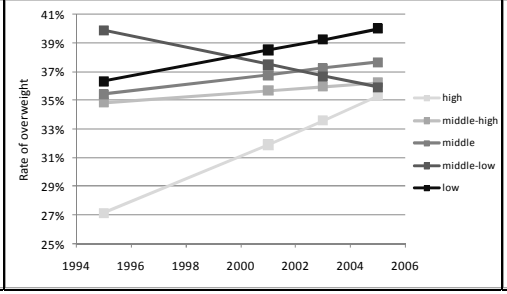


Figure 11. Obesity rates in men in Canada

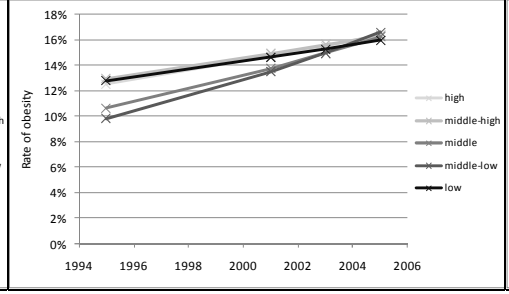
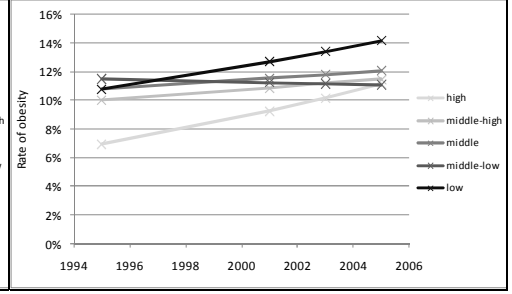


Figure 12. Obesity rates in women in Canada



Note: Estimated rates of obesity or overweight were calculated for 40-year old, married, non smoking and working individuals.

Figure 13. Overweight rates in men in England

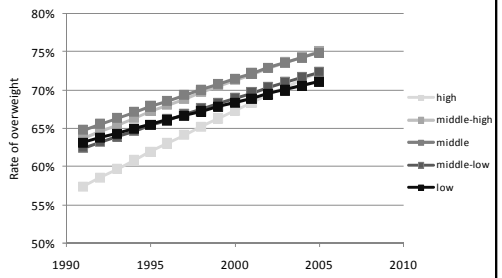


Figure 14. Overweight rates in women in England

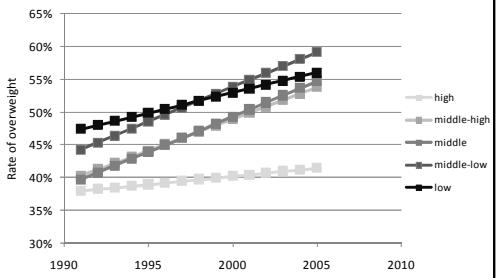


Figure 15. Obesity rates in men in England

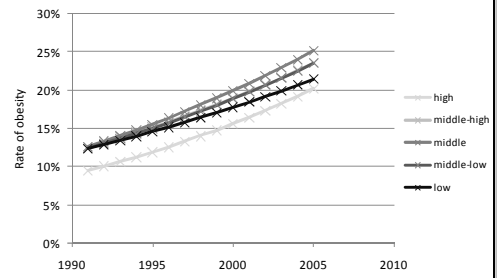


Figure 16. Obesity rates in women in England

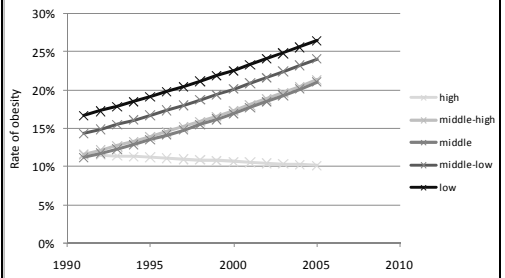


Figure 17. Overweight rates in men in France

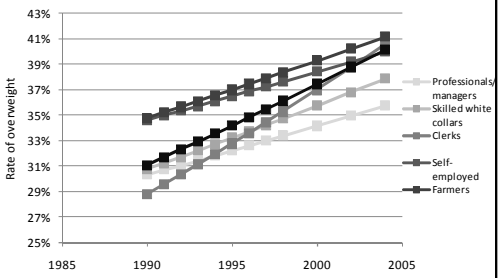


Figure 18. Overweight rates in women in France

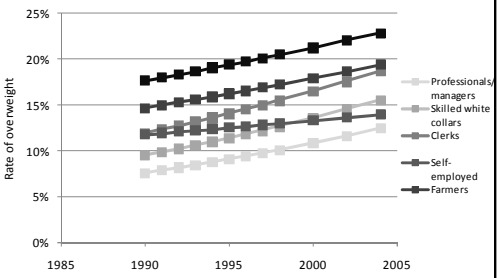


Figure 19. Obesity rates in men in France

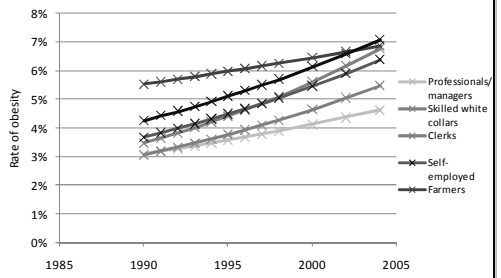


Figure 20. Obesity rates in women in France

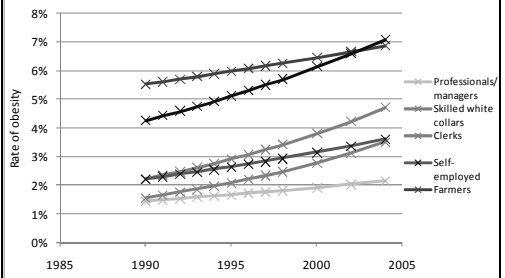


Figure 21. Overweight rates in men in Italy

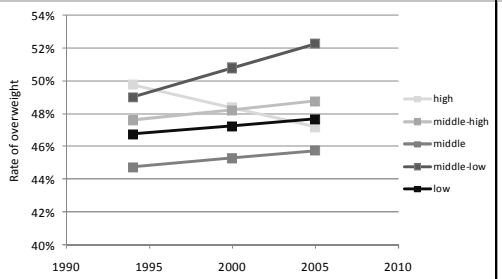


Figure 22. Overweight rates in women in Italy

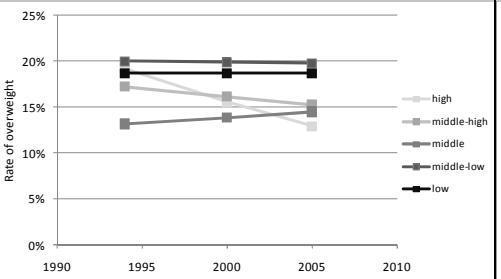


Figure 23. Obesity rates in men in Italy

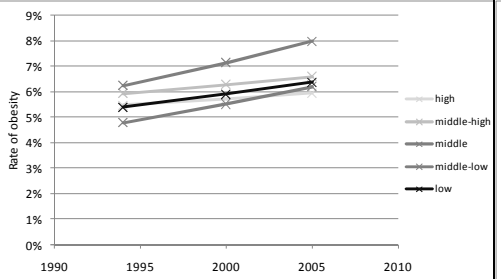
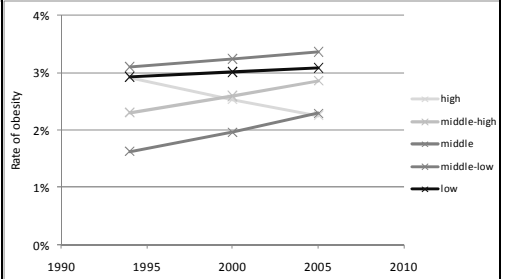


Figure 24. Obesity rates in women in Italy



Note: Estimated rates of obesity or overweight were calculated for 40-year old, married, non smoking and working individuals.

Figure 25. Overweight rates in men in Korea

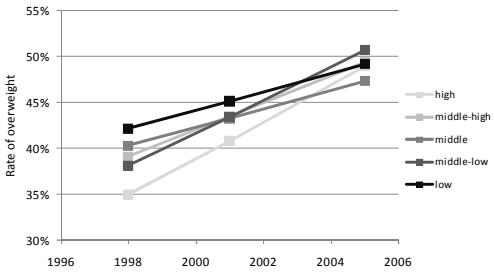


Figure 26. Overweight rates in women in Korea

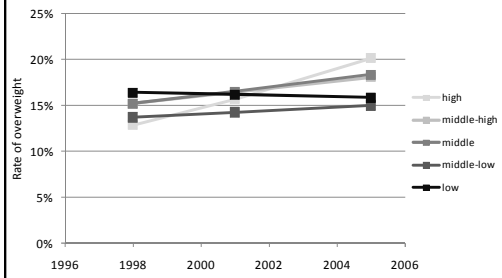


Figure 27. Obesity rates in men in Korea

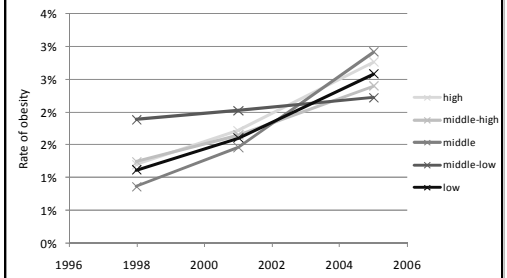


Figure 28. Obesity rates in women in Korea

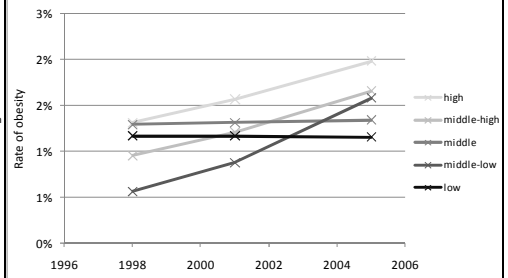


Figure 29. Overweight rates in men in Spain

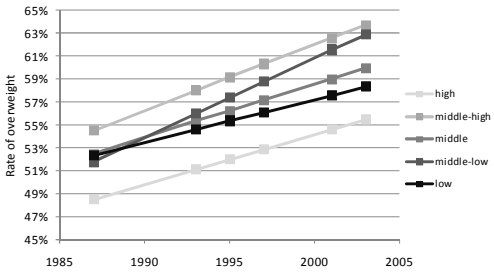


Figure 30. Overweight rates in women in Spain

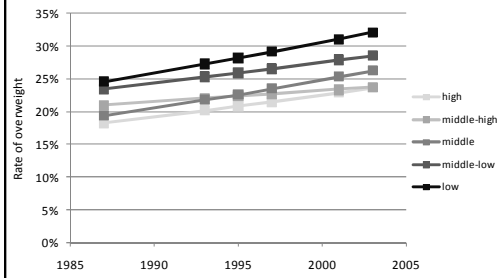


Figure 31. Obesity rates in men in Spain

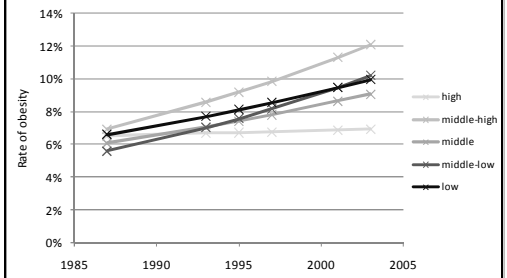


Figure 32. Obesity rates in women in Spain

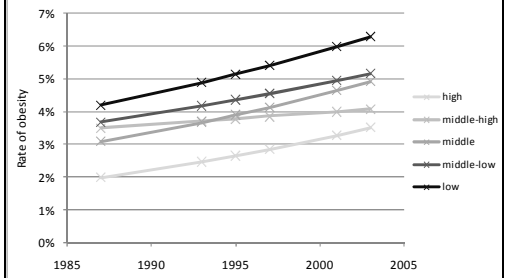


Figure 33. Overweight rates in men in the US

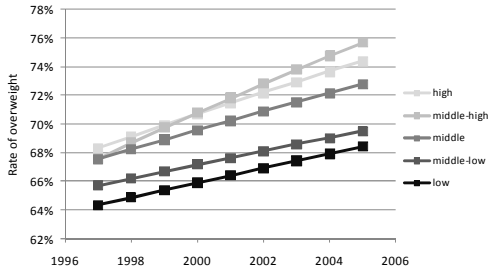


Figure 34. Overweight rates in women in the US

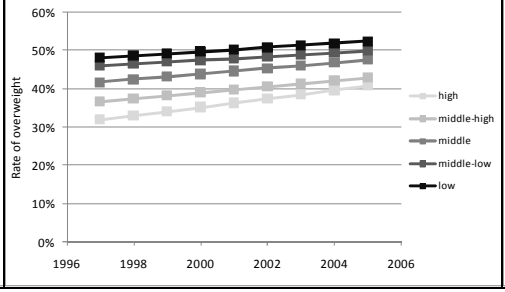


Figure 35. Obesity rates in men in the US

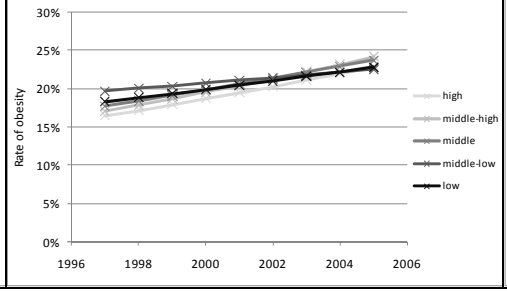
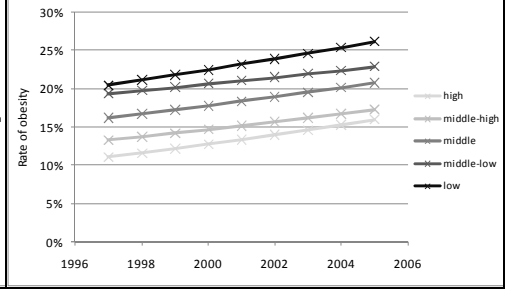


Figure 36. Obesity rates in women in the US



Note: Estimated rates of obesity or overweight were calculated for 40-year old, married, non smoking and working individuals.

ANNEX 6 – ESTIMATES AND STANDARD ERRORS FROM SINGLE-LEVEL AND MULTILEVEL LOGISTIC MODELS

Table 1: Coefficients and standard errors (S.E.) from both multilevel and single-level logistic models for the probability of obesity including interaction terms between gender and socio-economic condition

	England				France				Italy				Korea			
OBESITY	Multilevel model		Single-level model		Multilevel model		Single-level model		Multilevel model		Single-level model		Multilevel model		Single-level model	
	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.
age	0.1127 ***	0.0056	0.0984 ***	0.0049	0.1524 ***	0.0133	0.1375 ***	0.0118	0.1831 ***	0.0068	0.1703 ***	0.0062	-0.0350	0.0319	-0.0359	0.0309
age squared	-0.0011 ***	0.0001	-0.0009 ***	0.0001	-0.0013 ***	0.0002	-0.0012 ***	0.0001	-0.0016 ***	0.0001	-0.0015 ***	0.0001	0.0001	0.0004	0.0002	0.0003
Gender																
man	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
woman	-0.3946 ***	0.1145	-0.3496 ***	0.1039	-0.6784 ***	0.1545	-0.6019 ***	0.1448	-0.4883 ***	0.0761	-0.4385 ***	0.0705	0.1115	0.2510	0.1133	0.2452
Marital status																
single	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
married	0.2105 ***	0.0321	0.1859 ***	0.0278	0.0676	0.0693	0.0412	0.0614	0.2726 ***	0.0318	0.2359 ***	0.0287	0.3741 *	0.1972	0.3704 *	0.1910
divorced/sep./wid.	0.0918 **	0.0426	0.0827 **	0.0368	0.0017	0.1028	-0.0232	0.0906	0.1256 ***	0.0456	0.1172 ***	0.0409	0.4810 *	0.2598	0.4731 *	0.2510
Smoking status																
current smoker	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
ex-current smoker	0.5656 ***	0.0285	0.4847 ***	0.0242	0.4679 ***	0.0555	0.4049 ***	0.0488	0.2115 ***	0.0254	0.1839 ***	0.0224	-0.1230	0.1769	-0.1221	0.1720
not smoking	0.3252 ***	0.0246	0.2814 ***	0.0212	0.2091 ***	0.0517	0.1759 ***	0.0459	-0.0516 **	0.0225	-0.0492 **	0.0201	-0.4648 ***	0.1571	-0.4551 ***	0.1518
Occupation status																
working	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
not working	0.1970 ***	0.0230	0.1749 ***	0.0197	0.3125 ***	0.0489	0.2898 ***	0.0432	0.1711 ***	0.0231	0.1582 ***	0.0207	0.2523 **	0.1117	0.2454 **	0.1087
Ethnicity																
White	*ref.*		*ref.*													
Black	0.4785 ***	0.0568	0.4155 ***	0.0466												
Asian	-0.4492 ***	0.0487	-0.3943 ***	0.0404												
Education level																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle	0.2022 ***	0.0266	0.1870 ***	0.0231	0.1689 **	0.0740	0.1450 **	0.0675	0.4381 ***	0.0457	0.4051 ***	0.0419	0.2517 *	0.1345	0.2516 *	0.1311
low	0.4529 ***	0.0325	0.4190 ***	0.0280	0.6117 ***	0.0668	0.5676 ***	0.0603	0.8841 ***	0.0456	0.8256 ***	0.0415	0.9415 ***	0.1619	0.9236 ***	0.1564
SEC -Men																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle-high	0.2837 ***	0.0625	0.2377 ***	0.0552	0.1037	0.1022	0.0795	0.0925	0.0857 *	0.0499	0.0792 *	0.0444	0.1924	0.2275	0.1800	0.2214
middle	0.2931 ***	0.0625	0.2776 ***	0.0552	0.1800	0.1245	0.1651	0.1120	-0.0136	0.0498	-0.0059	0.0444	-0.1878	0.2397	-0.1739	0.2335
middle-low	0.1696 **	0.0704	0.1910 ***	0.0621	0.2826 **	0.1274	0.2650 **	0.1133	0.2190 ***	0.0600	0.1944 ***	0.0528	-0.1873	0.2415	-0.1777	0.2353
low	0.0602	0.0914	0.0852	0.0805	0.4920 ***	0.1595	0.4260 ***	0.1396	0.0138	0.0453	0.0219	0.0403	-0.3569	0.2687	-0.3399	0.2617
very low					0.3101	0.0982	0.3118	0.0885								
SEC -Women																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle-high	0.6276 ***	0.1040	0.5713 ***	0.0939	0.6205 ***	0.1993	0.5910 ***	0.1821	0.0017	0.0770	0.0071	0.0702	-0.2394	0.2049	-0.2416	0.2001
middle	0.6408 ***	0.1040	0.5763 ***	0.0939	0.9690 ***	0.2158	0.8910 ***	0.1928	-0.1914 ***	0.0723	-0.1756 ***	0.0661	0.1650	0.1856	0.1609	0.1802
middle-low	0.8964 ***	0.1062	0.8031 ***	0.1364	0.8831 ***	0.1467	0.8031 ***	0.1364	0.3944 ***	0.0823	0.3659 ***	0.0742	0.1289	0.1884	0.1256	0.1827
low	0.3333 ***	0.0685	0.9536 ***	0.1015	0.4541 ***	0.1539	0.4113 ***	0.1434	0.3333 ***	0.0685	0.3035 ***	0.0623	0.4750 **	0.1904	0.4557 **	0.1834
very low					1.3251	0.1535	1.1920	0.1414								
year	0.0594 ***	0.0033	0.0520 ***	0.0027	0.0380 ***	0.0068	0.0334 ***	0.0057	0.0185 ***	0.0027	0.0161 ***	0.0023	0.0717 ***	0.0170	0.0698 ***	0.0162
constant	-124.059 ***	6.5711	-108.562 ***	5.3483	-83.7137 ***	13.5747	-73.5585 ***	11.3640	-45.4791 ***	5.4886	-39.8711 ***	4.6698	-146.811 ***	33.9007	-142.556 ***	32.3766
rho	0.2359	0.0095			0.2810	0.0187			0.2632	0.0087			0.1736	0.0620		

Note 1: Only the most recent years (last decade) are analyzed. Regression models are unweighted because weights at the household level are not available.
Note 2: The estimates represent the impact of various socio-economic characteristics on the probability of obesity. The variable ethnicity is only available in England. The variable SEC (socio-economic condition) is a 5-class variable in England, Italy and Korea but it is a 6-class variable in France (professional and managers; skilled white collar; clerks; self-employed; farmers; unskilled workers). The SEC variable in Korea is based on equivalised household income quintiles whereas it is based on occupation in other countries.
Note 3: (*) means significant at 10%, (**) significant at 5%, (***) significant at 1%.

Table 2: Coefficients and standard errors (S.E.) from both multilevel and single-level logistic models for the probability of overweight including interaction terms between gender and socio-economic condition

	England				France				Italy				Korea			
OVERWEIGHT	Multilevel model		Single-level model		Multilevel model		Single-level model		Multilevel model		Single-level model		Multilevel model		Single-level model	
	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.
age	0.1135 ***	0.0045	0.0979 ***	0.0038	0.1343 ***	0.0080	0.1146 ***	0.0069	0.1506 ***	0.0037	0.1309 ***	0.0033	0.0937 ***	0.0133	0.0882 ***	0.0126
age squared	-0.0009 ***	0.0001	-0.0008 ***	0.0000	-0.0010 ***	0.0001	-0.0009 ***	0.0001	-0.0012 ***	0.0000	-0.0010 ***	0.0000	-0.0010 ***	0.0001	-0.0009 ***	0.0001
Gender																
man	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
woman	-1.0170 ***	0.0787	-0.8750 ***	0.0695	-1.3971 ***	0.0789	-1.1866 ***	0.0700	-1.4263 ***	0.0444	-1.2339 ***	0.0395	-0.7641 ***	0.0911	-0.7200 ***	0.0870
Marital status																
single	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
married	0.4044 ***	0.0247	0.3537 ***	0.0210	0.2918 ***	0.0415	0.2471 ***	0.0353	0.5076 ***	0.0182	0.4357 ***	0.0154	0.3775 ***	0.0792	0.3640 ***	0.0751
divorced/sep./wid.	0.1780 ***	0.0343	0.1533 ***	0.0297	0.1278 **	0.0647	0.1074 *	0.0553	0.2603 ***	0.0275	0.2337 ***	0.0236	0.4347 ***	0.1069	0.4178 ***	0.1012
Smoking status																
current smoker	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
ex-current smoker	0.5489 ***	0.0242	0.4789 ***	0.0209	0.5048 ***	0.0347	0.4243 ***	0.0295	0.1594 ***	0.0169	0.1356 ***	0.0146	0.2187 ***	0.0657	0.2042 ***	0.0622
not smoking	0.3274 ***	0.0193	0.2817 ***	0.0166	0.2734 ***	0.0306	0.2290 ***	0.0262	-0.1027 ***	0.0135	-0.0861 ***	0.0116	0.2168 ***	0.0605	0.2020 ***	0.0574
Occupation status																
working	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
not working	-0.0403 **	0.0191	-0.0400 **	0.0166	0.0973 ***	0.0314	0.0830 ***	0.0272	0.0672 ***	0.0143	0.0689 ***	0.0124	0.1186 ***	0.0443	0.1138 ***	0.0423
Ethnicity																
White	*ref.*		*ref.*													
Black	0.4359 ***	0.0506	0.3844 ***	0.0429												
Asian	-0.2481 ***	0.0366	-0.2135 ***	0.0300												
Education level																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle	0.1639 ***	0.0212	0.1560 ***	0.0185	0.1946 ***	0.0402	0.1687 ***	0.0350	0.3361 ***	0.0235	0.3048 ***	0.0202	0.1463 ***	0.0498	0.1417 ***	0.0472
low	0.3613 ***	0.0273	0.3404 ***	0.0238	0.5541 ***	0.0380	0.4970 ***	0.0326	0.6653 ***	0.0242	0.6041 ***	0.0207	0.5219 ***	0.0615	0.4929 ***	0.0576
SEC -Men																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle-high	0.2151 ***	0.0483	0.1915 ***	0.0424	0.0686	0.0555	0.0579	0.0475	-0.0182	0.0307	-0.0202	0.0263	-0.1370 *	0.0827	-0.1256	0.0781
middle	0.1087 **	0.0481	0.1182 ***	0.0422	0.0152	0.0698	0.0278	0.0600	-0.1289 ***	0.0300	-0.1030 ***	0.0257	-0.2226 ***	0.0824	-0.2091 ***	0.0779
middle-low	-0.0983 *	0.0544	-0.0523	0.0477	0.1724 **	0.0762	0.1428 **	0.0652	0.0401	0.0395	0.0450	0.0338	-0.3074 ***	0.0850	-0.2849 ***	0.0803
low	-0.1781 **	0.0709	-0.1198 *	0.0622	0.1217	0.1036	0.1339	0.0881	-0.1033 ***	0.0279	-0.0713 ***	0.0239	-0.5789 ***	0.0959	-0.5473 ***	0.0906
very low					0.0169	0.0556	0.0585	0.0477								
SEC -Women																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle-high	0.4303 ***	0.0700	0.3938 ***	0.0614	0.2507 ***	0.0799	0.2211 ***	0.0709	-0.0081	0.0445	1.0058	0.0391	-0.1132	0.0766	-0.1087	0.0731
middle	0.5028 ***	0.0700	0.4547 ***	0.0614	0.5724 ***	0.0765	0.5124 ***	0.0678	-0.1520 ***	0.0412	0.0058	0.0389	0.1091	0.0758	0.1028	0.0720
middle-low	0.7617 ***	0.0727	0.5124 ***	0.0678	0.3202 ***	0.1150	0.2897 ***	0.1007	0.3832 ***	0.0502	0.3565 ***	0.0436	0.1689 **	0.0765	0.1648 **	0.0726
low	0.3482 ***	0.0400	0.6637 ***	0.0720	0.7341 ***	0.1342	0.6558 ***	0.1160	0.3482 ***	0.0400	0.3115 ***	0.0349	0.2221 ***	0.0828	0.2106 ***	0.0782
very low					1.0452	0.0836	0.9166	0.0735								
year	0.0378 ***	0.0027	0.0333 ***	0.0022	0.0202 ***	0.0043	0.0172 ***	0.0034	0.0035 **	0.0017	0.0032 **	0.0014	0.0406 ***	0.0068	0.0384 ***	0.0063
constant	-78.5569 ***	5.3886	-69.2094 ***	4.4573	-45.1728 ***	8.5774	-38.5803 ***	6.8926	-11.6849 ***	3.4049	-10.5615 ***	2.7448	-84.4832 ***	13.5331	-79.9188 ***	12.4996
rho	0.1811	0.0076			0.2081	0.0108			0.2029	0.0048			0.0745	0.0160		

Note 1: Only the most recent years (last decade) are analyzed. Regression models are unweighted because weights at the household level are not available.
Note 2: The estimates represent the impact of various socio-economic characteristics on the probability of overweight. The variable ethnicity is only available in England. The variable SEC (socio-economic condition) is a 5-class variable in England, Italy and Korea but it is a 6-class variable in France (professional and managers; skilled white collar; clerks; self-employed; farmers; unskilled workers). The SEC variable in Korea is based on equivalised household income quintiles whereas it is based on occupation in other countries.
Note 3: (*) means significant at 10%, (**) significant at 5%, (***) significant at 1%.

Table 3: Coefficients and standard errors (S.E.) from both multilevel and single-level logistic models for the probability of obesity including interaction terms between gender and education level

	England				France				Italy				Korea			
OBESITY	Multilevel model		Single-level model		Multilevel model		Single-level model		Multilevel model		Single-level model		Multilevel model		Single-level model	
	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.
age	0.1128 ***	0.0056	0.0986 ***	0.0049	0.1529 ***	0.0132	0.1385 ***	0.0118	0.1795 ***	0.0068	0.1673 ***	0.0062	-0.0571 *	0.0322	-0.0574 *	0.0312
age squared	-0.0011 ***	0.0001	-0.0009 ***	0.0001	-0.0013 ***	0.0002	-0.0012 ***	0.0001	-0.0015 ***	0.0001	-0.0015 ***	0.0001	0.0004	0.0004	0.0004	0.0003
Gender																
man	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
woman	-0.1132 ***	0.0380	-0.0842 **	0.0340	-0.3892 ***	0.0962	-0.3215 ***	0.0902	-0.7859 ***	0.0860	-0.7258 ***	0.0817	-0.5738 **	0.2507	-0.5679 **	0.2461
Marital status																
single	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
married	0.2221 ***	0.0321	0.1959 ***	0.0278	0.0820	0.0689	0.0534	0.0612	0.2841 ***	0.0318	0.2456 ***	0.0287	0.4559 **	0.2000	0.4489 **	0.1936
divorced/sep./wid.	0.1040 ***	0.0425	0.0933 ***	0.0368	0.0088	0.1023	-0.0182	0.0905	0.1322 ***	0.0456	0.1235 ***	0.0409	0.4903 **	0.2626	0.4811 **	0.2538
Smoking status																
current smoker	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
ex-current smoker	0.5686 ***	0.0285	0.4871 ***	0.0242	0.4727 ***	0.0554	0.4095 ***	0.0488	0.2226 ***	0.0254	0.1926 ***	0.0224	-0.0458	0.1770	-0.0479	0.1722
not smoking	0.3236 ***	0.0245	0.2800 ***	0.0212	0.2137 ***	0.0516	0.1815 ***	0.0459	-0.0452 ***	0.0225	-0.0442 ***	0.0201	-0.4812	0.1559	-0.4706	0.1503
Occupation status																
working	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
not working	0.1923 ***	0.0230	0.1706 ***	0.0197	0.3349 ***	0.0485	0.3080 ***	0.0430	0.1631 ***	0.0231	0.1512 ***	0.0207	0.1495	0.1108	0.1475	0.1076
Ethnicity																
White	*ref.*		*ref.*													
Black	0.4834 ***	0.0567	0.4201 ***	0.0466												
Asian	-0.4495 ***	0.0486	-0.3954 ***	0.0404												
Education level -Men																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle	0.1402 ***	0.0352	0.1396 ***	0.0309	-0.0394	0.1041	-0.0268	0.0957	0.3813 ***	0.0558	0.3508 ***	0.0511	0.0312	0.1704	0.0389	0.1659
low	0.2728 ***	0.0424	0.2760 ***	0.0369	0.4042 ***	0.0845	0.3971 ***	0.0771	0.6693 ***	0.0548	0.6325 ***	0.0500	-0.1995	0.2315	-0.1888	0.2262
Education level -Women																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle	0.2763 ***	0.0360	0.2417 ***	0.0316	0.3954 ***	0.1005	0.3392 ***	0.0927	0.5422 ***	0.0763	0.5082 ***	0.0724	0.6686 ***	0.2196	0.6618 ***	0.2161
low	0.6299 ***	0.0419	0.5572 ***	0.0364	0.8536 ***	0.0869	0.7763 ***	0.0796	1.2310 ***	0.0743	1.1525 ***	0.0702	1.7705 ***	0.2288	1.7369 ***	0.2235
SEC																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle-high	0.3769 ***	0.0537	0.3323 ***	0.0473	0.1981 **	0.0857	0.1698 **	0.0779	0.0442	0.0426	0.0437	0.0374	-0.0157	0.1521	-0.0249	0.1472
middle	0.3805 ***	0.0546	0.3488 ***	0.0482	0.4137 ***	0.0894	0.3766 ***	0.0808	-0.0980 **	0.0416	-0.0845 **	0.0367	0.0585	0.1489	0.0580	0.1436
middle-low	0.4819 ***	0.0582	0.4506 ***	0.0511	0.3965 ***	0.1107	0.3694 ***	0.0983	0.2796 ***	0.0493	0.2547 ***	0.0427	0.0360	0.1516	0.0334	0.1461
low	0.5559 ***	0.0672	0.5085 ***	0.0586	0.6295 ***	0.1330	0.5610 ***	0.1146	0.1433 ***	0.0386	0.1347 ***	0.0339	0.2397	0.1598	0.2298	0.1533
very low					0.6536	0.0889	0.6081	0.0798								
year	0.0592 ***	0.0033	0.0519 ***	0.0027	0.0377 ***	0.0068	0.0332 ***	0.0057	0.0190 ***	0.0027	0.0165 ***	0.0023	0.0734 ***	0.0170	0.0716 ***	0.0162
constant	-123.680 ***	6.5594	-108.390 ***	5.3446	-83.2652 ***	13.5110	-73.3169 ***	11.3507	-46.2904 ***	5.4843	-40.5038 ***	4.6656	-149.546 ***	33.9355	-145.504 ***	32.3943
rho	0.2348	0.0095			0.2765	0.0187			0.2630	0.0087			0.1716	0.0624		

Note 1: Only the most recent years (last decade) are analyzed. Regression models are unweighted because weights at the household level are not available.
Note 2: The estimates represent the impact of various socio-economic characteristics on the probability of obesity. The variable ethnicity is only available in England. The variable SEC (socio-economic condition) is a 5-class variable in England, Italy and Korea but it is a 6-class variable in France (professional and managers; skilled white collar; clerks; self-employed; farmers; unskilled workers). The SEC variable in Korea is based on equivalised household income quintiles whereas it is based on occupation in other countries.
Note 3: (*) means significant at 10%, (**) significant at 5%, (***) significant at 1%.

Table 4: Coefficients and standard errors (S.E.) from both multilevel and single-level logistic models for the probability of overweight including interaction terms between gender and education level

	England				France				Italy				Korea			
OVERWEIGHT	Multilevel model		Single-level model		Multilevel model		Single-level model		Multilevel model		Single-level model		Multilevel model		Single-level model	
	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.	Estimates	S.E.
age	0.1139 ***	0.0044	0.0984 ***	0.0038	0.1348 ***	0.0079	0.1161 ***	0.0069	0.1471 ***	0.0038	0.1284 ***	0.0033	0.0735 ***	0.0136	0.0690 ***	0.0127
age squared	-0.0009 ***	0.0001	-0.0008 ***	0.0000	-0.0010 ***	0.0001	-0.0009 ***	0.0001	-0.0011 ***	0.0000	-0.0010 ***	0.0000	-0.0007 ***	0.0002	-0.0007 ***	0.0001
Gender																
man	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
woman	-0.8738 ***	0.0303	-0.7415 ***	0.0265	-1.1605 ***	0.0507	-0.9910 ***	0.0450	-1.6077 ***	0.0422	-1.3862 ***	0.0376	-1.3669 ***	0.0940	-1.2800 ***	0.0886
Marital status																
single	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
married	0.4158 ***	0.0247	0.3633 ***	0.0210	0.3104 ***	0.0412	0.2630 ***	0.0352	0.5214 ***	0.0183	0.4469 ***	0.0154	0.4587 ***	0.0819	0.4337 ***	0.0765
divorced/sep./wid.	0.1872 ***	0.0343	0.1609 ***	0.0297	0.1347 ***	0.0643	0.1132 ***	0.0552	0.2682 ***	0.0276	0.2402 ***	0.0236	0.4371 ***	0.1099	0.4147 ***	0.1025
Smoking status																
current smoker	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
ex-current smoker	0.5550 ***	0.0242	0.4842 ***	0.0209	0.5063 ***	0.0345	0.4273 ***	0.0295	0.1770 ***	0.0170	0.1492 ***	0.0146	0.2715 ***	0.0665	0.2473 ***	0.0620
not smoking	0.3276 ***	0.0192	0.2823 ***	0.0165	0.2744 ***	0.0305	0.2309 ***	0.0262	-0.0912 ***	0.0136	-0.0771 ***	0.0116	0.2014 ***	0.0611	0.1836 ***	0.0571
Occupation status																
working	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
not working	-0.0430 **	0.0191	-0.0420 **	0.0166	0.1254 ***	0.0311	0.1060 ***	0.0271	0.0531 ***	0.0143	0.0571 ***	0.0125	0.0351	0.0452	0.0366	0.0426
Ethnicity																
White	*ref.*		*ref.*													
Black	0.4441 ***	0.0506	0.3917 ***	0.0429												
Asian	-0.2478 ***	0.0366	-0.2141 ***	0.0300												
Education level -Men																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle	0.0198	0.0284	0.0352	0.0250	0.1021 *	0.0529	0.0896 *	0.0462	0.2702 ***	0.0297	0.2506 ***	0.0256	-0.0983	0.0644	-0.0877	0.0602
low	0.0426	0.0362	0.0746 **	0.0319	0.3621 ***	0.0462	0.3386 ***	0.0402	0.3986 ***	0.0299	0.3811 ***	0.0257	-0.3991 ***	0.0797	-0.3621 ***	0.0741
Education level -Women																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle	0.3301 ***	0.0282	0.2933 ***	0.0247	0.3279 ***	0.0572	0.2909 ***	0.0510	0.4238 ***	0.0367	0.3804 ***	0.0328	0.6390 ***	0.0817	0.6034 ***	0.0778
low	0.6738 ***	0.0349	0.5989 ***	0.0305	0.8017 ***	0.0502	0.7155 ***	0.0443	1.0350 ***	0.0366	0.9228 ***	0.0325	1.4524 ***	0.0885	1.3623 ***	0.0825
SEC																
high	*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*		*ref.*	
middle-high	0.2773 ***	0.0398	0.2520 ***	0.0346	0.1040 **	0.0458	0.0929 **	0.0393	-0.0347	0.0258	-0.0268	0.0216	-0.1094 *	0.0586	-0.1039 *	0.0539
middle	0.2504 ***	0.0406	0.2375 ***	0.0353	0.1839 ***	0.0499	0.1762 ***	0.0430	-0.1586 ***	0.0246	-0.1292 ***	0.0207	-0.0178	0.0586	-0.0217	0.0538
middle-low	0.3158 ***	0.0440	0.2967 ***	0.0382	0.2263 ***	0.0650	0.1921 ***	0.0552	0.1633 ***	0.0317	0.1591 ***	0.0264	-0.0269	0.0602	-0.0242	0.0552
low	0.2641 ***	0.0531	0.2508 ***	0.0463	0.3190 ***	0.0849	0.3006 ***	0.0708	0.0717 ***	0.0236	0.0765 ***	0.0197	-0.0825	0.0671	-0.0829	0.0614
very low					0.3479	0.0500	0.3338	0.0428								
year	0.0377 ***	0.0027	0.0332 ***	0.0022	0.0198 ***	0.0043	0.0170 ***	0.0034	0.0044 **	0.0017	0.0039 ***	0.0014	0.0438 ***	0.0070	0.0408 ***	0.0063
constant	-78.4284 ***	5.3800	-69.1841 ***	4.4556	-44.4653 ***	8.5069	-38.2414 ***	6.8769	-13.3601 ***	3.4090	-11.9321 ***	2.7455	-90.3995 ***	13.9406	-84.3367 ***	12.6058
rho	0.1799	0.0076			0.2017 ***	0.0107			0.2035	0.0048			0.0956	0.0166		

Note 1: Only the most recent years (last decade) are analyzed. Regression models are unweighted because weights at the household level are not available.
Note 2: The estimates represent the impact of various socio-economic characteristics on the probability of overweight. The variable ethnicity is only available in England. The variable SEC (socio-economic condition) is a 5-class variable in England, Italy and Korea but it is a 6-class variable in France (professional and managers; skilled white collar; clerks; self-employed; farmers; unskilled workers). The SEC variable in Korea is based on equivalised household income quintiles whereas it is based on occupation in other countries.
Note 3: (*) means significant at 10%, (**) significant at 5%, (***) significant at 1%.

REFERENCES

Abdul-Rahim H. F. *et al.* (2003), "Obesity in a Rural and an Urban Palestinian West Bank population", *International Journal of Obesity*, 27, pp. 140–146.

Aitkin, M., Anderson, D. and Hinde, J. (1981), "Statistical Modelling of Data on Teaching Styles (with Discussion)", *Journal of Royal Statistic Society,* A 144, pp. 148-61.

Aitkin M. and N.T. Longford (1986), "Statistical Modelling Issues in School Effectiveness Studies (with Discussion)", *Journal of Royal Statistic Society,* A 149, pp. 1-43.

Allman-Farinelli, M.A. *et al.*, (2008) "Age, Period and Birth Cohort Effects on Prevalence of Overweight and Obesity in Australian Adults from 1990 to 2000", *European Journal of Clinical Nutrition,* 62, pp. 898-907.

Arendt, J. N. (2004), "Does Education Cause Better Health? A Panel Data Analysis Using School Reforms for Identification", *Economics of Education Review,* 24, no. 2, pp. 149–60.

Bhargava, A. (2008), "Randomized Controlled Experiments in Health and Social Sciences: Some Conceptual Issues", *Economic and Human Biology*, 6(2), pp. 293-8.

Branca, F., H. Nikogosian and T. Lobstein (eds.) (2007), "The Challenge of Obesity in the WHO European Region and the Strategies for Response", Copenhagen, WHO Regional Office for Europe.

Case A. and A. Menendez (2007), "Sex Differences in Obesity Rates in Poor Countries: Evidence from South Africa", Cambridge, MA, National Bureau of Economic Research, Working Paper 13541 http://www.nber.org/papers/w13541.

Cawley, John (2000), "Body Weight and Women's Labor Market Outcomes", Cambridge, MA, National Bureau of Economic Research, Working Paper No. 7841.

Chaix, B. and P. Chauvin (2003), "Tobacco and Alcohol Consumption, Sedentary Lifestyle and Overweightness in France: A Multilevel Analysis of Individual and Area-Level Determinants", *European Journal of Epidemiology,* 18, pp. 531–538.

Chou, S., M. Grossman and H. Saffer (2003), "An Economic Analysis of Adult Obesity: Results from the Behavioral Risk Factor Surveillance System", *Journal of Health Economics,* 23, pp. 565–587.

Christakis, N. A. and J.H. Fowler (2007), "The Spread of Obesity in a Large Social Network over 32 Years", *New England Journal of Medicine,* 26:357(4), pp. 370-9.

Cutler, D. M., E.L. Glaeser and J.M. Shapiro (2003), "Why Have Americans Become More Obese?" *Journal of Economic Perspectives*, Vol. 17 (3, Summer), pp. 93-118.

Dollman J. and A. Pilgrim (2005), "Changes in Body Composition between 1997 and 2002 among South Australian Children: Influences of Socio-Economic Status and Location of Residence", *Australian and New Zealand Journal of Public Health*, 29, pp. 166–170.

Ebbeling, C.B., D.B. Pawlak and D.S. Ludwig (2002), "Childhood Obesity: Public-Health Crisis, Common Sense Cure", *The Lancet*, 360, pp. 473-482.

Eide, E. and M. Showalter (1999), "Factors Affecting the Transmission of Earnings Across Generations: A Quantile Regression Approach", *Journal of Human Resources,* 34(2), pp. 253-267.

Ellaway, A. *et al.* (2007), "Nowhere to Play? The Relationship between the Location of Outdoor Play Areas and Deprivation in Glasgow", *Health & Plac*e, 13, pp. 557–561.

Fienberg, S.E. and W.M. Mason (1985), "Specification and Implementation of Age, Period, and Cohort Models", *Cohort Analysis in Social Research*, New York: Springer-Verlag, pp. 45-88.

Butland, B. *et al.* (2007), "Tackling Obesities: Future Choices – Project Report", Government Office of the Chief Scientist, http://www.foresight.gov.uk.

Fontaine, K. R. *et al.* (2003), "Years of Life Lost Due to Obesity", *Journal of the American Medical Association*, 289, pp.187-193

Fu, W.J. (2000), "Ridge Estimator in Singular Design with Application to Age-Period-Cohort Analysis of Disease Rates", *Communications in Statistics-Theory and Method,* 29, pp. 263-278.

Fu, W. J. and P. Hall (2004), "Age-Period-Cohort Analysis: Structure of Estimators, Estimability, Sensitivity and Asymptotics", *Journal of the American Statistical Association*, under review.

Fu, W.J. and T.E. Rohan (2004), "Age-Period-Cohort Analysis: Consistent Estimation by the Intrinsic Estimator", *Journal of the American Statistical Association*, under review.

Glenn, N.D. (1976), *Cohort Analysis*, Quantitative Applications in the Social Sciences, Sage Publications.

Goldstein, H. (1986), "Multilevel Mixed Linear Model Analysis Using Iterative Generalized Least Squares", *Biometrika*, 73, pp. 43-56.

Gosling, A., S. Machin and C. Meghir (2000), "The Changing Distribution of Male Wages in the U.K.", *Review of Economic Studies*, 67:4, pp. 635–66.

Gortmaker, S.L. *et al.* (1993), "Social and Economic Consequences of Overweight among Adolescents and Young Adults", *New England Journal of Medicine*, 329, pp. 1008-12.

Guntupalli, A.M. (2006), "Inquiry into the Simultaneous Existence of Malnutrition and Overweight in India", http://paa2006.princeton.edu/download.aspx?submissionId=61837.

Hao, L. and J.H. Kim (2007), "Race-Ethnicity and Unhealthy Body Mass: A Quantile Regression Analysis", Prepared for presentation at the 2007 Annual Meeting of the Population Association of America, January 2007, http://paa2007.princeton.edu/download.aspx?submissionId=70920.

Iseri, A. and Arslan, N. (2008), "Obesity in Adults in Turkey: Age and Regional Effects", *European Journal of Public Health*, vol. 19, No. 1, 91-94.

Kahn, L. M. (1998), "Collective Bargaining and the Interindustry Wage Structure: International Evidence", *Economica*, vol. 65(260), London School of Economics and Political Science, pp. 507-34.

Kahn, H. S. *et al.* (1998), "Are Geographic Regions with High Income Inequality Associated with Risk of Abdominal Weight Gain?", *Social Science & Medicine*, 47, pp. 1–6.

Knai, C. et al. (2007), "Actions and Policies to Promote Physical Activity", *The Challenge of Obesity in the WHO European Region and the Strategies for Response*, Copenhagen, World Health Organisation.

Kerr, W.C. *et al.* (2007), "Age–Period–Cohort Influences on Trends in Past Year Marijuana Use in the US from the 1984, 1990, 1995 and 2000 National Alcohol Surveys", *Drug and Alcohol Dependence* 86, pp. 132–138.

Koenker, R.W. and G. Bassett Jr (1978), "Regression Quantiles", *Econometrica*, vol. 46(1), Econometric Society, pp. 33-50.

Koenker, R. and K. Hallock (2001), "Quantile Regression: An Introduction", *Journal of Economic Perspectives*, 15, pp. 143–156.

Knight, K. and W.J. Fu (2000), "Asymptotics for Lasso-type Estimators", *Annals of Statistics*, 28, pp. 1356-1378.

Kupper, L.L. *et al.* (1985), "Statistical Age-Period-Cohort Analysis: A Review and Critique", *Journal of Chronic Disease,* 38, pp. 811-830.

Kwon, J.W. *et al.* (2008), "Effects of Age, Time Period, and Birth Cohort on the Prevalence of Diabetes and Obesity in Korean Men", *Diabetes Care*, 31, 2, Health Module p. 255.

Lakdawalla, D. and T. Philipson (2002), "The Growth of Obesity and Technological Change: A Theoretical and Empirical Examination", Working Paper 8946, http://www.nber.org/papers/w8946

Lobstein, T. and R. Jackson Leach (2007), "Tackling Obesities: Future choices – International Comparisons of Obesity Trends, Determinants and Responses – Evidence Review", Foresight, Government Office of the Chief Scientist, http://www.foresight.gov.uk.

Longford, N.T. (1987), "A Fast Scoring Algorithm for Maximum Likelihood Estimation in Unbalanced Mixed Models with Nested Random Effects", *Biometrika*, 74, pp. 817–827.

Mackenbach, J.P. and A.E. Kunst (1997), "Measuring the Magnitude of Socio-Economic Inequalities in Health: an Overview of Available Measures Illustrated with Two Examples from Europe", *Social Science and Medicine,* Vol. 44 No. 6, pp. 757-771.

Mason, K.O. *et al.* (1973), "Some Methodological Issues in Cohort Analysis of Archival Data", *American Sociological Review*, 38, pp. 242-58.

McPherson, K., T. Marsh and M. Brown (2007), "Tackling Obesities: Future Choices—Modelling Future Trends in Obesity and their Impact on Health", Report for Foresight, Government Office of the Chief Scientist, http://www.foresight.gov.uk.

Mills T. C. (2009), "Forecasting Obesity Trends in England", *Journal of the Royal Statistical Society*, 172, Part 1, pp. 107-1017

Moolgavkar, S.H., R.G. Stevens and J.A.H. Lee (1979), "Effect of Age on Incidence of Breast Cancer in Females", *Journal of the National Cancer Institute*, 62, pp. 493-501.

Moon, G. *et al.* (2007), "Fat Nation: Deciphering the Distinctive Geographies of Obesity in England", *Social Science & Medicine*, 65, pp. 20–31.

Morris, S. (2006), "Body Mass Index and Occupational Attainment", *Journal of Health Economics*, 25, pp. 347-364.

Oberaigner, W. *et al.* (2006), "Reduction of Prostate Cancer Mortality in Tyrol, Austria, after Introduction of Prostate-specific Antigen Testing", *American Journal of Epidemiology,* Vol. 164, No. 4.

O'Brien, R.M. (2000), "Age Period Cohort Characteristic Models", *Social Science Research,* 29, pp. 123-139.

OECD (2007), *Health at a Glance*, OECD Indicators, OECD, Paris.

Olshansky S. J. *et al*. (2005), "A Potential Decline in Life Expectancy in the United States in the 21st Century", *The New England Journal of Medicine*, 352(11), pp. 1138-1145

Osmond, C. and M.J. Gardner (1982), "Age, Period and Cohort Models Applied to Cancer Mortality Rates", *Statistics in Medicine,* 1, pp. 245-59.

Pamuk, E.R. (1985), "Social Class and Inequality in Mortality from 1921 to 1972 in England and Wales", *Population Studies,* 39, pp. 17-31.

Rami, B. (2004), "Prevalence of Overweight and Obesity in Male Adolescents in Austria between 1985 and 2000; a Population Based Study", *Journal of Pediatric Endocrinology & Metabolism*, 17(1), pp. 67–72.

Raudenbush, S.W. and A.S. Bryk (1986), "A Hierarchical Model for Studying School Effects", *Sociology of Education*, 59, pp. 1-17.

Rice, N. *et al.* (1998), "The Influence of Households on Drinking Behaviour: a Multilevel Analysis", *Social Science & Medicine,* Vol. 46, No. 8, pp. 971-79.

Roberston, C. and R. Ecob (1999), "Simultaneous Modelling of Time Trends and Regional Variation in Mortality Rates", *International Journal of Epidemiology*, 28, pp. 955-963.

Ruhm, C. (2007), "Current and Future Prevalence of Obesity and Severe Obesity in the United States", *Forum for Health Economics & Policy*, vol. 10(2), Berkeley Electronic Press, page 1086.

Savage, J.S., J.O. Fisher and L.L. Birch (2007), "Parental Influence on Eating Behavior: Conception to Adolescence", *The Journal of Law, Medicine & Ethics*, 35 (1), pp. 22-34.

Skidmore, P.M.L. and J.W.G. Yarnell (2004), "The Obesity Epidemic: Prospects for Prevention", *QJM,* 97(12), pp. 817-825.

Snethen, J.A., J.B. Hewitt and M. Goretzke (2007), "Childhood Obesity: The Infancy Connection", *Journal of Obstetric, Gynecologic & Neonatal Nursing*, Volume 36, Number 5, pp. 501-510.

Sobngwi, E. *et al.* (2002), "Physical Activity and Its Relationship with Obesity, Hypertension and Diabetes in Urban and Rural Cameroon", *International Journal of Obesity*, 26, pp. 1009–1016.

Spasojevic, J. (2003), "Effects of Education on Adult Health in Sweden: Results from a Natural Experiment", PhD dissertation, Graduate Center, City University of New York.

van Lenthe, F. and J. Mackenbach (2002), "Neighbourhood Deprivation and Overweight: The GLOBE Study", *International Journal of Obesity*, 26, pp. 234–240.

Wagstaff, A., P. Paci and E. van Doorslaer (1991), "On the Measurement of Inequalities in Health", *Social Science & Medicine*, Vol. 33, No. 5, pp 545-557.

Wardle, J., J. Waller and M.J. Jarvis (2002), "Sex Differences in the Association of Socioeconomic Status with Obesity", *American Journal of Public Health*, 92, pp. 1299–1304.

Wei, M. *et al.* (1999), "Relationship between Low Cardiorespiratory Fitness and Mortality in Normal-Weight, Overweight and Obese Men", *Journal of the American Medical Association,* 282, pp. 1547–1553.

Willms, J., M. Tremblay and P. Katzmarzyk (2003), "Geographic and Demographic Variation in the Prevalence of Overweight Canadian Children", *Obesity Research*, 11, pp. 668–673.

World Health Organisation expert consultation (2004), "Appropriate Body-Mass Index for Asian Populations and its Implications for Policy and Intervention Strategies", *The Lancet,* 363, pp. 157-163.

Yang, Y., W. Fu and K. Land (2004), "A Methodological Comparison of Age-Period Cohort Models: the Intrinsic Estimator and Conventional Generalized Linear Models", *Sociological Methodology*, Volume 34, Issue 1, pp. 75-110.

Yang, Y. *et al.* (2008), "The Intrinsic Estimator for Age-Period-Cohort Analysis: What It Is and How to Use It", *American Journal of Sociology,* Volume 113, Number 6, pp. 1697–736.

OECD HEALTH WORKING PAPERS

No. 45 *THE OBESITY EPIDEMIC: ANALYSIS OF PAST AND PROJECTED FUTURE TRENDS IN SELECTED OECD COUNTRIES* (2009) Franco Sassi, Marion Devaux, Michele Cecchini and Elena Rusticelli

No. 44 *THE LONG-TERM CARE WORKFORCE: OVERVIEW AND STRATEGIES TO ADAPT SUPPLY TO A GROWING DEMAND* (2009) Rie Fujisawa and Francesca Colombo

No. 43 *MEASURING DISPARITIES IN HEALTH STATUS AND IN ACCESS AND USE OF HEALTH CARE IN OECD COUNTRIES* (2009) Michael de Looper and Gaetan Lafortune

No. 42 *POLICIES FOR HEALTHY AGEING: AN OVERVIEW* (2009) Howard Oxley

No. 41 *THE REMUNERATION OF GENERAL PRACTITIONERS AND SPECIALISTS IN 14 OECD COUNTRIES: WHAT ARE THE FACTORS EXPLAINING VARIATIONS ACROSS COUNTRIES?* (2008) Rie Fujisawa and Gaetan Lafortune

No. 40 *INTERNATIONAL MOBILITY OF HEALTH PROFESSIONALS AND HEALTH WORKFORCE MANAGEMENT IN CANADA: MYTHS AND REALITIES* (2008) Jean-Christophe Dumont, Pascal Zurn, Jody Church and Christine Le Thi

No. 39 *PHARMACEUTICAL PRICING & REIMBURSEMENT POLICIES IN GERMANY* (2008) Valérie Paris and Elizabeth Docteur

No. 38 *MIGRATION OF HEALTH WORKERS: THE UK PERSPECTIVE TO 2006* (2008) James Buchan, Susanna Baldwin and Miranda Munro

No. 37 *THE US PHYSICIAN WORKFORCE: WHERE DO WE STAND?* (2008) Richard A. Cooper

No. 36 *MIGRATION POLICIES OF HEALTH PROFESSIONALS IN FRANCE* (2008) Roland Cash and Philippe Ulmann

No. 35 *NURSE WORKFORCE CHALLENGES IN THE UNITED STATES: IMPLICATIONS FOR POLICY* (2008) Linda H. Aiken and Robyn Cheung

No. 34 *MISMATCHES IN THE FORMAL SECTOR, EXPANSION OF THE INFORMAL SECTOR: IMMIGRATION OF HEALTH PROFESSIONALS TO ITALY* (2008) Jonathan Chaloff

No. 33 *HEALTH WORKFORCE AND INTERNATIONAL MIGRATION: CAN NEW ZEALAND COMPETE?* (2008) Pascal Zurn and Jean-Christophe Dumont

No. 32 *THE PREVENTION OF LIFESTYLE-RELATED CHRONIC DISEASES: AN ECONOMIC FRAMEWORK* (2008) Franco Sassi and Jeremy Hurst

No. 31 *PHARMACEUTICAL PRICING AND REIMBURSEMENT POLICIES IN SLOVAKIA* (2008) Zoltán Kaló, Elizabeth Docteur and Pierre Moïse

No. 30 *IMPROVED HEALTH SYSTEM PERFORMANCE THROUGH BETTER CARE COORDINATION* (2007) Maria M. Hofmarcher, Howard Oxley, and Elena Rusticelli

A full list of the papers in this series can be found on the OECD website: www.oecd.org/els/health/workingpapers

RECENT RELATED OECD PUBLICATIONS:

OECD REVIEWS OF HEALTH SYSTEMS – TURKEY (2009)

THE LOOMING CRISIS IN THE HEALTH WORKFORCE: CAN OECD COUNTRIES RESPOND? (2008)

PHARMACEUTICAL PRICING POLICIES IN A GLOBAL MARKET (2008)

OECD HEALTH DATA 2008 (2008), available in English, French, German, Italian and Spanish on CD-ROM (Windows XP/Vista); online version features these languages.

HEALTH AT A GLANCE: OECD INDICATORS 2007 (2007).
See www.oecd.org/health/healthataglance for more information

OECD REVIEWS OF HEALTH SYSTEMS - SWITZERLAND (2006)

LONG-TERM CARE FOR OLDER PEOPLE (2005), *OECD HEALTH PROJECT SERIES*

HEALTH TECHNOLOGIES AND DECISION MAKING (2005), *OECD HEALTH PROJECT SERIES*

*OECD REVIEWS OF HEALTH CARE SYSTEMS - FINLAND (*2005)

OECD REVIEWS OF HEALTH CARE SYSTEMS - MEXICO (2005)

PRIVATE HEALTH INSURANCE IN OECD COUNTRIES (2004), *OECD HEALTH PROJECT SERIES*

TOWARDS HIGH-PERFORMING HEALTH SYSTEMS - POLICY STUDIES (2004), *OECD HEALTH PROJECT SERIES*

TOWARDS HIGH-PERFORMING HEALTH SYSTEMS (2004), *OECD HEALTH PROJECT SERIES*

OECD REVIEWS OF HEALTH CARE SYSTEMS - KOREA (2003)

A DISEASE-BASED COMPARISON OF HEALTH SYSTEMS: WHAT IS BEST AND AT WHAT COST? (2003)

MEASURING UP: IMPROVING HEALTH SYSTEMS PERFORMANCE IN OECD COUNTRIES (2002)

A SYSTEM OF HEALTH ACCOUNTS (2000)

For a full list, consult the OECD On-Line Bookstore at www.oecd.org,
or write for a free written catalogue to the following address:

OECD Publications Service
2, rue André-Pascal, 75775 PARIS CEDEX 16
or to the OECD Distributor in your country