

## Executive summary of work packages

### Work Package 1: Co-ordination of the Project

#### Introduction

For the coordination of the project the following objectives were formulated:

1. To support the overall running of the project through the co-ordination of activities of all work packages and the construction of a management information system.
2. To set up a structure for communication and information dissemination among project members, scientific networks and research groups working on physical activity, nutrition, overweight/obesity and health inequalities in the European Union.

More detail, the central responsibility for this the HOPE project included the following tasks: 1) the financial management of the entire project, 2) communication and reporting to the European Commission, 3) follow-up of progress of each work-package and objectives of the project as a whole. This work package thus was responsible for the day-to-day management played a central role in quality control and project reporting.

#### Methods and actions

Right from the start of the project, plenary meetings were organised. With intervals of approximately 6 weeks, phone conferences were organised in which the progress of the project, as well as the contents of the work was discussed. Over the whole period of the project, four steering committee meetings were organised in Rotterdam (the "kick-off" meeting, Geneva (May 2008), Amsterdam (November 2008) and Amsterdam (May 2009). To enhance the communication, a website was built in the first months of the project: [www.hopeproject.eu](http://www.hopeproject.eu). Information about the project was released through the website, including presentation given about the project. A weekly update on obesity ("obesity in the news") composed by the International Obesity Task Force/International Association for the Study of Obesity (IOTF/IASO) was made available through the HOPE website. This work package also coordinated writing the interim and this final report.

## **Work Package 2: Integrating obesity research in Europe: A network of networks**

### **Introduction**

The objectives stated in Annex 1 to the contract required the completion of a number of linked tasks:

- To set up a Network of research efforts at the European level on obesity and overweight prevention, nutrition and physical activity, and health inequalities in these issues across Europe, including special attention to Eastern Europe;
- To hold meetings of this Network for the purpose of exchanging information and reviewing the outputs of the HOPE project;
- To use the results of the HOPE reviews and Network meetings to collate existing and generated knowledge on obesity and determinants in order to provide the European Commission and other policy-makers a basis for further policy development.

This report summarises these activities, with a brief description of the methods and actions, a report of the outcomes and a short conclusion.

### **Methods and actions**

1. Network of Networks: Identification of obesity-related research and policy networks in Europe.

An extensive search using scientific websites, European Commission databases, members of the International Association for the Study of Obesity and the European Association for the Study of Obesity and other sources led to the compilation of an initial list of experts involved in research and policy development projects on obesity-related topics in Europe. Special attention was paid to ensuring representation from Eastern European member states. The results were circulated and refined, uploaded onto the HOPE website and used for the other parts of this work package.

2. Network meetings: strengthening the evidence base

In the course of the HOPE project two Network meetings were organized bringing together expertise from across Europe and beyond. The first Network meeting was designed to present the HOPE project and discuss its approach to the research issues and the initial findings of the work packages. The second Network meeting was designed to present the consolidated findings and conclusions of the work packages. In both meetings the intention was to share the process with experts from outside the project and discuss the implications of the project in terms of the potential added value for informing policy-making.

The invitation lists to join the two Network meetings were created from the Network of Network listings described above, plus policy making agencies and experts known to the International Association for the Study of Obesity working outside the European Union, both in other European countries and in other regions of the world.

In order to maximize the likelihood of good attendance, two approaches were taken. The first was to schedule the Network meetings immediately prior to the annual European Congress on Obesity (ECO) organized by the European Association for the Study of Obesity, normally attended by over 2000 researchers, clinicians and other specialists and related commercial operators working in the field of obesity. The second approach to ensure attendance was to offer some financial support to those potential attendees who were not intending to register for the ECO events. In the latter case, priority was given to attendees coming from Eastern European member states.

The format for the Network meetings was similar in both cases. The HOPE project work package findings were presented to the meeting, followed by invited responses from non-HOPE experts, followed by an open meeting discussion. In the second Network meeting, the invited respondents included policy makers from national governments and from DG Sanco, in addition to research experts.

### 3. Maintaining the Network: website and news services

Besides Network meetings, further efforts to maintain a viable Network were made through the development of the HOPE website and portal, and through the development of a HOPE weekly 'obesity in the news' service. The service is generated by the International Association for the Study of Obesity and fed through the HOPE website on a weekly basis, using material from general publications, news services and scientific journals. In addition to placing the news material on the HOPE website, a notice of fresh material is sent weekly to a subscriber list: this list is based on the Network listing and includes additional (mostly non-European) subscribers who have asked to join. Some 450 subscribers receive the weekly news alerting service by email, generating a regular flow of visitors to the HOPE website.

### 4. Eastern Europe: including broad expertise

The two Network meetings and the listing of Networks of Networks, described above, placed particular emphasis on ensuring inclusion of representation from experts in Eastern European member states. In addition to these actions, a third meeting was organized to invite representation from six Eastern European member states to discuss trends in obesity prevalence in their region. This meeting was also held in association with one of the ECO events. Invited Eastern European delegates were offered financial support to attend the meeting.

Further inclusion of Eastern European expertise was obtained through strengthened links made between individual work package leaders and colleagues in Eastern Europe, and through HOPE work package leaders travelling to Eastern Europe to participate in meetings.

## 5. Policy relevance: adding value to the evidence base

A further task for work package 2 was the dissemination of the research findings and Network expertise to the policy-oriented, non-research community. The approaches used to achieve this included (i) the expansion of the second Network meeting to ensure that policy-making bodies were represented and were formally participating as respondents to the HOPE work package findings, and (ii) the production of a document summarising the research findings and the implications for policy, laid out in a format relevant to policy-making organisations, and (iii) a short version of the document in the form of a 'Two-page summary' of the HOPE findings specifically aimed at policy-making organisations.

## **Outcomes**

### 1. Network of Networks

The search for information on obesity-related research groups and cross-European organisations and programmes resulted in over 130 entries to the Network listings. The results are available as a spreadsheet on the HOPE project website (See [http://www.hopeproject.eu/index.php?nav\\_id=9](http://www.hopeproject.eu/index.php?nav_id=9)).

### 2. Network meetings

An attendance of some 50 participants at each Network meeting was anticipated in the HOPE project proposals (Annex 1, p95). The first meeting was held in Geneva over two days, 13-14 May 2008, and attracted some 70 participants. The second meeting was held in Amsterdam for one day, 6 May 2009, and attracted over 100 participants. A summary of the proceedings from both meetings are included in the deliverables for the HOPE project.

### 3. Maintenance of Network

The weekly news service has continued for from 2008 through all of 2009 and will continue as a service from IASO through 2010. As of the end of the HOPE project, some 450 subscribers each week were receiving the 'obesity in the news' alerting service by email, generating a regular flow of visitors to the HOPE website. During 2010 this service will be duplicated on the website of the International Association for the Study of Obesity (IASO) at [www.iaso.org](http://www.iaso.org) and in 2011 it is expected that the HOPE website will be available only as an archive while the IASO website continues the news service.

### 4. Inclusion of Eastern Europe

The additional meeting of Eastern European representatives was held in Geneva on 14<sup>th</sup> May 2008. A record of its proceedings is included in the proceedings of the first Network meeting held 13-14<sup>th</sup> May. Six presentations were anticipated and in the event eight were made, from Slovenia, Czech Republic, Lithuania, Poland, Hungary, Bulgaria, Latvia and Romania. A further

fifteen Eastern European experts and ten HOPE work package leaders also attended this meeting.

Further activities were undertaken through visits made to meetings in Eastern Europe: in particular representatives from work package 2 and work package 8 gave presentations to the 3rd Balkan Congress on Obesity & 8th Macedonian Congress on Nutrition and Dietetics, 16-19<sup>th</sup> October 2008, held in Thessaloniki, Greece.

#### 5. Policy-related actions

Policy-related discussions were held in the Network meetings (see summaries) and these were instrumental in shaping the final two deliverables of this work package. The first output is the document summarising the research findings and the implications for policy, laid out in a format relevant to policy-making organisations, and the second output is a short version of the document in the form of a 'Two-page summary' of the HOPE findings specifically aimed at policy-making organisations. The main document crystallise the HOPE work package results, the discussions in the Network meetings, the contributions obtained from other research programmes and related material. The document was drafted by work package 2 staff and circulated for peer review to the other HOPE work package leaders. It is intended that the two-page summary and the policy document will be re-designed in early 2010 in order to be published as a stand-alone output from the HOPE project.

### **Conclusions**

The main activities in work package 2 involved the generation and maintenance of a resource – the Network of experts in Europe, including Eastern Europe – which could respond to the HOPE research effort and assist the HOPE consortium in the creation of a robust set of findings and, further, add value to the project by ensuring its results were available and relevant to policy-making organisations.

This was achieved through a variety of approaches outlined above. The project's outputs will continue into 2010 and beyond, through publications and through the maintenance of the Network and the web-based news services.

There is no external validation of the outputs of work package 2 in terms of the relevance for policy-makers, but the HOPE cross-European findings are closely consistent with the findings made in member state investigations, such as the UK Foresight enquiry, the French National Program for Nutrition and Health and other national reports concerning obesity policy.

## **Work Package 3: Early Childhood Obesity Prevention**

### **Introduction**

Based on the objectives stated in Annex 1 to the contract, the following reports were completed by the researchers in charge of the work package and their associates:

- Prevalence and socioeconomic correlates of overweight and obesity in infants and pre-school children in the European Union: a review of existing data.
- Early life determinants of overweight and obesity in infants and preschool children in Europe: a systematic review of reviews.
- Intervention for the prevention of overweight and obesity in infants and preschool children in Europe: a systematic review.

This report summarises the main findings of these three reports, with a brief description of the methods and a short conclusion.

### **Methods**

For the first review, all the available information on prevalence, time trends and association with social factors of overweight and obesity in infants and pre-school children in the 27 countries of the European Union (EU) was retrieved from the WHO databases on Nutrition Policies and on Child Growth and Malnutrition, from a list of references searched on PubMed and Google, and from researchers identified through these references and personal contacts. Data prior to 1990 were excluded from analysis, except for those used to analyse time trends, as well as studies that did not clearly report the methods used to collect and analyse data. For analysis, it was decided to use the 2000 references and cut-offs recommended by the International Obesity Task Force (IOTF) and the 2006 WHO child growth standards using as cut-offs the 1st, 2nd and 3rd standard deviations (SD) of the BMI-for-age. The associations between rates of overweight and obesity and socio-economic status (SES) in all the selected articles and reports in which such information was available were also examined. Because of the differences in choosing and defining SES variables in different countries, studies and reports, no attempt was made to analyse statistically or to compile summary tables of these data.

For the second review, owing to the voluminous number of papers retrieved, and the availability of earlier systematic reviews, it was decided to conduct a systematic review of existing reviews. The reviews were selected after a wide-ranging search for relevant studies using Medline and other databases that yielded more than 12,000 references. A sequential screening of titles, abstracts, keywords and full text, combined with a secondary search through cross references, own papers and experts, allowed identifying the 22 systematic reviews to be reviewed. Data were extracted from hard copies of the full papers and the

quality of the reviews was evaluated using the AMSTAR protocol. Finally, the database was searched for articles published after the date of the most recent systematic review for each determinant and 106 additional papers were used to update the results of the review of reviews.

The systematic review on interventions for the prevention of overweight and obesity in infants and preschool children focuses exclusively on randomized controlled trials (RCT's); studies and reviews focusing on treatment, and those without anthropometric measures as primary or secondary outcome were excluded. A search using Medline and other databases yielded 9,477 references, after duplicate removal. By a sequential screening of titles, abstract, keywords and full text, combined with a search on references of published systematic reviews, 31 references on potentially relevant RCT's were identified. After the exclusion of those without data on children under five years of age, 14 references on 7 RCT's were identified for the review. Data were extracted from hard copies of the full papers and their quality was evaluated using the Jadad scale. Finally, because birth weight and infant and young child feeding are considered important determinants of overweight and obesity in pre-school children, the available literature on interventions to improve them was reviewed to complement the results of the systematic review.

## **Results**

### *Prevalence*

Data on overweight and obesity in infants and pre-school children were available from 18 EU countries. Comparisons are problematic due to different definitions and methods of data collection and analysis. However, the original data and those obtained, whenever possible, from re-analysis of raw data using the IOTF reference and cut-offs, show that the prevalence of overweight plus obesity at four years ranges from 11.8% in Romania (2004) to 32.3% in Spain (1998/00), a three-fold difference. Countries in the Mediterranean region and the British islands report higher rates than those in middle, northern and Eastern Europe. Rates are generally higher in females than in males. The use of the WHO standard with cut-offs at 1, 2 and 3 SD yields lower rates, if one considers the 2 and 3 SD as thresholds for overweight and obesity, and removes the gender differences; the difference between the highest (Greece 2003/04: 15.7%) and the lowest (Czech Republic 2001: 5.4%) reported rates of BMI-for-age above 2 SD at four years is again three-fold. Figures 1 and 2 show how results differ when the same data on children 24 to 59 months of age are analysed using the IOTF reference and cut-offs or the WHO standard, by sex and country.

Data on trends over time are available for four countries using the IOTF reference and cut-offs (England, the Czech Republic, the Netherlands and France) and for three using the WHO standard (Romania, the Czech Republic and the Netherlands). The data refer to children 24 to

59 months of age, except for England (24 to 71 months) and France (36 to 59 months). With the possible exception of England, there is no obvious trend towards increasing prevalence in the past 20-30 years in these countries.

As far as SES and its association with overweight and obesity is concerned, comparisons among countries are complicated by the different definitions of SES used in different studies, in addition to the problems brought about by the different definitions and methods used to gather anthropometric data. Parental education is the most often reported SES factor, followed by parental occupation, income and area of residence. In general, studies report higher prevalence of overweight and obesity in the age group 2 to 18 years when parents have a lower level of education, are manual workers, have a lower income, and live in inner city areas. These associations, however, are not reported by all studies, and are often not complemented by a multivariate analysis.

#### *Determinants*

The evaluation of the methodological quality of the included reviews, carried out with the 11-point AMSTAR score, showed some heterogeneity, with an average score of 4.9 and 11 out of 22 reviews in the range between 4 and 5.5. Nine reviews focused on the relation between mother and child, and in particular on breastfeeding, and on maternal conditions or behaviours during pregnancy. Six other reviews explored family related risk and protective factors, two neighbourhood environmental factors, two society related issues, and four inherited traits and infant size and growth. Three of the four reviews with the highest AMSTAR scores focused on breastfeeding, while three of the four with the lowest scores centred on SES.

The review of reviews showed that obesity in pre-school children is predicted by parental obesity, including maternal birth weight. Several genes are probably involved in this inheritance; in most instances, however, the mechanisms underlying these associations have not been ascertained, and the size of the genetic contribution to childhood obesity has not been thoroughly investigated. Obesity in childhood is associated with low birth weight; infants who have been growth restrained in utero tend to gain weight, or catch up, more rapidly during the early postnatal period, which leads to increased central fat deposition and greater insulin resistance. Evidence suggests that the effect of maternal nutrition on foetal growth can in fact be programmed during the periconceptional period or even earlier in maternal life, thus contributing to an intergenerational cycle of obesity. But obesity is also associated with large birth weight and early growth; most studies show that rapid weight gain is consistently associated with increased risk. Maternal malnutrition early in pregnancy, gestational diabetes and prenatal exposure to smoking are associated with both birth weight and childhood obesity.

The exclusivity and duration of breastfeeding seem to be inversely associated with childhood and later obesity, though the adjustment for possible confounders tends to reduce the effect.

However, all the studies included in the systematic reviews were observational, because intervention studies on breastfeeding are almost impossible and would often be considered unethical. The only randomised trial that looked at the effect of an intervention on breastfeeding rates and duration, and subsequently at the effects of breastfeeding on obesity, did not report a lower prevalence of adiposity (measured as BMI and waist or hip circumference) among children in the intervention group compared to the control group. Randomization, however, was applied to clusters, as opposed to individuals, and looking at the effect of breastfeeding on obesity was not among the primary objectives of the study. Among other family factors, short sleep duration in infancy and early childhood was found to be associated with overweight at later ages. Recent studies have also related obesity in adulthood to early life experience of abuse and/or neglect. Finally, several studies found a higher risk of fatness associated with lower SES in childhood as determined by parental occupation or education or family income, or a combination of these factors; food insecurity or insufficiency may play a role in the aetiology of pre-school obesity even in high income countries.

As far as the physical and social environments are concerned, sedentarity, including high levels of TV viewing, is among the variables associated with overweight and obesity, while increasing levels of physical activity lower the risk. Social models of consumption may affect eating and drinking behaviours, and sedentarity. A positive association was found between greater intakes of sugar-sweetened beverages and weight gain and obesity in children. The association between TV viewing and childhood obesity is robust and confirmed by many studies, including a non-systematic review and an intervention study. However, the direction of causation and specific contribution of food advertising remains equivocal; a perennial problem in interpreting many of these studies is their cross-sectional design which raises the issue of reverse causality: while it is of course possible that the sedentary nature of TV viewing is a predictor of weight gain, it is equally likely that obesity in its own right may be related to TV viewing because other more strenuous childhood pastimes such as sports or active play are uncomfortable and therefore prohibitive for the overweight child.

Figure 3 presents the complex web of potential determinants of overweight and obesity in children less than five years of age as derived by this review of reviews.

### *Interventions*

Four of the seven interventions included in the review were carried out in pre-school and day-care settings, with an educational or physical activity component, or both; three of these interventions had also an educational module for parents. All these interventions, with duration ranging from 14 to 39 weeks, aimed at reducing TV viewing and at promoting healthy eating and physical activity. Despite some significant effect on intermediate outcomes (lower intake of saturated fatty acids, TV viewing), no effect on BMI and other growth measures could be attributed to the interventions. Two interventions were family based and targeted mothers

alone or both parents and children. In the first one, overweight mothers of children 9 to 36 months old were exposed to lessons emphasising mutual respect, child's encouragement techniques, psychological and behavioural goals (intervention) or to a generic parenting support module (control). Weight-for-height decreased in the intervention group while it increased in the control group, and the difference was almost statistically significant; at the end of the study, mothers in the intervention group engaged in less restrictive child feeding practices, i.e. mothers allowed children to eat a wider variety of foods, when compared with mothers in the control group. In the second study, a 13-year long prospective RCT, the intervention consisted of individualised dietary and lifestyle counselling given by a nutritionist and a physician at 1 to 3-months intervals until the child was two years old and biannually thereafter; the families in the control group only received the basic health education routinely given at well-child clinics. At 13 years of age, the intervention had no effect on any of the examined growth parameters. The trial, however, had a positive impact on diet with children in the intervention group having, at 4, 7 and 10 years of age, a significantly lower intake of calories per day, a lower calorie-adjusted fat intake and a higher ratio of unsaturated/saturated fat intake. The seventh intervention was carried out in maternity hospitals and consisted of a training of obstetric and paediatric staff of 16 hospitals on lactation management, while 15 hospitals acted as control. Despite a significant positive impact of the intervention on breastfeeding, no difference in anthropometric indices was recorded at 6.5 years of age.

## **Discussion and conclusions**

The main findings of the review of prevalence are that 9 out of 27 EU countries do not possess nationally representative data, that those with data use different definitions and methods for collection and analysis, that obesity is already prevalent in this age group in many EU countries, and that there are wide differences in reported prevalence among countries. Other interesting though less conclusive findings are that there is no evidence for an obvious trend towards an increasing prevalence in this age group, and that social inequalities may have different bearings in different countries. The use of different reference populations and cut-offs for overweight and obesity leads to different conclusions in terms of prevalence. It is unfortunately very difficult to decide which reference population and cut-offs should be used; to date, all cut-offs have been established in an arbitrary way, not based on clinical research on related health outcomes, and further research is therefore necessary. Further efforts are also required to develop a set of standard procedures for sampling and for anthropometric measurements; for the latter, the procedures recommended by the manual WHO has developed to train health workers on the use of its growth standard may be useful.

It is difficult to interpret the results of the reviews of determinants because of the complex associations of overweight and obesity with a large list of proximal and distal factors whose

reciprocal influence cannot be easily disentangled. Moreover, the evidence is stronger for some factors (genetic factors, parental obesity, maternal diabetes, large size at birth, rapid early growth, rapid catch-up growth after in utero growth restriction, lack or short duration of breastfeeding, sedentarity associate with TV viewing, excess use of sugar sweetened beverages) but weaker for others (marketing and advertising for unhealthy foods, intimate partner violence and child neglect, lack of green areas, difficult access to healthier foods in the environment, and food insecurity for the whole family). Also, none of the studies and reviews conducted so far has been able to include in a multivariate model all the factors potentially associated to childhood obesity. The large number of potential determinants means that for those with a causal association with childhood overweight and obesity this association may be weak. Yet, it remains important to identify those determinants for which it may be possible to implement effective interventions. Finally, the impact of an intervention on a potential determinant may have different effects in different populations owing to the relative weight of that determinant within the complex web of other determinants in different settings. Action on distant social determinants with a weak association with obesity may bring about larger effects than action on more proximal determinants with a strong association, due to the higher population preventable fraction. Multi-layered models of analysis are needed to identify the determinants to be targeted.

The conclusions of the review of interventions coincide with those of previous reviews in saying that so far no single or combined intervention has been able to show an effect in reducing overweight and obesity, or excessive growth, in pre-school children. In some cases, small effects have been observed in proxy variables, such as dietary and/or physical activity/sedentarity behaviours, but none of the examined interventions had an effect on weight gain or BMI. This result may be real, i.e. none of the interventions studied so far is effective, or spurious, i.e. the reported lack of effect may be due to faults in the design and conduction of the studies. The latter explanation may be at least partly true; by looking at the Jadad scores assigned to each of the seven trials, one sees that the average quality is low. But suppose the design and the conduction of the studies was good; the conclusion would be that interventions aiming at changing behaviour are ineffective, given the multiple factors involved in behavioural change, of which only few are targeted. It may be that only interventions that aim at modifying also the physical, cultural, economic, social and legislative environment, i.e. the upstream drivers of the obesity epidemic, have a chance of actually changing the rates of overweight and obesity. These environmental interventions are not only more difficult to implement, they are also difficult to evaluate because they imply getting out of the health sector to work with, for example, the media or departments in national or local administrations that deal with food prices and availability, traffic, green areas for leisure and physical activity, food industry, i.e. all those sectors that can bring about changes in the environment that would facilitate changes in behaviour and lifestyle.

## **Key findings and recommendations**

### Prevalence

- There are large differences across European countries and there is no evidence of an increasing trend in the prevalence of overweight and obesity in infants and pre-school children.
- There is a need for standard methods for monitoring overweight and obesity in infants and pre-school children in all European countries.
- WHO cut-off points for overweight and obesity in pre-school children need to be tested against IOTF cut-off points.

### Determinants

- Determinants of overweight and obesity most supported by data are for maternal nutrition, small and large birth weight, breastfeeding, catch-up growth, marketing of foods and beverages, and TV viewing.

### Interventions

- No single intervention in pre-school children has shown to be effective.
- Multi-faceted interventions in pregnant women, young children and families, acting on several determinants, may be effective and should target:
  - Control of smoking, promotion of diet and physical inactivity, and prevention of disease and infection in pregnancy.
  - Protection, promotion and support of breastfeeding.
  - Healthy family diet and physical activity, including reduced TV viewing.
  - Particularly among those with a low income, education, occupation, and residing in an obesogenic built environment).

## **Work Package 4: Obesity prevention among children and adolescents (10-18 years)**

### **Introduction**

Based on the objectives stated in Annex 1 to the contract, the following reports were completed by the researchers in charge of the work package and their associates:

- Prevalence and trends in overweight and obesity in childhood and adolescence (age 10-18) across Europe.
  - Theoretical frameworks and determinants of obesity in European children and adolescence – a literature review.
  - Behavioural patterns and environmental factors associated with the risk of overweight and obesity in adolescence – analysis of existing data sets.
- Effects of mass-media marketing on children's nutrition and sedentary behaviours - a literature review.

This report summarises the main findings of these three reports, with a brief description of the methods and a short conclusion.

### **Methods**

#### *Prevalence and trends*

Data on prevalence and trends of obesity among adolescents (age 10-18) in the 27 EC Member States, Iceland, Norway and Switzerland available by the end of 2008, were retrieved from a systematic search in Medline database. The reference lists of selected articles were screened for other relevant studies. Data from the WHO Nutrition Policy Database (WHO-NPD) and from the 2001/02 and 2005/06 "Health Behaviour in School-aged Children"-reports (HBSC) were extracted for the relevant countries, and the report "The challenge of obesity in the WHO European Region and the strategies for response" was searched for additional data. The WHO regional office for Europe and the International Obesity Task Force (IOTF) were contacted to obtain the most recent data on overweight and obesity among adolescents in the region.

#### *Theoretical frameworks and determinants of overweight and obesity in adolescence*

Two reviews of reviews were conducted based on literature searches in the PubMed database. The first search was for reviews on the relationship between energy-balance related behaviours (EBRB) and overweight/obesity. The second search was for reviews on the relationship between determinants (individual and environmental factors) and EBRB. Both searches were for reviews published from 2000-2008, covering all age groups but preferably adolescents/children. Based on the results of these reviews of reviews, an additional literature search was conducted in PubMed for European studies on determinants and EBRB among

adolescents published after the period covered by the reviews (in 2005-2008). Finally, relevant existing datasets from the 30 European countries were identified and reanalysed. This work was facilitated by a writing workshop in April 2008. The participants were contacted based on those suggested in Annex 1, studies found in literature searches and then cross-checked with the members of the HOPE consortium for completeness.

#### *Marketing review*

A review of systematic literature reviews was conducted to assess the potential impact of food marketing strategies on childhood risk of overweight, nutrition and sedentary behaviours.

## **Results**

#### *Prevalence and trends of overweight/obesity*

Prevalence data on overweight and obesity based on self-reported data from 11-, 13- and 15-yr olds were available from all the 29 countries (not Cyprus) through the HBSC-survey from 2005-06, and the majority of the countries (n=24) also participated in the 2001-2002 survey when such data were collected for the 13- and 15-year olds. The new countries added in 2005/06 were Bulgaria, Iceland, Luxembourg, Romania and Slovakia. In addition, prevalence data for overweight/obesity from the last decade based on national representative samples and objectively measured data were found for approximately half of the countries (table 1). However, the sources and quality of information varied, as did the sample sizes, response rates and age ranges studied. All studies reported the data by gender, but there were no clear patterns of gender differences across the countries. Among girls there seemed to be a decrease in prevalence of overweight/obesity by increasing age. The type of data collected on other socio-demographic factors varied and their relation with overweight/obesity prevalence were not necessarily reported. The well-known geographical differences with the highest prevalence among adolescents from southern Europe and the British Isles were confirmed. About half of the countries that did not have measured national data, had data on objectively measured height and weight from sub-national or convenience samples, in addition to the self-reported HBSC-data.

The WHO-report (2007) and an article by Jackson-Leach & Lobstein (2006) reported increasing trends of overweight/obesity among adolescents in the following countries: Greece (Crete), Denmark (Copenhagen), France (Northern), Germany (Zerbst, Hettsted, Bitterfeld), Northern Ireland, Spain (various regions), Sweden (Umeå), Sweden (Gottenburg), Switzerland, UK (England), UK (Scotland) and UK (South Northumberland). They did not report any countries with no change or a decrease. Since these publications, new reports on the increases have been reported from the following countries: Cyprus, Greece, Portugal, Ireland, UK (West Scotland), the Czech republic, Poland (Cracow) Poland (East rural), Finland, the Netherlands, Norway (Bergen) and Norway (middle) (Table 2). It should be noted that the more recent

studies from Sweden show stagnation or even decrease in the obesity epidemic among the girls in the samples of 10 year olds from Stockholm and Gottenburg. It should also be noted that most of these data are not national representative data and that data from the last 5 years are not yet available.

#### *Theoretical frameworks and determinants of overweight and obesity in adolescence*

Literature reviews on the relationship between the following dietary behaviours and overweight/obesity were found (number of reviews per behaviour): fast food (1), soft-drinks (3), breakfast (1), cereal grains/legumes (2), fruit/vegetables (2), calcium/dairy (1). In addition there were 3 reviews on overweight/obesity and physical activity and/or sedentary behaviours. There was a general lack of longitudinal or experimental studies within the dietary behaviours except for fast food and soft drinks, whereas for physical activity and sedentary behaviour there were many longitudinal studies. Only 5 of the reviews were on children/adolescents specifically. The majority of the studies reviewed were non-European.

Reviews on the determinants of dietary behaviours were found for: fruit and vegetable intake, family-related factors associated with breakfast consumption and environmental factors associated with total energy, fat, fruit, vegetables, juice, fast food, pizza's and snacks and soft drinks. Other less systematic reviews on the importance of parent-child feeding strategies, genetic and environmental determinants of food preferences, and importance of exposure for healthy eating, were also found to be relevant. A review on determinants of soft drink consumption has been initiated as part of this review process included. Another 3 systematic reviews of determinants of physical activity and sedentariness, television viewing, and environmental correlates of physical activity were found. In addition, a less systematic review on active commuting was included.

The strongest associations between each of the behaviours and the potential determinants were found for (see also figure 1):

- *Sugar sweetened beverages* with preferences, availability/accessibility, parental intake, lower socio-economic status
- *Fruit and vegetables* with preferences, availability/accessibility, parental intake, higher socio-economic status
- *Breakfast consumption* with parental breakfast consumption and living in two parent families
- *Physical activity* with boys, high SES, attitude, self-efficacy, goal orientation/motivation, physical education/school sports, family influences and friends support
- *Active commuting* with low SES, boys, increasing age, parental active commuting
- *TV-viewing* with parental TV viewing, TV in bedroom

The quality of the reviews varied, but the ones included here were either systematic or of higher quality/relevance.

From the search on European studies, 72 articles on potential determinants of EBRB were found of which 11 were longitudinal and only 17 studies (all cross-sectional) were inspired by/used a model or theory. The majority of articles and the theoretical studies came from the Netherlands, Belgium and UK. Few studies have investigated determinants from different levels (individual and environmental), with the behaviours and overweight/obesity in the same study. Assessing behavioural patterns and clusters of determinants was thus difficult, but two of the manuscripts from the writing workshop on existing data found protective effects of FV-consumption and sports participation on BMI, and that parental practices in childhood influenced dietary patterns in adolescence, respectively. The writing workshop has resulted in a series of 11 scientific papers, 9 of which will appear in a special issue of Public Health Nutrition; an additional 2 papers have already been published in other journals. Among these 11 articles, Eastern and Southern European countries (Poland, the Czech republic, Greece) were included, as well as the cross-national studies of HBSC and Pro Children. Collaboration with the HELENA-study has been established, but the data from this study are only now being analysed and published.

#### *Marketing review*

Available literature clearly demonstrates that food marketing targeting children through mass-media is highly prevalent. This child directed marketing consists both of 'traditional' advertising (TV, print media etc.), use of new electronic media (internet, mobile phones), but also point-of-purchase strategies and packaging. The marketed diet contrasts sharply with the recommended one. There is strong evidence showing that children recognize, enjoy and engage with this food promotion, and that food marketing is having an effect, particularly on children's preferences, purchase behaviour and consumption. This effect seems to be independent of other factors and operates at both brand and category level. Among the effects this food marketing is having on children's food consumption, is an increase in the intake of sugar sweetened soft drinks, sweet breakfast cereals, sweets and fast food. Thus, current mass media marketing of foods to children contribute to poorer nutrition and eating habits consistent with increased overweight rates. However, few studies to date have investigated the potential direct effect of such marketing on children's overweight status.

To date, few studies have investigated the effects of mass media marketing on children's sedentary behaviours.

## **Discussion and conclusions**

### *Prevalence and trends*

There is large heterogeneity in the quality and comparability of the data due to the methods used (self-report versus objective), the samples measured (national, sub national or convenience) and the variability of age groups and year of data collection. Often these data are only published in reports in native languages, which make them less accessible. On the positive side the IOTF cut-offs were often used to define prevalence of overweight/obesity. Based on the data found there are geographical differences, but no clear gender differences, whereas the data on development by age and for socio-demographic subgroups (i.e. SES and ethnicity) are not readily available. There are many reports on increasing prevalence of overweight/obesity over the 20-30 yrs prior to this decade, but less is known about what has taken place during the past 10 years. The majority of the measured trend data were not conducted in national, representative samples and most of the data were for early adolescence (10-14 yrs). The WHO European Childhood Obesity Surveillance Initiative aims to measure the trends in overweight and obesity in primary-school children (age 6-10) through standardized data collection procedures across Europe. The first data collection was in 2007/2008 and should be useful for postulating a similar system for adolescents as well. Finding these data was especially difficult as it was not possible to limit the search in PubMed to European studies, and many studies turned out to only be presented in reports in the countries native language.

### *Theoretical frameworks and determinants of overweight and obesity in adolescence*

There is a lack of prospective studies measuring both energy intake and output, as well as development of overweight/obesity. This is probably due to the methodological difficulty of measuring total diet and physical activity. Thus researchers present the evidences for sugar-sweetened beverages (SSB), fast food, physical activity (PA) and sedentary behaviour with caution. Yet, most evidence is found for increased consumption of SSB and fast food, and time spent watching TV as important contributors to the weight development. A recent review found a negative association between ready to eat cereals and overweight/obesity, but no association with fruit and vegetables. There are too few prospective studies on meal frequencies, whole grain and dairy/calcium consumption and overweight/obesity in children/adolescents to draw any conclusions. From a methodological perspective it was a problem that many of the reviews brought forward by our search strategies did not state their methodological approach (search terms, databases, limits etc), which makes it difficult to judge the quality of the reviews and thus reduced the numbers of reviews included here.

The majority of the studies take an a-theoretical, epidemiological approach to describing the relationship between behaviours and overweight/obesity. In Europe, there is especially a lack of theory-informed studies from southern and Eastern Europe. Most use of theories is seen in the analytical studies of determinants of the separate behaviours, and the strongest evidence

is thus to be found here (see figure 1). In the last decade, there has been a move from the use of individual level social-cognitive theories to ecological frameworks in explaining dietary and physical (in-)activity behaviours to encompass the influences of the social and physical environmental factors. However, the research on these environmental factors is still much in its infancy with regards to theory development, and the most frequently reported environmental factors are indicators of socio-economic status (SES). There is thus a paucity in figures/theoretical models that bridge these two levels of influential factors (individual and environmental (structural)), and that still are simple enough to have practical relevance for policy as well as research.

### *Marketing review*

As demonstrated by the included systematic literature reviews, there are an increasing number of studies pointing to the extent and impact of mass media marketing of food to children. While it is difficult to investigate the direct effect such marketing might have on children's weight status, there is strong evidence pointing to the overwhelmingly unhealthy diet that is being marketed, as well as the detrimental effects this is heaving on exposed children's diet. Young children are not able to differentiate between marketing strategies and educational efforts. Thus, the policy options pointed to is to reduce the overall exposure of marketing of unhealthy food and drinks to children, as well as to limit the use of particular persuasive marketing strategies targeting children. As food marketing through mass media to a large extent is international (i.e. it is being broadcasted across countries, often by multi-national food companies), there is a strong need for international (European) regulations limiting the amount of marketing of unhealthy food and drinks targeting children.

## **Key findings and recommendations**

### Prevalence and trends

- A cross-national monitoring system of overweight/obesity in adolescence with good data on socio-economic status and needed.
- Careful investigation into whether there are ethnic differences in overweight/obesity on European adolescents and whether any socio-demographic differences are mediated by social differences at the structural or cultural level.

### Theoretical frameworks and determinants of overweight and obesity in adolescence

Although several potential promising strategies to curb the overweight/obesity epidemic among adolescents are communicated from ongoing projects, the recommendations included here are those that can be derived from the published scientific literature identified as part of the work in this work package.

### Research

There is a need for more theory-based, longitudinal studies on development of overweight/obesity from across Europe, and development of a comprehensive theoretical framework of practical usefulness for policy as well as research.

### Practice

- School
  - Restrict availability/accessibility of SSB and fast food during the school day
    - Provide tasteful, healthful food and drink alternatives at feasible prices
  - Encourage physical activity time and equipment available (both during physical education (PE) and recess) and good teaching methods for PE.
- Families
  - Restrict availability/accessibility of SSB and fast food
    - Make tasteful, healthful food and drink alternatives easily available/accessible at home
  - Act as positive role models for consumption of breakfast, active commuting and TV/media use
  - Help children acquire taste preference for fruit and vegetables, whole grains, low-fat/low-sugar food and drinks, and water, and an active life style.
- Communities
  - Plan for safe and active commuting to school (also in adolescence).
  - Support parents in their parenting practices, including enforcement of rules, how to act as positive role models and how to develop taste preferences and an active life style.

### Marketing review

There is a need for international regulations limiting the amount of advertising of unhealthy food and drinks targeting children.

**Table 1:** Prevalence of overweight (incl. obesity) based on objectively measured weight and height among national representative samples of adolescents in European countries:

COUNTRY	YEAR	N (r.r. <sup>3</sup> )	AGE <sup>4</sup>	Prevalence (%) and age trend <sup>1</sup> of overweight/obesity <sup>2</sup> , age 10-18 yrs				Socio-demo graphics <sup>5</sup>	Source <sup>6</sup>
				BOYS	trend/age	GIRLS	trend/age		
<i>South/British Isles</i>									
Cyprus	1999-2000	2467 (95%)	6-17*	20-38	no pattern	13-32	decrease	U/R, Ot	Article
Greece	2003	14456 (87%)	13-19**	26-32	decrease	14-21	decrease	U/R, Et	Article
Spain	1998-2000	3534 (n.r.)	2-24**	31-33	no diff.	13-21	decrease	Ed, Ot	Article
Ireland	2002-2003	596 (n.r.)	5-12**	20	n.a.	17	n.a.	n.r.	Article
UK - England (4)	2004		5-17*	18-41	no pattern	17-33	no pattern		Pers.com/IOTF
- N. Ireland	2000	2017 (65%)	2, 15	20, 13	decrease	26, 19	decrease	Oc	Article
<i>East:</i>									
Bulgaria	2004		10-19	22		14			WHO-NPD
The Czech Republic	2001	31228 (n.r.)	10-18*	11-19	decrease	8-18	decrease	Ed, U/R	Article
Hungary	1997-2000		15-18	22		19			WHO-NPD
Poland	2000		10-18	20		13			WHO-NPD
Slovakia	2001		10-18	17		13			WHO-NPD
<i>North/Central:</i>									
Austria	2000	43504 (97%)	18	19		not included		Ed, G	Article
France	2006	1675 (68%)	3-17	16		19			Internet/IOTF
Germany	2002-2003	14836 (n.r.)	3-17**	17-18	no diff.	17-19	no diff.	Ot, Et, G	Article (DE)
Iceland	2004		15	20		10			WHO-NPD
Luxembourg	2000-2001		10-19	23		21			WHO-NPD
The Netherlands <sup>7</sup>	2002-2004	90071 (n.a.)	4-16*	13-16	increase	16-22	increase	Et, G	Article
Norway	2005-2006	1083 (82%)	9, 15	14	n.a.	13	n.a.	Ed, G, Et	Report (NO)
Switzerland	2002	2600 (76%)	6-12*	16-24	no pattern	21-23	no diff.	G	Article

1) Age trend is indicated as no pattern, increasing or decreasing prevalence by increasing age

2) The prevalences are given as range for the adolescent age group 10-18, IOTF age- and gender-specific definitions for overweight (incl. obesity) was used for all except: Austria (adult cut-offs for BMI), Germany (national standard) and Luxembourg (2000 CDC growth charts)

3) r.r = response rate (%), n.r = not reported, n.a. = not applicable

4) Age range for the entire study, \* Age can be disaggregated by year, \*\* Age can be disaggregated by age-intervals

5) Data collected on other socio-demographic factors: Ed = education, In= income, Oc=occupation, A= area social class, Et = ethnicity, U/R = urban/rural, G=geographical region, Ot = Other (i.e.: composite measures of socio-economic class)

6) Source: Article = published scientific article (language if other than English), pers.com/IOTF = Tim Lobstein & Rachel Leach reanalysis of HSE 2004, pers.com Lobstein May 2009, WHO-NPD =WHO- Nutrition Policy Database, internet/IOTF=Etude National Nutrition Sante ENNS 2006 - Institute de Veille Sanitaire, pers.com Lobstein May 2009 + <http://www.invs.sante.fr/surveillance/nutrition/enns.htm> 09.08.09

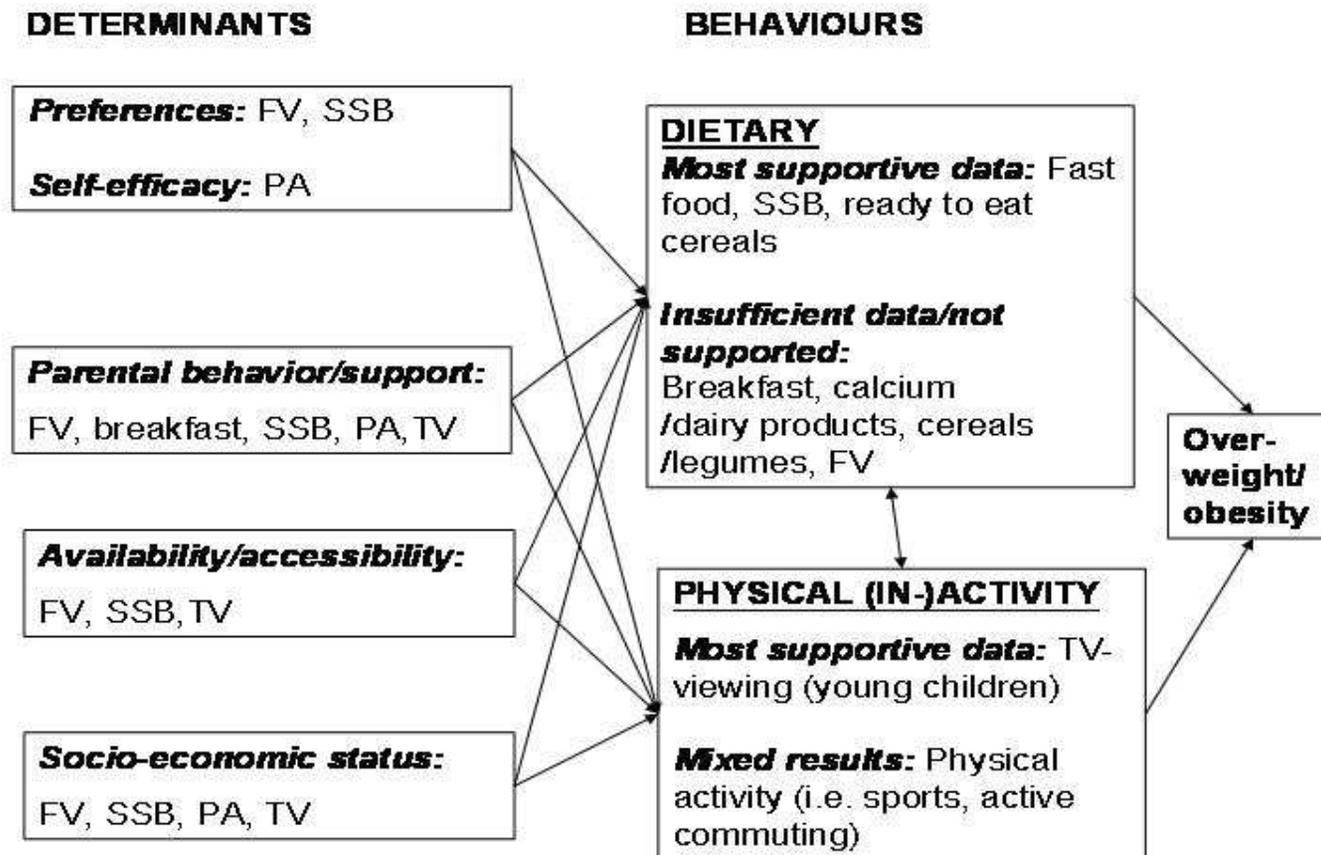
7) Collected from community health services, weighted for ethnicity and municipality size to match the distribution in the general population

**Table 2:** Trends in prevalence of overweight/obesity or other measures of adiposity based on weight and height among adolescents in Europe<sup>1</sup>:  
The HOPE-project, WP4

COUNTRY	YEAR	AGE <sup>2</sup>	GENDER	Measures <sup>3</sup>	Study quality <sup>4</sup>	Conclusion <sup>5</sup>	Notes <sup>6</sup>
<i>South/British Isles:</i>							
Cyprus	1997-2003	11	Both	IOTF	CSSx2, n>5000, M, N	<input type="checkbox"/>	For overweight in rural boys only
Greece	1981-1995	6-15*	Both	Median BMI	CSSx2, n=? , N/O	<input type="checkbox"/>	Lower increase in the older girls
Portugal	1960-2000	9-11*	Male	IOTF	CSSx5 , n=500-1000,Mr, O	<input type="checkbox"/>	High socio-economic group
Ireland	1990-2005	8-12	Both	IOTF + 2	CSSx2, n=<500, Mr/M, N	<input type="checkbox"/>	Not reported by gender/age
<i>UK</i>							
- Scotland (West)	1987-2006	15	Both	UK90	CSSx3, n=500-5000, M, O	<input type="checkbox"/>	Reported on obesity only
<i>East:</i>							
The Czech republic	1951-2001	2.5-18*	Both	BMI	CSSx4, n>50 000, M, N	<input type="checkbox"/>	
Poland (Cracow)	1971-2000	4/7-19*	Both	IOTF	CSSx3, n=1000-5000, M, O	<input type="checkbox"/>	Lower increase in the older girls
Poland (East, rural)	1980-2000	4-19*	Both	BMI	CSSx2, n>5000, M, O	<input type="checkbox"/>	Some variation by age/gender
<i>North/Central:</i>							
Finland	1977-1999	12-18*	Both	BMI	CSSx11, n>2500, SR, N	<input type="checkbox"/>	Linearly in all age/gender groups
The Netherlands	1980-2003	4-15*	Both	IOTF	CSSx3, n=n.a., M/Mr, N	<input type="checkbox"/>	Steepest increase 1997-2003
Norway (Bergen)	1971-2006	4-15*	Both	weight/height	CSSx2, n=1000-5000, M, O	<input type="checkbox"/>	Lower increase in the older ages
Norway (middle)	1966-1997	14-18	Both	BMI	CSSx2, n>5000, M, O	<input type="checkbox"/>	Higher in the upper BMI-groups
Sweden (Gottenburg)	1984-2005	10	Both	IOTF	CSSx3, n=4000-5000, Mr, O	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> btw 1984-2000, then <input type="checkbox"/> in girls
Sweden (Stockholm)	1999-2003	10	Both	IOTF	CSSx2, n=2000-3000, Mr, O	-	No change, slight decrease in girls

- References found in addition to those in the report "The challenge of obesity in the WHO European Region and the strategies for response" (WHO 2007) and the article by Jackson-Leach & Lobstein in Int. J. Pediatric. Obes. 2006.
- Age range for the entire study, \* Age can be disaggregated by year, \*\* Age can be disaggregated by age-intervals \* Age can be disaggregated by year, \*\*
- Anthropometric measures obtained/definition of overweight/obesity used: IOTF= age- and gender-specific definitions for overweight and obesity from International Obesity Task Force
- Study design: L=CSS = cross-sectional; n = # of participants at each time point, n.a.= not applicable; Data collection: M=measured, Mr=measured, but collected from records, SR = self-reported; Representativity: N=national, O = Sub-national or other convenience sample
- Overall conclusions from the articles:  = increase in overweight and /or obesity over time,  = decrease, - = no change
- Notes are comments on whether the trends were only pertaining to overweight or obesity, special groups, there were different patterns over time or by age or gender

**Figure 1:** Potential determinants of overweight/obesity in adolescence (FV = fruit and vegetables, PA = physical activity, SSB= Sugar-sweetened beverages, TV= television viewing).



## **Work Package 5: Obesity Prevention in adults**

### **Introduction**

For the work package on obesity prevention in adults, the following objectives were stated in Annex 1 to the contract:

- To review the influence of work-related and neighborhood environmental factors on physical activity and obesogenic nutrition and their contribution to socioeconomic inequalities in these behaviors.

To conduct an international comparative study on the contribution of environmental characteristics to socioeconomic inequalities in health-related behaviors.

The systematic review of the literature on obesity prevention in adults concentrated on the work and living environment, because these environments seemed to be the most promising settings for prevention. It was decided to organise the systematic reviews such that separate reviews were made for physical activity and diet, instead of including both health outcomes in one review for separate settings. This report summarises the main findings of the reports written, with a brief description of the methods and a short conclusion. In this work packages the role of environmental characteristics was placed central. This was done because environmental characteristics have received an increasing amount of attention (making up-to-date systematic reviews of the literature more valuable) and because it was expected to yield potential new entry points for policies and interventions.

### **Methods**

For the first review an extensive literature search was performed to identify publications on environmental correlates of physical activity (PA). The environment was defined as "everything and anything outside of the individual". Pubmed, PsychInfo, Embase and Web of Sciences were searched using broad search terms tailored to each literature database. The search was restricted to observational studies published in English between 1 January 2005 and 15 July 2008, with study participants being 18 years and older. This starting date (January 1, 2005) was chosen such that the review updated a previous study. Given the emphasis on policies in the HOPE project and the emphasis in the literature, the review concentrated mainly on the role of the *physical* environment.

Environmental characteristics were categorized by a) proximity to facilities, b) availability of facilities, c) accessibility of facilities, d) satisfaction with facilities, e) urbanization, f) neighborhood physical design, g) traffic characteristics, h) aesthetics, i) public open

spaces, and j) an overall environment score. Physical activity outcomes of the studies were categorized as general PA, sedentary behavior, walking, cycling, transport-related PA (including commuting, further called transport), leisure time PA, moderate PA, vigorous PA, combination of moderate and vigorous PA, and occupation PA.

It was recognized that physical environments are not equal everywhere, and that different man-made policies have contributed to different living environments. For this reason, it was attempted to interpret findings not only in themselves, but to also put them in an international perspective by classifying the results by continent (Europe, US and Oceania). This approach maximally allowed a straightforward comparison between the European studies in comparison to the rest of the world. A total of 89 studies were included in the review.

For the second review on environmental determinants of obesogenic dietary intakes, a review protocol based on guidelines from the Cochrane Reviewer's Handbook <sup>36</sup> was used. Studies conducted between 1 January 2005 and 1 October 2008 were located by searches in several major databases. The intake of total energy, fat, fibre, fruit, vegetables, sugar-sweetened beverages and meal patterns were included as outcomes, because these factors are suspected to contribute to overriding the normal physiological regulation of appetite and food intakes, and are associated with weight gain and overweight/obesity. Studies with any measure of weight status were also included. Four categories of environmental factors were distinguished: (a) accessibility and availability. Including physical and financial accessibility of products and shops that are needed for an (un)healthy diet, (b) social conditions, arising from interpersonal interactions, (c) cultural conditions, being the result of non-personal interactions or engagement with a larger group of people, and (d) material conditions, including financial situations, material and social deprivation, and unfavourable working, housing and neighbourhood conditions. A total of 29 studies were included in the review.

For the international comparative study, a total of 16 researchers from 12 different universities were approached to collaborate in this project. Among these 12 universities, 7 different European countries were included (the Netherlands, Belgium, England, France, Scotland, Sweden and Spain). To allow for comparisons with other continents, a leading researcher from the US and three research groups from Australia were included in the invitation. In the first step, the researchers were invited to express their willingness to participate in the project. An overwhelming majority of invited researchers expressed their interest in and the need for such a study. In the second phase of the project, "empty tables", including the results from the Dutch GLOBE study for illustrative purposes, were sent to the reviewers with the request to describe what exactly was measured in their study.

For the third review, studies on characteristics of participants and non-participants in worksite health promotion programmes aimed at physical activity and/or nutrition published from 1988 to 2007 were identified through a structured search in PubMed and Web of Science. Inclusion criteria were: (1) the article described a work site health promotion programme on physical activity and/or nutrition as primary preventive intervention, (2) a quantitative description of determinants of initial participation at the start of the programme was given, (3) the association between demographic, health-related, or work-related determinants and participation was expressed in a quantitative measure and (4) the article was written in English. A total of 22 publications were included in the review.

## **Results**

### *Environmental determinants of physical activity*

Most studies were conducted in the US and examined walking as PA outcome (Table 2). The majority of studies explored associations between self-reported measurements of environmental features, and self-reported PA outcomes in a cross sectional design. About 20% of all associations between characteristics of the neighborhood built environment and PA were positive. The highest percentage of positive associations was found when a total score for the environment was linked to PA. For proximity to and availability of facilities, urbanization, aesthetics and public open spaces (POS) 20% or more of the associations showed a positive association with PA. About three-quarter of the associations between an overall environment score and PA were positive in the US; although there were only few studies conducted on this association in Europe and Oceania, they significantly more often showed no association. A remarkable similar percentage of studies found positive associations between neighborhood aesthetics and PA in all three regions.

For walking, 27% of all reported associations were positive. The highest percentage of positive associations was found when a total score for the environment was linked to walking. For proximity to and availability of facilities and for urbanization –relatively often explored – over 30% of the associations were positive. While walking appeared to be the type of PA most often linked to the physical environment, evidence from European studies was scarce. Associations between the neighborhood built environment and walking were more often positive in Oceania than in Europe. Few publications focused on cycling (for transport and in leisure time); approximately 15% of the associations was significant. For transport related cycling, a significant higher percentage of positive associations with the neighborhood built environment was found in the US as compared to Europe. 13% of the associations between

the neighborhood built environment and moderate, vigorous or a combination of moderate and vigorous PA (MVPA) was positive. The association between the proximity to facilities and MVPA was significantly more often positive in Europe as compared to the US and Oceania. The study suggested that research on physical environmental correlates of physical activity was mainly conducted in the US; within Europe approximately one-third of the number of US studies were conducted. Given that the study – acknowledging methodological weaknesses – suggested the existence of continental differences in associations between characteristics of the built environment and physical activity, there is a need to expand research on this theme in Europe.

#### *Environmental determinants of diet*

The vast majority of studies were conducted in the USA, with other studies taking place in Australia or New Zealand and Japan; only three studies were conducted in Europe. With the exception of one natural experiment, all studies were cross-sectional. The majority of these studies examined fruit and vegetable consumption, followed by weight status, fat intake and the consumption of takeaway or fast food. Of the environmental characteristics, the majority focused on accessibility factors, followed by social and material factors. The majority of associations between access to supermarkets, grocery/convenience, fruit and vegetable stores and fruit and vegetable consumption were not statistically significant. However, five associations measured differences in weight status by access to supermarkets and four of these found that people with greater access to supermarkets had lower BMIs/prevalence of overweight/obesity compared to those with less access. The majority of associations (five out of eight) examining access to takeaway food outlets and weight status found that greater access was associated with greater BMI/prevalence of overweight/obesity. With regard to social factors, the review confirmed previous findings that being married was related to a higher fruit and vegetable consumption than being never married. Remarkably few studies explored the role of environmental characteristics and dietary intake. Among the material factors, living in a socioeconomically deprived neighbourhood was consistently related to obesity, lower fruit and vegetable intake and more irregular meal patterning.

Although not the focus of the review, continental patterns could be identified in the review. Not only the majority of studies were conducted in the US, significant findings on the association between access to supermarkets and BMI were conducted in the US. This finding is consistent with a recent review suggesting that the existence of so-called “food-deserts” is in the US only. Implications of these findings for Europe are that there is a need to confirm the absence of food deserts in Europe, as well as to protect policies that could result to these food-desserts.

### *International comparative study*

An explicit starting point for the study was that outcomes should be measured specifically, because previous studies have reported for example that residents from more deprived neighborhoods walk and cycle more for transport and less for recreational purposes than residents from more affluent neighborhoods [2]. As a result, specific outcomes were included in the tables. It appeared that 4 research groups measured walking and 5 groups measured cycling; one group however, included recreational and transport related physical activity together. There was a wide variety in the measurement of physical activity. While the IPAQ questionnaire nowadays may be the most frequently applied questionnaire, only one group reported the use of this questionnaire. Interestingly, 6 out of 7 studies measured fruit and vegetable intake. Three main categories of environmental characteristics were asked for: 1) distances to facilities, 2) environmental aesthetics and 3) social safety. Under the heading of distances to facilities, we included measures of presences and quality of sidewalks and cycling tracks. It appeared that only 2 studies collected data on these characteristics, and the similarity between these measures were sub-optimal. While the distance to facilities was measured in more studies, there were substantial differences in the measurement techniques employed. Particularly, some studies used audit instruments (often developed by the particular research group) to obtain information about the distance to the closest facilities, while other studies applied geographic information systems. Surprisingly little information was available on environmental aesthetics and social safety. The overwhelming majority of studies did not include these issues. While these characteristics nowadays receive more attention in research, an explanation for our finding was that the initial focus of environmental characteristics of physical activity was at the "distance-related" characteristics. Even more important however, particularly in the light of the fact that most studies were able to explore neighborhood inequalities in fruit and vegetable consumption, was that environmental characteristics that potentially could explain neighborhood inequalities in diet were hardly included in many studies. Three studies appeared to have data on the distance to facilities, the price and quality of fruit and vegetables for neighborhoods of different socioeconomic environments, but data collected differed too much to allow a comparative study. It was concluded that the first generation of studies measuring environmental characteristics of physical activity and diet did not allow a high quality comparison. Given the importance of information that can result from such a comparison, it is highly recommended to develop a comparative study in Europe.

### *Determinants of participation in work place interventions*

In total, 23 studies were included with 10 studies on educational or counseling programs, 6 fitness centre interventions, and 7 studies examining determinants of participation in multi-component programs. Participation levels varied from 10% to 64%, with a median of 33% (95% CI 25–42%). In general, female workers had a higher participation than men (OR = 1.67; 95% CI 1.25–2.27]), but this difference was not observed for interventions consisting of access to fitness centre programs. For the other demographic, health- and work-related characteristics no consistent effect on participation was found. Pooling of studies showed a higher participation level when an incentive was offered, when the program consisted of multiple components, or when the program was aimed at multiple behaviors.

## **Conclusions**

Place matters in obesity prevention.

Yet, there is still little concrete evidence how the physical and social environment are related to physical activity in the European context. Findings from other continents may not hold for Europe.

- Worldwide, the best evidence is found for the relation between land mix use, proximity to and availability of facilities and walking, but these associations are hardly explored in Europe.
- In Europe, there is some evidence linking proximity to facilities to moderate and vigorous exercise.
- Unhealthy food consumption is most prevalent among residents of deprived living environments.
- Yet, evidence that the distribution of takeaway outlets and supermarkets is related to obesity is derived from US studies only.
- Participation of employees in work site health promotion programs can be improved.

## **Implications for policies**

- Target places and people, both in their living environment and in the work-setting.
- Physical activity: Policies aimed at improving mixed land use and the proximity to facilities can also result in changes in physical activity; they therefore need to be supported from a perspective of obesity prevention.
- Diet: Policies should aim to avoid large segregation of facilities, which requires (continuation of) rules, regulations, and policies aimed at an equal distribution of facilities.
- Policy instruments need to be used to enhance active commuting to work.

**Implications for research**

- Europe clearly lags behind the US and (to a lesser extent) Oceania in research on the environmental determinants of physical activity, diet and obesity.
- There is need for cross-country comparisons in the association between environmental determinants of physical activity and diet. Such research can maximally benefit from 'between-country' variation in the environment.
- There is a need to evaluate natural experiments within countries and policy regulations between countries

## **Work Package 6: National policy obesity prevention interventions**

The most comprehensive and up to date reviews and analyses of national nutrition and/or physical activity policies carried out have been provided by the World Health Organisation (WHO) and the Organisation for Economic Development (OECD). The current review, taken together with the work carried out by WHO and OECD, means that there is currently both a comprehensive and in depth picture in Europe of the current status of national and multinational policies relevant to obesity prevention.

The current review identified 120 policies from 31 different European states, and two multinational groupings, the European Union and Nordic collaborations. It is divided into 2 parts:

- Part 1 is a narrative review which includes: an exploration of the broader context for the development, implementation and analysis of national and multinational obesity prevention policies, for example obesogenic environmental components, and models for the development and implementation of obesity prevention policies; an analysis of the Inventory (Part 2); and a section on the results of evaluations of policies, and probably more importantly approaches to and limitations of obesity policy evaluations.
- Part 2 is a country by country Inventory of national and multinational obesity prevention policies, which is available separately.

The obesogenic environmental components which have featured most in the literature related to supportive environments for physical activity include: transport, safety issues such as street lighting and urban planning, and for healthy eating include: nutrition labelling, food production, advertising and marketing to children, and food taxes/subsidies. The most usual form in which obesogenic environmental components were addressed in the policies described in the Inventory was through safe transport routes, land use planning, development of community sports facilities, and catering (often in schools). A few policies specifically mentioned introducing measures to address marketing and advertising of foods to children, and a similar number proposed actions to encourage food reformulation by manufacturers. Economic measures were only identified infrequently, and were often proposals rather than commitment to definite action.

In terms of a foundation for developing and implementing obesity policies, the evidence base for obesity prevention policies is growing, but will require consideration of a range of types of evidence. There are traditional policy frameworks, but in recent years more focused approaches have been developed to support the development of obesity policies.

For example, there has been work to develop tools that systematically identify policy gaps, barriers and opportunities for obesity prevention.

Relatively few evaluations of obesity prevention policies were identified, and these included information for all of the Scandinavian countries, Germany, Slovenia and the UK.

The paucity of evaluations is probably unsurprising if the difficulties associated with evaluating obesity policies are considered. Evaluations that use data from national surveys are the only type (for most countries) that can be used to assess progress towards national quantitative targets. However, they cannot measure the effect of the different policy components (e.g. legislative policies, government guidance, information campaigns, financial support of relevant local infrastructures, and many others). Not only that, they are a crude measure of all of the relevant changes happening within a country, for example economic conditions, global trade policies, or media led fashions in diet. Sometimes focused evaluations are carried out for policies or policy components, but it requires foresight to collect baseline data, and even if this is done there is still no control group, so once again these evaluations are susceptible to changes in the external environment which are nothing to do with the policy.

This analysis leads to the conclusion that it is very important that countries and the EU resource research on the effectiveness of interventions which mimic possible policy initiatives. These can then be carried out to a high scientific standard, and with a view to assessing generalisability to the larger population and sustainability of any effects.

One of the clearest points to emerge from the report is that there is no shortage of policies. There is a shortage of dedicated financial and human resources, and sustained and politically backed implementation. In the future it is likely to become more important to monitor implementation and outcomes than to track policy development.

The overview of the report concludes with a checklist to support the development, implementation and evaluation of obesity prevention policies. The key recommendation for all member states' obesity prevention policies is to identify and allocate dedicated financial and human resources to enable implementation and evaluation of the policies. This needs to be accompanied by a long-term, high-level, cross party, commitment to take forward agreed actions to tackle obesity.

## **Section summaries**

Detailed information and references are supplied in the main body of the report.

### *Section 1: Introduction*

The three aims of this work were:

1. To prepare an inventory of multinational (including European), and national obesity prevention policies, action plans and strategies initiated within the last 5 years from EU member countries, and where appropriate in an accompanying narrative review to consider other countries with comparable economic and cultural backgrounds e.g. Australia, Canada and the US.
2. To prepare a review of evaluations of multinational, and national obesity prevention policies, action plans and strategies published within the last 10 years from EU member countries, and where appropriate in the narrative text to consider other countries with comparable economic and cultural backgrounds e.g. Australia, Canada and the US.
3. To review obesogenic environmental components of multinational, and national policies, action plans and strategies, with a special emphasis on the effectiveness of these components for lower socio economic groups. The primary focus was EU member states, with consideration of other countries with comparable economic and cultural backgrounds e.g. Australia, Canada and the US, where this was appropriate.

The project used a retrospective documentary analysis approach. Searches were carried out for published and unpublished information in order to prepare this narrative review (Part 1) and also to construct a separate country by country Inventory of national and multinational obesity prevention policies (Part 2). Part 2 is available as an Excel spreadsheet, and the data in this have also been merged into a Word document.

The definition of 'policy' which was used was 'a coherent set of government sponsored decisions with common long-term objectives relevant to reducing obesity levels. Decisions of this type often use legislative tools, and apply to a country or group of countries, as a whole'.

This work focused on obesity policies and policies for the determinants that are immediately 'downstream' i.e. nutrition and physical activity. These in turn sometimes included policy areas even further downstream e.g. advertising foods to children, but specific searches were not carried out for policies at this level. Similar searches for

obesity, nutrition and physical activity policies yielded some 'upstream' policies e.g. public health, but again these were not specifically searched for.

Twelve primary data sources were used. These were core sources of information for both the narrative review and the Inventory. They were identified through colleagues in HOPE, Europrevob and the World Health Organisation, and by contacting individuals who had particular knowledge or expertise in obesity and associated policies, and during the secondary data searches.

Secondary data sources contained information relevant to specific countries or aspects of the work. They were identified by searching electronic databases, the Internet, and websites of relevant government departments and agencies. Searches were carried out systematically, using specified inclusion and exclusion criteria. A translation of material that was not in English was carried out when this was feasible.

786 secondary data sources were initially included based on the title. 349 were finally included after the abstract, and where necessary the full text, had been scrutinised. 182 were used to inform this narrative review, and the remaining 167 were relevant to the specific countries and country groupings in the Inventory.

The Inventory was structured using a widely accepted policy framework. This has five stages: problem formation; policy formulation; policy adoption; policy implementation; and policy evaluation. These stages were used as the main categories for the policy analysis, but within these more detailed information was extracted. The categories for the detailed information were drawn from the WHO framework to evaluate progress in implementing diet and physical activity strategies, with additional fields to meet the aims of this project.

### *Section 2: Background*

The purpose of this section of the report was to explore the broader context for the development, implementation and analysis of national and multinational obesity prevention policies, and describe the literature that was identified on policy development and analysis.

The impact of socio-economic, cultural and environmental conditions in influencing levels of obesity has been understood for some time, and these factors are acknowledged and embodied to some extent in national, EU wide, and global policies, strategies and action plans. Despite this there is an unease that the forces which create obesogenic

environments in westernized countries are so powerful that it is unlikely that the growth in obesity levels will be halted unless coordinated and politically backed high level policies are developed and implemented.

The obesogenic environmental components about which there has been discussion, and in some cases action, include:

- Factors affecting physical activity levels, including increasing car use, fear of traffic/violence, and lack of opportunities for cycling and walking
- Economic factors, which in turn has led to suggestions of using tools such as taxes and subsidies to shift consumer consumption patterns in a healthier direction. However, although the positive effects include: inconsistent, but overall modest effects on diet and weight outcomes; sending a signal to producers, manufacturers and consumers; and raising revenue, which could be used to support other aspects of an initiative to prevent obesity (or spent on subsidies), there are negative effects which include: if only taxes and no subsidies are introduced all consumers could potentially pay more for food; taxes on food, by themselves are regressive and affect lower income consumers more; the economic approach would be an administrative burden and could take a long time to implement; legal challenges could prove time consuming and costly; economic instruments, possibly more than others, may have unintended consequences.
- Nutrition labelling, which could make a small but important contribution towards making the existing point-of-purchase environment more conducive to the selection of healthy choices. In particular, interpretational aids can help consumers assess the nutrient contribution of specific foods to the overall diet. There has been a good deal of EU activity around this in recent years, and the European Commission has published regulations to control nutrition and health claims, and adopted a proposal for a regulation on the provision of food information to consumers. The role of different types of simple front of pack schemes to help consumers understand the nutritional contribution of specific foods to their diet is still being explored.
- Food production, at both a macro-level and smaller scale production. The two main potential levers are agricultural policies and agricultural production practices, which can affect diet through their influence on food availability, price, and nutrient quality. Routine health impact assessments of food production policies would be one course of action which could be more widely adopted.
- Advertising and marketing to children. A recent systematic review concluded that there was sufficient evidence that marketing and advertising foods to children can affect overall levels of consumption of 'unhealthy' foods. This is further confirmed

by the work carried out within work package 4 of this HOPE project. Estimates of the percentage of TV advertisements for food aimed at children for unhealthy foods ranged from 49% in Italy to nearly 100% in Denmark and the UK. Surveys which have been done have reported an ineffective and incoherent pattern of regulation with most governments relying on voluntary industry codes. The development of nutrient profiling approaches is a step forward in more objective identification of 'less healthy' foods, and agreement on this together with actions to tackle cross border advertising, could remove some of the barriers to tougher regulation.

In terms of a foundation for developing and implementing obesity policies, the evidence base for obesity prevention policies is growing, but will require consideration of a range of types of evidence. There are traditional policy frameworks, but in recent years more focused approaches have been developed to support the development of obesity policies. For example, there has been work to develop tools that systematically identify policy gaps, barriers and opportunities for obesity prevention, as part of the process of developing and implementing a comprehensive obesity prevention strategy. This could include analysis grids to identify which areas are amenable to legal and regulatory intervention across all levels of governance.

In addition the EU funded PorGrow project, which through a stakeholder consultation process, has identified potential policy initiatives to tackle the growing rates of obesity in the countries of the EU. So, the basis and structures are there. However, in the face of the escalating levels of obesity across the EU, policy development for the prevention of obesity will have to adopt a pragmatic approach – sometimes looking at where the existing evidence points rather than what the evidence proves.

### *Section 3: Analysis of the Inventory of national and multinational obesity prevention policies*

The most comprehensive and up to date reviews and analyses of national nutrition and/or physical activity policy documents have been provided by the World Health Organisation (WHO) and the Organisation for Economic Development (OECD). The current review, taken together with the work carried out by WHO and OECD, means that there is currently both a comprehensive and in depth picture in Europe of the current status of national and multinational policies relevant to obesity prevention.

The current review focused on policy documents available between the first of January 2004 and the 31-st of October 2008. Searches for evaluations went back further to the

first of January 1998. A total of 120 policy documents from 31 different European states, and two multinational groupings, the European Union and Nordic collaborations were identified. The policies varied from very wide ranging (e.g. covering sustainability and broad environmental issues) to extremely specific ones (e.g. food marketing, cycling).

Around half of the policies were population wide, and the remainder identified priority groups to focus on. The most frequent of these groups were children and/or young people.

The majority of policies claim to be multisectoral, cover a range of settings (e.g. schools, workplaces etc), contain information on implementation plans, and use a mixture of approaches (e.g. information provision, legislation, availability and access).

Most of the policies did not contain information on human or financial resources to support policy implementation, and do not adequately include workforce development as an explicit strategy priority.

Nearly two thirds of countries had policies that did contain some component that addressed disadvantaged groups, and around half contained some elements of support for local initiatives.

Only about a third of policies appeared to have quantitative goals, and these were more often for nutrition than for physical activity or obesity.

Most countries have national/multinational monitoring systems in place, collecting data on obesity and/or diet and/or physical activity, but only about half contained references or occasionally more detailed plans, for policy evaluation in addition to using the national/multinational monitoring systems.

The most usual form in which obesogenic environmental components were addressed was through a series of actions to create supportive environments for physical activity (e.g. safe transport routes, land use planning, development of community sports facilities) followed by creating supportive environments for healthy eating (e.g. developing and promoting initiatives with the food industry, labelling, initiatives to improve access and availability of healthier food choices). Catering, often in schools, and also in publicly funded institutions was the most frequent specific action to be identified in relation to promoting healthy eating, and a few policies specifically mentioned introducing measures to address marketing and advertising of foods to children, and a similar number proposed actions to encourage food reformulation by manufacturers.

Economic measures were only identified infrequently, and were often proposals rather than commitment to definite action.

Some countries have a tradition of policies which have an umbrella of sustainability, for example in Austria. However, with the growth of environmental concerns globally, and the food security issues in some individual countries, more countries have food and nutrition policies which highlight sustainability and/or food security issues

The most recent review of breastfeeding policies in Europe assessed stage of policy development against four criteria, and only five countries had policies that met all four criteria. Policies in nine countries met three out of four criteria. Even when countries have national policies and plans, they may not be acted upon, or may not be compatible with well recognised evidence-based recommendations.

One of the clearest points to emerge is that there is no shortage of policies. There is a shortage of dedicated financial and human resources, and sustained and politically backed implementation. In the future it is likely to become more important to monitor implementation and outcomes than to track policy development.

#### *Section 4: Effectiveness of national and multinational obesity policies*

Relatively few evaluations of obesity prevention policies (including separate nutrition and physical activity policies) were identified. This is probably unsurprising if the difficulties associated with these types of evaluations are considered.

The obesity prevention policies that are described in the Inventory are strategic public health initiatives that have been developed and endorsed by government. These are sometimes accompanied by other legislative tools, and often form the umbrella under which national and local obesity prevention programmes are created and operate. How can strategic public health initiatives of this type be evaluated? The evaluations which have been identified in this review fall into three categories: studies which examine quantitative data from regularly repeated national surveys, and compare this with the policy aims; quantitative and qualitative evaluations of specific aspects of policy implementation; and studies which have used a qualitative approach and identify barriers to the implementation of policies and learning points (process evaluation).

#### **National monitoring surveys**

The first of these, evaluations that use data from national surveys, are the only type (for most countries) that can be used to assess progress towards national quantitative

targets. However, they cannot measure the effect of the different policy components (e.g. legislative policies, government guidance, information campaigns, financial support of relevant local infrastructures, and many others). Not only that, they are a crude measure of all of the relevant changes happening within a country, for example economic conditions, global trade policies, or media led fashions in diet. A specific public health policy can be only a small part of the 'mix'.

This was the most usual type of quantitative evaluation reported in this review. One conclusion that can be drawn generally from these evaluations is that across EU member states, fat as a percentage of energy has shown decreases; the proportion of saturated fat as a percentage of energy has also tended to decrease – but not as much as total fat; everyday physical activity has decreased; and the proportion of obese individuals has increased. Breastfeeding prevalence has increased significantly in duration and exclusiveness in some countries compared to the 1970s. Clearly, there are more specific results for individual countries. One of the questions though is how much the four changes described reflect public health policies and how much reflect the social and employment changes which have happened in Europe over the last few decades.

Nevertheless national surveillance of diet, physical activity, and prevalence of obesity is invaluable in tracking changes using measures and approaches which are comparable from year to year. More recently there have been attempts to develop measures/indicators of environmental change that could impact on diet and physical activity patterns. Further development and validation of these approaches opens up the possibility of these measures being incorporated into national surveillance instruments.

### **Quantitative and qualitative evaluations of specific aspects of policy implementation**

These are potentially the most valuable in terms of evaluations directly relevant to the policies. However, to undertake work of this type requires adequate resources, commitment at high levels, and foresight – to enable baseline data collections before policy implementation starts. Even then, the evaluation will be compromised by the lack of a control group. The implication of this is that it may be preferable to resource research on the effectiveness of interventions which mimic possible policy initiatives, and which can be carried out to a high scientific standard. This research would also need to be carried out so that the findings can, with a reasonable degree of confidence, be generalised to the larger population. Work packages 8 and 9 of the HOPE project have reviewed research of this type in order to assess the effectiveness of nutrition and physical activity interventions respectively.

## **Research into the barriers and learning points for the implementation of policies**

Finally, studies have been reported which have identified barriers to the implementation of policies and learning points. Examining the findings it seems that some of the barriers to perceived effectiveness of implementation are:

- Poor political support and understanding
- No dedicated resources
- Lack of quantitative goals
- Lack of clear timescales
- Poor coordinating mechanisms
- Poor leadership and accountability
- Competitive sport-oriented policies do not seem to influence behaviour in the wider population (physical activity)
- Lack of engagement with the food supply chain (nutrition)

Some of the factors that aid perceived effectiveness of implementation at a national level are:

- Stable governments with commitment to policy implementation across different administrations, without the distraction of further national policy or structural changes.
- Ministerial commitment maintained throughout.
- Consistent policies across national government and at regional and local level.
- Administration and organisation at a national level are needed to ensure sufficiently high political commitment, visibility, leadership, and supporting functions such as research, education, and distribution of information.
- Convergence with other widely recognised trends in the policy-making climate and changes in the social environment.
- Adequate and sustained resourcing for advocacy, development, implementation and evaluation.
- Use of regulatory powers and incentives can be appropriate.
- Multisectoral collaboration at both national and local levels.
- Regular monitoring is included throughout the course of the implementation phase.
- Clear, realistic and measurable objectives are set, backed up with relevant, reliable and up-to-date information.
- Actions need to be focused and prioritised towards delivering policy and founded upon the overarching strategic themes or 'directions of travel' with which all stakeholders (state, supply chain and consumers) can engage.

- Mechanisms for capturing, building on and sharing ongoing learning need to be developed and used collaboratively across projects and areas.
- The orientation of the physical activity policies emphasises activity for the whole population and the provision of an appropriate infrastructure (physical activity).

And at a local and regional level:

- Local authorities and other local organisations are primary partners who will need support
- Implementation is institutionalised at local and regional level.
- A participatory approach is used.
- Local action is backed by evidence of 'what works', with resources, staff and skills to deliver.
- Sufficient time is allocated to engendering community engagement and ownership of both problems and solutions.
- Scoping local links, including effective producer networks, can be crucial for maintaining food co-operatives.

### **Checklist for the development, implementation and evaluation of national and multinational obesity prevention policies**

Research has demonstrated that the most effective interventions relevant to obesity a) adopt an integrated, multidisciplinary, and comprehensive approach b) involve a complementary range of actions, and c) work at an individual, community, and macro environmental levels (Cavill *et al.* 2006, Flynn *et al.* 2006, Stockley 2001, Swedish Council on Technology Assessment in Health Care 2005). A framework of policies directed towards reducing obesity levels is invaluable in supporting an integrated approach of this type. This report provides clues on how such a framework can be developed, implemented and evaluated, with the most likelihood of some degree of success. The checklist below attempts to capture these clues:

#### **Policy formulation**

- Get political support and understanding, including (if possible) commitment to a long-term approach which crosses party political boundaries.
- Ensure that these initial phases have adequate financial and human resources to: co-ordinate multisectoral collaboration (and 'buy-in'), involvement of potential

partners (e.g. local administrations) at the outset, and commission any preliminary research which is necessary.

- Consolidate the best quality research available, based on a range of methodologies.
- Build on emerging social and political trends where possible.
- Rather than producing ad hoc policies, if possible place these within a coherent policy framework acting at individual, community, and environmental levels, and which addresses inequalities. Some elements will be best achieved through regulation, others through development and support of local initiatives, influencing 'higher' policy making e.g. European or international (e.g. Codex) level, and a multitude of other possible approaches.
- Consider using one of the tools mentioned in Section 4 of this report to systematically identify policy gaps, barriers and opportunities for obesity prevention.
- Build in allocation of financial resources and development of human resources, to ensure that policies can be delivered and evaluated. It would be helpful if financial resources were ring fenced, so that they are not depleted by competing priorities.
- Include specific, measurable, realistic and time defined quantitative goals.
- If specific policy areas are amenable to evaluation, ensure that baseline data are collected.
- Build process evaluation into as many aspects of policy delivery as possible.
- Ensure that relevant national monitoring and surveillance systems are adequate to track relevant health measures, behaviours, environmental and social factors.
- Emphasise the importance of continued resourcing for research relevant to assessing the effectiveness of policy interventions using research approaches which are as rigorous as possible, for example controlled trials and high quality qualitative research. This will be important for the next round of policy development.
- Consider possible unintended consequences e.g. on the prevalence of eating disorders.

### **Policy implementation**

- Do everything necessary to ensure continued political support across parties.
- Implementation should include agreed institutional responsibilities and accountability at national and local level.

- Process evaluation and routine monitoring should form an integral part of the implementation phase, to ensure responsiveness to external changes, unexpected barriers and new opportunities.
- Use a participatory approach with all partners and relevant sectors, and develop mechanisms to share and develop learning.
- Continuing development of relevant workforce attributes should be an integral part of implementation.

### **Policy Evaluation**

- Use the most appropriate tools for assessing progress on the policy framework as a whole, or specific policy components e.g. national surveillance systems, specific evaluations.
- Consider using elements (or all) of the EU/WHO framework for monitoring and evaluation. One advantage of this would be that using the same approach will help to compare information across countries in Europe.
- An independent organisation should carry out the evaluations/monitoring.
- Better quality evaluations are obtained if a collaborative approach is used.
- Make evaluation findings as widely available as possible, even at local level. This includes negative as well as positive findings. Whilst negative findings can be embarrassing politically, withholding them holds back using the learning which can be gained and used, to avoid similar failures in the future.

### **Other Recommendations**

Obesity is increasing in most European member states at a frightening rate. Given that the problem is so huge, and only seems to be becoming worse; positive, unequivocal well resourced policies and actions, with high level political support and long term commitment need to be developed and implemented in as many European member states as possible, now. There are always reasons to prevaricate, but the longer action is delayed, the less likely it is to succeed.

- Those member states that do not have policies which clearly address obesity, should develop them now.
- This review shows that generally, there is no shortage of such policies. Where there are policies these should be considered to assess whether there is a need for any additional elements to develop a coherent and integrated approach.

- Policies should be flexible enough to accommodate new research findings as they come on-stream.
- Research funding within countries and from the EC should give a higher priority to research that assesses the effectiveness of interventions which can form policy components, using different methodologies and carried out to rigorous quality standards.
- There may also be some merit in carrying out a comparative analysis of policies and policy led interventions in countries with different levels and rates of growth of obesity. This could assess the 'quality' of policies using some of the indicators suggested in the checklist above, with a view to testing the suggestions which emerged during the process of carrying out this review against obesity outcomes.
- Another approach would be to carry out some in depth case studies exploring the links between integrated policies which have supported behavioural change in regard to one of the risk factors associated with obesity, and obesity outcomes. For example, this could be done in Sweden where policy approaches were key to increasing breastfeeding prevalence.
- The key action for all member states is to identify and allocate dedicated financial and human resources to enable implementation and evaluation of obesity prevention policies. This needs to be accompanied by a long-term, high-level, cross party, commitment to take forward agreed actions to tackle obesity.

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## **Work Package 7: Policies on socio-economic inequalities in overweight and obesity and their determinants across Europe**

### **Introduction**

This work package aimed to assess socio-economic differences in the progression of the obesity epidemic. It assessed to what extent the prevalence of overweight and obesity differs between socio-economic groups, and it performed in-depth analysis aimed to understand these inequalities. First, the work package described socio-economic differences in the prevalence of overweight and obesity among adults across Europe. Next, it described socio-economic differences in obesogenic nutrition and physical activity patterns, also among adults across Europe. Finally, as part of these analyses, the work package aimed to contribute to the explanation of socio-economic differences in overweight, obesity in European populations. This report summarises the main findings of these analyses. The concluding section will formulate the main implications of these findings for policies, monitoring and future research.

### **Methods**

An overview of socioeconomic inequalities in the prevalence of overweight and obesity has been conducted using data from most EU member states. This analysis was based on data from national health interview surveys among adults from 22 European countries. Two papers were prepared on the basis of this analysis. The central paper described the relationship between overweight and obesity with educational level among all adults aged 25 years and over in the 22 countries. In an additional paper, an international overview was made of socioeconomic inequalities in overweight and obesity among men and women ages 16 to 25 years in the same countries.

The same international data set was also used to describe socioeconomic inequalities in physical activity and vegetable intake among adults in several European countries. Again, two papers were produced. In the first paper, we utilised information that was available from health surveys of 15 countries to assess educational differences in the prevalence of leisure-time physical activity. In the second paper, we assessed socioeconomic inequalities in vegetable consumption, thereby utilising the availability of comparable data for 10 European countries. The prevalence of vegetable consumption was measured in relationship to both educational level and occupational class.

The availability and comparability of data from national health surveys was limited,

especially with regards to obesogenic nutrition. In order to complement the fragmentary evidence that was obtained in the international overviews of vegetable consumption, we also performed a literature review. This systematic review assessed the evidence from recent European studies on socioeconomic inequalities in the prevalence of the main nutritional determinants of obesity, including fat intake, fibre intake and total energy intake. After the literature search and a strict application of methodological criteria to each study that was initially found, a final selection of 53 papers was left for review. A similar systematic review was conducted to assess the evidence for socioeconomic inequalities in leisure time physical activity; a final selection of 57 studies was reviewed.

The work package mostly focussed on the description, rather than the explanation, of socioeconomic inequalities in overweight/obesity, physical activity and obesogenic nutrition. This focus was chosen in order to provide the empirical input that was needed for work package 10, which modelled the impact of overweight and obesity on the burden of ill health in each socioeconomic group. For further details, we refer to the summary report of work package 10.

Despite this descriptive focus, the work package also aimed to contribute to the understanding of inequalities in overweight/obesity, physical activity and obesogenic nutrition. For this, we decided to utilise the evidence available from the international comparisons. More specifically, we explored to what extent the magnitude of inequalities was associated with national factors such as the level of socioeconomic development or nutritional policies. Through such “contextual” analyses, we aimed to identify national factors that may be related to greater or smaller inequalities in overweight and obesity.

## **Results**

### *Overweight and obesity*

The international comparative studies showed that inequalities in the prevalence of overweight and especially obesity were widespread in the early 2000's (Roskam et al 2009). These inequalities existed at all adult ages from 25 years up to old age, and were larger among women (as compared to men), and for obesity (as compared to overweight). The largest inequalities were found among women in southern Europe. Baltic and Eastern European men were the exceptions, with weak, positive associations between educational level and the prevalence of overweight and obesity.

This pattern is illustrated in figure 1 with data for 11 countries. The higher the bar, the larger the Rate Ratio comparing obesity prevalence of low to high educated people, and

thus the larger these inequalities. Inequalities were observed in all populations, except among Lithuanian men. Inequalities were especially large among women in southern Europe. In the northern part of Europe, inequalities were much larger in some countries than in others.

In addition to the analysis for adults aged 25 years and over, an overview of socioeconomic inequalities in overweight and obesity was also made for men and women aged 16 to 25 years in 22 European countries (Amankwa et al, in preparation). We found that, in most European countries, inequalities in overweight were relatively small for those aged 16-19 years, and larger among those 20-25 years. This suggested that inequalities in overweight and obesity further increase when adolescents enter into adulthood.

#### *Physical inactivity and obesogenic nutrition*

Socioeconomic inequalities in the prevalence of physical inactivity were found to be large in all 15 European countries for which information was available (Demarest et al, in preparation). As illustrated in figure 2, lack of physical activity was more common among low educated people in all countries for which data were available. Inequalities in physical inactivity were generally larger among women than among men. We observed generally the smallest inequalities in the Baltic and Eastern European countries. More generally, inequalities in physical activity were smallest in countries where physical inactivity was common, while countries with a low or intermediate national prevalence of physical activity showed the largest relative inequalities.

Using the same international data set, we found an association between educational level and the prevalence of vegetable consumption in each of the 10 countries for which comparable data were available (Prättälä et al, 2009). However, the direction of the association varied between countries. In the Nordic and Baltic countries, those with the highest educational level were more often daily consumers of vegetables, while in the Mediterranean countries, the lower educated people consumed vegetables more often. In all countries, however, daily consumption of vegetable was more common in non-manual occupational classes as compared to manual classes.

The systematic review of recent European studies confirmed that inequalities in fruit and vegetable consumption were substantial in many countries (Giskes et al, 2009). Many recent studies also observed inequalities in fat and fibre intake, with lower socioeconomic groups having higher fat intake and lower fibre intakes. However, these inequalities were smaller and less marked as compared to the inequalities in fruit and vegetable intake.

Surprisingly, the systematic review did not yield consistent evidence for substantial inequalities in total energy intake. Because of a small number of studies, no consistent evidence could be obtained on inequalities in other nutritional determinants of obesity, such as consumption of energy rich drinks.

The systematic review on inequalities in physical activity showed that the overall direction of the associations was positive indicating that the higher SEP groups were more physically active compared to the lower SEP groups. For pure leisure time physical activity and vigorous physical activity the evidence was most consistent. For total physical activity, which often also included occupational physical activity, the associations showed a less consistent pattern. The review showed that there is evidence that lower SEP groups use more often active means of transportation compared to higher SEP groups although this outcome measure was relatively understudied. Sedentary behaviours were even more understudied. The findings suggest that physical activity may contribute to socioeconomic inequalities in overweight and obesity. However, more research is needed to see whether these results will be the similar when occupational physical activity is considered.

#### *Explanations*

The international variations in the magnitude of inequalities in overweight and obesity raise questions as to the role of specific national factors. In further analysis, we explored the association with the level of socioeconomic development (Roskam et al). We found a clear association for men. A 10,000 euro increase in national Gross Domestic Product was related with a three percent increase of overweight and obesity for low educated men, but a four percent decrease for high educated men. No clear associations with GDP were however observed for women.

With regards to inequalities in vegetable consumption, further analyses suggested a relationship with the availability or pricing of vegetables (Prättälä et al). Countries with high availability and relatively low prices of vegetables, especially the Mediterranean countries, were precisely those countries where inequalities in vegetable consumption were small or even opposite.

The fact that inequalities in overweight and obesity were largest among Southern women, despite the small inequalities in vegetable consumption, may ultimately be related to the fact that lower-educated women in these countries often assume a traditional role patterns (Roskam et al, 2009). This, in turn, may be linked to inequalities in overweight in several ways. The direct effects may be that a lower degree of labour participation is related to smaller amounts of leisure time physical activity of low

educated women. Second, the dual role of worker and mother that is disproportionately expected from women of higher education in these countries, is (literally) more energy demanding than full-time motherhood. Third, working women, especially those of higher educational levels, work in a social environment where the social norm emphasizes thinness and healthy food patterns.

## **Discussion**

To summarise, within all European countries, men and women from lower socioeconomic groups have a higher prevalence of overweight and especially of obesity. In most countries, men and women from lower groups are also at higher risks to be physically inactive and to have diets conducive to obesity. However, the evidence for the role of nutrition is not consistent, possibly because of large variations in nutritional regimes and policies across Europe.

### Policy recommendations

The findings are relevant to policies aimed at tackling the obesity epidemic. Recommendations can be formulated for policies at both local and (inter)national levels. For the local levels, we recommend to target effective local interventions towards disadvantaged groups or places. For example, work-based interventions should ensure to cover "manual" work places, while school-based interventions need to include schools for students at lower training levels. Similarly, interventions aimed to improve the living environment should ensure to include socio-economically deprived areas. For local policies or specific interventions, we also recommend tailoring these interventions in order to respond to the needs of disadvantaged groups. For example, preventive services should consider using forms of provision that have been found to be effective in reaching lower socioeconomic groups, such as provision through GP practices. Similarly, health education programs may need to choose the media and articulate their messages in such a way as to effectively reach men and women with low levels of health literacy.

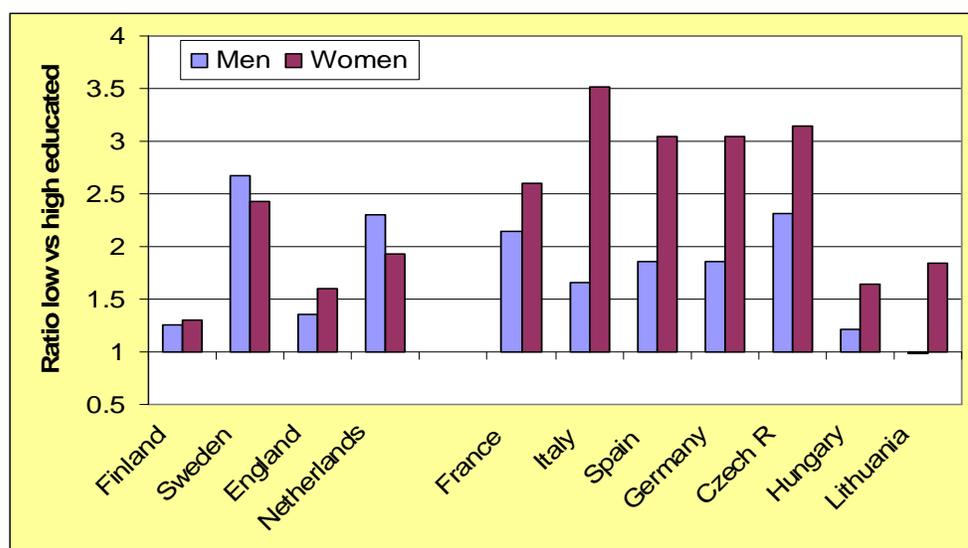
For policies at (inter)national levels and for more comprehensive programs to tackle the obesity epidemic, we recommend prioritizing policies on (inter)national factors that are likely to affect lower groups most. Possible examples of such policies include regulations to restrict junk food marketing, and policies addressing economic factors such as price policies. Further, comprehensive policies at national level, but at local levels as well, may be far more effective if they link up with a broader set of policies under the umbrella of integral health policies. Example of policies that may have large positive effects in the long run include socioeconomic policies to improve employment and income situation of

deprived groups, and urban policies to upgrade their housing and living environment.

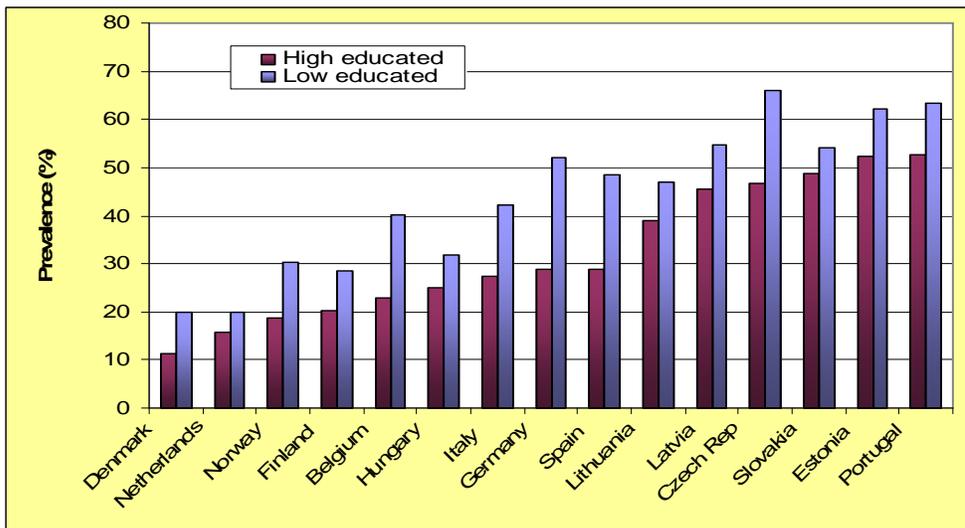
### Recommendations for research

In order to inform future policies, it is important to monitor inequalities in overweight and obesity on a regular basis, and to stimulate new explanatory research. With regards to monitoring, we recommend (a) including socioeconomic variables in the monitoring of (inter)national trends in overweight and obesity, (b) using educational level as a key socio-economic variable, in view of its practical advantages and its predictive power and (c) if feasible, also using complementary socioeconomic measures such as occupational class, household income or household wealth. With regards to explanatory research, we recommend funding of programs to stimulate (a) studies assessing the role of “intermediate factors” such psychosocial and environmental factors, and (b) studies aiming to assess the effect of interventions in different socioeconomic groups. The latter studies would be particularly useful if they identify interventions that have larger effects among lower socioeconomic groups as compare to higher groups.

**Figure 1:** Prevalence of obesity in low compared to high educated groups in selected European countries. Source National health surveys, early 2000’s



**Figure 2:** The prevalence of physical inactivity according to educational level, men. Source National health surveys, early 2000’s



## **Work Package 8: Effectiveness of physical activity interventions and policies for curbing the obesity epidemic**

### **Introduction**

Based on the objectives stated in Annex 1 to the contract, the following work was completed by the researchers in charge of the work package and their associates:

- A systematic literature review of school-based physical activity interventions in European children and adolescents.
- A systematic literature review of workplace-based physical activity interventions in European adults.
- An inventory of ongoing physical activity promotion efforts on healthy diet and nutrition across 10 European countries; this part of the work was performed in collaboration with researchers in work package 9 (see corresponding report).

This report summarises the main findings with a brief description of the methods and a short conclusion.

### **Methods**

#### *School-based interventions*

The aim of this work was to update the evidence on effectiveness of physical activity promotion interventions in a school-based setting, with a specific focus on interventions performed in Europe, and on obesity-related outcomes. We conducted a systematic review of published literature using electronic data sources up to March 2008. Electronic databases searched included Medline, Web of science, SportDiscus, PsycInfo, Cochrane and Cinahl. This was completed by manual search of relevant references found in individual papers or existing reviews and by data obtained from researchers identified through these references or personal contacts. Inclusion criteria were: school-based physical activity intervention study, performed in Europe, including an evaluation of physical activity and/or obesity related outcomes, in schoolchildren between age 6 and 18 years, published in English. Physical activity outcomes of interest included habitual physical activity level, walking, cardio respiratory fitness, and muscular strength. Obesity-related outcomes included: changes in body weight, BMI, weight status, or body composition (% body fat). Methodological quality was assessed and levels of evidence determined. Assessment of evidence was based on the proportion of studies that were randomized controlled trials, together with methodological quality, size of study populations, and significance of results.

#### *Work-based interventions*

The aim of this work was to update the evidence of effectiveness of physical activity promotion interventions in the worksite setting with a specific focus on interventions performed in Europe, and on obesity-related outcomes. The search was based on a similar strategy as the one described above for the review of school-based interventions. Inclusion criteria were: physical activity intervention in adults at the workplace, performed in Europe, including an evaluation of physical activity and/or obesity related outcomes, published in English.

#### *Ongoing efforts*

(See Summary report of work package 9).

A survey was conducted among public health promotion professionals and policy makers in 10 selected countries (Spain, Sweden, UK, Norway, Lithuania, France, Czech Republic, Italy, Slovenia and Germany) to make an inventory of ongoing physical activity and nutrition promotion efforts across Europe. Health promotion professionals were contacted by phone and asked to fill an online survey or send information by email about ongoing school-based efforts and work place-based efforts in their country that promote physical activity and/or healthy diet.

## **Results**

#### *School-based interventions*

The literature search identified 20 European studies. Studies originated mostly from the UK (n=9 studies, 45%), then Greece (n=3, 15%), Belgium and France (n=2 each, 10%), Ireland, the Netherlands, Sweden and Spain (n=1 each, 5%). Included studies could be divided in three categories according to the type of intervention performed: educational (n=10, 50%), environmental (n=7, 35%) and multi-component (n=3, 15%) interventions. Thirteen studies (65%) were considered of high methodological quality. For physical activity outcomes, the evidence available was graded as limited for environmental (mostly changing playgrounds for activities during recess) and for educational (mostly physical education class-related) interventions. In contrast, the evidence for multi-component studies to increase physical activity was graded as strong, although there were few of this type of studies. Only 8 (27%) studies included an evaluation of obesity-related outcomes. The evidence available for effectiveness on obesity-related outcomes was graded as inconclusive for environmental interventions, moderate for educational interventions and, again, strong for multi-component interventions. Among 3 multi-component studies, 2 were randomized controlled trials, both of good quality, and showed prevention of weight gain in children over time..

### *Work-based interventions*

The literature search identified 30 studies conducted in Europe. Studies originated mostly from the UK (n=10 studies, 33%), then Finland (n=6, 20%), Switzerland (n=4, 13%), Belgium, the Netherlands and Sweden (n=2 each, 7%), and Germany (n=1, 3%). Included studies could be divided in 6 categories: counselling (n=4, 13%), exercise training (n=13, 43%), active commuting (n=4, 13%), walking (n=2, 7%), stair use (n=6, 20%) and multi-component (n=1, 3%) interventions. Fifteen studies (50%) were considered of high methodological quality. For physical activity outcomes, the evidence was graded as inconclusive for counselling, walking and multi-component interventions. The evidence was graded as limited to moderate for exercise training and active commuting studies.

For exercise training interventions (most of them focused on a combination of aerobic fitness and muscular training), there was a consistent body of data showing evidence of effectiveness on physiological markers such as cardio respiratory fitness and strength. For active commuting studies (focused on only cycling in half of the studies, and on both walking and cycling for the remaining studies), evidence of effectiveness was also found for cardio respiratory fitness. Among included studies, 17 (57%) had included an evaluation of obesity-related outcomes. However, according to the grading system, there was either no evidence (counselling, exercise training, active commuting, stair use) or inconclusive evidence of effectiveness on obesity-related outcomes in these studies.

### *Ongoing efforts*

(See Summary report of work package 9).

In total 45 school-based efforts and 3 work-based efforts were described.

Most of the school-based efforts were focused on primary school children and combined nutrition and physical activity. The majority of the initiatives included only educational OR environmental components. Lack of motivation in the school management and/or teachers was the most mentioned barrier for implementation.

From the 3 work-based efforts, one initiative focused solely on nutrition, one solely on physical activity and one on both nutrition and physical activity. One of the initiatives included educational components, one environmental and one a combination of educational and environmental components.

## **Discussion and conclusions**

### *School-based interventions*

School based physical activity interventions appear to have a high overall potential to increase physical activity levels and to prevent obesity in children and adolescents.

Especially multi-component interventions are likely to impact positively on both outputs. Interventions that focus on changing only the physical environment in the school setting appear an interesting approach but their (usually) short duration and the use of heterogeneous assessment methodologies, result in difficulties to grade the evidence provided. In assessing changes induced by these school-based intervention studies, there is a need to have more data on obesity-related variables, to move from body weight to body composition assessment, and to have an extended follow-up duration. The number of European studies in children and adolescent on these issues is still limited.

#### *Work-based interventions*

Some evidence of effectiveness was found concerning physical activity promotion in working adults, especially in those with lower fitness. Active commuting and exercise training emerge as promising approaches to promote physical activity in the workplace. Increasing stair use also appears an interesting approach; however, the short duration of these studies and the use of heterogeneous assessment methodologies, result in difficulties to grade the evidence provided. The effect of work-place based physical activity interventions on obesity-related outcomes (body weight, body composition variables) remains to be better defined. The potential importance of availability of, and accessibility to physical activity opportunities in this setting to increase participation would also need further study.

#### *Ongoing efforts*

Most of the school-based initiatives focused both on nutrition and physical activity, but a minority of the projects combined educational & environmental components. Attention should be given how to motivate school management and teachers to implement effective physical activity and healthy diet interventions in the school setting. Initiatives to promote healthy diet and physical activity in the workplace are still missing.

### **Key findings and recommendations**

#### School-based interventions:

School-based physical activity interventions should combine multiple components including educational and environmental components to have an impact on body weight changes over time and obesity prevention. This includes new opportunities for physical activity, defined time in or outside the curriculum for the proposed activities, and also to involve multiple actors in the process (school teachers/management, families/associations, school nurse, community).

The duration of the intervention and the time frame for collecting evidence of changes in body weight/ body composition needs to be prolonged for preferably a number of years in order to be relevant for obesity prevention.

Work-based interventions:

Providing exercise training programmes and facilitating active commuting (walking, cycling) can increase cardio respiratory fitness, an important physiological risk marker. The potential importance to change parts of the design of working places (e.g. stairs) to increase physical activity needs further assessment.

## **Work Package 9: The effectiveness of nutrition interventions and policies for curbing the obesity epidemic**

### **Introduction**

Based on the objectives stated in Annex 1 to the contract, the following work was completed by the researchers in charge of the work package and their associates:

- A systematic literature review of school-based nutrition interventions and policies in European children and adolescents.
- A systematic literature review of workplace-environment based nutrition interventions and policies in European adults.
- An inventory of ongoing promotion efforts on healthy diet and nutrition across 10 European countries.

This report summarises the main findings with a brief description of the methods and a short conclusion.

### **Methods**

#### *School-based interventions*

The objective of the first review was to summarise the existing European published and 'grey' literature on the effectiveness of school-based interventions to promote a healthy diet in children (6-12 years old) and adolescents (13-18 years old). Eight electronic databases, websites, and contents of key journals were systematically searched, reference lists were screened, and authors and experts in the field were contacted for studies evaluating school-based interventions, promoting a healthy diet solely or in combination with physical activity and aiming at primary prevention of obesity, published between 1 January 1990 and 31 December 2007, with outcome measures on behaviours and/ or anthropometrical measures.

#### *Work-based interventions*

The objective of the second review was to summarise the existing European published and 'grey' literature on the effectiveness of work-based interventions to promote a healthy diet in adults ( $\geq 18$  years old). Five electronic databases, several websites and contents of key journals were systematically searched, reference lists were screened, and contacting authors and experts in the field were contacted for studies evaluating work-based interventions promoting a healthy diet solely or in combination with physical activity and aiming at primary prevention of obesity, published between 1 January 1990 and 31 December 2007, with outcome measures on behaviours and/ or anthropometrical measures.

### *Ongoing efforts in schools*

A survey was conducted among public health promotion professionals and policy makers in 10 selected countries (Czech Republic, France, Germany, Italy, Lithuania, Norway, Slovenia, Spain, Sweden, UK) to make an inventory of ongoing PA-promotion efforts across Europe. Health promotion professionals were contacted by phone and asked to fill an online survey or send information by email about ongoing school-based efforts and work-based efforts in their country that promote physical activity and/or healthy diet.

## **Results**

### *School-based interventions*

The literature search resulted in 53 European studies: 42 focused only on promoting a healthy diet (29 in children, 13 in adolescents) and 11 on both promoting a healthy diet & physical activity (6 in children 5 6 in adolescents).

For the interventions focusing only on promoting a healthy diet, effects on anthropometrics were often not measured, and therefore delivered inconclusive evidence. In *children* strong evidence was found for multi-component interventions on presumed determinants of fruit and vegetable intake and fruit and vegetable intakes itself. Limited evidence was found for educational interventions delivered by teachers (e.g. taste-testing) on determinants and behaviour and for environmental interventions (e.g. fruit subscription) on fruit and vegetable intake. Interventions that specifically targeted children from lower socioeconomic status groups showed limited effect on behaviour.

In *adolescents*, moderate evidence was found for educational interventions on behaviour. Further limited evidence was found for educational interventions on determinants and for multi-component programmes on behaviour.

For the interventions focusing on promoting both a healthy diet & physical activity no evidence was found for effectiveness of educational only interventions (e.g. adapted nutrition and physical activity curriculum) on anthropometrical obesity-related measures. Moderate evidence was found that multi-component interventions combining an educational (e.g. computer-tailored nutrition and physical activity advice) and an environmental component (new opportunities for physical activity, availability of tap water) had a positive impact upon anthropometrics in *adolescent* girls.

In both children and adolescents effects of a multi-component program showed more favourable results on determinants and behaviour as those only using education.

### *Work-based interventions*

Sixteen studies solely focusing on a healthy diet were identified, including 7 educational, 1 environmental and 8 multi component interventions. None met the methodological criteria to be rated as “strong”, 8 met the criteria for “moderate” quality. Regarding the promotion of both nutrition and physical activity, 9 studies, mostly educational, were included; only 2 multi component studies were identified. Moderate evidence was found on diet for educational and multi component nutrition interventions. In the studies combining nutrition and physical activity, limited evidence was found for educational interventions on physical activity in leisure time. The majority of the included nutritional interventions didn’t meet the required general criteria for successful workplace health practice.

#### *Ongoing efforts*

In total 45 school-based efforts and 3 work-based efforts were described.

Most of the school-based efforts were focused on primary school children and combined nutrition and physical activity. The majority of the initiatives included only educational OR environmental components. Lack of motivation in the school management and/or teachers was the most mentioned barrier for implementation.

From the 3 work-based efforts, one initiative focused solely on nutrition, one solely on physical activity and one on both nutrition and physical activity. One of the initiatives included educational components, one environmental and one a combination of educational and environmental components.

### **Discussion and conclusions**

#### *School-based interventions*

Evidence for effectiveness on anthropometrical obesity-related measures of nutrition only interventions is lacking. Evidence was found for the effectiveness of especially multi-component interventions promoting a healthy diet in school-aged children on self-reported dietary behaviour and behavioural determinants.

School-based nutrition and physical activity interventions suggest that combining an educational and an environmental component might be preferable if effects on anthropometrics are aimed at children and adolescents. The results also showed that aiming at knowledge effects is not a good policy; the focus would rather be on strategies that would be able to change nutrition as well as physical activity habits at the same time. These strategies should combine an educational component with environmental facilitation.

#### *Work-based*

Modest positive effects of nutrition interventions in the workplace on dietary behavior were found. The limited effects can possibly be explained by the absence of the success criteria for workplace health promotion in most of the studies.

#### *Ongoing efforts*

Most of the school-based initiatives focused both on nutrition and physical activity, but a minority of the projects combined educational & environmental components. Attention should be given how to motivate school management and teachers to implement effective physical activity and healthy diet interventions in the school setting. Initiatives to promote healthy diet and physical activity in the workplace are still missing.

### **Key findings and recommendations**

#### School-based interventions

School interventions should combine education and environmental/policy components and focus on nutrition + physical activity to have an impact on obesity. Potentially relevant aspects include:

- new opportunities for physical activity
- fruit subscription
- tap water to replace sugar-sweetened beverages
- education through computer-tailoring
- involve school teachers/management, families/associations, school nurse, community.

It is not recommended to implement educational interventions ONLY or environmental interventions ONLY at schools, since these have poor chances of relevant effects

#### Work-based interventions

Moderate effect for educational nutrition and multi-component interventions on food intake

Participation in work place interventions is a main problem in intervention studies

#### Recommendations based on finding of the review & of the inventory

It is recommended to implement multi-component (educational + environmental) instead of the ongoing single-component interventions in schools. Special attention should be given to increase the current motivation in school management and teachers and increase the number of ongoing efforts in secondary schools.

## **Work Package 10: Scenarios for the impact of obesity on the health of European populations**

### **Introduction**

This work package aimed at estimating the impact of trends in overweight and obesity on future trends in population health in the European Union. In this work package, we developed and quantified scenarios that were based on the input from all other work packages in the project. In “autonomous” scenarios, we estimated the impact of possible future trends of overweight and obesity on future rates of mortality and disability in the European Union. In policy-based scenarios, we evaluated the potential impact of new policies and interventions, both on future patterns of overweight and obesity, and on future rates of mortality and disability in the European Union. This report summarises the main findings of these analyses.

### **Methods**

#### *The EPHOPE simulation model*

The work package had to use a model that was able to simulate the effects of future changes in the prevalence of overweight and obesity on the health of European populations. At the start of the project, we evaluated the possibility to use existing models such as Prevent to address this goal. We had to conclude that models that were currently available at the start of the project, were not sufficiently flexible for addressing these goals. Therefore, we decided to develop and apply a model specifically designed for the HOPE project. In this section, we briefly describe this model, which we called “EPHOPE”. For further details, we refer to deliverable 10.1.

The model is designed to assess the effects of obesity prevention in national populations. The model had to be able to evaluate possible strategies of obesity prevention through the development of alternative “intervention” scenarios. The model was to estimate future trends in health outcomes under an “intervention” scenario and to compare these trends to those under a “no intervention” scenario. EPHOPE does not model the specific ways in which interventions could affect BMI, but takes the expected amount of reduction in BMI as the input to “intervention” scenarios.

EPHOPE is a multi-state life table with a distinction between two states: “disabled” and “non-disabled”. As a result, the model is able to simulate the effects of trends in overweight and obesity on both mortality and the prevalence of disability. Where

appropriate, these measures are expressed in terms of life expectancy, and disability-free life expectancy.

The model is cohort based. EPHOPE can primarily be used to model individual birth cohorts or generations. The model is therefore able to assess the effects of obesity prevention in specific generations, such as those who are teenagers in 2010. EPHOPE can be run simultaneously for all generations living at a certain moment in time. As a result, the model can also present health effects in a period-wise way, i.e. for different calendar years between the years 2010 and 2100.

The model was made to be maximally transparent. For users it is possible to re-trace and intuitively understand the final outcomes that are produced by the model. Sophisticated elements such risk factors dynamics and uncertainty estimates were not included in order to ensure transparency of model and outcomes.

#### *Empirical input*

The model was constructed to be flexible with regards to the epidemiological input. It enabled the input of data that represented the situation in specific European regions or countries. Similarly, it was easy to include empirical input that represented lower or higher educational groups. The model was also able to take into account secular trends in obesity in specific European countries, and to distinguish between period-specific and generation-specific trends.

For the simulations presented below, the model utilised the following empirical estimates:

- Age-sex-specific rates of disability incidence, disability recovery and mortality (of disabled and non-disabled, respectively): estimates were derived from longitudinal analyses of the European Community Household Panel (ECHP). These estimates were available for 12 EU member states covered by the ECHP between 1994 and 2000. For the scenarios presented below, we utilised the estimates for the 12 countries together. From the same source, similar estimates could also be made with distinction by educational level. We applied a two-level distinction between elementary&lower secondary education versus upper secondary&higher education.
- Age-sex-specific national averages of BMI: estimates were derived from national health interview surveys from 22 European countries included in the "Eurothine" database (see work package 7). These estimates were available for each of the 22 countries covered by this database. For the scenarios presented below, we utilised the averages measured for the 12 countries covered by the ECHP. Within the

model, the prevalence of overweight and obesity were derived from the average level of BMI, for each age and sex separately. From the same source, BMI estimates were also available according to educational level, using the same two levels as above.

- The magnitude of effects of overweight and obesity on age-sex-specific rates of disability incidence, disability recovery and mortality: Relative Risk estimates were made on the basis of a review of the epidemiological literature. We particularly relied on a review focussing on effects of overweight and obesity on disability transitions. We also ensured consistency with reported effects of overweight and obesity on levels of total mortality. We mainly relied on recent epidemiological studies, instead of some older epidemiological studies that reported much larger mortality effects. We also evaluated possible variations in effect size according to age and sex. From this evaluation, we concluded that such variations could be ignored because they seemed to be relatively small and they were not consistent across different epidemiological studies.

We also had to make assumptions with regards to time-related changes in average BMI, including trends between subsequent birth cohorts, and changes according to age over the life course of single cohorts. Estimates were made on the basis of a review that we made of studies on cohort, period or age-related changes. Estimates that we derived from these reviews were checked for consistency with the age patterns of average BMI as observed in the data from "Eurothine" database mentioned above.

## **Results**

### *"Autonomous" scenarios*

In the first set of scenarios, we estimated the impact of likely future trends in overweight and obesity on future rates of mortality and disability in the European Union, assuming no new policy measures are implemented. We constructed several scenarios. For sake of simplicity, here we give results only for two scenarios that represent two strongly contrasting situations. The first scenario assumes that the recent generation-wise increase in average BMI levels would continue over the next generations. The second scenario assumes that this increase would stop; starting with the generation that is born around 1990 and that started to reach adult age in about the year 2005.

In table 1, the two scenarios are compared with regards to the life expectancy, and the expectancy of life without disability, as expected for years between 2010 and 2070. If we were to halt the obesity epidemic starting with the generation born around 1990, this

would have little effect on the life expectancy. This life expectancy might even decrease on the short term (because less people would be exposed to the relatively low risk of mortality associated with moderate overweight) but increase on the long term (because of an opposite effect, related to the less people being exposed to the increased risks associated with obesity). However, the effects are small. The effects on disability-free life expectancy are larger and consistently in the same direction. Stopping a further rise of the obesity epidemic would have the effect to increase disability-free life expectancy by more than 300 days, i.e. almost 1 year. This effect would however only be achieved in about 2070, i.e. after more than half of century from now.

**Table 1:** Change in life expectancy and in disability-free life expectancy if generation-wise increase in BMI were to be stopped in 2005. Estimates with the EPHOPE model for the years 2010 to 2070.

Period	Men		Women	
	Life expectancy at age 20 (days)	Disability-free life expectancy at age 20 (days)	Life expectancy at age 20 (days)	Disability-free life expectancy at age 20 (days)
2010	-0.53	0.14	-0.15	0.41
2020	-2.29	3.29	-0.83	4.51
2030	-3.46	15.70	-1.88	18.79
2040	0.03	46.04	-1.46	54.14
2050	13.81	101.83	4.54	121.77
2060	42.83	184.45	21.12	226.79
2070	85.48	285.33	49.48	362.62

In table 2, the projected health impacts are presented according to generation. This table focuses on disability. For each generation born between 1986-1990 (i.e. those 15-19 years in 2005) and 2046-2050, the table presents the effect on disability-free life expectancy and on the prevalence of disability in the population. For these young and future generations, the health impact is substantially larger than the period effects shown in table 1. For example, the scenarios project a gain in disability-free life expectancy of 331 days for girls born in 2006-2010, and already 616 days for girls born in 2026-2030. The impact is also large in terms of the life-time disability prevalence, which would decrease by 3 to 4 percent for the male and female 2006-2010 generations, and 6 to 7 percent for the 2026-2030 generations.

**Table 2:** Change in disability-free life expectancy and in the prevalence of disability if

generation-wise increase in BMI were to be stopped in 2005. Estimates with the EPHOPE model for the generations born in 1986-90 up to 2046-2050.

Generation	Men		Women	
	Disability free life expectancy at age 20 (days)	Relative change in disability prevalence rate	Disability free life expectancy at age 20 (days)	Relative change in disability prevalence rate
1986-1990	46.82	0.70%	61.58	0.85%
1996-2000	142.83	2.07%	192.49	2.53%
2006-2010	240.57	3.36%	331.14	4.19%
2016-2020	338.28	4.57%	473.70	5.77%
2026-2030	434.24	5.69%	615.94	7.25%
2036-2040	526.84	6.70%	753.61	8.61%
2046-2050	614.70	7.61%	882.87	9.81%

Thus, in terms of disability-free life expectancy, it makes a huge difference whether or not the recently born and future generations would be exposed to the same BMI levels as cohorts born before 1990, or whether their BMI levels would be substantially higher.

#### *Policy-based scenarios*

In additional scenarios, we aimed to estimate the future trends in overweight and obesity, and future trends in mortality and disability, assuming the implementation of new policies and interventions as identified in the other work packages. Unfortunately, the evidence from other work packages on the effectiveness of interventions in terms of reducing BMI levels in target populations is scarce, fragmentary and inconsistent. The most consistent evidence comes from the reviews made in the HOPE project of the effectiveness of interventions among children and adolescents. The example below is based on this evidence.

According to estimates from the most successful interventions, comprehensive interventions may be able to achieve a reduction of average BMI by about 1.0 units among children and adolescents. This estimate could be taken as a basis for a policy-based scenario, under the assumption that (a) the same effectiveness could be achieved when these interventions, perhaps supported by wider policies, were to be implemented among national populations, and (b) this intervention, and related policies, would be so enduring that the positive health effects were to persist over the entire life course of the target generations.

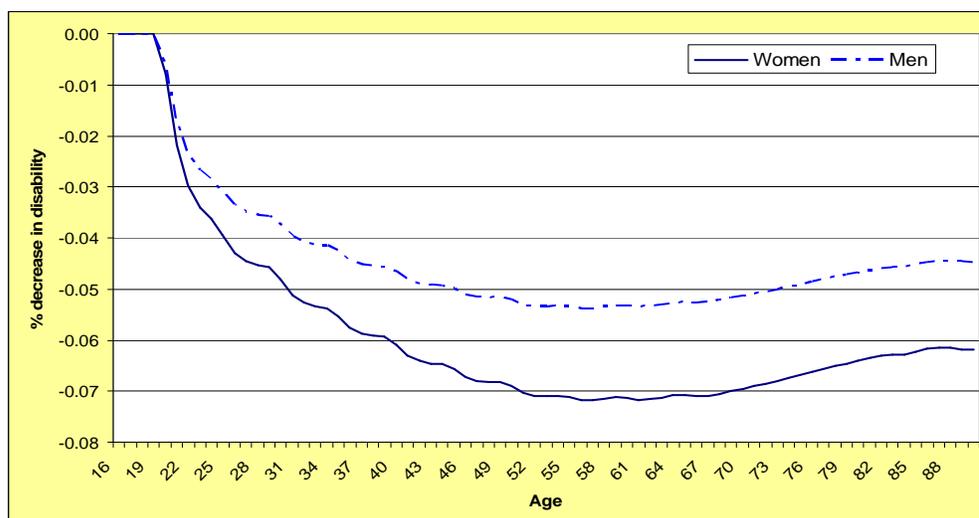
Using the EPHOPE model, we thus estimated what would happen if the average BMI in generations born around 1990 would decline with 1.0 unit. In this scenario, this reduction in average BMI is assumed to be achieved at the age of 20 years, and maintained over the entire life time of this generation. As above, these estimates apply to an “average” European cohort – the data being pooled for the 12 countries covered by the ECHP. For this European cohort, the gain in life expectancy would be modest: only 71 days. The gain in disability-free life expectancy would however be much larger: 208 days. The prevalence of disability in national populations would decline by about 3 percent, with slightly larger declines (about 4 percent) in disability prevalence rates at middle ages than at older ages (about 2-3 percent).

*The impact of socioeconomic inequalities*

In one other type of scenario, we utilised information on the effect of socioeconomic factors (see work package 7) in order to obtain further evidence on the potential effect of reductions in BMI on mortality and disability in European populations. In this scenario, we explored the situation that lower educational groups would have the same average BMI as higher educational groups. Even though this is an entirely hypothetical example, it serves to illustrate the potential health impact of a change in population BMI levels that might potentially be achieved.

Key results are presented in figure 1. If lower socioeconomic groups were to reduce the BMI levels up to that of higher socioeconomic groups, this would decrease the prevalence of disability substantially. The largest relative decrease is observed in middle age, with declines of about 5 percent among men and even 7 percent among women.

**Figure 1:** The percent reduction in the prevalence of disability of lower educational groups if their BMI levels were to reach that of higher groups. Estimates based on the EPHOPE model



## **Discussion**

We have made large efforts to produce relatively robust estimates by developing a model that has a transparent structure, and that made relatively light demands on the empirical input. Most of this input was directly derived from special analyses that we made of primary data sources that were representative of several European countries. Relatively few assumptions had to be made to complete the empirical input to the model

None the less, the estimates based on the EPHOPE models, as with any other simulation model, should be interpreted with caution. The model does not represent the “true” situation in European countries. Nor can the scenarios of future trends be interpreted as forecasts of the most likely trends in the years ahead. The EPHOPE model is not designed for this purpose, but for the only purpose to compare alternative scenarios, and to learn from the differences between these scenarios.

When we compared two “autonomous” scenarios, we found that it could make a huge difference to the health of European populations whether or not the obesity epidemic would be halted by now. For new generations, this effect is visible not so much in terms of life expectancy, but it is in terms the number of years that people can expect to live free of disability.

When we developed policy-based scenarios, we also observed important effects of obesity prevention on the life expectancy, and especially the disability-free life expectancy, of the generations that would be targeted. However, the magnitude of health impact is yet highly uncertain, because lack of consistent evidence on the effectiveness of interventions in terms of reducing BMI levels.

The latter exercise especially brought to light that most of the interventions evaluated up to now lack evidence about their effectiveness in terms of reducing BMI. Moreover, it is very hard to judge the potential effectiveness of single interventions in the hypothetical case that they would be implemented in entire national populations. Similarly, there is an alarming lack of evidence on the effectiveness at the longer run, as seen from the perspective of the entire life course of the target generations. The EPHOPE model thus

revealed an important gap between the evidence generated by intervention studies, and the evidence needed to assess the future health impact of these interventions in national populations.

The final ambition of this work package was to summarize the potential benefits of the full implementation of new policies and interventions on future population health in the European Union. We have to conclude that the future course of the obesity epidemic can make a huge difference, especially for the health of recent and future generations, but that the contribution of single interventions cannot yet be determined in detail. We first need to accumulate more evidence on the long term effects of interventions when implemented at national levels.

### **Reference**

Kunst AE, van Hooijdonk C. EPHOPE: a dynamic simulation model for assessing the Effects on Population Health of Obesity Prevention in Europe. Deliverable 10.1 to the HOPE project. Rotterdam: Erasmus MC, 2010