

Social Variations in Health Expectancy in Europe

An ESF Scientific Programme

1999 – 2003



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1 Origin of the à la Carte Programme and Initial Aims

'Social variations in health expectancy in Europe' is an ESF Programme to advance most recent promising research developments in this field. At the time of preparing a proposal for this Programme substantial evidence on social inequalities in health between and within European countries was available. It was also obvious that reduction in inequalities in health had become a priority for several European governments.

The past 25 years of social epidemiological research on health inequalities have provided basic tools, standardised methods and rich empirical evidence. Most importantly cross-national comparative analyses on socio-economic differences in mortality in Europe revealed a consistent pattern of a stepwise increased risk according to lower educational and occupational standing: In a Concerted Action, sponsored by the European Union, in which teams from 15 countries participated, these substantial findings were obtained. However, less evidence was available so far on what factors may influence the observed mortality differences.

It was concluded that, building on these achievements, it is now the task of science to move from describing towards *explaining* social variations in health.

In an exploratory workshop, leading researchers from 14 European countries identified research areas which offer particular potential for scientific advance through European and transatlantic collaboration. In the workshop and in the subsequent proposal, it was agreed that a scientific programme should concentrate on the following aims:

1. Advancing explanations in the three following research clusters which hold special promise for scientific progress:
 - *Life-course influences on health*
 - *Health effects of stressful environments in adult life: The interaction of biological and psychosocial factors*
 - *Macrosocial determinants of morbidity and mortality*

The three research areas differed in the extent to which they represent relatively new approaches (life course influences on health), could build on existing collaborations (health effects of stressful environments in adult life) and are characterised by scientific disagreement about evidence and explanation (macrosocial determinants of morbidity and mortality). The aim was therefore best achieved by establishing three respective working groups (WG) whose programme is defined by a common research agenda.

2. Strengthening transdisciplinary collaboration between biomedical and social science research teams. A joint ESF support from the EMRC and SCSS committees provides a necessary prerequisite of continued cooperation throughout the Programme.
3. Developing a strong science transfer component across Europe, including the creation of scientific networks as well as recruitment and involvement of young scholars.
4. Contributing to health policy activities at the European and national level by informing responsible agencies and bodies about major research results and their implications e.g. for the design of preventive measures.

These aims served as the agreed upon frame of reference for the activities of this scientific Programme which are summarised below.

2 Organisation

2.1 Management structure and mode of operation

Steering Committee: A Steering Committee has been established to run the Programme. Members from each participating country have been selected on the basis of their scientific expertise. The Steering Committee has maintained overall responsibility for the management of the Programme, the monitoring of its progress and budget and has met once a year.

☞ Members of the Steering Committee are listed in appendix A 3: Steering Committee.

Core Group: A small management committee of six members has given detailed attention to the planning and realisation of activities.

☞ Members of the Core Group are listed in appendix A 4: Core Group.

Working Groups: The three working groups mentioned were established to carry out the essential programme tasks. This has been achieved by a number of group meetings, plenary sessions and collaboration on joint research projects. Essential criteria for identifying potential participants for work groups were the quality of research performed in the area, the disciplinary background and the respective expertise from the range of European experience in the field.

☞ Members of the Working Groups are listed in appendix A 2: Participants.

Coordinating centre: A coordinating centre was established at the department of the scientific director. Support was provided by ESF for a half time scientific coordinator located at the centre. The research co-ordinator was critically important in maintaining the network, strengthening communication between participants as well as arranging and preparing scientific and organisational meetings.

2.2 Subdivision in thematic groups

The essential subdivision of Programme activities into thematic groups was accomplished through the three working groups:

- Working Group 1 on 'Life course influences on health'
- Working Group 2 on 'Health effects of stressful environments in adult life: The interaction of biological and psychosocial factors'
- Working Group 3 on 'Macrosocial determinants of morbidity and mortality: Their contribution to the explanation of inequalities in health'

As can be seen from the reports of the three working groups, further topical or methodological subdivisions were arranged within each group.

2.3 Organisation of secretarial services

Organizational work conducted at the coordinating center and at the administrative unit of the Duesseldorf University was supplemented by support from secretarial services at the European Science Foundation in Strasbourg.

☞ Collaborators of the European Science Foundation are listed in appendix A 5: ESF support.

3 Achievements

3.1 Report of Working Group I

3.1.1 Background and aims

Background and WG membership

Lifecourse perspectives on health and health inequalities represent a new field of research on health and health inequalities. Perspectives which recognise that individual well being is shaped by processes operating over the course of life ('the lifecourse') have long been central to other research fields, including psychology and sociology. But these perspectives are only beginning to assume the same centrality in social epidemiology, bringing to the discipline a greater appreciation of how people's health is influenced by biological and social factors acting over time and across generations - and how differential exposure to these factors contributes to inequalities in health (Ben-Shlomo and Kuh, 2002). Both across Europe and internationally, the development of lifecourse epidemiology is stimulating new conceptual and methodological approaches which bridge the social and biological sciences and which bring research closer to policy.

Understanding the lifecourse influences on adult health requires a focus on the different and changing environments in which children grow up and adults grow older. An eco-social perspective is thus integral to a lifecourse perspective, with studies seeking to track risk factors operating at range of hierarchical levels - from the macro-social, through the meso-social environments of home, workplace and community, to the individual and molecular level (Ben-Shlomo & Kuh 2002; Kuh et al, in press-a). As this suggests, the three Working Groups in the Programme are working to develop perspectives on socioeconomic inequalities in health which are complementary and inclusive.

The 21-person membership of the lifecourse group covers the Czech Republic, Denmark, Germany, Ireland, The Netherlands, Norway, Finland, Italy, Spain, Sweden and the UK, together with Canada and the US. WG1 includes researchers working on major international data-sources for tracking lifecourse influences on adult health. These include studies in Denmark (for example, Danish Longitudinal Study on Work, Unemployment and Health, Metropolit2000, Danish National Birth Cohort Study), Finland (Kuopio Ischaemic Heart Disease Risk Study, Tampere cohort study), Italy (Turin longitudinal study), the Netherlands (GLOBE study), Sweden (Stockholm Heart Epidemiology Programme, Swedish Survey of

Living Conditions), Norway (Oslo Mortality Study), UK (Scottish collaborative study, Aberdeen study, 1946 birth cohort study, 1958 birth cohort study) and the US (Alameda County Study). WG researchers are also involved in the development of the new birth cohort studies, including those in Denmark, Ireland, the Netherlands and the UK. Across these older and newer data-sources, the WG has brought together those already at the leading edge of life-course research as well as those developing their profile of lifecourse research.

We sought to make the WG a stimulating and supportive network which respects these national and individual differences. Our Programme looked for synergies - in scientific questions and methodological challenges, in existing datasets and new cohort studies - through which lifecourse perspectives on health inequalities could be advanced at European and international level. Over the last four years, the WG has developed into a productive forum for scientific exchange and collaboration. Nonetheless, we recognise that it is too early to assess fully the WG's contribution to advancing health inequalities research in Europe. The longer-term impact of the WG will not be evident until the knowledge-transfers and research networks that it has facilitated have all had time to translate into scientific papers and programmes of research. This report therefore provides an interim picture of WG1's achievements.

Objectives and work plan

The research agenda outlined for the Working Group in the Programme Proposal, drawn up in 1998, identified conceptual and methodological development as a priority. It pointed to the opportunities for developing theoretical models and study designs, for developing analyses which examined patterns among women and men, and for integrating qualitative and quantitative data.

The agenda was discussed at the inaugural meeting of the Programme in May 1999, with WG participants noting the developments in lifecourse research likely to come on stream over the lifetime of the Programme, including new data-sources. Discussion focused on areas in which the WG could best make a contribution to the enhancement and scientific transfer of lifecourse perspectives in Europe. Three areas were identified, and the objectives of the WG were revised to give priority to them. The objectives were to:

1. pool the skills of the group to tackle conceptual and methodological issues central to lifecourse analyses;
2. exploit the potential of established datasets to investigate questions about lifecourse influences on health and health inequalities;

3. take the opportunity presented by new cohort studies to establish dialogue and, if possible, cross-linkages between them.

In line with the original Programme proposal, attention has been paid to developing explanations of health inequalities which are alert to potential gender differences in lifecourse exposures and health outcomes.

Across the 4 years of the Programme, the WG has met regularly to build research networks, to share knowledge and to make progress on the three core objectives.

The three objectives have been met through three complementary streams of activity. As part of objective 1, joint WG meetings have been held with WG2 to debate and tackle the methodological and conceptual challenges. For objectives 2 and 3, sub-groups were established for WG members working on established datasets and on the development of new cohorts.

Beyond the input of the two WG leaders, H. Graham and C. Power, WG colleagues have also given generously of their time. This final report provides an opportunity to for the WG leaders to record our thanks to all WG1 participants for their commitment to the ESF Programme. We would like to record particular thanks to those who shared the work of organising WG meetings (A.-M. Nybo Andersen, C. Kelleher, D. Leon, J. Lynch) and in working with us on the ESF 2001 summer school (Y. Ben-Shlomo, J. Hallqvist, C. Hertzman, D. Kuh, J. Lynch).

To give a flavour of WG activity, the meetings held in one academic year (October 2001 to September 2002) are detailed below.

Table 3.1.1: WG1 Meetings in 2001/2002

<ul style="list-style-type: none"> - Joint meeting of Working Group 1 and Working Group 2 Analysing lifecourse, repeat measurement data: methodological problems and opportunities, November 16 & 17 2001, London; organised by J. Lynch (WG1) and D. Blane (WG2). - Meeting of WG1 researchers involved in comparative analyses of lifecourse effects, November 15 2001, London; organised by C. Power and H. Graham. - Meeting of WG1 researchers involved in the new cohort studies, January 10 & 11 2002, London; organised by C. Kelleher. - 2nd meeting of WG1 researchers involved in comparative analyses of lifecourse effects, May 2002, London; organised by C. Power and H. Graham. - 2nd Joint meeting of WG1 and WG2 Analysing lifecourse, repeat measurement data: methodological problems and opportunities, May 23 & 24 2002, London; organised by J. Lynch (WG1) and D. Blane (WG2). - Meeting of researchers involved in the Metropolit & Aberdeen cohort studies, Sept 19 & 20 2002, Aberdeen; organised by A.-M. Nybo Andersen and D. Leon.
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3.1.2 Contributions and outputs for objective 1

Pooling the skills of the group to tackle conceptual and methodological issues central to lifecourse analyses

Understanding how health-determining influences operate across the lifecourse, and in societies undergoing rapid and varied processes of development, is a major research challenge. Among these challenges, the WG identified the need for:

- the clarification of key terms and concepts, to aid the development of lifecourse models and their operationalisation in testable hypotheses and analytical strategies;
- the continuing development of theoretical models which postulate the pathways linking exposures across life to health outcomes in adulthood;
- the development of analytical strategies through which to test different lifecourse hypotheses;
- feeding lifecourse research into the evidence-base of policy, both to improve health and reduce inequalities.

Clarification of key terms and concepts

Because lifecourse epidemiology is a new and dynamic field, its key terms are also in the process of development. WG members have been actively engaged in clarifying key life-course concepts and processes, through a series of papers aimed at both the scientific and policy community (for example, Ben-Shlomo and Kuh, 2002; Graham, 2002; Kuh et al, 2003; Power and Hertzman, 2003). We would single out the two conceptual papers led by Y. Ben-Shlomo and by D. Kuh, as providing 'state-of-the-art reviews. They were informed by discussions at WG meetings, including joint meetings with WG2, and at the ESF 2002 summer school (Ben-Shlomo and Kuh, 2002; Kuh et al, 2003). These meetings provided the opportunity to debate, if not always resolve, differences in the use of terms.

Continuing development of lifecourse models

Advances in lifecourse research require the elucidation of the social and biological mechanisms through which circumstances at different life stages contribute to inequalities in diseases which manifest in adulthood. An appreciation of how lifecourse processes vary across time and space is also fundamental to refining our understanding of why there are persisting socioeconomic inequalities in health.

Researchers in WG1 have taken on these challenges. For example, they have provided perspectives on population health which take account of the lifecourse factors operating in different historical periods and on different birth cohorts (Hertzman and Siddiqi, 2000; Lynch and Davey Smith, in press; Lynch et al, submitted). In addition, they have developed lifecourse models which map how risk factors act across the lifecourse and across generations to influence health in adulthood.

With respect to lifecourse models, a variety of typologies have been suggested to capture the temporal relationships between exposure and health outcome. These distinguish between health consequences which result from exposures at key points earlier in life irrespective of intervening experiences; health consequences which result from the accumulation of episodes of illness and injury, adverse environmental conditions and health damaging behaviours; and health consequences which result from adverse exposures earlier in life triggering a sequence of linked exposures in later life. These overlapping processes have been clarified in a series of important reviews by WG members (see, for example, Hertzman et al, 2001; Ben-Shlomo and Kuh, 2002; Power and Hertzman, in press; Kuh et al, in press-b). Important work has also been undertaken on their implications for understanding gender and ethnic inequalities in health (for example, Graham, 2000; Kuh and Hardy, 2002; Power and Parsons, 2002; Hertzman, 2003; Chor et al, in press).

These models are generating testable hypotheses. For example, hypotheses about accumulation of risk have been tested by developing measures of socioeconomic position across the lifecourse. These analyses by WG researchers have linked cumulative socioeconomic disadvantage to poorer health, coronary heart disease (CHD) and cardiovascular disease mortality (Power et al, 1999; Wamala et al, 2001; Davey Smith and Hart, 2002). For example, J.I. Elstad has found that accumulation of disadvantageous working conditions (especially physical exposures) during the working career is associated with health at age 55, after adjustment for earlier health status and unhealthy behaviours during adulthood (Elstad, 2003). The research team led by C. Power has uncovered an important dose-response effect on health of lifetime socioeconomic conditions. In the 1958 birth cohort study, the proportion of the cohort in poor health in adulthood rose in line with duration of exposure to poor circumstances. Important from a policy perspective, favourable circumstances in adulthood did not entirely compensate for earlier disadvantage and conversely, later disadvantage was not offset by a favourable early start in life (Power et al, 1999). G. Davey Smith's analysis of the Scottish collaborative study demonstrated that there were no important interactions between childhood socioeconomic circumstances and behavioural risk factors in adulthood (Davey Smith and Hart, 2002).

Models which hypothesise that social disadvantage in early life sets children on disadvantaged social and biological trajectories have also been tested and refined by WG1 researchers. The research team led by C. Hertzman, at British Columbia, has focused on the special role of child development, and the biological embedding of systematic socioeconomic differences in children's physical, cognitive, socio-emotional and behavioural development. Collaboration with WG researchers is part of this work (for example, Jefferies et al, 2002). A major programme is underway, mapping socioeconomic differences in the quality of early life experiences, and their influence on the development of school-related competences in pre-school children and on their subsequent educational performance (Hertzman et al, 2002). Members of WG1 (P. Due and J. Lynch) have also worked with a Danish group on the role of school connectedness as a mechanism within a disadvantaged social trajectory. They found that parental disengagement in the children's school to be strongly associated with children's symptom load. Their analysis points to this as a possible inter-generational mechanism, whereby parents' school experiences may be part of the cascade of early-life influences which lead to later social and health disadvantage (Due et al, 2003).

Development of analytical strategies

It is recognized that lifecourse models, and the social and biological processes which they capture, are not mutually exclusive. This raises a range of methodological challenges, and the lifecourse WG have highlighted the difficulty of developing analytical strategies to disentangle the effects of these inter-connected processes. WG1 researchers have considered how much health-related social mobility contributes to the inverse relationship between socioeconomic position and health (Manor et al, in press; Claussen and Naess, 2002). J.I. Elstad has discussed under what circumstances social mobility is likely to constrain the magnitude of socioeconomic health differences ('gradient constraint') (Elstad, 2001). He has also examined how socioeconomic inequalities in perceived health in a population of Norwegian men changed over a 10-year period (Elstad and Krokstad, 2003). It was shown that socioeconomic health differentials widened as the sample matured from age 25-49 to age 35-59. Analyses suggested that the widening of health differentials among those employed during the study period was almost solely due to social causation, i.e. to social class differences in exposures to health-detrimental environments. However, the widening health differences between those employed and those outside employment during the study period had a different explanation. Here, the main reason was transitions from paid labour to non-employment because of emerging health problems.

J. Hallqvist led a WG collaboration which worked through the methodological problems of disentangling the effects of accumulation, critical period and social mobility (Hallqvist et al, 2004). Their analysis suggests that the task of separating these processes is hindered by the fact that, both conceptually and empirically, there is a limited number of trajectories available, and these can not be arranged in such a way as to provide exposure contrasts free of confounding. At this stage in the development of lifecourse epidemiology, there does not appear to be a definitive test to disentangle these causal processes.

Feeding lifecourse research into the evidence-base of policy

At state, national and international level, governments are paying greater attention to the evidence base for public health policies. These policies are seeking to reduce inequalities in health, at a time when social and economic trends are widening inequalities in their underlying social determinants.

WG members have sought to locate lifecourse analyses of health inequalities in the context of rapid social and economic change, and have been active in feeding developments in lifecourse epidemiology into policy debates (Hertzman and Siddiqi, 2000; Graham, 2001, 2002; Power et al, 2002). For example, C. Hertzman has established a research/policy partnership,

the Human Early Learning Partnership (HELP), to spearhead research on the role of child development in social and health inequalities, and to inform policies seeking to reduce inequalities in children's developmental opportunities and future health. As a second example, H. Graham and C. Power have been commissioned by the public health policy community in England to develop a lifecourse framework to inform health and social policies targeting children in poverty (Graham and Power, 2003).

3.1.3 Contributions and outputs for objective 2

Exploiting the potential of established datasets to investigate questions about life-course influences on health and health inequalities

The development of lifecourse perspectives on health and health inequalities require study designs which enable exposures and outcomes to be temporally ordered. The available pool of studies which meet these design criteria include birth cohort studies where participants have reached mid-adulthood; historical cohort studies extended by follow-up data on participants; longitudinal studies with retrospective information on early life; and data-linkage using information from population censuses, civil registers and social surveys.

WG researchers have sought to exploit this pool of studies to answer questions about:

- The contribution of conditions in childhood and adulthood to adult ill-health and premature mortality
- The contribution of conditions in childhood and adulthood to biological and behavioural risk factors for adult ill-health and premature mortality
- Continuities in poor health across generations.

In addition, through its review of data-sources, the WG identified two cohort studies – the Aberdeen and Copenhagen studies – as having important similarities. The Programme therefore supported a meeting to test the potential for collaborative analyses using the two studies.

Contribution of conditions in childhood and adulthood to premature mortality and adult ill-health

In previous work, a relation between adverse childhood circumstances and higher risk of *premature mortality* has been found in some, but not all, studies. Studying childhood influences across a wider range of cohorts, time-periods and societies has been a major research undertaking by members of the WG (for example, Beebe-Dimmer et al, 2003; Naess

and Claussen, 2002; Naess et al, submitted-a; Kuh et al, in press-a, b). These studies have underlined the role of childhood in adult health. For example, in an analysis of 1946 cohort, the death rate in mid-adulthood for women and men who had experienced poor conditions in childhood was double that for women and men brought up in the best conditions (Kuh et al, 2002).

The importance of biological as well as social risk in early life has been underlined in WG1 studies. For example, in the Metropolit study, while the association between childhood socio-economic circumstances and early adult mortality remained, it was attenuated after adjustment for birth weight and childhood cognitive function (Osler et al, 2003). The analyses established a set of heterogeneous associations between measures of intra-uterine growth and mortality in young and early adulthood, suggesting a complex of mechanisms related to social position, genetic factors and specific organ programming (Nybo Andersen and Osler, in press). Analyses by WG1 members have also confirmed the importance of social conditions in adulthood for mortality risk in adulthood. An analysis of the Turin study of the influence of fetal growth and socioeconomic circumstances on all cause mortality found that adult circumstances were a stronger predictor of death in men than in women (Spadea et al, 2002). As a further example, in a collaboration between B. Claussen and G. Davey Smith based on the Oslo Mortality Study, social conditions in both childhood and adulthood contributed to mortality risk in adulthood, among both men and women.

Alongside these analyses of all-cause mortality, the WG has been examining lifecourse influences on *specific causes of death*. The research strategy of the team led by G. Davey Smith at Bristol University has been to follow up cohorts on whom data exists across the lifecourse. Using a range of datasets and in analyses involving a number of WG1 collaborators, they have demonstrated that the relative contribution of social circumstances in early and later life varies between health outcomes (Leon and Davey Smith, 2000; Davey Smith et al, 2001; Davey Smith et al, 2002). Some conditions, like stroke and stomach cancer mortality, depend on childhood circumstances; for others, including deaths from lung cancer and accidents/violence, adult circumstances play the more important role. In a third group, including CHD and respiratory disease mortality, their evidence suggested that there is an accumulation of exposures across the lifecourse. The collaboration between B. Claussen and G. Davey Smith has been investigating the timing of influence of socioeconomic conditions in the Oslo Mortality Study (Claussen et al, 2003; Naess et al, submitted-b). In this study, cardiovascular disease mortality was more strongly associated with childhood circumstances; for deaths from psychiatric diseases and from accidents and violence, the association was stronger with adult circumstances (Claussen et al, 2003). In line with this finding, analyses of women's mortality risk, using a large US study, found that the childhood effect was stronger

for CVD than for all cause mortality (Beebe-Dimmer, in press). In J. Hallqvist's analysis of the SHEEP study, both childhood and adult socioeconomic position influenced the risk of myocardial infarction.

The finding that CVD risk is powerfully influenced by childhood circumstances has been confirmed in a systematic review of 26 studies undertaken by G. Davey Smith and J. Lynch. The review demonstrated strong and consistent findings for the role of low childhood socioeconomic position in adult CVD. These effects were more reliably demonstrated in prospective studies where childhood position was measured in childhood rather than through recall in adulthood (Galobardes et al, invited paper).

The WG has extended the focus on all-cause and cause-specific mortality to include measures of *adult health and wellbeing*. Through a series of studies, the group of researchers have found that of childhood socioeconomic circumstances make a unique contribution to adult health, net of adult social position. For example, J. Lynch and colleagues have demonstrated independent childhood effects on cognitive function, diabetes risk and dimensions of psycho-social health like hopelessness and hostility (Kaplan et al, 2001; Harper et al, 2002; Maty et al, submitted). Jon Ivar Elstad has analysed data from a Norwegian study of men born in 1946. He found that dimensions of childhood adversity (material, health, psychosocial) all had effects on health in middle age (varying with type of health outcome) after adjustment for adult exposures, suggesting latent effects of childhood adversities on later adult health (i.e. effects not primarily transmitted via adult social positions and adult health behaviours). Childhood psychosocial stress appeared to have an independent impact on later ill health, not reducible to childhood material deprivation or ill health as a child (Elstad, forthcoming).

Gender has been a focus of WG analyses of child and adult influences on adult health. J. Lynch and colleagues have examined women's mortality risk using the first large population study in the US to include women working in the home. They found an independent effect of low childhood socioeconomic position after extensive controls for adult socioeconomic position and adult behaviour (Beebe-Dimmer, in press). The research team led by C. Power has examined the influence of gender on socioeconomic inequalities in health in the 1958 birth cohort study, focusing on women's social roles and home-work characteristics (Matthews et al, 1999; Matthews and Power, 2002). The research team led by D. Kuh has examined whether women's experiences over the lifecourse affect their risk of poor health in middle age. In their analysis of the 1946 cohort study, they found that, even after taking account of the powerful effect of recent life stress, women with high level of psychological distress had different lifecourse trajectories than women with less psychological distress in middle age (Kuh et al, 2002). Lifecourse influences are also confirmed in women's reproductive health,

including reproductive ageing. In analyses of the 1946 birth cohort study, age at menopause was more strongly related to childhood socioeconomic circumstances than to education or adult socioeconomic position (Hardy and Kuh, submitted).

Contribution of conditions in childhood and adulthood to biological and behavioural risk factors for adult ill-health and premature mortality.

There is a set of adult risk factors, including smoking and obesity, which have been identified as playing a key role in the development of adult disease. These risk factors display a marked and steepening socioeconomic gradient in most European countries, and make a major contribution to the socioeconomic gradient in morbidity and premature mortality in adulthood. WG1 researchers have therefore given priority to studying the lifecourse influences on the development of these risk factors. The findings indicate that the timing of influence differs for obesity and smoking (and for different dimensions of smoking behaviour).

With respect to *adult obesity*, a variety of analyses have shown that childhood socioeconomic circumstances have long-lasting effects (Parsons et al, 1999; Power and Parsons, 2002). For example, in the 1958 cohort study, social class in early life showed persisting effects on obesity in early adulthood (Power et al, in press). In the older 1946 cohort study, childhood socioeconomic circumstances were again related to adult obesity, independent of social class in early and later adulthood. Adult social class also influenced obesity risk in women but not in men. Upwardly mobile men and women were less obese than those remaining in their social class of origin (Langberg et al, in press). In a separate analysis of the cohort, poor social origins and high relative weight in adolescence were found to be associated with higher mean BMI across adult life, independent of education and adult social class, with these effects increasing with age (Hardy et al, 2000). In the Tampere cohort study, effects of childhood socioeconomic circumstances were evident for BMI among women and physical leisure activity among men (Huure et al, 2003).

Lifecourse analyses are also helping to pinpoint the factors which underlie the relation between childhood social circumstances and adult obesity. For example, analyses of the 1958 cohort study suggest that the effect of social class in early life on BMI in adulthood is not primarily a reflection of parental BMI. While education level is strongly associated with adult obesity, confounding by education does not explain the effect of social class in early life (Power et al, in press).

With respect to *adult smoking*, analyses of the Tampere cohort study found that childhood socioeconomic circumstances had a significant effect on smoking in early adulthood for both men and women (Huure et al, 2003). In an analysis of the 1958 birth cohort study, childhood

circumstances were found to predict persistent smoking in women; among men, the association with childhood circumstances was no longer significant after adjusting for adult circumstances (Jefferis et al, in press).

Building on these studies, WG members have undertaken analyses of the contribution of childhood and adult socioeconomic circumstances to obesity and smoking behaviour among middle-aged men and women. The group was able to draw on seven major studies in Europe and the US, covering cohorts born from 1910 to 1976, and to include, to our knowledge for the first time, the three components of adult smoking status (ever smoking, ex-smoking and current smoking). Adult socioeconomic circumstances were an important influence on obesity and quitting smoking. Manual social origins also increased the risk of obesity and reduced the risks of quitting in adulthood in most of the populations studied (WG1 sub-group, in preparation-a).

Taken together, analyses undertaken by WG1 highlight the importance of a lifecourse approach to understanding socioeconomic differentials in major risk factors for adult disease. These findings point to the need for policies which address both the early life and the later life influences on obesity and smoking in adulthood.

Continuities in poor health across generations

The ESF Programme has facilitated a collaboration between C. Kelleher and workgroup contributors from the Harvard School of Public Health and University of Michigan, Ann Arbor, which enabled C. Kelleher to take up a Fulbright scholarship to study the health of Irish migrants in the US. The objective was to explore whether the adverse risk factor profile seen in migrants from Ireland to the United Kingdom, often lasting at least two generations, would be replicated in the US also. Data from the unique US census archive confirmed this to be indeed the case.

In collaboration with J. Lynch, two papers have been produced, suggesting that the adverse health profile of Irish people at home and abroad is contributed to by social disadvantage, mediated in part by adverse lifestyle (Kelleher et al, in press; Kelleher et al, submitted). However there is reasonable and persuasive evidence that the persistence of this disadvantage over generations of migrants, particularly for some conditions like cardiovascular disease, suggests that a genetic or constitutional basis should be explored, particularly in relation to dietary exposure patterns (Ulmer et al, 2003). A strongly contextual approach has been taken with this research programme to date. Considerable misconceptions exist in relation to social support and social capital among the Irish at home and abroad. In fact, their health experience as a population constitutes something of a paradox, as a country with high de-

grees of social capital in some respects but in rapid economic transition, making this research very relevant to the current international interest in neo-material and psychosocial influences on relative disadvantage (Kelleher et al, 2003; Tay et al, submitted).

Aberdeen and Copenhagen cohort studies

Another result of the work in the *Life-course influences of health*-group was the establishment of a collaboration between the research groups in the UK (London, Aberdeen, Bristol) working on the Aberdeen-based study 'Children of the 1950s' and the research group based on University of Copenhagen, Denmark working on the 'Metropolit2000' study.

These two cohorts were established in the early 1960s by sociologists, aiming to study predictors of poor mental health and learning disabilities, anti-social behaviour and social mobility. They were based on large cohorts of children who were born in the first half of the 1950s. The data collected by then encompassed birth data, parental social position, cognitive function in childhood and a variety of variables describing living conditions and school experience of the children.

These, very similar data sets, have independently been revitalised during the last couple of years, with the purpose of using them for epidemiological research (Osler et al, submitted, Batty et al, in press). They provide a new opportunity to gain further insights into the life course processes involved in disease causation, since they have rich data on parental socio-economic conditions and at different phases of childhood, together with health outcomes in middle age. These later-life endpoints have been recently collected through linkage to disease and mortality registers and through questionnaire surveys.

The ESF Programme made it possible to gather the research groups working on the two cohort studies to discuss areas of collaboration, led by A.-M. Nybo Andersen and D. Leon. The aims for the collaboration are a) to replicate findings in different contexts, b) to pool data in order to gain statistical power when we study rare outcomes, c) to compare influences of macro-factors, such as the school system, and d) to share expertise.

The collaboration has resulted in two long-term visiting fellowship exchanges, one aiming to examine the association between IQ and mortality found in both data materials (Osler et al, 2003, and Leon et al, in prep.), and one to examine the birth dimensions and later mortality/morbidity findings (Nybo Andersen et al, in press). The recently collected and planned survey information on exposures and follow-up of both populations has been co-ordinated, which allow for common and comparative studies in the future.

3.1.4 Contributions and outputs for objective 3

Taking the opportunity presented by new cohort studies to establish dialogue and, if possible, cross-linkages between them

The beginning of the 21st century was marked by the establishment of new cohort studies recruiting participants in early, or even intrauterine, life. Lifecourse research has played a major role in this development. It has established the importance of early life in shaping adult health and socioeconomic position, as well as the accumulation of exposures over the course of life for development of health later in life. In so doing, it has pointed to the contribution of inequalities in childhood to inequalities in adult health. Tackling inequalities in health is central to public health policy both at EU and national level. Further, while child health in most countries has improved, the early phase of life is still a period of high risk: proportions of babies born with congenital malformations or born preterm has not improved substantially in the past decades in many European countries. In addition, health in childhood is now threatened by new problems, such as the growing epidemic of obesity and allergic diseases.

The new studies offer an opportunity to study perinatal, child and, ultimately, adult health in different contexts, and potentially the information could be pooled to address the aetiology of rare diseases.

Mapping the new cohort studies

A sub-group of WG1 was established to identify and review the new cohort studies, and to build links between the research teams. New studies, established or planned, have been identified in the Czech republic, Denmark, France, Italy, Ireland, the Netherlands, Norway and the UK. Major examples are given in the table below.

The new studies have been surveyed, with information on their design and scope tabulated (WG1 subgroup, in preparation-b). The review has uncovered similarities between them. The studies:

- are recruiting representative samples of children born in the decade from 1994-2004;
- have a multi-disciplinary perspective, informed by knowledge and questions driving biological, medical and social sciences. National policy agendas, relating to economic and social change, health inequalities and social exclusion for example, have provided an important stimulus for this new wave of cohort studies;
- rely primarily on self-report; some studies additionally collect biological material (e.g. ultrasound, blood samples) and have record-linkage systems (e.g. to medical records);

- have a common data-structure, with information collected on the following dimensions: parental and child socioeconomic circumstances (including maternal education and paternal occupation); maternal health histories; maternal health and health behaviour in pregnancy; child health history (including illness and vaccinations); child development (e.g. physical, cognitive, socio-emotional) - area-based measures are also included in a number of studies.
- Because of this common data-structure, the studies facilitate cross-cohort analyses, both with earlier cohorts within the study-country and across the new cohorts.
- rely on the support of service providers for data-collection and/or linkage;
- are needing to address common ethical issues related to biological sampling and storage, confidentiality and data access.

The Programme has played an important role in facilitating the network of researchers involved in the new cohort studies and the review they have undertaken. The review has underlined the scope for future lifecourse research on the social determinants of health inequalities, both at national and at cross-European level. Cross-national analyses, already underway in the WG (for example, WG1, in preparation-a), represent an important new frontier for lifecourse research.

Table 3.1.2: Examples of new cohort studies in Europe

Study and year of recruitment	Design and sample size	Types of data collected	Information on	Plans for follow-up
Danish National Birth Cohort (Denmark, 1997 - 2002)	100,000 children, followed from first trimester of pregnancy throughout life	Phone Interview data FFQ during pregnancy Blood samples Register data	<u>Child</u> : health, development <u>Mother</u> : health, SES, life-style <u>Father</u> : SES	6 months (interview) 18 months (interview) 8 years (questionnaire) Life-long register-based follow-up of medically treated morbidity and mortality
Lifeways Cross-Generation Cohort Study (Ireland, 2001 - 2003)	1,000 children, followed from second trimester of pregnancy Biological parents One sibling One living grandparent	Questionnaire data Routinely recorded data Register data from birth	<u>Child</u> : health, development <u>Mother</u> : health, SES, life-style <u>Father</u> : SES	Annual reports on health status from GP till age of 5 years
Norwegian Birth Cohort (Norway, 2001 – 2005)	100,000 children, followed from mid-pregnancy throughout life	Questionnaire data Ultra sound report Blood samples Register data from pregnancy and birth	<u>Child</u> : health, development <u>Mother</u> : health, SES, life-style <u>Father</u> : SES	6 months (questionnaire) 18 months (questionnaire) 6 years (questionnaire)
The Millennium Cohort Study (UK, 2001-2005)	21,000 infants, born year 2000. Recruited 9 months old	Home interviews Routinely recorded data	<u>Child</u> : health, development <u>Mother</u> : health, SES, life-style <u>Father</u> : SES Area characteristics	3 years (interviews) 5 years (interviews)
Generation R (The Netherlands, 2002-2005)	10,000 children born in Rotterdam followed from first antenatal visit	Questionnaire data Ultrasound reports Blood samples Register data	<u>Child</u> : health, development <u>Mother</u> : health, SES, life-style <u>Father</u> : SES	2 questionnaire per year to parents Children involved when they start primary school
Pre- and postnatal determinants of child development and health (France, 2003-2006)	Children recruited in mid-pregnancy in 3 maternity units in different part of France	Questionnaire data	<u>Child</u> : health, development <u>Mother</u> : health, SES, life-style	6 months (questionnaire) 1 year (health examinat.) 3 years (health exam.) 5 years (health exam. + blood test)

3.1.5 Conclusions

The inclusion of lifecourse stream in the Programme has enabled the ESF to support an emerging field of social epidemiology with the potential to transform explanations of socio-economic inequalities in health. Lifecourse perspectives place a unique focus on processes operating over time: over people's lives and across generations. These temporal processes –

social and biological – may well hold the key to understanding the development of chronic diseases, diseases which are driving trends in population health and in health inequalities in Europe.

The report has summarised some of the lifecourse research undertaken by members of WG1 across the four years of the Programme. It is inevitably selective, and illustrates only some of the research questions addressed by WG members. From our report, we would highlight the following major achievements.

Firstly, the Programme has strengthened the infrastructure of lifecourse research in Europe, through both European and transatlantic collaboration. Specifically, it has:

- widened the European network of lifecourse researchers, drawing in countries and researchers with a less established tradition of longitudinal research, and building links between researchers at different stages of their research careers. Transatlantic links have been an important part of the WG's contribution to the research infrastructure.
- facilitated collaborations between researchers working on the older cohort studies.
- exploited the opportunity offered by the wave of new cohort studies to establish links between research teams.

Secondly, WG1 researchers have played a major role in the conceptual development of lifecourse epidemiology. The WG meetings and the Programme summer schools have provided rare opportunities for European and US researchers to focus on the conceptual and methodological challenges facing this new field of research. The dialogue and debate generated by these meetings has fed into a series of papers which review, clarify and refine lifecourse perspectives. These are set to provide the touchstone for lifecourse research over the next 5 years.

Thirdly, through a series of separate and linked analyses, WG researchers have established the unique contribution of childhood socioeconomic circumstances to health in adulthood. These analyses suggest that childhood position has enduring effects on adult health, aging and premature mortality, and particularly on chronic disease risk. For example, a number of studies undertaken by WG1 researchers have found that childhood socioeconomic position exerts a stronger influence on CVD and CVD mortality than on other causes of ill-health and premature mortality. Studies by WG1 members have shown, too, that socioeconomic circumstances in childhood have persistent effects on risk factors for chronic disease, including obesity and dimensions of smoking behaviour.

Finally, the WG has worked to build bridges between lifecourse epidemiology and public health policy. A number of WG members are centrally involved in taking lifecourse research into policy: summarising findings and drawing out implications for those developing and directing health policy. Research conducted by WG1 members has been the major resource for this important task of translating research for policy.

At this stage, we are only able to provide an interim assessment of the WG's contribution to these areas: to infrastructure and conceptual development, to clarifying the role of childhood socioeconomic position in adult health and health inequalities, and to building policy links. The volume of publications in press indicates the extent to which the Programme has yet to make its full impact on health inequalities research in Europe.

Hilary Graham and Chris Power on behalf of Working Group I

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3.1.6 References

(Papers with * refer to the ESF Programme in their Acknowledgement)

- Batty GD, Morton S, Cambell D, **Davey Smith G**, Hall M, Macintyre S & **Leon DA** (in press). The Aberdeen Children of the 1950s cohort study: background, methods and follow-up information on the new resource for the study of life-course and intergenerational effects on health. *Paediatric Perinat Epidemiol*
- Beebe-Dimmer J, **Lynch JW**, Turell G, Lustgarten S, Raghunathan T & Kaplan GA (in press). Childhood and adult socioeconomic conditions and 31-year mortality risk in women. *Am J Epidemiol*
- Ben-Shlomo Y & Kuh D** (2002). A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and inter-disciplinary perspectives. *Int J Epidemiol*, 31, 285-93 *
- Chor D, Faerstein E, **Lynch J** & Kaplan GA (in press). Association of weight gain with ethnicity and lifecourse socioeconomic position among Brazilian civil servants: cross sectional analysis. *Int J Epidemiol*
- Claussen B, Davey Smith G** & Thelle D (2003). Impact of childhood and adulthood socioeconomic position on cause specific mortality: the Oslo Mortality Study. *JECH*, 57, 40-45 *
- Claussen B** & Naess Ø (2002). The selection hypothesis of social inequalities in health: the Oslo Mortality Study. *Norsk Epidemiologi*, 12, 43-6
- Davey Smith G, Ben-Shlomo Y & Lynch JW (2002)** Lifecourse approaches to inequalities in coronary heart disease risk. In: Stansfeld S & Marmot M (Eds.). *Stress and the Heart: Psychosocial Pathways to Coronary Heart Disease*. London: British Medical Journal Books
- Davey Smith G**, Gunnell D & **Ben-Shlomo Y** (2001). Lifecourse approaches to socio-economic differentials in cause-specific adult mortality. In: Leon D & Walt G (Eds.). *Poverty, Inequality and Health*. Oxford: Oxford University Press
- Davey Smith G & Lynch JW** (in press-a). Socioeconomic differentials. In: Kuh D & Ben-Shlomo Y. *A Lifecourse Approach to Chronic Disease Epidemiology (Vol 2)*. Oxford: Oxford University Press *
- Davey Smith G & Lynch JW** (in press-b). Life course approaches to coronary heart disease. In Marmot MG, Elliot P (Eds.) *Coronary Heart Disease Epidemiology*. 2nd Edition. Oxford: Oxford University Press
- Due P, Lynch JW**, Holstein BE & Modvig J (2003). Socioeconomic health inequalities in a nationally representative sample of Danish adolescents: the role of social relations. *J Epidemiol Community Health*, 57, 692-98
- Elstad JI** (2001). Health-related mobility, health inequalities and gradient constraint: discussion and results from a Norwegian study. *European Journal of Public Health*, 11 (2), 135-140
- Elstad JI** (2002). Strategien mot sosioøkonomiske helseulikheter: Skal den innbefatte helsesrelatert seleksjon? [Should strategies to combat socioeconomic inequalities in health include health selection?] *Norsk Epidemiologi* [Norwegian Journal of Epidemiology], 12 (1), 39-42 *
- Elstad JI** (2003). Livsstil, arbeidsmiljøbelastninger og helseulikheter blant 55-årige menn [Lifestyles, working conditions, and health inequalities among men aged 55], *Tidsskrift for Den norske lægeforening* [The Journal of the Norwegian Medical Association], 123 (16), 2289-91
- Elstad JI** (in press). Childhood adversities and health variations among middle-aged men: a retrospective lifecourse study. *European Journal of Public Health*
- Elstad JI & Krokstad, S** (2003). Social causation, health-selective mobility, and the reproduction of socioeconomic health inequalities over time: panel study of adult men. Accepted for publication in *Social Science & Medicine*, 57, 8, 1475-89
- Galobardes M, **Davey Smith G & Lynch JW** (invited paper) Childhood socioeconomic factors and adult cardiovascular disease. *Epidemiol Reviews*, 2004
- Graham H** (2000). Socio-economic change and inequalities in men and women's health. In Annandale E & Hunt K (Eds.) *Gender Inequalities in Health*. Buckingham: Open University Press

- Graham H** (2001). Science into policy: options for reducing health inequalities. In: D. Leon & G. Walt (Eds.) *Poverty, Inequality and Health*. Oxford: Oxford University Press
- Graham H** (2002). Building an inter-disciplinary science of health inequalities: the example of life-course research. *Social Science and Medicine*, 55, 2005-16 *
- Graham H & Power C** (2003). Childhood disadvantage and adult health: a lifecourse framework. London: Health Development Agency
- Hallqvist J, Lynch J, Bartley M, Lang T & Blane D** (2004). Can we disentangle life course processes of accumulation, critical period and social mobility? An analysis of disadvantaged socio-economic positions and myocardial infarction in the Stockholm Heart Epidemiology Programme (SHEEP). *Social Science & Medicine* (in press)*
- Hardy R & **Kuh D** (submitted). Social and environmental conditions across the lifecourse and age at menopause in a British birth cohort study.
- Hardy R, Wadsworth M & **Kuh D** (2000). The influence of childhood weight and socioeconomic status on change in adult body mass index in a British national birth cohort. *Int Jnl of Obesity*, 24, 1-10
- Harper S, **Lynch JW**, Everson SA, Hsu W-L, Raghunathan T & Kaplan GA. (2002). Lifecourse socioeconomic position and depression, cynical hostility and hopelessness in adulthood. *Int J Epidemiol*, 31, 395-403
- Harper S, **Lynch JW**, Yang S, Angell S, Hillemeier M, Morenoff J & **Davey Smith G** (submitted). Social capital and cause-specific mortality in US metropolitan areas 1989-1998
- Hertzman C** (2003). The life course contribution to ethnic disparities in health. *National Academy of Sciences, National Research Council Committee on Population*
- Hertzman C**, McLean SA, Kohen DE, Dunn J & Evans T (2002). Early Development in Vancouver: Report of the Community Asset Mapping Project (CAMP). Vancouver: Human Early Learning Partnership (HELP), University of British Columbia, <http://www.earlylearning.ubc.ca>
- Hertzman C, Power C**, Matthews S & Manor O (2001). Using an interactive framework of society and lifecourse to explain self-rated health in early adulthood. *Soc Sci Med*, 53, 1575-85
- Hertzman C & Siddiqi A** (2000). Health and rapid economic change in the late twentieth century. *Social Science and Medicine*, 51, 809-19
- Huure T, Aro H & **Rahkonen O** (2003). Well-being and health behaviour by parental socioeconomic status: a follow-up of adolescents aged 16 until 32 years. *Soc Psychiatry and Psychiatric Epidemiology*, 38, 249-55
- Jefferis BJ, **Power C, Graham H & Manor O** (forthcoming). Do childhood socio-economic circumstances have an effect on persistent smoking beyond adult circumstances? *American Journal of Public Health*
- Jefferis B, **Power C & Hertzman C** (2002). Birthweight, childhood socio-economic environment and cognitive development in the 1958 British birth cohort. *British Medical Journal*, 325, 305-8
- Kaplan GA, Turrell G, **Lynch JW**, Everson SA, Helkala EL & Solonen JT (2001). Childhood socioeconomic position and cognitive function in adulthood. *Int J Epidemiol*, 30, 256-263
- Keating DP & **Hertzman C** (1999). Modernity's paradox. In: Keating DP & **Hertzman C** (Eds.) *Developmental Health and the Wealth of Nations*. London: Guilford Press
- Kelleher CC**, Friel S, Nic Gabhainn S & Tay JB (2003). Socio-demographic predictors of self-rated health in the Republic of Ireland: findings from the National Survey on Lifestyle, Attitudes and Nutrition, SLAN. *Soc Sci Med*, 57, 3, 477-86 *
- Kelleher CC**, Harper S & **Lynch JW** (submitted). What goes up must come down? Evidence for the contribution of migration, social deprivation and life-course processes to the rise and fall of coronary heart disease epidemic in the United States of America
- Kelleher C, Lynch JW**, Harper S, Tay JB & Nolan G. (in press). Hurling alone? How social capital failed to save the Irish from heart disease. *Am J Public Health*
- Kuh D, Ben Shlomo Y, Lynch J & Hallqvist J** (in press-a). A glossary for life course epidemiology. *J Epidemiol Community Health* *
- Kuh D & Hardy R** (2002). A lifecourse approach to women's health, Oxford: Oxford University Press

- Kuh D**, Hardy R, Langberg C, Richards M & Wadsworth MEJ (2002). Mortality in adults aged 26-54 years related to socioeconomic conditions in childhood and adulthood: post war birth cohort study. *BMJ*, 325, 1076-80
- Kuh D**, Hardy R, Rodgers B & Wadsworth MEJ (2002). Lifetime risk factors for women's psychological distress in midlife. *Social Science and Medicine*, 55, 1957-73
- Kuh D**, **Power C**, Blane D & Bartley M (in press-b). Socioeconomic pathways between childhood and adult health. In: **Kuh DL & Ben-Shlomo Y** (Eds.) A Life Course Approach to Chronic Disease Epidemiology: tracing the origins of ill health from early to adult life. Oxford: Oxford University Press, 2nd edition
- Langberg C, Hardy R, **Kuh D**, Brunner E & Wadsworth MEJ (in press). Central and total obesity in middle-aged men and women in relation to lifetime socioeconomic status: evidence from a national birth cohort. *J Epidemiol Community Health*
- Leon DA**, Batty DG & Morton SM (in preparation). Childhood intelligence and subsequent cause-specific mortality: evidence from the Aberdeen cohort study
- Leon DA & Davey Smith G** (2000). Infant mortality, stomach cancer, stroke and coronary heart disease: ecological analysis. *BMJ*, 320, 1705-6
- Lynch JW & Davey Smith G**. (in press). Rates and states: An essay review of the Health of Nations. *Int J Epidemiol*
- Lynch JW**, Harper S & **Davey Smith G** (in press). Plugging leaks and repelling boarders: where to next for the SS Income Inequality. *Int J Epidemiol*
- Lynch JW**, Harper S, **Davey Smith G**, Hillemeier M, Ross N & Wolfson M (submitted). Is income inequality a determinant of population health? A Review with New Evidence from Long-term Mortality Trends in the US
- Lynch JW**, Harper S, **Davey Smith G**, Ross N, Wolfson M & Dunn J (in press). Income inequality and health: The story so far and its implications for understanding regional mortality trends in the US. *Demographic Research*
- Manor O, Matthews S & **Power C** (in press). Health selection: the role of inter- and intra-generational mobility on social inequalities in health. *Soc Sci Med*
- Maty S, **Lynch JW**, Kaplan GA. Trajectories of socioeconomic disadvantage and the 34-year risk of Type 2 diabetes. *Am J Epidemiol*
- Matthews S, Manor O & **Power C** (1999). Social inequalities in health: are there gender differences? *Soc Sci Med*, 48, 49-60
- Matthews S & **Power C** (2002). Socio-economic gradients in psychological distress: a focus on women, social roles and work-home characteristics. *Soc Sci Med*, 55, 1989-2004
- Naess Ø & **Claussen B** (2002) Life-course influences on social inequality in adult mortality: a review, *Norsk Epidemiologi*, 12, 43-6
- Naess Ø, **Claussen B & Davey Smith G** (submitted-a). All cause and cause specific mortality risk by four indicators of socioeconomic position. *Scandinavian Journal of Public Health*
- Naess Ø, **Claussen B & Davey Smith G** (submitted-b). Relative impact of childhood and adulthood social conditions on cause specific mortality. *JECH*
- Nybo Andersen A-M** & Osler M (in press). Birth dimensions, parental mortality and mortality in early adult age: a cohort study of Danish men born in 1953. *Int J Epidemiol*
- Osler M, **Nybo Andersen A-M**, Batty DG, Lund R, Andersen CØ, Damsgaard MT, **Due P** & Holstein BE (submitted). Revitalising the Metropolit 1953 Danish male birth cohort: background, aims and some preliminary findings
- Osler M, **Nybo Andersen A-M**, **Due P**, Damsgaard MT & Holstein B (2003). Parental social position, birth weight, cognitive function and mortality in adult life. A longitudinal study of Danish men born in 1953. *J Epidemiol Community Health*, 57, 681-6
- Parsons T, **Power C**, Logan S & Summerbell CD (1999). Childhood predictors of adult obesity. *Int J Obesity*, 23, Suppl 8, s1-s107
- Power C & Hertzman C** (in press). Health and human development from life course research. In: Barer M, Evans R, **Hertzman C** & Heyman J (Eds.) Population Health: Policy Dilemmas

- Power C**, Manor O & Li L (2002). Are inequalities in height underestimated by adult social position? Effects of changing social structure and height in a cohort study. *BMJ*, 325, 131-4
- Power C**, Manor O & Matthews S (1999). The duration and timing of exposure: effects of socio-economic environment on adult health. *American Journal of Public Health*, 89, 7, 1059-1066
- Power C**, Manor O & Matthews S (in press). Child to adult socio-economic conditions and obesity in a national cohort. *International J of Epidemiology*
- Power C** & Parsons T (2002). Overweight and obesity from a lifecourse perspective. In: **Kuh D & Hardy R** (Eds.) A lifecourse approach to women's health, Oxford: Oxford University Press
- Spadea T**, Faggiano F, Armaroli P, Maina L & Costa G. (2001). Effect of socioeconomic factors and fetal growth on adult mortality and morbidity. *J Epidemiol Community Health*, 55, supplement I, A25-94
- Tay JB, **Kelleher CC**, Hope A, Barry M, Nic Gabhainn S & Sixsmith J (submitted). Influence of socio-demographic and neighbourhood factors on self-rated health and quality of life in rural communities: Findings from the Agriproject in the Republic of Ireland
- Turrell G, **Lynch JW**, Kaplan GA & Everson SA (2002). Socioeconomic position across the lifecourse and cognitive function in late middle age. *J Gerontol B Psychol Sci Soc Sci*, 57, S43-51
- Ulmer H, **Kelleher C**, Diem G & Concin H (2003). Long-term tracking of cardiovascular risk factors among men and women in a large population-based health system. The Vorarlberg Health Monitoring & Promotion Programme. *Eur Heart J*, 24 (11), 1004-13
- Wamala SP, **Lynch JW** & Kaplan GA (2001). Women's exposure to early and later life socioeconomic disadvantage and coronary heart disease risk. *Int J Epidemiol*, 30, 275-284 *

In preparation

- WG1 subgroup 'Using established cohort and record-linkage studies to examine life course influences on health inequalities': The contribution of childhood and adult socioeconomic circumstances to adult obesity and smoking behaviour: an international comparison.
- WG1 subgroup 'New cohort studies': Great expectations! New birth cohort studies in Europe: addressing lifecourse influences on health in the 21st century.

3.2 Report of Working Group II

3.2.1 Aims

As stated in the Programme Proposal and in subsequent minutes of working group meetings, the main objectives of working group 2 (WG 2) were:

- 1) to advance explanations of social inequalities in health across Europe by focusing on the mesosocial level of analysis, in particular by identifying stressful psychosocial environments and by testing their impact on health;
- 2) to advance the development of standardized measures of stressful psychosocial environments across Europe and to initiate comparative data analysis;
- 3) to develop new psychobiological markers of stress and to apply them to exposed socio-economic/psychosocial population groups.

These objectives are further specified by the following sub-goals:

- Ad 1)
- to refine the conceptual basis of analysis, with a special focus on work stress (demand/control, effort-reward imbalance); social support, and coping;
 - to extend respective concepts beyond work (home, family, civic life; third age activities);
 - to test associations with health indicators that were not studied in previous research;
 - to test associations in European regions without previous evidence;
 - to differentiate mediating and modifying effects of stressful psychosocial environments in explaining social inequalities in health.
- Ad 2)
- to translate available measures into different European languages and to assess their psychometric properties;
 - to advance the methodology (e.g. by developing short versions, new indices etc.);
 - to compare the prevalence and effect size of the measures across countries.
- Ad 3)
- to identify new psychobiological markers of stress with particular relevance to cardiovascular risk and disease, by exploring their effects in laboratory investigations;
 - to further develop and standardize the non-invasive measurement of stress markers (esp. salivary cortisol);
 - to compare the level of stress markers between different population groups according to exposure to stressful socio-economic/psychosocial environments.

These aims are particularly relevant in view of several shortcomings and gaps of knowledge that were obvious from the state of art at the time when this Programme was developed (1997 - 1999). More specifically, the following shortcomings were identified.

- While a large amount of information on social inequalities in health across Europe was available at the descriptive level, relatively few studies provided in-depth analyses of explanatory frameworks at the mesosocial level (with notable exceptions, such as the Whitehall studies).
- Work stress models were studied separately, in a few European countries only, with a restricted range of health indicators and with different measures that were not fully comparable.
- Few studies analysed the potential gender (role) differences in associations of social inequalities, work stress and health.
- Moreover, there was a lack of attempts to extend the promising concepts of personal control and social reward beyond work life.
- It was also obvious that debates on the relative importance of material versus psychosocial circumstances in explanations of social inequalities in health called for theory-driven empirical testing of alternative explanations.
- Finally, more evidence on psychobiological pathways was needed in order to explain the links between socio-economic status, stressful psychosocial environment and reduced health.

Against this background the following main results were achieved in the frame of WG 2 activities of this Scientific Programme.

3.2.2 Main Results

Aim 1: To advance explanations of social inequalities in health across Europe by focusing on the mesosocial level, in particular by identifying stressful psychosocial environments and by testing their impact on health.

Refining theoretical concepts

In order to evaluate the significance of scientific progress in this field it may be useful to give a brief explanation of the basic terms and concepts that have guided our scientific collaboration.

The mesosocial level of analysis is related to the core societal institutions and social roles that have a direct impact on individual experiences in everyday life. Examples include home and family, the work setting and community life. By using the term 'psychosocial environment' instead of 'social environment' we emphasize the significance of the structure of social

opportunities (e.g. occupational role, civic role, family role) for the self of a person (need satisfaction, well-being, health). This focus is in line with several scientific traditions, e.g. symbolic interactionism in sociology (Mead 1983), major theories of social psychology (e.g. Bandura 1986) and social production function theory in economy (Lindenberg & Frey 1993). It also opens a window towards analysing the transmission of personal experience resulting from exchange with the social environment to central nervous system activation and bodily responses. This perspective is essential for understanding how the social environment 'gets under the skin', in other words for elucidating the biopsychosocial dimension of human health and disease (Weiner 1992).

The term 'stressful experience' delineates the special quality and intensity of an experience that results from struggling with a threatening socio-environmental challenge or demand. A threat is experienced if the mastery of a challenge is uncertain and if lack of personal control results in a significant personal loss (Fink 2000). Acting in the face of demands and threats is termed coping as long as there is a positive outcome expectancy (Kristenson et al. 2004, Ursin 1998). Different patterns of coping may develop among individuals and become more or less fixed over the life course. These patterns of coping can modify the effects of the psychosocial environment on health, either in a favourable (e.g. mastery, optimism) or unfavourable way (e.g. exhaustive coping (overcommitment), helplessness (low self reliance)) (Lazarus & Folkman 1984, Henry & Stephens 1977). Reverse effects are also obvious (sustained psychosocial adversity negatively affects personal coping patterns (e.g. Theorell, Alfredsson et al. 2000)).

In sociological terms, adult life is characterized by people's agency through a cluster of core social roles, such as the family and marital role, the work role, and civic roles. These roles offer options for three essential functions of self-regulation: self efficacy, self esteem, and self integration (social identity). The emotional costs (and adverse health effects) of unsuccessful self-regulation through social role agency are substantial (Siegrist 2000). This holds true for people who are threatened by a loss of core social roles (e.g. unemployment, forced separation, exclusion from membership) and for people who are confined to unrewarding roles due to failed social reciprocity (e.g. at work; see below).

These latter conditions are expected (a) to be more prevalent in lower socio-economic status (SES) groups, (b) to increase the risk of experiencing ill health and of developing several chronic diseases (as far as influences of the autonomic nervous system are involved), and (c) to contribute to explanations of SES differences in health and disease (Marmot & Wilkinson, 1999).

In addition to the established significance of the concept of social support for health (with its essential functions of providing self esteem and social identity; see Berkman & Glass 2000), two concepts related to the work role have been developed and tested more recently: the demand-control model (Karasek & Theorell 1990) and the effort-reward imbalance model (Siegrist 1996). The demand-control model posits that exposure to jobs defined by high (quantitative) demands in combination with low control (decision authority, skill discretion) elicits sustained stressful experience and increases the risk of stress-related diseases (lack of autonomy and self efficacy). The same holds true for conditions identified by the effort-reward imbalance model where a lack of reciprocity between costs spent and gain received (high cost/low gain conditions at work) triggers enhanced stressful experience (low self esteem and approval).

These conditions operating at the meso social level are influenced by macro social, socio-economic processes (that are analysed by WG 3). Several contributions within WG 2 have shown how changes in the labour market and the business cycle modify the associations of work stress with health (e.g. Godin & Kittel 2004, Jeding et al. 2003).

This theoretical framework has been in part elaborated and in part refined by several contributions to the Scientific Programme, and especially to this WG (see e.g. Berkman & Glass 2000, Marmot & Bobak 2000, Siegrist 2000, Steptoe & Marmot 2002, Theorell 2001, Kristenson et al. 2004).

Extending respective concepts beyond work

The research team at University College of London has applied the demand-control model to the home environment and has studied associations of high demand and low control at home with reduced health (Griffin et al. 2002, Chandola et al. 2004). Griffin and colleagues found that the risks associated with low control at home (or work) were unevenly distributed across social positions: women in the lower employment grades reporting low control at home (or work) were at higher risk for depression and anxiety. According to Chandola and colleagues, low control at home significantly predicted CHD among women. It seems that low control at home results from a lack of material and psychological resources to cope with excessive responsibilities and thus explains part of the association between household position and CHD among women.

The extension of the concept beyond work is relevant in at least two regards. First, it broadens the scope of stressful psychosocial environments to population groups who are excluded or distant from the labour market. Secondly, it offers opportunities of testing cumulative or moderating effects of the work-home interface on well-being and health.

The research team at Duesseldorf University has extended the model of effort-reward imbalance beyond work to include other types of cooperative social relationships with a risk of non-reciprocity of exchange. In adult life, the marital and parental relationships and cooperative engagements in civic life are of particular relevance. Commonalities and differences of 'high cost/low gain' conditions between the work role and other social roles were elaborated. Findings indicate, among others, that the risk of depressive symptoms is increased by more than 100 % among middle aged and elderly groups who suffer from non-reciprocity in social exchange outside work (Knesebeck & Siegrist 2003).

Again, this extension is relevant for the topic under study as 'high cost/low gain' conditions may be more prevalent in lower SES groups and as less effective personal and material resources of coping with adversity may be available in these groups. Moreover, by extending the theoretical model, elderly people and other non-working population groups can be included in respective research (Siegrist, Knesebeck & Pollack et al. 2004).

More recently, the concepts of social support, demand-control and effort-reward imbalance have been included into a new European research initiative dealing with employment, retirement, quality of life and health in 'third age' populations (see below Follow-up Activities, 5.2).

Test of associations with new health indicators

The unique opportunity of initiating and intensifying collaborative research through the WG of this Programme resulted in a number of new scientific findings. A relevant part of these findings concerns further empirical tests of the suitability of the three concepts of stressful psychosocial environments (lack of social support, high demand/low control jobs, effort-reward imbalance at work) to explain increased risks of ill health and disease. In several established cohort studies, measures of these concepts were incorporated, respective data were collected and their associations with selected health indicators were analysed. In some cases, this effort resulted in the construction of proxy measures derived from already existing data sets.

Most importantly, this extended collaboration offered options of exploring health conditions which had not yet been studied before in relation to these concepts (at least in Europe).

Associations of low social support with depression were analysed in the British Whitehall II study (Griffin et al. 2002) and in the French GAZEL Study (Niedhammer et al. 1998, Paterniti et al. 2002), with special reference to social support at the work place. Similarly, poor self-rated health was associated with low social support in the GAZEL Study (Melchior et al. 2003a). Low levels of social support at work increased the numbers of spells and days of absence among male employees in the GAZEL Study (Melchior et al. 2003b).

The main outcomes of collaborative research within this WG concerns tests of extensive and innovative associations of work stress models with health (for a summary of findings from prospective epidemiological studies see table 3.2.1).

Associations of the two work stress models with coronary heart disease (CHD) were replicated in the prospective Whitehall II Study, using clinical information on incident non-fatal and fatal ischaemic heart disease after a mean 11 year period of observation (an earlier publication by Bosma et al. 1998 was related to a mean 5 year observation period and combined self-reported coronary heart disease with clinical information). High demand/low control (job strain) was associated with a 38 % increase of CHD risk (Kuper et al. 2003). Similarly, effort-reward imbalance at work was associated with a 36 % increase of CHD risk. If combined with low social support at work, the respective odds ratio was 1.51 in the job strain model and 1.77 in the effort-reward imbalance model (Kuper et al. 2002). Interestingly, in a prospective study conducted in Finland, job strain and effort-reward imbalance were independently associated with a 2.20 to 2.36-fold elevated risk of cardiovascular mortality (Kivimäki et al. 2002).

Additional, currently unpublished evidence indicates strong associations of effort-reward imbalance with incident angina in men (T. Chandola, personal communications) and of high job demands with non-fatal myocardial infarction and cardiovascular mortality (H. Pikhart, personal communication).

Using data from a large Swedish case-control study of patients with myocardial infarction (SHEEP Study) a Swedish-German collaborative group resulting from this WG demonstrated that combining the two work stress models improves risk estimation of CHD in a substantial way (Peter et al. 2002). To our knowledge, this is the first published evidence of combined risk estimation. Meanwhile, at least one independent report following this strategy has been published (e.g. Ostry et al. 2003).

Other newly analysed health indicators are self-rated health (Pikhart et al. 2001, Niedhammer et al. 2004, Siegrist, Starke et al. 2004), depressive symptoms (Larisch et al. 2003, Pikhart et al. 2004), musculoskeletal disorders (Dragano et al. 2003, Joksimovic et al. 2002, Tornqvist et al. 2001, Vingard et al. 2000), alcohol dependence (Head et al. 2004), type II diabetes (Kumari et al. 2004) and hypertension (Alfredsson et al. 2002).

Table 3.2.1: New results on associations of work stress (demand-control (DC) model and effort-reward imbalance (ERI) model) with health outcomes from prospective epidemiological studies*

<i>study / first author</i>	<i>country</i>	<i>total sample</i>	<i>exposure</i>	<i>health measure and length of follow-up</i>	<i>adjustment</i>	<i>relative risk (odds ratio (OR), hazard ratio (HR))</i>	<i>remarks</i>
Kuper et al. 2003 Kuper et al. 2002	UK	10,308	DC ERI	CHD events (11 yr. follow-up)	age, gender, SES	DC 1.38 (1.1–1.8) ERI 1.36 (1.1–1.6)	HR HR
Kivimäki et al. 2002	FIN	812	DC ERI	cardiovascular mortality (25 yr. follow-up)	age, gender, alternative model	DC 2.20 (1.2-4.2) ERI 2.36 (1.3-4.4)	HR HR
Niedhammer et al. 2004	FR	4,475	ERI	self-reported health (1 yr. follow-up)	age, marital status, SES, depressive symptoms, smoking, alcohol, overweight, overcommitment, life events, chronic conditions	ERI men 1.78 (1.1-2.8) ERI women 2.18 (1.2-3.9)	OR OR
Head et al. 2004	UK	10,308	DC ERI	alcohol dependence (CAGE) (5 yr. follow-up)	age, SES, GHQ, longstanding illness, smoking, alcohol (phase 1), exercise, height, negative affectivity, social support	DC n.s. ERI 1.93 (1.4-2.7)	OR men only
Kumari et al. 2004	UK	10,308	DC ERI	type 2 diabetes (10.5 yr. follow-up)	age, SES, ethnic group, ECG abnormalities, family history of diabetes, BMI, height, SBP, exercise, smoking, life events	DC n.s. ERI 1.65 (1.0-2.8)	OR men only

* assessment of work stress was partly based on approximate measures

Test of associations in European countries without previous evidence

Before the start of this WG activity the bulk of evidence linking the concepts of stressful psychosocial environments to health was available from studies conducted in the United Kingdom and Sweden, and to some extent from Germany and the Netherlands. It should be noticed that a large comparative epidemiological study, the Job Stress, Absenteeism, and Cardiovascular disease in Europe study (JACE Study, see below) was already initiated when this Programme started, but was not yet developed to the extent that comparative data was available.

New evidence was obtained from France and Belgium (especially with regard to effort-reward imbalance), and from Central and Eastern European countries (Czech Republic, Poland, Lithuania, Hungary) and from Russia, with regard to all three constructs.

In the French GAZEL Study, social support, job strain and effort-reward imbalance were analysed in combination with several health indicators, as mentioned above (Melchior et al. 2003a, Paterniti et al. 2002, Niedhammer et al. 2004). In Belgium, demand/control and effort/reward imbalance were related to absenteeism, psychosomatic complaints and depressive symptoms (Godin & Kittel 2004).

Demand/control, effort-reward imbalance and lack of social support (at work) were all found to be associated with poor self-rated health in a cross-sectional investigation of populations in four post-communist countries, Czech Republic, Hungary, Poland and Lithuania. After adjustment for age, sex, community and perceived control only two work-related factors remained associated with poor health: the odds ratios for effort-reward imbalance (one standard deviation increase in the log transformed ratio) and job variety (protective) were 1.51 and 0.82 respectively (Pikhart et al. 2001). More recently, similar findings from Central and Eastern Europe were reported for depressive symptoms (Pikhart et al. 2004) and alcohol consumption (Bobak et al. 2002).

It should be noticed that the demand/control model has been tested extensively in a European collaborative research network JACE (Job stress, Absenteeism, and Cardiovascular Disease in Europe) involving subjects from six countries and analysing prospective relations with absenteeism and CHD incidence (Houtman et al. 1999). Two of the JACE team members are also involved in this WG and provide their expertise in cross-cultural data analysis.

A Dutch study called SMASH that was used in JACE as well (as far as the older cohort was concerned; cf. de Jonge, Reuvers et al. 2000) investigated the Demand-Control-Support (DCS) Model by (1) using a more focused measure of job control, (2) testing for both interactive and non-linear relationships, and (3) further extending the model to the prediction of an objective outcome measure (i.e., company administrated sickness absence). Results showed

both linear and curvilinear associations between work stress and most outcome measures. Interestingly, the model was not supported using a more objective outcome measure (sickness absence). Another JACE study conducted in Belgium (called BELSTRESS) among 21,419 employees revealed that perceived distress was most strongly associated with psychological job demands. Again, some evidence of non-linear associations was found (PelFRENE et al. 2001).

Taken together, the evidence of adverse effects on health produced by distinct stressful psychosocial environments across a number of European countries has increased rapidly and consistently over the past few years.

The role of psychosocial work environments in explaining social inequalities in health

So far, new research results have shown that stressful psychosocial work environments are associated with a range of indicators of reduced health and physical disease. To a lesser extent, this was also shown for low social support. Taken together, evidence summarized in sections '*Test of associations with new health indicators*' and '*Test of associations in European countries without previous evidence*' must be considered a key scientific outcome of this Programme. These new findings on adverse effects of stressful psychosocial work environments on health need to be interpreted in the context of the fact that midlife is the period of life, after the first year of life, during which social inequalities in health manifest themselves most strongly. It is therefore crucial to ask how one would decide that an adverse psychosocial environment is responsible, in part, for the social gradient in disease.

To answer this question, first, and most obviously, the predicting variable (a measure of the constructs of adverse psychosocial environment) must be related to the outcome variable, disease in question. This association should be independent of relevant confounders. In fact, the summary given above has indicated that, to a substantial extent, this is the case. Second, either of two other relations should be seen. The predicting variable should be differentially distributed by social position (thus possibly mediating the association of SES with health), or it should interact with factors that are differentially distributed by social position (thus possibly modifying the effect measure in the SES-health association). Finally, a further question relates to gender-specific differences in the SES-health association. These different questions are briefly explored in following sections.

The social gradient of stressful psychosocial work environments

Concerning the job strain model, a social gradient of low control at work has been documented in a large number of studies (e.g. Bosma et al. 1998, Griffin et al. 2002, Godin & Kitzel 2004). However, high demands, or the combination of high demand and low control, were not more prevalent in lower SES groups. With respect to the effort-reward imbalance model, a social gradient of low reward at work was observed in several studies (Bosma et al. 1998, Niedhammer et al. 2000, Siegrist, Starke et al. 2004) , although associations varied to some extent depending on whether SES was measured by educational degree or occupational position. High effort or a ratio between effort and reward were not consistently related to SES. To the contrary, in some studies, effort was positively associated with SES. Interestingly, most recent findings from the Whitehall II Study indicate that worsening of effort-reward-imbalance over time is strongly associated with occupational position leaving lower grade civil servants at higher levels of work stress (Chandola, personal communication).

The fact that components only of the two models of stressful psychosocial work environments are associated with SES reduces the probability that a positive association between work stress and disease is the result of confounding by social class, as argued by some critics (e.g. MacLeod et al. 2001; see below).

Macrosocial and economic determinants need to be included in this analysis. This has been done, among others, by the Stockholm group who analysed the effects of expansion, downsizing, outsourcing, unemployment and several other labour market changes on associations between work stress and health. Under these conditions, work stress in terms of low decision latitude and high effort-reward imbalance had an effect on long term sick leave, even after adjusting for SES. It was also found that women working in expanding public organisations exhibit increased long term sick leave. This may be due to the fact that expansion in the public sector often means centralisation and re-organisation which may cause psychosocial strain (Theorell et al 2003, Oxenstierna et al 2003, Westerlund et al 2003, Jeding et al. 2003).

Mediating effects

Mediation was analysed, among others, with regard to low control at work as this condition was shown to be more prevalent among lower status groups. Low control was also shown to predict CHD incidence in British civil servants, after adjustment for relevant confounders (Marmot et al. 1997). As CHD was more prevalent among lower employment grade civil servants it was hypothesized that low control at work mediates the inverse association of SES with CHD.

In multivariate analysis, low control in the work place accounted for about half the social gradient of CHD (i.e. reduced the odds ratio of CHD in the low employment grade group from about 1.4 to about 1.2) after respective adjusting. Importantly, the relation between low control and CHD was not removed by adjusting for SES.

Similar findings were obtained in a Czech case-control study of CHD patients (Bobak et al. 1998). As low control at work reduces self-efficacy and positive outcome expectancy, these psychological conditions are hypothesized to be more frequent in lower status groups. Moreover, they might mediate part of the association between low SES and CHD. In fact, new findings from a prospective investigation support this argument (H. Bosma, personal communication).

In order to further rule out the often cited criticism that the link between work stress and health may not be causal, but due to confounding with low SES, and particular conditions in early life (MacLeod 2001) the prospective Finnish study of work stress and cardiovascular disease mortality reported above (Kivimäki et al. 2002) was reanalysed, introducing the following additional covariates (as markers of low SES, and particularly adverse circumstances early in life): father's occupational group, subject's height, subject's education, subject's occupational group at study entry and subject's level of salary. After adjusting for all these covariates the effect between job strain and cardiovascular mortality remained highly significant. The hazard ratio was 2.15 (1.1, 4.4). The effect of effort-reward imbalance at work on cardiovascular mortality was even stronger. The hazard ratio was 2.56 (1.2, 5.3) (E. Brunner, personal communication). These results clearly demonstrate that the link between work stress and cardiovascular disease is robust and that it is likely that work stress plays a role in mediating the association between SES and health.

Effect modification

The effect modification hypothesis posits that susceptibility to an exposure is higher among lower status compared to higher status people and, therefore, that among people with lower socio-economic status, the effect size produced by the exposure, is higher. This hypothesis was tested in several prospective studies that documented a stronger effect of high demand and low control at work, or of high effort and low reward at work, on the risk of CHD incidence in lower status groups (Johnson & Hall, 1988; Hallqvist et al. 1998, Kuper et al. 2002). For instance, Kuper, Singh-Manoux, Siegrist et al. (2002) analysed the relation of effort-reward imbalance to CHD incidence (quartiles of the effort-reward ratio) in a 11 year follow-up period in the Whitehall II study. While they found an increased risk of CHD in the upper quartile of scores of the effort-reward ratio within the total study population, this effect was

relatively strongest in the lowest employment group (clericals). In the clerical as compared to the administrative group the odds ratio of effort-reward imbalance was 1.56 versus 1.19 for all CHD, and was 1.71 versus 1.27 for fatal CHD / non-fatal acute myocardial infarction.

Further support for effect modification with regard to effort-reward imbalance is derived from baseline data of the Swedish WOLF study on risk factors in working men and women of the greater Stockholm area. Preliminary findings in more than 5500 men and women showed the most robust association between effort-reward imbalance and hypertension among individuals with low education (i.e. less than 12 years). Respective odds ratios for effort-reward imbalance were 2.18 for women and 1.98 for men. In the group with 12 and more years of education respective odds ratios were 1.31 for women and 1.32 for men (Peter 2003).

In summary, in this Programme, advances were achieved concerning the explanation of social inequalities in health in terms of an adverse psychosocial work environment. Some evidence was found for both approaches, mediation and effect modification.

Gender differences

Gender differences in social inequalities in health have been an issue of major concern in recent research in health related social and behavioural sciences (e.g. Hunt & Annandale 1999, Wamala & Lynch 2002) While this analysis is clearly beyond the scope of the aims of this WG it is nevertheless important to explore gender-specific associations of an adverse psychosocial work environment with health (Brisson 2000).

Several activities within this WG were related to this research question. From a theoretical perspective, it may well be that gender roles are crucial in this process. For instance, in terms of the social cognitive theory of gender differentiation (Bussey & Bandura 1999), women may be better suited to combine different roles or to change roles with more flexibility and thus to profit from multiple sources of self-efficacy and self esteem. Men, on the contrary, often stick more exclusively to their occupational role as it provides a major source of self-reliance.

As a result of socialized gender roles, men may generally be more vulnerable to the threats of their occupational role (job insecurity, lack of promotion prospects, status inconsistency) compared to women. Several papers produced in the context of collaborative efforts of this WG explored gender (role) specific effects of an adverse psychosocial environment on health (Chandola et al. 2004, Kunz-Ebrecht, Kirschbaum et al. 2004, Niedhammer et al. 2004).

Broadly speaking, sociocultural factors influence the appraisal of demands and threats in salient social roles in adult life, and particular in gender roles. Interestingly, two studies of

occupational stress and cardiovascular risk comparing men and women in Sweden found some evidence along these lines (Peter et al. 1998, Peter et al. 2002). In men, the threats to occupational status (low control and low reward due to restricted mobility, job insecurity etc.) were more strongly associated with cardiovascular risk than in women. Conversely, excessive ways of personal coping with the demands at work (overcommitment) predicted disease risk more strongly in women than in men.

Health effects of an adverse psychosocial work environment may also be contingent on the ratio between men and women working in specific occupations. One hypothesis posits that in male dominated jobs, women are exposed more often to stressful conditions. This may be due, among others, to the dynamics of group processes and social comparison processes. Very recent analyses with data from Swedish case-control study were conducted to investigate gender differences in the association between effort-reward imbalance and myocardial infarction (Peter et al. 2003). Findings showed that gender segregation on the job influenced the prevalence of work stress in terms of effort-reward imbalance among women but not among men. Moreover, the strongest association between myocardial infarction and overcommitment was found among women working in male dominated jobs as compared to women employed in female dominated jobs (OR 2.71 vs. 1.54 respectively).

Moreover, in a small concerted action within this WG comparative analyses of gender specific associations of SES with health and the role of work stress in explaining these associations were initiated. Final results are not available at present.

In conclusion, all five sub-goals of the first aim were met to an impressive extent by these WG activities. These activities laid ground for a scientific collaboration which exceeded expectations in its intensity and scientific output, and which will certainly continue to exist beyond the lifetime of this Programme (see below 4.5). By elaborating the role of distinct stressful psychosocial environments in the development of ill health and disease in adult life this WG has made a significant contribution to the international state of art in research on social inequalities in health. Scientific progress quite substantially depends on accurate measures and on a high quality of data collection and data analysis. This aspect of scientific collaboration is discussed in the next paragraph.

Aim 2: To advance the development of standardized measures of stressful psychosocial environments across Europe and to initiate comparative data analysis.

Translation of instruments and assessment of psychometric properties

Job Content Questionnaire (JCQ) measuring the demand control model

The JCQ was designed to measure the demand control model by a standardized self-administered questionnaire (Karasek et al. 1998). This questionnaire has been widely used in international research both within and beyond Europe and has been psychometrically tested and prospectively validated in many studies. Research in this WG substantially contributed to these latter developments, most extensively in the framework of the above mentioned JACE study (see section 1.4).

The following questions were addressed: (1) Does the (factorial) structure of the Demand-Control-Support Model measure identical job stress risk factors in different European countries along the North-South axis? (2) Are differences in this structure mainly related to differences in labour force structure? Data came from six countries (Sweden, The Netherlands, Belgium, France, Spain and Italy) and eight research institutes and were gathered from men and women from 35 to 59 years of age. The sample consisted of a total number of 24.976 employees.

The data indicated that for the north and middle European countries a 5-factor model (i.e. demand, authority, skill discretion, supervisor and coworker support) fits the data much better than a 3-factor model (i.e. demand, control, support). So, separating the scale of decision latitude into decision authority and skill discretion and the support scale into separate scales for supervisor and coworker support fit the data best. For the south of Europe a 4-factor model fits best, that is, only separating the decision latitude scale into skill authority and skill discretion. In addition, splitting up the database into male and female workers did not add much to this interpretation. The results were rather robust across gender. Finally, reliability by means of Cronbach's alpha was in general quite reasonable (total sample ranging from .65 to .87). However, taking the North-South axis into account, a few scales showed unacceptable internal consistencies. These findings will be topic of a separate publication which is currently in preparation.

Effort-reward imbalance (ERI) Questionnaire

The ERI questionnaire measures the model by assessing self-reported data that combine descriptive and evaluative information. 23 Likert-scaled items are answered that define three

psychometric scales, 'effort', 'reward' and 'overcommitment'. The scale 'reward' is more complex than the other two scales as it is composed by three subscales measuring 'esteem', 'salary and promotion' and 'job security'. The combination of information from these scales according to a predefined algorithm provides an opportunity of measuring the theoretical construct: a ratio of the sum score 'effort' (enumerator) and the sum score 'reward' (denominator, adjusted for unequal number of items) serves as an approximate estimate of imbalance. This ratio can be transformed into a binary variable (cut point 1.0) or into tertiles or quartiles based on log-transformed continuous information (Siegrist 1996, Siegrist, Starke et al. 2004).

While this ratio reflects the perceived situational components of stressful experience at work the sum score of the scale 'overcommitment' assesses a personal pattern of coping with demands at work characterized by an excessive overcommitment and a high need for approval. A high score, as defined by the upper tertile, indicates a critical threshold associated with an increased health risk. The two components of the model, 'situational' and 'personal', can be analysed separately, but their combination provides the most appropriate risk estimation.

The questionnaire was originally developed and tested in German language. Since 1997/98, English, Swedish, French and Dutch versions were developed. The collaboration evolving in the frame of this Scientific Programme enabled researchers to improve the existing versions and, for the first time, to perform comprehensive comparative statistical analyses in order to assess the psychometric properties of the questionnaire (see Hanson et al. 2000, Niedhammer et al. 2000, Siegrist, Starke et al. 2004).

Today, as a direct or indirect result of this WG activity, the ERI questionnaire has been translated according to established standards of cross-cultural research into the following European languages: Dutch, English, French, Italian, Finnish, Norwegian, Polish, Hungarian, Czech, Danish, Spanish and Russian (see also <http://www.uni-duesseldorf.de/MedicalSociology/index-eri.htm>).

The comparative analysis of psychometric properties of the scales is one of the important direct outcomes of this WG activity, and it concerns comparative data analysis of the following studies: 1. the SOMSTRESS-Study (Belgium), 2. the GAZEL-Cohort Study (France), 3. the WOLF-Norrland Study (Sweden), 4. the Whitehall II Study (United Kingdom), 5. the Public Transport Employees Study (Germany).

Results are available in a joint paper (Siegrist, Starke et al. 2004) and are briefly summarized as follows: Internal consistency of the scales was satisfactory in all samples, and the factorial structure of the scales was consistently confirmed. Using confirmatory factor analysis all goodness of fit measures were $> .92$. Thus, a psychometrically well justified measure of

work-related stress (ERI) is available for comparative socio-epidemiologic investigations across Europe and beyond.

Finally, cross-sectional psychometric analyses of efforts and rewards as well as overcommitment (based upon Dutch translations of original ERI scales) showed that (confirmatory) factorial validity exists for the ERI scales (de Jonge, van der Linden et al. 2003). Furthermore, internal consistencies of all scales were satisfying and comparable to other (non-Dutch) databases. In table 3.2.2, an overview of implementation of the two work stress measures in epidemiologic studies across Europe is given.

Table 3.2.2: Work stress measures in European epidemiological studies

<i>study</i>	<i>country</i>	<i>author/ project leader</i>	<i>total sample</i>	<i>design</i>	<i>work stress model</i>	
<i>established studies</i>						
GAZEL	France	I. Niedhammer M. Goldberg	20,624	prospective	JCQ	ERI
Somstress	Belgium	F. Kittel I. Godin	3,796	2 wave-design	JCQ	ERI
Whitehall II	UK	M. Marmot	10,308	prospective	JCQ	ERI
WOLF Stockholm	Sweden	L. Alfredsson	5,700	prospective	JCQ /proxy	ERI / proxy
WOLF Norrland	Sweden	A. Knutsson	960	prospective	JCQ / proxy	ERI / proxy
<i>new studies</i>						
HAPIEE pilot	Czech Rep. Poland Russia	M. Bobak	2,200	cross sectional	proxy	ERI
HAPIEE	Czech Rep. Poland Russia	M. Bobak	30,000 (still in progress)	prospective	JCQ	ERI
HAPIEE	Czech Rep. Poland Russia Sweden	M. Bobak	2,000	cross sectional	proxy	ERI
JACE	Belgium France Italy Netherlands Sweden	I. Houtman	53,426	prospective	JCQ	---
NEXT	Belgium Finland France Germany Italy Netherlands Poland Slovakia Sweden UK	H.M. Hasselhorn	60,000 (still in pro- gress)	2 wave-design	JCQ	ERI
Recall	Germany	J. Siegrist	4,800 (still in pro- gress)	prospective	JCQ	ERI
Waterland	Netherlands	S. v. d. Linden J. d. Jonge	301	3 wave panel survey	JCQ	ERI

Methodological developments and comparisons

Demand-control model

Three separate groups established by the international JCQ Board are working on the evaluation of the (three) JCQ scales and addressed points for future research. Two of the

WG members are also involved in these groups and provide their expertise. Based upon intensive psychometrical assessment, methodological developments that were achieved so far are:

- the adaptation of the current versions of the JCQ scales (i.e. demands, decision latitude and support) by deleting bad items and adding new items;
- adding new dimensions to the current scales, e.g. emotional demands or macro-level decision latitude;
- rethinking of the current response rates of the JCQ scale (transformation from 'dis-agreement-agreement' into frequency-based response rates);
- the development of a domain-specific Demand-Control Model, i.e. different sources of job demands may be buffered by a specific job resource;
- the impact of the global economy on the JCQ measures (e.g. social relations at work);
- theoretical expansion of the social support construct in the direction of 'social capital and health';
- comparison of JCQ measures with ERI measures in similar research studies (e.g. as far as psychometrics and predictive validity are concerned).

Several additional methodological developments were achieved with regard to this model, such as comparison of externally assessed versus subjectively rated control at work. Moreover, within the context of the Musculoskeletal Intervention study in Norrtälje (a mixed urban and rural area in the Stockholm region), the so-called MUSIC Norrtälje study) interviews were performed as a supplement to questionnaires assessing demands, decision latitude and support (the Swedish DCQ version). The results were based upon 2000 subjects and showed that interviews may provide more "objective" information regarding these psychosocial aspects of the work environment than self-administered questionnaires (Waldenstrom et al. 2002).

Effort-reward imbalance

Four methodological developments were achieved in the frame of WG activities since 1999. First, H. Pikhart, in his doctoral dissertation (Pikhart 2002), demonstrated that the dichotomous measure of the ratio of effort and reward (>1.0 versus ≤ 1.0) which was used so far as a summary measure was statistically inferior to a logarithmic continuous measure of the ratio. Logarithmic transformation of the continuous scale is performed in order to place 1.0 as

center point for the scale (when effort and reward are equalized). The use of a continuous measure has the advantage of providing more information compared to the binary measure. Based on continuous information, quartiles or tertiles of the ratio can be defined, and dose-response relationships between effort-reward imbalance and health can be explored. In his study of associations of work stress with self-rated health in four post-communist societies, Pikhart showed that a model composed by the continuous log (effort-reward ratio) produced the relatively strongest effects on health, if compared with five alternative statistical models, including the dichotomised ratio. In a likelihood ratio test comparing the models, the highest chi-square value was obtained from this new summary measure.

Meanwhile, at least two independent prospective studies confirmed the superior statistical power of this approach (Kuper et al. 2002, Niedhammer et al. 2004).

Secondly, a short version of the scale 'overcommitment' was developed. The original scale contained 29 items measuring four relevant aspects of this coping pattern: 1. need for approval, 2. competitiveness and latent hostility, 3. impatience and disproportionate irritability, and 4. inability to withdraw from work obligations (Siegrist 1996). The four respective subscales were repeatedly found to load on one latent factor in a second order factor analysis, and a high score on the total factor (upper tertile) was shown to predict adverse health in several studies. However, subsequent analyses demonstrated that most of the predictive power of this scale was due to the last one of the four subscales, inability to withdraw. Therefore, exploratory and confirmatory factor analyses were conducted using data from different study samples to develop a statistically more appropriate short scale. In its final version this uni-dimensional scale contains six four-point Likert scaled items (Siegrist et al. 2001).

A third development concerns the test of the dimensional structure of the theoretical model, using higher order confirmatory factor analysis. Recent analyses indicate that the model fit of a theoretically specified factorial structure as opposed to a less specified factor structure is clearly improved (as indicated, e.g., by a GFI value of .914 vs. .876). This model posits the following latent structure: 1. the latent construct 'effort-reward imbalance' explains the three factors 'effort', 'reward' and 'overcommitment'. 2. The factor 'reward' explains the three sub-factors 'esteem', 'salary and promotion' and 'job security' (Rödel et al. 2003, Siegrist, Starke et al. 2004, de Jonge, van der Linden et al. 2003).

Finally, in addition to the global effects of reward in the effort-reward imbalance model specific effects of the three subcomponents of reward have been analysed. This is important for two reasons. First, if non-economic reward (esteem) is shown to produce effects on health as strong as economic reward this information would indicate additional evidence in favour of a psychosocial as opposed to an exclusively materialistic framework of analysis. Secondly,

information on differential effects of reward components may be useful in designing more tailored intervention measures of worksite health promotion and prevention. In this WG, two analyses have been advanced exploring this approach. Van Vegchel et al. (2002) showed consistent associations of the three subcomponents with health in a cross-sectional study on health care workers. Similar findings were obtained in a study on employees of a public transport company (Siegrist, Falck et al. 2003). Interestingly, both studies showed relatively strongest associations of the subscale 'esteem' with health.

In addition to these methodological developments comparative analyses were conducted by applying identical measures of effort-reward imbalance at work to working populations in five different European countries (France, Belgium, Germany, Sweden, United Kingdom). As respective results are published in detail, they need not be summarized here (Siegrist, Starke et al. 2004). However, it may be of interest to indicate that consistent associations of the effort-reward ratio with self-reported health were found with odds ratios ranging from 1.6 to 5.2. Consistent, but less strong effects were also observed for the model component 'overcommitment'.

In conclusion, this information documents substantial advances in methodology resulting from scientific collaboration in the frame of this WG. Future comparative assessments of stressful psychosocial environments across European countries can build on these advances.

Aim 3: To develop new psychobiological markers of stress and to apply them to exposed socio-economic/psychosocial population groups

Stress markers with relevance to the cardiovascular system

It should be stressed that the majority of scientific activities of this Programme is confined to research in the frame of observational epidemiological studies. While this is an appropriate strategy to advance our knowledge on social determinants of population health, it may not be sufficient to identify the specific causal pathways underlying the observed observations. As argued in the proposal submitted to ESF the combination of psychological and sociological information on the one hand and of biological and biomedical information on the other hand has the potential of exploring causal pathways underlying observed statistical associations. Therefore, this WG put special emphasis on the intensification of transdisciplinary research. Several centres participating in this WG are involved in transdisciplinary research of this type, most notably the research teams of M. Marmot, A. Steptoe and E. Brunner at the Uni-

versity College London, the research teams of T. Theorell in Stockholm, of M. Kristenson in Linköping, of H. Ursin in Bergen and of C. Kirschbaum in Duesseldorf.

A combination of epidemiological information with information derived from laboratory experiments (or ambulatory monitoring in everyday settings) holds special promise for scientific advances because stress reactions can be analysed in epidemiologically defined risk groups. For instance, subjects characterized by different SES or by different exposure to stressful psychosocial environments (as described above) are recruited for laboratory or ambulatory in-depth research where new stress markers are explored. This strategy has been followed most intensely in the London UCL team led by A. Steptoe during the past few years. He was able to combine the two methods in the context of the Whitehall II Study, with particular emphasis on the cardiovascular system. This research supported by grants from MRC and from the British Heart Foundation resulted in a series of discoveries that are briefly summarized here. It should be mentioned that the discussions and collaborative exchanges in the frame of this WG had a favourable impact on these investigations (see also References).

In the main study 240 Whitehall civil servants (recruited according to socio-economic / psychosocial profile) underwent a 2.5 hr laboratory session with standardized mental stress testing. In addition, ambulatory monitoring was conducted.

During the laboratory tests, a large number of psychobiological responses was assessed. Among the many new findings of experimental and ambulant monitoring studies, the following ones deserve special attention in the frame of this scientific programme.

1. This study substantiated the hypothesis that psychobiological responses are meaningful both in terms of magnitude of reactions (change from baseline to task periods) and of recovery time (return towards baseline 45 minutes post-stress) (Steptoe & Marmot 2002).
2. Concerning the recovery rate following stress-induced arousal, low SES participants had a significantly higher risk of incomplete recovery after 45 minutes than higher SES participants. The respective odds ratio was 2.6 for blood pressure and 5.9 for heart rate variability (Steptoe, Feldman, Kunz et al. 2002).
3. In lower SES participants higher concentrations of C-reactive protein and of human heat shock protein were observed following laboratory stress exposure (Owen et al. 2003, Lewthwaite et al. 2002). This finding is important because these markers of inflammation may play a role in atherogenic processes of arteries underlying the development of CHD.
4. Absolute levels of interleukin-6, as assessed during the laboratory session, were inversely related to SES (Owen et al. 2003).

5. During ambulatory monitoring it was obvious that the mean level of systolic blood pressure (SBP) and heart rate (HR) was higher among low SES participants than among higher SES participants (especially in the morning period) (Steptoe, Feldman et al. 2002). Furthermore, male low SES participants scoring high on overcommitment exhibited significantly elevated SBP values during work days (Steptoe et al. 2004).
6. Concerning salivary cortisol measures, the importance of distinguishing cortisol profiles over the day from cortisol increase that occurs on waking was further substantiated. Concerning mean salivary cortisol output over a working day, significantly higher excretion was observed in male low SES participants, but not in female low SES participants (Kunz-Ebrecht, Kirschbaum et al. 2004). Moreover, in men who scored high on overcommitment a significantly increased salivary cortisol output was observed.
7. Concerning cortisol responses to waking, an association with job demand was found. As the impact of high job demands varied with SES greater waking responses were found in lower SES participants (Kunz-Ebrecht, Steptoe et al. 2003).

An intensive neurohormone sub-study with biological samples collected over two working days was carried out with the cooperation of a random sample of 220 men drawn from the Whitehall II Study. The sub-study, led by E. Brunner, used a case-control design, in which a group of metabolic syndrome cases were compared to a group of healthy controls. A research nurse visited participants' offices in order to minimise observation bias. The main scientific question was to study the extent to which functioning of the main stress hormone pathways were altered in the presence of the metabolic syndrome. Metabolic syndrome is a condition in which people have three or more of the following risk factors: central (abdominal) obesity, high blood pressure, high blood sugar, raised levels of triglycerides and low levels of HDL cholesterol (good cholesterol). An estimated 7 million people in the UK have the metabolic syndrome and are at a greater risk of diabetes, heart attack and stroke.

Key results were as follows:

1. Metabolic syndrome was accompanied by changes in the two major neurohormonal stress pathways (adrenocortical and autonomic) and in cardiac autonomic activity (Brunner et al. 2002). Mean salivary cortisol collected on two working days at 1630h and 2000h did not differ between cases and controls. Twenty-four hour urinary output of cortisol and noradrenaline metabolites was higher, and heart rate variability was lower, indicating sympathetic predominance and reduced vagal tone. The latter find-

ings indicate that the balance of unconscious nervous inputs to the heart was tilted towards stimulation and against relaxation.

2. Markers of low-level inflammation (interleukin-6 and C-reactive protein) were raised in the metabolic syndrome, and higher levels of inflammation were linked with more adverse (lower) heart rate variability.
3. Psychosocial factors and health related behaviours partly explained the neurohormonal disturbances that accompany the metabolic syndrome.
4. This is significant evidence that chronic psychosocial stress may contribute to development of metabolic syndrome, a precursor state of coronary heart disease.

Adults of lower rather than higher SES are at higher risk of having the metabolic syndrome (Brunner et al. 1997). Our research points to the possibility of an important interaction between stress and obesity. Overweight and obese individuals produce more stress hormones such as adrenaline and cortisol, and these excess levels of hormone output seem in part to be due to psychosocial factors such as work stress. Interestingly, in a prospective Finish study mentioned above a significant association was reported between work stress in terms of effort-reward imbalance and weight gain over a ten year observation period (Kivimäki et al. 2002).

To study metabolic syndrome-related risk factors, a detailed examination was carried out of the cross-sectional and longitudinal associations over ten years between psychosocial exposures and biomarkers in the Whitehall II study, a large population sample of working adults. Work characteristics and risk factors were measured in 4759 male and 1904 female civil servants at baseline, when participants were aged 35-55, and after two intervals of five years. Low decision latitude and job strain (high demands and low decision latitude combined) were linked cross-sectionally and prospectively with low serum HDL cholesterol, high plasma fibrinogen and with adverse levels of fasting and post-OGTT glucose and insulin in both sexes. The serum HDL cholesterol level showed the most consistent relation to perceived work stress, and deserves more attention as a candidate stress biomarker (Brunner et al. 2003, McCarthy et al. 2003). With regard to plasma fibrinogen, similar findings were made in the SHEEP Study in Stockholm (Tsutsumi et al. 1999).

Based on these new findings, a list of potential new psychobiological markers of stress (with particular relevance to cardiovascular risk and disease) can be proposed for further research, as indicated in table 3.2.3.

Table 3.2.3: New psychobiological markers of stress

<i>Parameter</i>	<i>Design</i>	<i>Reference</i>
HDL cholesterol	naturalistic study	Brunner et al. 2003
Cortisol profile over the day (diurnal pattern)	naturalistic study (salivary cortisol according to standardised protocol)	Kunz-Ebrecht, Kirschbaum et al. 2004
Cortisol waking response	naturalistic study	Kunz-Ebrecht, Steptoe et al. 2003
Rate of recovery (HR, SBP, DBP) (return towards baseline 45 min post stress) *	stress testing under experimental conditions	Steptoe & Marmot 2002
Post stress blood clotting responses: factor VIII, plasma and blood viscosity	stress testing under experimental conditions	Steptoe, Kunz-Ebrecht, Rumley et al. 2003
C-reactive protein	stress testing under experimental conditions	Owen et al. 2003
Hsp 60 (human heat shock protein)	stress testing under experimental conditions	Lewthwaite et al. 2002
inflammatory cytokines (IL-6**, TNFa, IL-Ra)	stress testing under experimental conditions	Steptoe, Owen et al. 2002

* in combination with impedance cardiography to analyse peripheral resistance and cardiac output (Steptoe, Willemsen et al. 2003)

** IL-6 has also been obtained from saliva samples in naturalistic studies (M. Kristenson, personal communication)

Standardization of non-invasive stress measures (esp. salivary cortisol) and comparison between groups

The three working groups in Duesseldorf (C. Kirschbaum), Linköping (M. Kristenson) and Stockholm (T. Theorell) were particularly active with regard to this aim of the WG. A study involving some 250 participants with ambulatory saliva cortisol measures and psychosocial data was performed at the University of Linköping (see below) and an additional study including some 600 participants with ambulatory saliva cortisol measures and medical as well as psychosocial data was carried out in Stockholm. Both cortisol data analyses was performed in close collaboration with Kirschbaum's laboratory in Duesseldorf.

The aim of the Linköping study was to assess relations between psychosocial factors and ambulatory cortisol levels. 129 women and 129 men 30-64 years old attended. They were all recruited among those who in 1999 had responded to a health survey of 10 000 individuals, via a postal questionnaire. In this survey the response rate was 65%. A random sample of 200 women and 200 men 30-65 years old was invited, and 129 women and 129 men, together 258, accepted, yielding a response rate also in this part, of 65%.

Questionnaires included instruments on social integration and social support, demand, control and social support at work, coping, self-esteem, hopelessness, depression and vital exhaustion. The sampling of saliva was done at home during three consecutive days; always on working days and not the day after holiday. The first sample was taken directly after awakening (PWC), the second 30 minutes after awakening and the third in the evening before going to bed. Samples were taken using salivette (Saarson), they were frozen immediately at home and sent by post to the laboratory. Cortisol analysis was done using an in-house immunoassay with time-resolved fluorescence detection (DELFI) at the laboratory led by C. Kirschbaum in Duesseldorf, Germany. Intraassay coefficients were less than 10%.

The volunteers also filled in a detailed questionnaire on exact time for sampling, awakening time, perceived quality of sleep and stressful events the day preceding the sampling.

The day to day variation was relatively large, $r = 0.45$. Cortisol data were not normally distributed and were significantly dependent on awakening time. Therefore, in analyses relating cortisol to psychosocial factors means values of the three days were used, and partial correlations, adjusted for awakening time on logarithmic data, used to assess relations between cortisol levels (and deviations) and scale scores of instruments on psychosocial characteristics.

Cortisol levels at 30 minutes after awakening were about 50% higher compared to PWC. Both PWC and +30min levels differed significantly according to awakening time. +30 cortisol levels were highest among those waking up 06.00 to 07.00.

Table 3.2.4 shows relations between cortisol levels and group status. In this table raw means are presented i.e. not standardized for awakening time. We found no differences between men and women in morning values but women had higher evening values (5.6 vs. 5.1 nmol/l, $p=0.04$). People above age 55 had lower PWC and +30 min. levels with no other significant effects of age. While education had no effect on cortisol levels, blue-collar men had lower +30 min values than white-collar (33,1 vs. 35,7 nmol/l, $p=0.05$).

In this study, cortisol levels were also related to several psychosocial factors (for details see Kristenson, Sjögren et al. 2002).

Table 3.2.4: Mean levels of saliva cortisol (SD) according to gender and age, p-values for differences between groups (Kristenson, Sjögren et al. 2002)

		<i>PWC</i>	<i>+30 min</i>	<i>Evening</i>
Men	124	23.2 (8.4)	33.8 (10.7)	5.1 (3.3)
Women	128	23.6 (7.6)	35.1 (11.7)	5.6 (3.0)
	252			
<i>p</i>		<i>0.73</i>	<i>0.48</i>	<i>0.04</i>
Age				
30-34	29	22.8 (9.2)	32.1 (9.8)	5.4 (3.0)
35-44	63	24.3 (7.6)	36.1 (9.8)	5.3 (3.0)
45-54	83	24.7 (7.5)	36.8 (11.6)	5.8 (3.3)
55-64	76	21.4 (8.0)	31.4 (11.7)	4.9 (2.3)
	251			
<i>p</i>		<i>0.07</i>	<i><0.01</i>	<i>0.24</i>

Based on these preliminary results, a new Swedish cohort study is currently in preparation at the University of Linköping (M. Kristenson). The planning is done in collaboration with M. Bobak, UCL London, in order to obtain measures in several domains that are comparable to those assessed in the HAPPIE study.

In the Stockholm group, saliva specimens for the assessment of cortisol were collected in a second phase of a large epidemiological study of mental health in the greater Stockholm population, the PART study (principal investigator is I. Lundberg, National institute for working life institute).

In the second step of this study 900 participants with and without low mental well being were selected for an in-depth study comprising psychiatric diagnoses, assessment of working life conditions and collection of salivary cortisol samples.

Half of these participants have a low mental ill health score according to the WHO questionnaire. Specimens are taken at awakening, 30 minutes later, at lunch time and at bed time in the evening. Instructions include avoidance of food or beverage before the specimen is collected.

The assessments are based upon radioimmunoassay and kits from Orion are used. Our laboratory collaborates with the other Nordic laboratories as well as with C. Kirschbaum's laboratory in Duesseldorf. A direct comparison has been made with C. Kirschbaum's laboratory using the same specimens in both laboratories. This comparison which is based upon 30 specimens shows that despite a very high linear correlation between the two laboratories ($r=0.98$) our assessments are on average 1.19 nmol/l (12.5%) lower (95% CI 0.15-2.23), $p=0.03$) than the assessments in C. Kirschbaum's lab. Thus we have to caution that epidemiological comparisons may be problematic since there may be a systematic difference in estimated levels between the laboratories (which is a 'normal' finding). When we compare

with population studies that have been using Kirschbaum's laboratory (for instance the Linköping study) we may have to raise our levels by 12.5 %.

Data of variations of salivary cortisol with regard to socio demographic, medical and psychosocial variables (family and work conditions, life events, social support) will be available in the near future. Direct comparisons to the Linköping samples will contribute substantially to our understanding of discriminant functions of this important psychobiological stress marker.

Studies in Stockholm have also illuminated the inter-relationships between IL-6 and cortisol regulation and between IL-6 concentration in serum and psychosocial factors. An epidemiological study showed that both men and women with a small difference between serum cortisol in the morning and at noon had significantly higher IL-6 serum concentrations than others. In addition, in men a low decision latitude was associated with a high IL-6 concentration (Theorell, Hasselhorn et al. 2000). A high IL-6 level was also predictive of a poor prognosis in men who had developed an acute episode of low back pain (Hasselhorn et al. 2001, Theorell et al. 2002, Hasselhorn et al. 2001).

In conclusion, significant progress with regard to the development of new psychobiological markers of stress and their application to different groups in Europe was achieved. One example for a direct spin-off of the close interactions between members of this WG, there are now two large-scale epidemiological studies under way in which salivary cortisol measures are now being obtained repeatedly from over 20,000 individuals. In the Whitehall II and in the British Birth Cohort studies, these measures were added to the study protocols of the current waves based on the extensive knowledge about the stress – cortisol interactions accumulated over the past years. All samples are being analysed in the Duesseldorf lab which allows for a comparison of results between studies. Without the activities in the WG, there would have been no addition of this biological stress marker to the study protocols.

3.2.3 Further activities

Involvement of young scholars

Two international Summer Schools (2001, 2002) were held with a special intention to disseminate research expertise in the field across Europe and to recruit young scholars for further scientific exchange between cooperating centres. Following these activities in 2001 and 2002 a number of young scholars became actively engaged in scientific collaboration (in particular M. Melchior, (Paris), H. Orphana (Ottawa), N. Dragano (Duesseldorf), M. Hyde (London, Stockholm), N. van Vegchel (Utrecht)). Additional scholars were recruited during the Programme's lifetime, in particular I. Godin (Brussels), H. Bosma (Maastricht), T. Chandola, J. Head (London), O. v.d. Knesebeck (Duesseldorf) and S. van der Linden (Utrecht).

A Ph.D. dissertation was designed in this context at the University of Utrecht, supervised by J. de Jonge, W. Schaufeli and J. Siegrist, testing the effort-reward imbalance model in Dutch health care work (S. van der Linden). A major aim of this study is to test and to refine the ERI Model in a panel sample of Dutch health care workers. The central question is whether a specific mismatch between (high) efforts and (low) rewards may lead to adverse health effects in health care work. Next to this, several innovative points for further research will be addressed: (1) the measurement and psychometric qualities of the key constructs, particularly in Dutch language; (2) the multidimensional nature of both effort and reward; (3) time-dependent (i.e. longitudinal) effects of both effort and reward on adverse health; (4) the role of negative affectivity in the job stress process; and (5) validation of the ERI Model with more objective parameters. In addition, results will be cross-validated whenever possible by means of another panel sample of Dutch health care workers. The research questions will be investigated with the help of an already collected longitudinal database consisting of a 3-wave panel survey in several Dutch nursing homes.

Preparation of a Special Issue

WG 2 members were actively involved in the preparation of a special issue of a widely distributed, internationally distinguished journal, *Social Science and Medicine*, with the intention of documenting a substantial part of its collaborative scientific activities. At the time of finalizing this report, this special issue is in press. It is entitled 'Health Inequalities and the Psychosocial Environment' and the WG leaders M. Marmot and J. Siegrist act as guest editors

☞ Contributions to the Special Issue are listed in chapter 5 Publicity.

Transatlantic link

Two transatlantic links were established through activities of this WG: A link to a research group at the University of San Francisco (USA), and a link to a research group at the University of Quebec (Canada).

GROW Study, San Francisco, USA

R. Rugulies, member of the sub group on work stress models, his US American colleagues P. Blanc (Principal Investigator), Jeff Braff (Study Coordinator) and colleagues are currently carrying out the GROW Study (Gradients in Occupational Health in Hospital Workers). This study investigates how socioeconomic gradients in health are mediated by the psychosocial and physical work environment. The study is conducted as a combined case-control and

prospective study with 150 cases (musculoskeletal injuries) and 450 controls. Subjects are being recruited from a study base of 5000 hospital workers in two San Francisco hospitals. Musculoskeletal injury in the case-control phase and hypertension, salivary cortisol, mental health, and self-rated health in the prospective phase will be evaluated in the context of socioeconomic status and work environment. The study includes extensive quantitative measurements for psychosocial stress at the workplace (including both the demand-control-support model and the effort-reward-imbalance model), an objective assessment of physical/ergonomic exposure, a qualitative research programme, and the development of methods to improve workers' health. So far, no results are yet available from this ongoing study.

Canadian studies, Quebec, Canada

Two major studies based on the work stress models (demand control, effort-reward imbalance) are currently conducted at the Laval University of Quebec, Canada. The research network persists between T. Theorell and J. Siegrist and the Canadian researchers C. Brisson and M. Vézina.

Study 1) An Evaluative Intervention Research on Psychosocial Work Factors and Health

The objective of this study is to evaluate the benefits of interventions aimed at reducing adverse psychosocial work factors in a large white collar institution compared with a suitable control group employing, all told, 2,700 women and men. Adverse psychosocial work factors are defined by the ERI model and the DC (demand-control-support) model. The study integrates the three phases of intervention research. The development phase aims to produce knowledge that will foster the development of well-adapted interventions. The implementation phase aims to systematically document how the intervention is carried out. The effectiveness evaluation phase aims to measure the extent to which the intervention will reduce the frequency of adverse psychosocial work factors and their health effects. This is achieved through a quasi-experimental pre-test post-test design with a control group. A comprehensive range of health indicators are evaluated: 1) ambulatory blood pressure; 2) medically certified sick leave; 3) psychological distress; and 4) a validated self-reported indicator of musculoskeletal disorders.

The first wave of measures were completed in 2003 with an excellent participation rate (80%). Manuscripts related to this first wave of measures are currently in preparation. The development and implementation phases are now underway. This 5-year study has received a grant from the US National Institute for Occupational Safety and Health (NIOSH) 2003-2005 (Brisson, Vézina et al. 2003).

Study 2) Psychosocial work environment and evolution of ambulatory blood pressure: a 5-year prospective study (CIHR 2002-2006)

This study is based on the same population and uses, in part, the same instruments as study 1. It aims to evaluate the effect of duration of exposure to adverse psychosocial work factors defined by the ERI and the DC models on the evolution of blood pressure measured 3 times over a 5-year period. The study will specifically evaluate the complementarity of the two models in their effect on the evolution of blood pressure over time. The prospective design, the use of ambulatory blood pressure measures in a large population and the simultaneous use of the ERI and the DC models also insure that this study will make a solid contribution to the improvement of our knowledge. Manuscripts related to the first wave of data collection are currently in preparation. This 5-year study received a grant from the Canadian Institutes of Health Research (2002-2006) (Brisson et al. 1999).

Two other ongoing prospective studies have been designed to evaluate the effect of psychosocial factors at work on the incidence of cardiovascular diseases and on the risk of their recurrence. These 8-year and 5-year prospective studies are conducted among large populations including respectively 9,000 and 1,000 men and women. At the second follow-up, ERI measures were added to complete the evaluation of the psychosocial work environment of the participants. In addition to cardiovascular diseases, the first study (n=9,000) will also evaluate the effect of psychosocial factors at work on the 8-year incidence of mental health problems and musculoskeletal disorders. These studies have a very good participation rate at baseline (75% and 85%) and an excellent participation rate at follow-up (90%). As follow-up is planned to be completed in 2003, the main results will be published in the following year. These large prospective studies have received grants from the Medical Research Council, the Social Sciences and Humanities Research Council and the Heart and Stroke Foundation of Canada (1991-2003) (Brisson, Leblanc, et al. 2003).

Impact on other running scientific activities

International Commission on Occupational Health (ICOH)

The Third International Conference on Work Environment and Cardiovascular Diseases was held at Duesseldorf University on March 20-22, 2002 and was organised in close cooperation with the ESF Programme. The conference aim was the presentation and discussion of recent scientific progress in the area of work-related influences on the development and the course of cardiovascular diseases in a broader sense. Some 100 experts on occupational psychosocial health from all over the world presented and discussed most recent and ongoing research, among them a number of WG 2 members. Cross fertilization between programme

members and congress members was very productive, especially so during the ESF WG 2 sub group meeting. This latter meeting had also a strong dissemination component as a group of Eastern European occupational health researchers were made familiar with current research developments. Thus the conference provided a platform for a broad and very fruitful exchange between experts on occupational health.

International Society of Behavioral Medicine (ISBM)

ISBM is a worldwide association of national societies of behavioural medicine devoted to research, training and intervention in the field of behavioural medicine. The topic of social inequalities in health has received continued special attention in the biannual congresses since 1990. Most members of the Core Group were involved in one or several of these congresses. Two of the ESF Programme's members, A. Steptoe and J. Siegrist, served as President of ISBM – a further indication of the close and fruitful collaborative links.

The 7th Congress held at Helsinki University in August 2002 was again a very successful event attracting up to 700 participants from all over the world. Some 20 active members of the ESF Programme contributed papers and posters to the congress, especially so to the following five tracks: 1. Socioeconomic factors and health; 2. Health, policy and economic structures; 3. Work-related health; 4. Gender and health; 5. Child and adolescence development.

American Psychological Association/National Institute of Occupational Safety and Health (APA/NIOSH)

In the context of the international conference at least ten contributions were given WG 2 members, including L. Alfredsson, J. de Jonge, I. Houtman, R. Peter, H. Pikhart and T. Theorell. As special symposium was organised presenting new findings on the two work stress models.

3.2.4 Follow up activities

The Four-Centres-Initiative

The methodological developments and the substantive findings resulting from collaboration among WG 2 scientists will lay ground to subsequent activities that are summarized under the heading 'The Four-Centres-Initiative' as follows.

The four centres listed below agreed to continue their scientific collaboration in a formal way because it forms an important part of their main research programme:

- International Centre for Health and Society, London (M. Marmot)
- National Institute of Psychosocial Factors and Health, Stockholm (T. Theorell)
- Department of Medical Sociology, University of Duesseldorf (J. Siegrist)
- Unité de Recherche 088 INSERM, Paris (M. Goldberg)

Each centre carries out a long term research programme in which the network's topic is of central importance. In London, the main studies are the Whitehall II study, the HAPPIE study, and the ELSA/AMANDA studies. The main investigations in Stockholm are the WOLF, the PART and the WES studies, in Duesseldorf the RECALL and the AMANDA studies, and in Paris the GAZEL study.

As documented above in table 3.2.2, this collaboration is largely based on shared scientific concepts and measures, joint data analyses and publications, exchange of scientists and scientific meetings.

The Four-Centres-Initiative takes the following responsibilities:

- *To organize an annual scientific meeting on salient research topics:* These meetings are open to the members of WG 2 and to newly recruited European researchers working in this area. They represent an effort to continue and intensify the collaboration that was successfully initiated by the ESF Programme. For the year 2004, the Duesseldorf centre has submitted a respective grant proposal to the German Research Foundation which is currently under review. For the years 2005 – 2007, respective initiatives will be developed by the remaining centres.
- *To continue and update the systematic exchange of scientific information, especially so be means of a joint homepage (based on the current ESF homepage):* For the years 2004 and 2005 the scientific coordinator of the ESF Programme, S. Weyers, located at the Duesseldorf centre, offers a limited amount of time to provide homepage services.
- *To provide opportunities for exchange of scientists (especially young scholars) between the centres:* As far as centre-specific resources are available, scientists from the centres (or research teams associated with them) are hosted for a limited time with the intention of intensifying collaboration and promoting capacity building by training and education.

The European research project AMANDA

The Advanced Multidisciplinary Analysis of New Data on Ageing (AMANDA, formerly SHARE, see below) is an EU funded multi centre research project (QLRT2002002426) under the directorship of A. Boersch-Supan, an economist at the University of Mannheim, Germany. It consists of newly collected internationally comparable multidisciplinary micro data on the elderly, including the prototype wave of the Survey on Health, Ageing, and Retirement in Europe (SHARE), first wave of the English Longitudinal Study on Ageing (ELSA) and several national data sets that combine information on health and socioeconomic status.

The collaboration is organised in twelve working groups where several members of WG 2 are involved, in particular the working group on well being and social productivity (J. Siegrist, M. Marmot, D. Blane, M. Hyde, O. v. d. Knesebeck). Cross country analyses are conducted in the United Kingdom, France, Italy, Greece, the Netherlands, Germany, Belgium, Switzerland, Finland and Denmark.

Within the module on well being and social productivity a special focus is put on the social stratification of health as a powerful determinant of population health in the countries under study. Three broad hypotheses are derived from this evidence:

1. Low SES is associated with an increased burden of disease in midlife and in early old age;
2. low SES is associated with a higher amount of early retirement or loss of productive engagement;
3. low SES is associated with a higher prevalence of circumstances resulting in reduced quality of life following retirement, compared to higher SES.

Differential exposure to health hazards, material deprivation and a stressful psychosocial work environment provide explanatory frameworks for these associations. In this respect, the AMANDA project can integrate and further develop essential achievements of WG 2, in particular the conceptual and methodological advances with regard to the demand-control and the effort-reward imbalance models of work stress.

Currently, pretests are carried out in the countries mentioned above in order to develop and test the standardised instrument of the main study, to conduct the interviews and to analyse the data.

In conclusion, significant follow up activities of this WG were initiated which enable the continuation of collaborative research, in particular through the Four-Centres-Initiative and the AMANDA research project. The WG members acknowledge the fruitful support provided by this European Science Foundation Programme.

Johannes Siegrist and Michael Marmot on behalf of Working Group II

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Please remember that this report contains a number of new, currently unpublished findings. Therefore, we kindly ask you not to quote unpublished materials.

3.2.5 References

(Papers with * refer to the ESF Programme in their Acknowledgement)

- Akerstedt T, Knutsson A**, Westerholm P, **Theorell T, Alfredsson L** & Kecklund G (2002). Work organisation and unintentional sleep: results from the WOLF study. *Occupational Environmental Medicine* 59, 595 – 600*
- Alfredsson L, Hammar N**, Fransson E, Faire U de, Hallqvist J, **Knutsson A**, Nilsson T, **Theorell T** & Westerholm P (2002). Job strain and major risk factors for coronary heart disease among employed males and females in a Swedish study on work, lipids and fibrinogen. *Scandinavian Journal of Work Environment and Health* 28, 4, 238 – 248*
- Bandura A (1986). *Social Foundations of Thought and Action*. Englewood Cliffs: Prentice-Hall
- Berkman L** & Glass T (2000). Social integration, social networks, social support, and health. In: LF Berkman & I Kawachi (Eds.), *Social Epidemiology* (pp. 137-173). New York: Oxford University Press.
- Bobak M**, Hertzman C, Skodova Z & **Marmot M** (1998). Association between psychosocial factors at work and non fatal MI in a population based case-control study in Czech men. *Epidemiology* 9, 43 - 47
- Bobak M, Pikhart H**, Malyutina S, Pajak A, Kubinova R & **Marmot M** (2002). Effort-reward imbalance at work and markers of heavy drinking in Eastern Europe (unpublished congress presentation)
- Bosma H, **Peter R, Siegrist J & Marmot M** (1998). Two alternative job stress models and the risk of coronary heart disease. *American Journal of Public Health* 88,1, 68 - 74
- Brisson C (2000). Women, work, and cardiovascular disease. In: Schnall PL, Belkic K, Landsbergis P & Baker D (Eds). *The Workplace and Cardiovascular Disease*. Occupational Medicine: State of the Art Reviews, 15. Chapter 2, 7-68
- Brisson C, Laflamme N, Moisan J, Milot A, Mâsse B, Vézina M (1999). Effect of family responsibilities and job strain on ambulatory blood pressure among white-collar women. *Psychosomatic Medicine* 61 (2), 205-13
- Brisson C, LeBlanc R, Bourbonnais R, Dagenais G, Maunsell E, Vézina M et al. (2003). Psychological distress in workers who are back to work after a myocardial infarction (MI) compared to workers who never suffered a MI (submitted)
- Brisson C, Vézina M, **Alfredsson L, Theorell T**, Maunsell E, Moisan J & Bourbeau J (2003) Identifying targets for preventive intervention in the psychosocial work environment (submitted)
- Brunner E J**, McCarthy N, Kuper H, Shipley M J & **Marmot MG** (2003). Short and long term association of psychosocial work characteristics with obesity and metabolic syndrome variables: the Whitehall II study (submitted)
- Brunner EJ** et al (1997). Social inequality in coronary risk: central obesity and the metabolic syndrome. Evidence from the Whitehall II study. *Diabetologia* 40, 1341-1349
- Brunner EJ**, Hemingway H, Walker BR, Page M, Clarke P, Juneja M, Shipley MJ, Kumari M, Andrew R, Seckl JR, Papadopoulos A, Checkley S, Rumley A, Lowe GDO, Stansfeld SA & **Marmot MG** (2002). Adrenocortical, Autonomic, and Inflammatory Causes of the Metabolic Syndrome: Nested Case-Control Study. *Circulation* 106, 2659 - 2665*
- Bussey K & Bandura A (1999). Social cognitive theory of gender development and differentiation, *Psychological Review*, 106, 676-713
- Cardano M, **Costa G** & Demaria M (2004). Social mobility and health in The Turin Longitudinal Study. *Social Science & Medicine*, 58, 8, 1536-1574 *
- Chandola T, Kuper H, Singh-Manoux A, **Bartley M & Marmot M** (2004). The effect of control at home on CHD events in the Whitehall II study: gender differences in psychosocial domestic pathways to social inequalities in CHD. *Social Science & Medicine*, 58, 8, 1501-1509 *
- Dragano N, von dem Knesebeck O, Rödel A & **Siegrist J** (2003). Psychosoziale Arbeitsbelastungen und muskulo-skeletale Beschwerden: Bedeutung für die Prävention (Psychosocial work stress and musculo-skeletal disorders: significance for prevention). *Zeitschrift für Gesundheitswissenschaften* 11, 3, 196-207

- Eriksen HR**, Hysing M, Sivertsen B & **Kristenson M** (in preparation). Socio-economic status and health - the mediating effect of psychosocial and lifestyle variables: a literature review *
- Fink G (ed) (2000). Encyclopedia of Stress. New York: Academic Press
- Fuhrer R**, Shipley MJ, Chastang JF, Schmaus A, **Niedhammer I**, Stansfeld SA, **Goldberg M & Marmot MG** (2002). Socioeconomic position, health and possible explanations: a tale of two cohorts. *American Journal of Public Health*. 92,1290 - 1294
- Gaudemaris de R, **Lang T**, Chatellier G, Hamici L, Lauwers-Cancès V, Maître A & Diène E, for the IHPAF Working physicians group (2002). Socioeconomic Inequalities in Hypertension Prevalence and Care: The IHPAF Study. *Hypertension* 39, 1119 – 1125*
- Godin I & **Kittel F** (2004). Differential economic stability and psychosocial stress at work: associations with psychosomatic complaints and absenteeism. *Social Science & Medicine*, 58, 8, 1543-1553 *
- Goldberg M**, Melchior M, Leclerc A & Lert F (2003). Épidémiologie et déterminants sociaux des inégalités sociales de santé. *Revue d'Epidémiologie et de Santé Publique* 51: 381-401*
- Griffin JM, **Fuhrer R**, Stansfeld SA & **Marmot M** (2002). The importance of low control at work and home on depression and anxiety: *Do these effects vary by gender and social class?* *Social Science & Medicine* 54, pp. 783-798, 2002.
- Hallqvist J, Diderichsen F, **Theorell T** & the SHEEP Study Group (1998): Is the effect of job strain on myocardial infarction due to interaction between high psychological demands and low decision latitude? Results from Stockholm Heart Epidemiology Programme (SHEEP). *Social Science and Medicine* 46, 1405 - 1415
- Hallqvist J, Lynch J, **Bartley M, Lang T & Blane D** (2004). Can we disentangle life course processes of accumulation, critical period and social mobility? An analysis of disadvantaged socio-economic positions and myocardial infarction in the Stockholm Heart Epidemiology Programme (SHEEP). *Social Science & Medicine*, 58, 8, 1555-1562*
- Hanson EKS, Schaufeli W, Vrijkotte T, Plomp NH & Godaert GLR (2000). The validity and reliability of the Dutch effort-reward imbalance questionnaire. *Journal of Occupational Health Psychology* 5, 142 - 155
- Hasselhorn HM, Theorell T**, Vingård E & the MUSIC-Norrtälje Study Group (2001). Endocrine and Immunologic parameters indicative of 6-months prognosis after the onset of low back pain or neck/shoulder pain. *Spine*, 26(3), D1-D6
- Head J, Martikainen P, Kumari M, Kuper H & **Marmot M** (2002). Work environment, alcohol consumption and ill health. The Whitehall II study. HSE Contract Research Report. Suffolk: HSE Books
- Head J, Stansfeld S & **Siegrist J** (2004). Psychosocial work environment and alcohol dependence. *Occupational & Environmental Medicine*, 61, 219-224.
- Henry J & Stephens P (1977): Stress, Health and the Social Environment: A Sociobiologic Approach to Medicine. New York: Springer
- Houtman ILD**, Kornitzer M et al. (1999). The Job Stress, Absenteeism and Coronary Heart Disease European Cooperative Study (the JACE-study) - Design of a Multicenter Prospective Study. *European Journal of Public Health*, 9, 52-57
- Hunt K & Annandale E (1999) (Eds). Gender & Health. Special Issue. *Social Science and Medicine*, 48, 1
- Jeding K, Ferrie J, Hagberg J, Oxenstierna G, **Siegrist J**, Westerlund H & **Theorell T** (2003): Differences in the effort-reward balance in downsizing, stable and expanding organisations (submitted)
- Johnson JV & Hall EM (1988). Job strain, workplace social support, and cardiovascular disease: a cross-sectional study of a random sample of the Swedish working population. *American Journal of Public Health* 78, 1336 - 1342
- Joksimovic L, **Starke D**, von dem Knesebeck O & **Siegrist J** (2002). Perceived work stress, overcommitment, and self reported musculoskeletal pain: a cross-sectional investigation. *International Journal of Behavioral Medicine* 9, 122-138
- Jonge J de**, Bosma H, **Peter R & Siegrist J** (2000). Twee werkstress-modellen en psychische gezondheid: het Job Demand-Control Model en het Effort-Reward Imbalance Model (Two job

- stress models and mental health: the Job Demand-Control Model and the Effort-Reward Imbalance Model). *Gedrag en Gezondheid* 28, 106 - 122*
- Jonge J de**, Peeters MCW, Hamers JPH, Vegchel N van & Linden S van der (2003). Gender differences in the relationship between work-home interference, job characteristics and employee well-being in health care work. In: J Hellgren, K Näswall, M Sverke & M Söderfeldt (Eds.). *New Organizational Challenges for Human Service Work*. Mering: Rainer Hampp Verlag*
- Jonge J de**, Reuvers MMEN, **Houtman ILD**, Bongers PM & Kompier MAJ (2000). Linear and nonlinear relations between psychosocial job characteristics, subjective outcomes, and sickness absence: baseline results from SMASH. *Journal of Occupational Health Psychology*, 5 (2), 256-268
- Jonge J de**, van der Linden S, Schaufeli W, **Peter R & Siegrist J** (2003). Validity and reliability of the Dutch ERI scales: Preliminary findings (unpublished congress presentation)
- Karasek R, Brisson C, Kawakami N, **Houtman I**, Bongers P & Amick B (1998). The Job Content Questionnaire (JCQ): An instrument for Internationally Comparative Assessment of Psychosocial Job Characteristics. *Journal of Occupational Health Psychology*, 3, 4, 322-355
- Karasek R & **Theorell T** (1990): *Healthy Work: Stress, Productivity, and the Reconstruction of Working Life*. New York: Basis Books
- Kivimäki M, LeinoArjas P, Luukkonen R, Riihimäki H, Vahtera J & Kirjonen J (2002). Work stress and risk of cardiovascular mortality: prospective cohort study of industrial employees. *British Medical Journal* 325, 857 - 860
- Knesebeck Ovd & **Siegrist J** (2003). Reported non reciprocity of social exchange and depressive symptoms. Extending the model of effort-reward imbalance beyond work. *Journal of Psychosomatic Research* 55, 209-214 *
- Knesebeck Ovd, Lüschen G, Cockerham WC & **Siegrist J** (2003). Socioeconomic status and health among the aged in the United States and Germany: a comparative cross-sectional study. *Social Science and Medicine* 57, 1643-1652*
- Kristenson M**, **Eriksen HR**, Sluiter JK, **Starke D & Ursin H** (2004). Psychobiological mechanisms of socioeconomic differences in health. *Social Science & Medicine*, 58, 8, 1511-1522*
- Kristenson M**, Sjögren E & the Lin Quest Group (2002). Saliva cortisol and psychosocial factors in a population sample of Swedish middle aged men and women (unpublished congress presentation)
- Kudielka BM, Broderick JE & **Kirschbaum C** (2003): Compliance with saliva sampling protocols: electronic monitoring reveals invalid cortisol daytime profiles in noncompliant subjects. *Psychosomatic Medicine* 65, 313 - 319*
- Kumari M, Head J & **Marmot M** (2004). Prospective study of social and other risk factors for incidence of type 2 diabetes in the Whitehall II study. *Annals of Internal Medicine* (in press)
- Kunz-Ebrecht SR, **Kirschbaum C & Steptoe A** (2004). Work stress, socioeconomic status, and neuroendocrine activation over the working day. *Social Science & Medicine*, 58, 8, 1523-1530 *
- Kunz-Ebrecht SR, **Steptoe A**, Feldman PJ, Kirschbaum C & Marmot M (2003). Changes in cortisol awakening response on work days compared to weekends in women and men from the Whitehall II cohort (submitted)
- Kuper H & **Marmot M** (2003). Job strain, job demands, decision latitude, and risk of coronary heart disease within the Whitehall II study. *Journal of Epidemiology and Community Health* 57, 147 - 153
- Kuper H, Singh-Manoux A, **Siegrist J & Marmot M** (2002). When reciprocity fails: effort-reward imbalance in relation to coronary heart disease and health functioning within the Whitehall II study. *Occupational Environmental Medicine* 59, 777 - 784
- Larisch M, Joksimovic L, Knesebeck Ovd, **Starke D & Siegrist J** (2003). Berufliche Gratifikationskrisen und depressive Symptome: eine Querschnittstudie bei Erwerbstätigen im mittleren Erwachsenenalter (Effort-reward imbalance and depressive symptoms). *Psychotherapie, Psychosomatik und Medizinische Psychologie*, 53, 223 - 228
- Lazarus RS & Folkman S (1984). *Stress, Appraisal, and Coping*. New York: Springer

- Lewthwaite J, Owen N, Coates A, Henderson B & **Stephoe A** (2002). Circulating human heat shock protein 60 in the plasma of British civil servants: relationship to physiological and psychosocial stress. *Circulation* 106, 196 - 201
- Lindenberg S & Frey B (1993). Alternatives, frames, and relative prices: a broader view of rational choice". *Acta Sociologica* 36, 191 - 205
- MacLeod J, Smith GD, Heslop P et al. (2001). Are the effects of psychosocial exposures attributable to confounding? Evidence from a prospective observational study on psychological stress and mortality. *Journal of Epidemiology and Community Health* 55, 878 - 84
- Marmot M & Bobak M** (2000). International comparators and poverty and health in Europe. *British Medical Journal* 321, 1124 - 8
- Marmot M** & Wilkinson R. (1999). Social Determinants of Health. Oxford: University Press
- Marmot MG**, Bosma H, Hemingway H et al. (1997). Contribution of job control and other risk factors to social variations in coronary heart disease incidence. *Lancet* 350, 235 - 239
- McCarthy N, **Brunner E J**, Kuper H, Shipley MJ & **Marmot M G** (2003). Short and long term association of psychosocial work characteristics with haemostatic factors. Findings from Whitehall II and literature review (submitted)
- Mead GH (1983): Mind, Self, and Society. Chicago: University Press
- Melchior M, **Berkman L**, **Niedhammer I**, Chea M & **Goldberg M** (2003a). Social relations and self-reported health: a prospective analysis of the French GAZEL cohort. *Social Science & Medicine* 56, 1817 - 1830
- Melchior M, **Niedhammer I**, **Berkman LF** & **Goldberg M** (2003b). Do psychosocial work factors and social relations exert independent effects on sickness absence? A six year prospective study of the GAZEL cohort. *Journal of Epidemiology and Community Health* 57, 285 - 293
- Mirowski J & Ross CE (1989). Social Causes of Psychological Stress. Hawthorn, NY: Aldine de Gruyter
- Niedhammer I** & Chea M (2004). Psychosocial factors at work and self-reported health: comparative results of cross-sectional and prospective analyses of the French GAZEL cohort. *Occupational and Environmental Medicine* (in press)
- Niedhammer I** (2002). Psychometric properties of the French version of the Karasek Job Content Questionnaire: a study of the scales of decision latitude, psychological demands, social support, and physical demands in the GAZEL cohort. *International Archives of Occupational and Environmental Health*, 75, 129 - 144
- Niedhammer I**, **Goldberg M**, Leclerc A, Bugel I & David S (1998). Psychosocial factors at work and subsequent depressive symptoms in the GAZEL cohort. *Scandinavian Journal of Work, Environment and Health* 24, 3, 197 - 205
- Niedhammer I**, **Siegrist J**, Landre M, **Goldberg M** & Leclerc A (2000): Etude des qualités psychométriques de la version française du modèle du D'équilibre Efforts/ Récompenses. *Revue d'Epidémiologie et de Santé publique* 48, 419 - 437
- Niedhammer I**, Teck ML, **Starke D** & **Siegrist J** (2004). Effort-Reward Imbalance Model and self reported health: Cross-sectional and prospective results from the GAZEL Cohort. *Social Science & Medicine*, 58, 8, 1531-1541 *
- Ostry AS, Kelly S, Demers PA, Mustard C & Hertzman C (2003). A comparison between the effort-reward imbalance and the demand control models. *BMC Public* 3, 10 - 21
- Owen N, Poulton T, Hay FC, Mohamed-Ali V & **Stephoe A** (2003). Socioeconomic status, C-reactive protein, immune factors, and responses to acute mental stress (submitted)
- Oxenstierna G, Jeding K, Westerlund H, Ferrie J, Hyde M, Hagberg J & **Theorell T** (2003). Structural work change and health - studies of long spells of sick leave and hospitalisation among working men and women during a period of marked changes in the Swedish labour market. In: C. Cooper & AS Antoniou (Eds): New perspectives in the area of Occupational Health (in press)
- Paterniti S, **Niedhammer I**, **Lang T** & Consoli SM (2002). Psychosocial factors at work, personality traits and depressive symptoms. Longitudinal results from the GAZEL Study. *British Journal of Psychiatry* 181, 111 - 117*

- Pelfrene E, Vlerick P, Mak RP, De Smets P, Kornitzer M & De Backer G (2001). Scale reliability and validity of the Karasek 'Job Demand-Control-Support' model in the Belstress study. *Work and Stress* 15, 297-313.
- Peter R** (2003). Psychosoziale berufliche Belastungskonstellationen – ein Ansatz zur Erklärung gesundheitsbezogener sozialer Ungleichheit? (Work stress – an approach to explain social inequality in health?) In: Behrens J., Berger P., Stosberg M. (Eds.): *Ungleiche Gesundheit und die Soziologie sozialer Ungleichheit*. Leske & Budrich (in press)
- Peter R, Alfredsson L, Hammar N, Siegrist J, Theorell T & Westerholm P** (1998). High effort, low reward and cardiovascular risk factors in employed Swedish men and women: baseline results from the WOLF-Study. *Journal of Epidemiology and Community Health* 52, 540-547
- Peter R, Hammarström A, Hallqvist J, Siegrist J, Theorell T & the SHEEP Study Group** (2003). Gender-specific coping behavior is associated with acute myocardial infarction – findings from the Sheep study (submitted)
- Peter R, Siegrist J, Hallqvist J, Reuterwall C, Theorell T & the SHEEP Study Group** (2002): Psychosocial work environment and myocardial infarction: improving risk estimation by combining two alternative job stress models in the SHEEP Study. *J Epidemiology and Community Health* 56, 294-300
- Pikhart H** (2002). *Social and psychosocial determinants of self-rated health in Central and Eastern Europe*. Boston: Kluwer Academia Press
- Pikhart H, Bobak M, Pajak A, Malyutina S, Kubinova R, Topor R, Sebakova H, Nikitin Y & Marmot M** (2004). Psychosocial factors at work and depression in three countries of Central and Eastern Europe. *Social Science & Medicine*, 58, 8, 1475-1482 *
- Pikhart H, Bobak M, Siegrist J, Pajak A, Rywik S, Kyshegyi J, Gostautas A, Skodova Z & Marmot M** (2001). Psychosocial work characteristics and self-rated health in four post-communist countries. *Journal of Epidemiology and Community Health* 55, 624 - 630
- Ribet C, **Lang T, Zins M, Bingham A, Ferrières J, Arveiler D, Amouyel P, Bonenfant S, Chastang JF, Goldberg M & Ducimetière P** (2001). Do cardiovascular risk factors in men depend on their spouses' occupational category? *European Journal of Epidemiology* 17, 347 - 56*
- Rödel A, **Siegrist J, Hessel A, Brähler E** (2003). Psychometrische Testung des Fragebogens zur Messung beruflicher Gratifikationskrisen an einer repräsentativen deutschen Stichprobe (Psychometric test of the scales measuring effort-reward imbalance) (submitted)
- Siegrist J** (1996): *Soziale Krisen und Gesundheit*. Reihe Gesundheitspsychologie, Band 5. Göttingen: Hogrefe
- Siegrist J** (2000): Place, social exchange and health: proposed sociological framework. *Social Science & Medicine* 51, 1283 – 1294*
- Siegrist J & Marmot M** (2004). Health inequalities and the psychosocial environment - two scientific challenges. *Social Science & Medicine*, 58, 8, 1463-1473 *
- Siegrist J, Falck B & Joksimovic L** (2003). The effect of effort-reward imbalance at work on health. In: C.L. Cooper & A. S. Antoniou (Eds.) *New Perspectives in the Area of Occupational Stress* (in press)
- Siegrist J, Knesebeck Ovd & Pollack CE** (2004). Social productivity and well-being of older people: a sociological exploration. *Social Theory and Health*, 2, 1-17
- Siegrist J, Starke D, Chandola T, Godin I, Marmot M, Niedhammer I & Peter R** (2004). The measurement of Effort-Reward Imbalance at work: European comparisons. *Social Science & Medicine*, 58, 8, 1483-1499 *
- Siegrist J, Starke D, Knesebeck v d O, Joksimovic L & Dragano N** (2001). *Soziale Reziprozität und Gesundheit (Social reciprocity and health)*. Unpublished manuscript, University of Duesseldorf
- Stansfeld S & Fuhrer R** (2002). Social relations and coronary heart disease. In: S. Stansfeld & M. Marmot: *Stress and the Heart. Psychosocial pathways to coronary heart disease*. London: BMJ Books
- Stansfeld S, Head J, Cattell V, Wardle J & Fuhrer R** (2003). Work, partner's employment status and depressive symptoms in women. *Trends in Evidence Based Neuropsychiatry* (in press)

- Steptoe A & Marmot M** (2002). The role of psychobiological pathways in socio-economic inequalities in cardiovascular disease risk. *European Heart Journal* 23, 13-25
- Steptoe A**, Feldman PM, Kunz S, Owen N, Willemssen G & **Marmot M** (2002). Stress responsivity and socio-economic status: a mechanism for increased cardiovascular disease risk? *European Heart Journal* 23, 1757 – 1763
- Steptoe A**, Kunz-Ebrecht S, Owen N, Feldman PJ, Willemssen G, **Kirschbaum C & Marmot M** (2003). Socioeconomic status and stress-related biological responses over the working day. *Psychosomatic Medicine* 65 (3): 461 - 470
- Steptoe A**, Kunz-Ebrecht S, Rumley A & Lowe GD (2003). Prolonged elevations in haemostatic and rheological responses following psychological stress in low socioeconomic status men and women. *Thrombosis and Haemostasis* 89, 83-90
- Steptoe A**, Owen N, Kunz-Ebrecht S & Mohamed-Ali V (2002). Inflammatory cytokines, socioeconomic status, and acute stress responsivity. *Brain, Behavior, and Immunity* 16, 774-784
- Steptoe A**, Willemssen G, Kunz-Ebrecht SR & Owen N (2003). Socioeconomic status and hemodynamic recovery from mental stress. *Psychophysiology* (in press)
- Steptoe A, Siegrist J, Kirschbaum C & Marmot M** (2004). Effort-reward imbalance, overcommitment, and measures of cortisol and blood pressure over the working day. *Psychosomatic Medicine* (in press)*
- Theorell T** (2001). Everyday biological stress mechanisms. *Advanced Psychosomatic Medicine* 22, 1 – 6
- Theorell T, Alfredsson L**, Westerholm P & Falck B (2000). Coping with unfair treatment at work – what is the relationship between coping and hypertension in middle-aged men and women? *Psychotherapy and Psychosomatics*, 69, 86-94
- Theorell T**, G Oxenstierna, Westerlund H, Ferrie J & **Alfredsson L** (2003). Downsizing of staff is associated with lowered medically certified sick leave in female employees with high cardiovascular risk. *Occupational and Environmental Medicine* 60, e9
- Theorell T, Hasselhorn HM & the MUSIC Norrtälje Study Group** (2002). Endocrinological and immunological variables sensitive to psychosocial factors of possible relevance to work-related musculoskeletal disorders. *Work & Stress* 16 (2), 154-165
- Theorell T, Hasselhorn HM**, Vingard E, Andersson B & the MUSIC-Norrtälje Study Group (2000). Interleukin 6 and cortisol in acute musculoskeletal disorders: results from a case-referent study in Sweden. *Stress Medicine* 16(1), 27-35
- Tornqvist EW, Kilbom A, Vingard E, **Alfredsson L**, Hagberg M, **Theorell T**, Waldenström M, Wiktorin C, Hogstedt C & the MUSIC-Norrtälje Study Group (2001). The Influence on Seeking Care Because of Neck and Shoulder Disorders from Work-Related Exposures. *Epidemiology*, 12, 537 – 545
- Tsutsumi A, **Theorell T, Hallqvist J & Reuterwall C** (1999). Association between job characteristics and plasma fibrinogen in a normal working population: a cross sectional analysis in referents of the SHEEP Study. *Journal of Epidemiology and Community Health* 6, 348-354
- Ursin H** (1998). The psychology in psychoneuroendocrinology. Invited Review. *Psychoneuroendocrinology*, 23, 555-570
- Vegchel N van, **de Jonge J**, Bakker AB & Schaufeli WB (2002). Testing global and specific indicators of rewards in the Effort-Reward Imbalance Model: Does it make any difference? *European Journal of Work and Organizational Psychology* 11, 403 – 421
- Vingard E, **Alfredsson L**, Hagberg M, Kilbom A, **Theorell T**, Waldenström M, Hjelm E W, Wiktorin C, Hogstedt C & the MUSIC -Norrtälje Study Group (2000). To what extent do current and past physical and psychosocial occupational factors explain care-seeking for low back pain in a working population? Results from the Musculoskeletal Intervention Center-Norrtälje Study. *Spine*, 25, 493-500
- Waldenstrom M, **Theorell T**, Ahlberg G, Josephson M, Nise P, Waldenstrom K & Vingard E (2002). Assessment of psychological and social current working conditions in epidemiological studies: experiences from the MUSIC-Norrtälje study. *Scandinavian Journal of Public Health*. 30, 94-102
- Wamala S & Lynch J** (2002) (Eds.): Gender and Social Inequities in Health. Lund: Studentlitteratur *

Weiner H (1992). *Pertubing the organism*. Chicago: The University of Chicago Press

Westerlund H, **Alfredsson L**, Westerholm P & **Theorell T** (2003). Organisation stability (WOLF), the demand-control model and risk factors for cardiovascular disease. *European Journal of Public Health* (in press)

Westerlund H, Ferrie J, Hagberg J, Jeding K, Oxenstierna G & **Theorell T** (2003). Workplace expansion - an overlooked risk factor for long-term sickness absence and hospital admission (submitted)

3.3 Report of Working Group III

3.3.1 Aims and state of the art

Most research on (the explanation of) inequalities in health has been focussed on individual and micro–social aspects. However, a focus on these ‘proximal’ (mediating) factors may conceal important influences from more distal determinants of morbidity and mortality. It has been increasingly recognised that it is important to bring back the context in public health research, including research on socio-economic inequalities in health (Diez-Roux, 1998).

The main aims of this working group were to study the effect of the macro-social environment on health, and more specifically to study the contribution of the macro-social environment to the explanation of socioeconomic inequalities in health. The area to be covered by Working Group 3 was broad, and it was therefore important to develop a more specific focus before we could collaborate in a fruitful way. A specific focus was initially found by identifying a limited number of attributes of the macrosocial environment for which there were important indications of their relevance for the explanation of socio-economic inequalities in health:

- Income inequality. The (ecological) relationship between income inequality and life expectancy and other aggregate health measures was one of the key areas of research in social epidemiology, and had many obvious connections with the area of socio-economic inequalities in health.
- Social cohesion. Introduced first as a possible explanation for the link between income inequality and health, and between aggregate deprivation and health, research into the effects of social cohesion on health promised to become important for the explanation of socioeconomic inequalities in health.
- Aggregate deprivation. Studies have shown that, even after adjustment for individual level socio-economic status, socio-economic characteristics of the environment people live in (e.g. neighbourhood) have an independent effect on health. The health effects of living in a deprived area may therefore form part of the explanation of socio-economic inequalities in health.

In each of these three areas, important conceptual, methodological and empirical issues remained to be addressed. As described in the Programme Proposal, further enhancement of concepts and methods, and cross country comparative studies were important for the advance of research in this area. The *ESF initiative* aimed to make a significant contribution to this, by pooling the available expertise and by taking advantage of the variations in macro-social environments as they exist in Europe. Many of the studies which have been done so far have used data from the United States, and it was therefore expected that analyses of

European data (and a comparison of these data with those from the US) would add importantly to the evidence-base in this area.

At the first meeting of the working group in Stockholm, the group decided to structure further work according to the (geographical) level at which research into the effect of macro-social factors could be conducted. Two levels were distinguished which seemed particularly promising, because of the large amount of ongoing work and the potential to make a significant contribution to the understanding of macro-social factors: the national level (for the United States and Canada this would be the state level) and the local ('neighbourhood') level. Based on an inventory of available data-sets, it was concluded that (1) the best contribution at the national level could be made by further exploring the relationship between income inequality and health. Based on availability of data in several countries, it was also concluded that (2) the best contribution at the neighbourhood level could be made by further exploring the association between neighbourhood deprivation and health.

For both levels, working group meetings were used as a discussion forum for on-going research of members, and as brainstorming sessions for developing proposals for new comparative research. The results will be discussed below. First, we will describe the results of three comparative studies that were designed and carried out under the auspices of the working group. These comparative studies concerned

1. income inequality and health,
2. aggregate deprivation and health, and
3. welfare state regimes and health inequalities.

The latter area, although not identified at the first meeting in Stockholm, gradually developed as an important topic for comparative research during subsequent meetings of the working group. Second, we will briefly describe the topics covered by the working group meetings-as-discussion-forum-for-on-going-work.

3.3.2 Main results

Ad 1: Income inequality and health

Aim 1: To discuss challenges for future research on the association between income inequality and health

Short history of the debate

In 1992, a now famous paper was published showing that among 9 Western industrialised countries, those nations which had less income inequality appeared to have higher life ex-

pectancy (Wilkinson, 1992). A few years later, this was replicated in analyses looking at income inequality and mortality in states within the US – analyses which seemed more secure because of the larger datasets and the better quality of the data (Kaplan, Pamuk, Lynch, Cohen, & Balfour, 1996; Kennedy, Kawachi, & Prothrow-Stith, 1996). These findings were seen to have important implications: they suggested that income inequality is bad for the health of the population as a whole, not only for the health of those with the lowest incomes. The area of research however, became controversial; two major themes for discussion focussed on the veracity of the findings and, to the extent that they could be seen to be real, on the interpretation of the associations.

With these two themes being major issues in discussions in the international scientific literature, meetings of the working group could very effectively be used to further the debate, because many of the protagonists in the debate were active members of the working group. The following section reflects the conclusions reached. These were also used as input for an editorial in the BMJ (Mackenbach, 2002).

Is there a relationship between income inequality and population health?

Discussions on the veracity of the findings focussed on the quality of the data. Serious criticisms of the selection of countries, the quality of the data and the lack of control for confounding in the 1992 paper (Judge, 1995) were partly countered (Wilkinson, 1995), but some doubts remained. Many aspects of this debate are still unresolved, but it has recently become clear that the findings in the 1992 BMJ paper were an artefact of the selection of countries: now that good income inequality data have become available for 16 instead of 9 Western industrialised countries, the association between income inequality and life expectancy has disappeared (Lynch et al., 2001). This reduces the evidence on the income inequality/mortality relation almost entirely to analyses of geographical units within the United States. An interesting comparison between the US and Canada had already shown that the income inequality/mortality relation at the state level only exists in the former (Ross et al., 2000) and on the basis of the available evidence one cannot but conclude that the US are the exception rather than the rule. This does not imply, however, that income inequality is irrelevant to health: on the contrary, the existence of a strong association between income and health at the individual level is undisputed.

Explanations for the relationship

Simultaneous with discussion on the veracity of the findings, a debate started about the explanation of the findings. Generally, three explanations were distinguished (Lynch, Smith, Kaplan, & House, 2000):

a) The relationship between income and health at the individual level

Several studies have suggested a curvilinear relation between individual income and health. Aggregating this curvilinear relationship to the population level would result in an association between income inequality and health. Thus, this interpretation assumed that the health effects at the population level were merely the result of individual effects.

b) A psychosocial explanation

According to this explanation, there is an additional impact of income inequality on health over and above individual income, and this additional impact stems from differences in relative standards ("relative incomes"). Moreover, differences in relative standards are thought to imply an influential role of psychosocial pathways, either through the direct psychosocial effects of low social status or through the poorer quality of social relations found in more hierarchical societies.

c) A neo-material explanation

Concerns have been raised about the above described psychosocial explanation between income inequality and health, the main concern being the disconnection between psychosocial and material factors. According to the neo-material explanation, the association between income inequality reflects negative exposures and lack of resources held by individuals, and a systematic under-investment in a range of human, physical, health and social infrastructure.

Research on income inequality and population health: the way forward

Given the debates about the veracity and interpretations of the findings, the working group decided to concentrate on an aspect for which further empirical evidence could be obtained that could help to resolve some of these controversies (see below).

In addition, the discussions in the working group identified several other issues which remain to be addressed in future research. Firstly, there is a need for better theory. From this theory, it should among others become more clear a) what the most appropriate level is at which income inequality affects health, and b) which groups are particularly vulnerable for the consequences of income inequality on health. Further, concepts should be improved (for exam-

ple, what is the role of taxes and other policies) and how are environments characterised? Even more complex, it should be attempted to capture the life-course in theory as well. Secondly, there is real need for additional data sets which include measures of income inequality, individual income and different health indicators. To obtain a truly international perspective, these data sets should also include information from developing countries.

Aim 1.2: To carry out a comparative study to enhance understanding the relationship between income inequality and health

Rationale

The working group decided that it would be particularly interesting to compare the shape of the association between individual income and health between countries. The first reason, as mentioned before, was that the shape of the association between individual income and health plays an important role in the interpretation of the association between income inequality and health. If there is a curvilinear association between individual income and health, in the sense that the beneficial health effects of a higher income are larger at lower income levels than at higher income levels then this alone would explain a positive association between the extent of income inequalities and average health. The second reason was that the shape of this association could shed some light on the mechanisms underlying the individual-level relationship between income and health. A curvilinear relationship, where health declines throughout the income range but particularly rapidly at lower levels of income, is more consistent with poverty and material circumstances being major determinants of health. A linear association, where health declines at a constant rate with declining income, is more consistent with explanations in terms of an accumulation of material, psychosocial and behavioural factors that contribute to ill-health over the entire range of incomes. Although some studies have been done on the shape of the relationship between individual income and health, the existing evidence is inconsistent and limited to a small number of countries.

Main findings

The working group had access to a large data set, collected with support from the European Union under the Fifth Framework Programme, that contained information on individual income and self-assessed health as measured in nationally representative health, level of living or similar surveys in 7 European countries (Belgium, Denmark, England, Finland, France, the Netherlands, and Norway) in the 1990's. The analysis confirmed that a higher household equivalent income is associated with better self-assessed health in all countries, but the exact shape of the relation appeared to differ between countries. The relationship is generally

curvilinear, and characterised by less improvement in self-assessed health per unit of rising income in the higher income ranges. This curvilinearity can be observed in all countries, but the degree of curvilinearity varies. Interestingly, in the lowest income ranges there appears to be an additional curvilinearity in some but not all countries: in these countries the deterioration in self-assessed health per unit of declining income reverses into an improvement at the lowest incomes. The shape of the association is broadly similar for men and for women.

The findings are broadly consistent with explanations in terms of the direct and indirect health effects of material disadvantage, although differences between countries and the reversal of the association at the lowest income levels raise further questions that need to be explored in future research. The findings have been reported in a collective paper that will be submitted to an international scientific journal (Mackenbach et al., 2003)

Ad 2: Aggregate deprivation and health

Aim 2.1: To discuss conceptual and methodological problems in research on the association between aggregate deprivation and health

Short history of the debate

Already in previous centuries, ecological studies have shown that living in deprived neighbourhoods affects health unfavourably (Krieger, 2001). The ecological nature of these studies did not allow to make inferences at the individual level. In addition, these studies could not investigate whether the association between neighbourhood deprivation and health was exclusively due to (differences in) the socioeconomic composition of the neighbourhoods. Due to methodological advances, in particular the development of multilevel modelling, individual and higher level (i.e. neighbourhood) data can now be included simultaneously in statistical models. In the past years, several (Davey Smith, Hart, Watt, Hole, & Hawthorne, 1998; Diez Roux et al., 2001; Diez-Roux et al., 1999; Hart, Ecob, & Davey-Smith, 1997; Stafford, Bartley, Mitchell, & Marmot, 2001; van Lenthe & Mackenbach, 2002), though not all (Sloggett & Joshi, 1994), multilevel studies have shown that living in deprived neighbourhoods affects health unfavourably (after taking into account the socio-demographic characteristics of neighbourhood residents). This suggest that it indeed matters for your health where you live, regardless of who you are (Macintyre, Maciver, & Sooman, 1993)

The results of the multilevel studies carried out thus far warranted further research. Along with the ability to include individual and environmental variables in studies on inequalities in health however, came a number of conceptual and methodological issues. The working group therefore devoted considerable time to a thorough discussion of the most important issues and their consequences for future research (see below).

Improving theoretical models

There is a need to improve theoretical models linking the neighbourhood socioeconomic environment to health, thereby including things about people *and* about places. According to Macintyre, who presented and discussed her theoretical work in the working group, a new starting point is needed which focuses on what humans need in order to lead a healthy life, given the particular socio-economic and socio-cultural context (Macintyre, Ellaway, & Cummins, 2002). She described a 'hierarchy of human needs', which embraces aspects such as air, water and food on the one side and information, personal relationships and play etc. on the other. From an analysis of basic human needs, measures have to be derived and hypotheses about the likely impact of specific features of the local, social and physical environment have to be developed. Theoretical models should take into account that neighbourhood deprivation and other relevant neighbourhood characteristics have differentiated effects on health outcomes, and that these associations may also differ by subgroups and over time. Thus far, a distinction is often made between 'contextual' and 'compositional' area characteristics. While the separation is useful as a first step for analytical purposes, it is nonetheless found to be artificial; in fact contextual and compositional characteristics are interrelated (Macintyre et al., 2002) Finally, it should be recognised that processes linking areas and people are complex and dynamic.

Improving the methodology

Several methodological issues were identified that remain to be addressed in future research. Firstly, while current studies often define neighbourhoods on criteria developed for administrative purposes, historical and geographical criteria may perhaps better be applied. In addition, there may be a discrepancy between 'objectively' defined neighbourhoods and perceived neighbourhoods by residents. Secondly, the measurement of relevant area attributes needs to be improved. In this context, the working group discussed the development of a manual, including all relevant area attributes for health. It was concluded however, that a universally applicable toolkit/manual on area attributes did not seem to be sensible - neither conceptually nor practically. Thirdly, the role of individual-level characteristics needs to be specified, as this may have consequences for the analysis. Individual factors may be seen as confounding variables, but also as mediators between neighbourhood deprivation and health. If there is a causal relation between neighbourhood deprivation and individual socioeconomic indicators, the association between neighbourhood deprivation and health may be easily "over-adjusted" and therefore underestimated. Further, individual socio-economic indi-

cators may act as effect modifiers. Indeed, a working group member recently reported that living in deprived neighbourhoods had the most negative health effects on poorer individuals (Stafford & Marmot, 2003).

Perhaps the most suitable study designs for addressing important issues regarding (the mechanisms responsible for) the association between neighbourhood deprivation and health include longitudinal designs (prospective studies, including information about the life-course, residential history, neighbourhoods and people over time).

A key issue in current research on the role of neighbourhood deprivation for health is the exploration of the driving forces shaping differences in health across neighbourhoods. In order to gain a better understanding of these driving forces the working group decided to compare the size of the association between neighbourhood deprivation and health between countries. The design and results of this study have been summarised below.

Aim 2.2: To carry out a cross-national comparative study on the association between neighbourhood deprivation and mortality

Rationale

One way to improve understanding of the processes underlying the association between neighbourhood deprivation and health is to compare the association in different countries. Is there a universal mechanism, resulting in approximately similar associations in different countries, or are these associations different by country because underlying processes occur in some but not all countries? Although studies have been performed in different countries, conceptual and methodological differences in these studies have until now limited the possibility to compare their results. The working-group therefore decided to carry out a comparison of the association between neighbourhood deprivation and all-cause mortality, based on a co-operatively developed plan of analysis.

Main results

The working group had access to data from three prospective cohort studies (ARIC (US), Whitehall II (UK) and GLOBE (the Netherlands)) and three population based registry studies (Helsinki (Finland), Turin (Italy) and Madrid (Spain)). Neighbourhood unemployment was used as an indicator of neighbourhood deprivation, because it was the variable that was available systematically across studies.

The results of the analyses show that the hazard of living in the neighbourhoods with the largest unemployment rates is significantly increased in all countries (approximately 10-

30%), the hazard being the highest in the US. In the latter study, the hazard further attenuates after adjustment for individual income of neighbourhood residents. It was concluded that living in neighbourhoods with high unemployment rates is associated with increased all cause mortality rates in the US and the five European countries. Thus, there was no evidence that country modified this association.

Possibilities were identified for differences between countries in the size of the association, including differences in range in levels of deprivation, residential segregation, and physical and social environments between countries. The implications of the results of the study for these potential explanations are discussed. The results of the study are described in a collective paper that will be submitted to an international scientific journal (van Lenthe et al., 2003)

Ad 3: Welfare state regimes and health inequalities

Short history of the debate

As described above, the research field on macro-social determinants of health is broad, which prompted the working group to narrow the focus of its work, particularly to the above-mentioned two topics. During its meetings, however, other macro-social factors of potential importance for health and health inequalities were also discussed. It became clear that the way in which societies are organised potentially has important effects on the health of their populations as well as on the size and pattern of health inequalities within their populations. The working group therefore decided to work collectively on a reflective paper on the associations between welfare regimes and health.

This paper was motivated by an empirical finding that has led to much confusion, namely that in Western Europe health inequalities seem to be about as large in egalitarian countries as in the less egalitarian ones (Kunst, Groenhouf, Mackenbach, & health, 1998; Mackenbach et al., 1997). In order to resolve this puzzle, a link will have to be made between two different strands of research: comparative welfare state research and comparative research on health inequalities.

Over the last decades, social scientists have provided a number of categorisations of welfare states. The most influential one has been the typology developed by Esping-Andersen (Esping-Anderson, 1990). His basic claim was that we cannot understand welfare state variation linearly, but that there are qualitative differences in the way social provision is provided. Welfare states tend to cluster in three different regimes, defined according to two dimensions: extent of de-commodification (i.e. extent to which social policy makes individuals independent of the market) and extent of stratification (i.e. extent to which a welfare state differentiates in the treatment of different groups). Esping-Andersen identified three 'worlds of welfare states',

which he labelled 'conservative-corporatist', 'liberal' and 'social-democratic' regimes. This typology has served as the backdrop for most, if not all of the comparative welfare state studies that have been conducted throughout the 1990's, but the possible link between these regimes and health inequalities has never been investigated, although it has mostly been assumed that the 'social-democratic' or 'nordic' welfare state regime leads to smaller health inequalities than the other two.

The working group therefore decided to contribute to this field by (1) making an in-depth theoretical analysis of the possible mechanisms underlying a link between welfare state regimes and health inequalities, and (2) reviewing cross-national comparative studies of the size of health inequalities in countries characterised by different welfare state regimes.

Why should welfare regimes influence health inequalities?

The working group identified five possible links between welfare state regimes, particularly the 'social-democratic' regime, and health inequalities:

- Universalism (i.e. welfare benefits and services are granted to everyone on the basis of citizenship) promotes social integration, which reduces health inequalities;
- Decommodification (i.e. all those out of work will still be able to maintain the material means to lead a decent life) prevents ill-health, which reduces health inequalities;
- Provision of publicly financed welfare and health services leads to equal access of services, which reduces health inequalities.
- Strong labour movements (which have a salient imprint on 'social-democratic' welfare states) promote good labour conditions, which reduces health inequalities;
- Welfare state institutions provide safety nets and rehabilitation mechanisms throughout the lifecourse and prevent vicious circles of accumulating social and health problems, which reduces health inequalities.

Empirical findings

International comparative research on health inequalities started to accumulate from the late 1970s onwards (Karisto, Notkola, & Valkonen, 1978; Valkonen, 1989). A more systematic approach was facilitated by the availability of EU funding to a series of comparative studies of inequalities in both mortality and morbidity (Cavelaars, Kunst, Geurts, Crialesi et al., 1998; Cavelaars, Kunst, Geurts, Helmert et al., 1998; Kunst, Groenhof, & Mackenbach, 1998; Kunst, Groenhof, Mackenbach et al., 1998; Kunst & Mackenbach, 1994; Mackenbach et al.,

1997). For mortality, these studies showed that relative inequalities by occupational class and educational level were not smaller, and sometimes even larger, in the Nordic countries than in other European countries; for absolute inequalities in mortality the picture varied strongly between the Nordic countries. For morbidity, relative inequalities by educational level tended to be larger in the Nordic countries than in other European countries. Although the results of these international-comparative studies of health inequalities have not always been consistent, it is clear that variation between countries in size and pattern of health inequalities is largely unrelated to the classification of welfare state regimes as laid down by Esping-Andersen.

Possible conclusions

The discrepancy between what one would theoretically expect (i.e. smaller health inequalities in countries with a 'social-democratic' welfare state regime) and what is actually found in cross-country comparisons of health inequalities could be due to (1) problems in data and statistical methods, (2) incorrectness of the theoretical links proposed between welfare state regimes and health inequalities, and (3) unanticipated side-effects of welfare state regimes. The working group has carefully reviewed each of these possibilities, and identified a number of areas for further research that should shed light on these puzzling findings. The results of this study have been described in a collective paper that will be submitted to an international scientific journal (Dahl et al., 2003)

3.3.3 Other topics: on-going work of working group members

In addition to the development of co-operative projects in the working groups, the meetings served the purpose of being a platform for discussion of ongoing work. As such, the meetings appeared to be a unique possibility to exchange information about current work, and more importantly, to benefit from the critical opinions of experts in the working group. To make use of this possibility in an optimal way, mainly project proposals, study designs and preliminary results were discussed in the working group. Further, discussions about presented work often initiated discussions on more general conceptual and methodological issues. The following issues were discussed:

Social cohesion and health

Presentations:

- Social cohesion and health (B. Kennedy, Stockholm 2000)
- Conceptual and methodological issues of social cohesion (F. Diderichsen, Stockholm, 2000)

Currently, social cohesion is measured in different ways, and there is a need to develop a more standardised way to measure this macro-social determinants of health. Standardisation would improve the possibilities to compare the role of social cohesion for health across countries.

Aggregate deprivation and health

Presentations:

- Aggregate deprivation and health (A. Diez Roux, Stockholm 2000)
- Conceptual and methodological issues of aggregate deprivation (C. Duncan, Stockholm 2000)
- The design of the Project on Human Development in Chicago neighbourhoods (I. Kawachi, Duesseldorf 2001)
- Explaining associations between neighbourhood deprivation and health-related behaviour in the GLOBE study: a research proposal (F. van Lenthe, Duesseldorf, 2001)
- The SHEEP study (F. Diderichsen, Duesseldorf, 2001)
- The Falcon study (N. Hammar, Duesseldorf, 2001)
- The Helsinki Mortality Study (P. Martikainen, Duesseldorf, 2001)
- A comparative study of neighbourhood deprivation and health (P. Martikainen & M. Stafford, Rotterdam 2002)
- Avoidable deaths in Portugal (P. Santana, Rotterdam 2002)
- Mortality Study of the Region of Madrid (E. Regidor, Rotterdam 2002)

Many studies were not designed with the specific purpose of investigating the association between aggregate deprivation and health. Possibilities to include data on levels other than the individual level were discussed, and the design of a study explicitly developed for analyses at the aggregate level was discussed.

Further, processes underlying the association between aggregate deprivation and health in neighbourhoods were discussed. It remains unclear what the processes underlying this association are. A research proposal has been discussed, in which physical and neighbourhood characteristics are included. Ways to measure these characteristics appropriately were also discussed. Besides a causal role for such characteristics, the potential importance of selective migration processes was discussed. Finally, it was discussed what the most appropriate geographical levels for research on aggregate deprivation and health is: many studies are carried out at the neighbourhood level, but studies at other levels can also reveal information. For example, a study was carried out in which 28 geographical areas in Portugal were identified, and “avoidable” deaths (premature mortality for causes amenable to medical care) were calculated in each area. It appeared that areas located far away from the most important national structural axes present a clear disadvantage, socioeconomically as well as concerning avoidable deaths. Perhaps, factors like distances to specialised health services for health are related to avoidable deaths in Portugal.

Integrating databases

Presentations:

- An integrated database for explanatory research on macrosocial determinants of morbidity and mortality (Vogel, Duesseldorf, 2001 and Rotterdam 2002)

It has been explored and discussed whether there were possibilities to develop and use databases including macrosocial determinants of health. Altogether, the initiative to prepare a blueprint of databases seemed unfeasible as a working group collaboration.

Income inequalities and health in smaller regions

Presentations:

- Investigating income inequality at the regional level in Norway (Dahl, Duesseldorf 2001)
- Income inequalities, aggregate deprivation and health in Italy (Costa, Duesseldorf, 2001)
- Trends in all cause mortality, infant mortality and life expectancy in US states between 1950 and 1990 (Kennedy, Duesseldorf, 2001)
- Associations between income distribution and life expectancy in regions of Spain (Regidor, Duesseldorf, 2001).

One approach to an improved understanding of processes underlying an association between income inequality and health was to explore such associations in smaller regions within countries. Efforts to obtain and analyse such data were discussed.

Indicators of socioeconomic status

Presentations:

- Health inequalities by income among men and women in Finland from 1986 to 1996 (E. Lahelma, Duesseldorf 2001)
- Socioeconomic indicators and health in Finnish men and women (E. Lahelma, Rotterdam, 2002)

The role of different indicators of socioeconomic status for health outcomes was discussed.

3.3.4 Further Activities

Summer School

Three working group members composed a curriculum for two days of the summer school (A. Kunst, F. van Lenthe, and M. Stafford), presented by the latter two in Coimbra in 2001.

Johan Mackenbach and Frank van Lenthe on behalf of Working Group III

September 2003

3.3.5 References

(Papers with * refer to the ESF Programme in their Acknowledgement)

- Blomgren J, **Martikainen P**, Mäkelä P & **Valkonen T** (in press). The effects of regional characteristics on alcohol-related mortality - a register-based multilevel analysis of 1.1 million men. *Social Science & Medicine* *
- Cavelaars A, **Kunst A E**, Geurts J, Crialesi R, Grötveld L, Helmert U, **Lahelma E**, Lundberg O, Mielck O, Matheson J, Mizrahi A, Rasmussen N, **Regidor E**, Spuler T & **Mackenbach JP** (1998). Differences in self-reported morbidity by educational level: a comparison of 11 Western European countries. *J Epidemiol Comm Health*, 52, 219-227
- Cavelaars A, **Kunst AE**, Geurts J, Helmert U, **Lahelma E**, Lundberg O, Matheson J, Mielck A & **Mackenbach JP** (1998). Differences in self reported morbidity by income level in six European countries. In: A. Cavelaars (Ed.), Cross-national comparisons of socioeconomic differences in health indicators. Rotterdam: Erasmus University
- Dahl E**, Elstad JI & Hofoss I. Income inequality and mortality in Norway (in preparation) *
- Dahl E**, Fritzell J, **Lahelma E**, **Martikainen P**, **Mackenbach JP** & **Kunst AE** (2003). Welfare regimes and health inequalities (in preparation) *
- Davey Smith G, Hart C, Watt G, Hole D & Hawthorne V (1998). Individual social class, area based deprivation, cardiovascular disease risk factors, and mortality. *J Epidemiol Comm Health*, 52, 399-405
- Diez Roux AV**, Merkin SS, Arnett D, Chambless L, Massing M, Nieto F J, Sorlie P, Szklo M, Tyroler HA & Watson RL (2001). Neighborhood of residence and incidence of coronary heart disease. *N Engl J Med*, 345(2), 99-106
- Diez-Roux AV**, Nieto FJ, Caulfield L, Tyroler HA, Watson RL & Szklo M (1999). Neighbourhood differences in diet: the Atherosclerosis Risk in Communities (ARIC) Study. *J Epidemiol Community Health*, 53(1), 55-63
- Diez-Roux AV** (1998). Bringing context back into epidemiology: variables and fallacies in multilevel analysis. *Am J Public Health*, 88(2), 216-222
- Esping-Anderson R (1990). Three worlds of welfare capitalism. Oxford: Polity Press
- Hart C, Ecob R & Davey Smith G (1997). People, places and coronary heart disease risk factors: a multilevel analysis of the Scottish Heart Health Study Archive. *Soc Sci Med*, 45, 893-902
- Judge K** (1995). Income distribution and life expectancy: a critical appraisal. *BMJ*, 311, 1282-1285
- Kaplan GA**, Pamuk ER, Lynch JW, Cohen RD & Balfour JL (1996). Inequality in income and mortality in the United States: analysis of mortality and potential pathways. *BMJ*, 312(7037), 999-1003
- Karisto A, Notkola V & **Valkonen T** (1978). Socio-economic status and health in Finland and the other Scandinavian countries. *Soc Sci Med*, 12c, 83-88
- Kennedy BP**, **Kawachi I** & Prothrow-Stith D (1996). Income distribution and mortality: cross sectional ecological study of the Robin Hood index in the United States. *BMJ*, 312(7037), 1004-1007
- Krieger N (2001). Historical roots of social epidemiology: socioeconomic gradients in health and contextual analysis. *Int J Epidemiol*, 30(4), 899-900
- Kunst AE** & **Mackenbach JP** (1994). The size of mortality differences associated with educational level in nine industrial countries. *Am J Public Health*, 84, 932-937
- Kunst AE**, Groenhouf F & **Mackenbach JP** (1998). Mortality by occupational class among men 30-64 years in 11 European countries. *Soc Sci Med*, 46, 1459-1476
- Kunst AE**, Groenhouf F, **Mackenbach JP** & the EU Working Group on Socioeconomic Inequalities in health (1998). Occupational class and cause-specific mortality in middle-aged men in 11 European countries. *BMJ*, 316, 1636-1641
- Lynch J, Smith GD, Hillemeier M, Shaw M, Raghunathan T & **Kaplan G** (2001). Income inequality, the psychosocial environment, and health: comparisons of wealthy nations. *Lancet*, 358(9277), 194-200

- Lynch JW, Smith GD, **Kaplan GA** & House JS (2000). Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions. *BMJ*, 320(7243), 1200-1204
- Macintyre S**, Ellaway A & Cummins S (2002). Place effects on health: how can we conceptualise, operationalise and measure them? *Soc Sci Med*, 55, 125-139
- Macintyre S**, Maciver S & Sooman A (1993). Area, class and health: should we be focusing on places or people? *J Soc Policy*, 22, 213-234
- Mackenbach JP** (2002). Income inequality and population health. *BMJ*, 324(7328), 1-2
- Mackenbach JP, Kunst AE**, Cavelaars A, Groenhouf F, Geurts J & the EU Working Group on Socio-economic Inequalities in Health (1997). Socioeconomic inequalities in morbidity and mortality in Western Europe. *Lancet*, 349, 1655-1659
- Mackenbach JP, Martikainen P, Lahelma E**, Dalstra J, Looman CW & **Kunst AE** (2003). The shape of the relationship between income and self-assessed health: an international study (in preparation)*
- Martikainen P, Lahelma E**, Marmot M, Sekine M, Nishi N & Kagamimori SA (submitted). A comparison of socioeconomic differences in physical functioning and perceived health among male and female employees in Britain, Finland and Japan *
- Ross NA, Wolfson MC, Dunn JR, Berthelot JM, **Kaplan GA** & Lynch JW (2000). Relation between income inequality and mortality in Canada and in the United States: cross sectional assessment using census data and vital statistics. *BMJ*, 320(7239), 898-902
- Santana P** & Nogueira H (in press). A Geografia do Risco de morrer em Portugal por tumores malignos. Proceeding of III Colóquio de Coimbra: Territórios Desiguais. Culturas Globais, 2001 *
- Santana P** & Nogueira H (submitted). 'Avoidable' deaths as an assessment indicator for health and health care in Portugal in the 1990's (PFH2003) *
- Santana P**, Vaz A & Fachada M (submitted). Measuring health inequalities in Portugal in 1990's" . Presented to PFH2003; International Conference Poverty, Food & Health in Wealfare. Current Issues, future perspectives, Lisbon, 4 th, July 2003 (PFH2003) *
- Sloggett A & Joshi H (1994). Higher mortality in deprived areas: community or personal disadvantage? *BMJ*, 309, 1470-1474
- Stafford M** & Marmot M (2003). Neighbourhood deprivation and health: does it affect us all equally? *Int J Epidemiol*, 32, 357-366 *
- Stafford M**, Bartley M, Mitchell R & Marmot M (2001). Characteristics of individuals and characteristics of areas: investigating their influence on health in the Whitehall II study. *Health & Place*, 7(2), 117-129
- Stafford M**, Martikainen P, Lahelma E & Marmot M (submitted). Neighbourhoods and health: a comparison of London and Helsinki *
- Valkonen T** (1989). Adult mortality and level of education: a comparison of six countries. In: A. Fox (Ed.) Health Inequalities in European Countries (pp. 142-160). Gower: Aldershot
- van Lenthe FJ & Mackenbach JP** (2002). Neighbourhood deprivation and overweight: the GLOBE study. *Int J Obes Relat Metab Disord*, 26(2), 234-240
- van Lenthe FJ**, Borell L, **Martikainen P**, **Stafford M**, Marinacci C, **Regidor E** & **Diez Roux AV** (2003). Neighbourhood unemployment and all-cause mortality: a comparison of six countries (in preparation) *
- Wilkinson RG** (1992). Income distribution and life expectancy. *BMJ*, 304, 165-168
- Wilkinson RG** (1995). Commentary: A reply to Ken Judge: mistaken criticisms ignore overwhelming evidence. *BMJ*, 311, 1285-1287

3.4 Other Programme Achievements

3.4.1 Summer Schools

The training of young researchers and the European-wide dissemination of expertise in this area was a further aim of this Programme. Two summer schools were held to meet this aim.

Summer School 2001

The first ESF summer school on 'Links between Social Structure and Health' was hosted by P. Santana and was held at the University of Coimbra from 16 to 26 September 2001. 16 ESF Programme members (F. van Lenthe, R. Rugulies, M. Stafford, H. R. Eriksen, H. Pikhart, J. Siegrist, D. Starke, A. Steptoe, T. Theorell, H. Ursin, Y. Ben-Shlomo, H. Graham, J. Hallqvist, C. Hertzman, J. Lynch and C. Power) taught 39 young researchers from Europe, Canada and USA on the following topics:

- Introduction (background, history and significance of the problem in a global perspective)
- Descriptive evidence: development and current state of social variations in health (data sources and SES measures; cross-national comparisons, east/west and north/south analyses; within country analyses; challenges for future research, open issues)
- Macrosocial explanations (methodological issues; contextual versus compositional effects; social capital and health; income inequality and health; aggregate deprivation and health)
- Explaining pathways from social structure to bodily disease (methodology of experimental/laboratory studies; basic principles of stress research; basic models of health behaviour; gender-related differences; concepts of psychosocial stress and coping, e.g. social support, demand/control, effort-reward, optimism, mastery)
- Explanations from a life-course perspective (methodology of longitudinal studies, e.g. birth cohort studies; early life, programming versus cumulative model; pathways into early adult life)
- Towards a synthesis; open conceptual and methodological problems
- Implications of current state of knowledge for public health policy measures

The evaluation showed that modules, learning effects, opportunities for informal exchange and atmosphere were all rated very positive. Given its success, a second summer school was scheduled for the subsequent year.

☞ Evaluation at [http://www.uni-duesseldorf.de/health/Evaluation Summer School 2001.pdf](http://www.uni-duesseldorf.de/health/Evaluation%20Summer%20School%202001.pdf))

Summer School 2002

In fact, a second Summer School could be held at the University of Coimbra, Portugal, due to the hospitality of P. Santana. This school was on 'New Theoretical and Methodological Developments in Understanding Social Inequalities in Health' and it was held on September 6 - 12, 2002. 8 ESF Programme members (M. Bobak, M. Kristenson, H. Pikhart, C. Kirschbaum, M. Kristenson, T. Theorell, M. Bartley and D. Blane) presented the following topics to 18 doctoral or post doc students from 11 European countries and Canada:

- The current gap in life expectancy between Eastern and Western European countries (descriptive evidence; current explanations and unexplained gaps; new research approaches needed);
- the role of psychosocial stress in explaining social inequalities in health (role of stress in this area of research; scientifically most updated concepts of stress research; new promising psychobiologic stress markers and measurement of these);
- the accumulation of disadvantage over the life course, especially the burden of social inequalities in health in early old age (significance of the problem; conceptual and methodological tools needed to successfully cope with these challenges; assessment of quality of life in early old age);

The evaluation showed that the students considered this event very useful because of the great expertise of invited speakers and the many opportunities for discussion and informal exchange.

☞ Evaluation at [http://www.uni-duesseldorf.de/health/Evaluation Summer School 2002.pdf](http://www.uni-duesseldorf.de/health/Evaluation%20Summer%20School%202002.pdf)

3.4.2 Health policy transfer of scientific evidence

During the Programme's life time several programme members participated in European/international *conferences* on policy implications of social inequalities in health. Among these, the 'International Conference on Reducing Social Inequalities in Health' held in *Copenhagen* from 27 to 29 September 2000 was probably the one with most visible direct impact (see 'The Copenhagen Declaration on Reducing Social Inequalities in Health').

Another important conference was held in *Brussels* on 'Coping with Stress and Depression related Problems in Europe' from 25 – 27 October 2001 under the *EU presidency* of Belgium. This conference gave special emphasis on the role of social stress in children and adolescents as well as work stress and its impact on health and resulted in twelve Council conclusions adopted by the European Council of Health Ministers on 15 November 2001 as well as in a resolution of the World Health Organisation Executive Board in Geneva in January 2002.

In addition, several programme members were active in advising *national governments* on *policy recommendations* and *programmes* to reduce social variations in morbidity and mortality in different population and age groups. In this regard, programme members in the United Kingdom, in the Netherlands and in Finland were particularly active.

- The UK Health Variations Programme from 1996 to 2001 (Graham 1997) was designed to contribute to the research base for public health policy. Its major aim was to illuminate the pathways through which socio-economic inequality exerts its influence on health. National health inequality targets resulting from findings of the programme focus on infant mortality and area inequalities in life expectancy. Members were also involved in the preparation of a government report on reducing health inequalities (Department of Health 1999, Department of Health 2000).
- In the Netherlands, the issue of socioeconomic inequalities in health has been studied by two national research programmes in the 1990ies the first of which relied to a large extent on secondary data analysis and the second of which focused on research of effectiveness of interventions (Stronks 2002). Based on to the findings, the Dutch Programme Committee on Socioeconomic Inequalities in Health issued a set of 26 recommendations in 2001 (Mackenbach et al. 2002).
- In Sweden, research on inequalities in health has been considered important and is high on the political agenda. Over three years, a commission consisting of scientific experts and advisers from national authorities, universities etc. has developed strategies to tackle social inequalities in health (Burström et al. 2002) and in the policy 'Health on equal terms' (Ostlin et al. 2000) targets were set for a range of determinants.
- More information on policy measures to reduce inequalities in health can be found in a publication of J. Mackenbach and M. Bakker (2002) and an article recently published in the *Lancet* (Mackenbach 2003).

Finally, transfer of scientific evidence to health policy experts was intensified at the ESF Dublin *final conference* where one high ranking health policy expert per member country had been invited and informed about the Programme's aims and activities. Experts from Belgium, Denmark, Ireland, Italy, Netherlands, Norway, Portugal, Sweden and United Kingdom did

attend and contributed to the plenary discussions. Furthermore, the final conference lecture on 'comments on the Programme's policy implications' was given by E. Ziglio, head of the WHO European Office for Investment for Health and Development.

3.4.3 References

- Burström B, **Diderichsen F**, Östlin P & **Östergren PO** (2002). National Experiences: Sweden. In: J Mackenbach & M Bakker (Eds.) *Reducing Inequalities in Health: A European Perspective*. London: Routledge, 25-49
- Department of Health (1999). *Reducing Health Inequalities: an Action Report*. London: The Stationary Office
- Department of Health (2000). *The NHS Plan: a Plan for Investment, a Plan for Reform*. London: The Stationary Office
- Graham H** (1997). Health Variations: A new ESRC Research Programme. *Social Policy Association News*, May/June: 14-16
- J Mackenbach** & M Bakker (2002). *Reducing Inequalities in Health: A European Perspective*. London: Routledge
- Mackenbach J**, Bakker, MJ, Sihto M & **Diderichsen F** (2002). Strategies to reduce socioeconomic inequalities in health. In: J Mackenbach & M Bakker (Eds.) *Reducing Inequalities in Health: A European Perspective*. London: Routledge, 25-49
- Mackenbach JP** (2003). Tackling socioeconomic inequalities in health: analysis of European experiences. *Lancet* 362, 1409-14
- Ostlin P, **Diderichsen F** (2000). *Equality-Oriented National Strategy for Public Health in Sweden. A Case Study*. Policy Learning Curve Series, 1. Brussels: European Centre for Health Policy
- Stronks K (2002). National experiences: the Netherlands. In: J Mackenbach & M Bakker (Eds.) *Reducing Inequalities in Health: A European Perspective*. London: Routledge, 249-261

4 General evaluation

Based on this Final Report, the Steering Committee conducted an overall evaluation of the scientific Programme at its annual meeting in Dublin on 10 October, 2003. All committee members agreed that the Programme as a whole was very successful.

Outstanding achievements are

- 1) substantial scientific progress in major areas of the Programme;
- 2) an impressive amount of scientific publications (in particular with regard to limited funding);
- 3) advancement of comparative research across Europe with regard to specific work group topics and development of validated methods;
- 4) cross fertilisation across disciplines in transdisciplinary work;
- 5) building and strengthening research networks within Europe including transatlantic link;
- 6) involvement, training and exchange of young scientists.

At the same time it was concluded that further progress in the Programme's achievements would have been desirable in the following areas:

- 1) more intensified cross fertilization between the three work groups;
- 2) more comprehensive inclusion of intervention research (as far as available);
- 3) more emphasis on health policy implications of the Programme's scientific outputs.

The Steering Committee agreed that there are still important gaps and controversies in current scientific explanations of social variations in health expectancy in Europe, both at the conceptual and empirical level. Therefore, a continuation of activities of the scientific network developed through this Programme is strongly recommended. In view of the merits of this Programme, the Steering Committee raised the issue of possibly extending the life time of successful à la carte Programmes in future ESF regulations.

5 Publicity

Within this Programme several types of activities concerning publicity and dissemination of information were developed.

1) A website has been established which provides information on the Programme in general, research topics, forthcoming events (e.g. workshops including minutes), and an updated overview of scientific output.

☞ Website at <http://www.uni-duesseldorf.de/health/>

2) A brochure has been manufactured which informs on the background of the Programme, describes research topics and lists addresses of the Steering Committee members and relevant contact persons.

☞ Brochure at <http://www.uni-duesseldorf.de/health/brochure-Dateien/Brochure.pdf>

3) An inventory of ongoing studies has been compiled providing an overview of some 47 studies conducted in research centres of members of the scientific programme. This inventory proved to be extremely helpful in identifying options of collaboration, exchange of data, joint data analyses etc.

☞ Inventory at http://www.uni-duesseldorf.de/health/ongoing_studies.pdf

4) A Special Issue containing original scientific articles from members of WG II has been prepared which is currently in press in a widely distributed international scientific journal, Social Science and Medicine (Volume 58, Issue 8, Pages 1461-1574; April 2004). The Special Issue which is entitled 'Health Inequalities and the Psychosocial Environment' contains the following contributions of programme members:

- Health inequalities and the psychosocial environment - two scientific challenges (J. Siegrist & M. Marmot)
- Psychosocial factors at work and depression in three countries of Central and Eastern Europe (H. Pikhart, M. Bobak, A. Pajak, S. Malyutina, R. Kubinova, R. Topor, H. Sebakova, Y. Nikitin, M. Marmot)

- The measurement of Effort-Reward Imbalance at work: European comparisons (J. Siegrist, D. Starke, T. Chandola, I. Godin, M. Marmot, I. Niedhammer, R. Peter)
- The effect of control at home on CHD events in the Whitehall II study: gender differences in psychosocial domestic pathways to social inequalities in CHD (T. Chandola, H. Kuper, A. Singh-Manoux, M. Bartley, M. Marmot)
- Psychobiological mechanisms of socioeconomic differences in health (M. Kristenson, H.R. Eriksen, J.K. Sluiter, D. Starke, H. Ursin)
- Work stress, socioeconomic status, and neuroendocrine activation over the working day (S.R. Kunz - Ebrecht, C. Kirschbaum, A. Steptoe)
- Effort-Reward imbalance model and self reported health: cross-sectional and prospective findings from the GAZEL Cohort (I. Niedhammer, M-L. Teck, D. Starke, J. Siegrist)
- Differential economic stability and psychosocial stress at work: associations with psychosomatic complaints and absenteeism (I. Godin, F. Kittel)
- Can we disentangle life course processes of accumulation, critical period and social mobility? An analysis of disadvantaged socio-economic positions and myocardial infarction in the Stockholm Heart Epidemiology Programme (SHEEP) (J. Hallqvist, J. Lynch, M. Bartley, T. Lang, D. Blane)
- Social mobility and health in the Turin Longitudinal Study (M. Cardano, G. Costa, M. Demaria)

5) Some 45 scientific papers with acknowledged benefit from this Programme have been published so far.

☞ All contributions are listed in appendix B 2: Publications with acknowledgement.

6) Publicity activities in preparation include a documentation of the proceedings of the final meeting in Dublin (CD or book) and publication of this final report.

6 Budget

The lifetime of the Programme has been from July 1999 to December 2003. Fourteen ESF member countries have agreed to contribute to the à la carte Programme budget. The annual costs have been funded by ESF Member Organisations both the social and medical sciences. This reflects an appropriate balance of expertise of the interdisciplinary Programme. Funding organisations and annual expenditures can be taken from the following two tables.

6.1 Contributing member organisations

Country	Member Organisations
Belgium	Fonds National de la Recherche Scientifique (FNRS) Fonds voor Wetenschappelijk Onderzoek - Vlaanderen (FWO)
Czech Republic	Akademie ved Ceske republiky Grantová agentura Českè republiky
Denmark	Statens Samfundsvidens-kabelige Forskningsrad
Finland	Suomen Akatemia/Finlands Akademi
France	Centre National de la Recherche Scientifique (CNRS) Institut National de la Santé et de la Recherche Médicale (INSERM)
Germany	Deutsche Forschungsgemeinschaft (DFG)
Ireland	Health Research Board
Italy	Consiglio Nazionale delle Ricerche (CNR)
Netherlands	NWO Social Science Research Council NWO Council for Medical and Health Research
Norway	Research Council of Norway (Division of Culture and Society and Division of Medicine and Health)
Portugal	Instituto de Cooperaçao Ciêntifica e Tecnológica Internacional (ICCTI)
Sweden	Swedish Council for Medical Research Swedish Council for Social Research
Switzerland	Schweizerischer Nationalfonds zur Förderung der Wissenschaftlichen Forschung (SNF)
United Kingdom	Economic and Social Research Council (ESRC) Medical Research Council (MRC)

Budget

6.2 Expenditures

Year		1999	2000	2001	2002	2003
Budget (incl. carry-over from previous year)	€	205653,73	379576,89	446292,63	312752,44	207153,7
Research Assistance						
	€	15443,40	26359,89	18508,71	5391,62	26561,69
Committee meetings	€	18156,54	23262,38	9779,34	6367,07	1619,10
Workshops, conferences	€	5766,45	88415,41	125065,16	90388,30	135210,67
Grants	€	0,00	1491,59	0,00	1265,51	11088,02
Publication, publicity	€	0,00	2140,73	111,10	0,00	843,02
External administrative	€	89,23	3930,78	0,00	289,42	116,93
ESF administrative	€	10282,69	11186,71	11186,48	1500,00	0,00
Miscellaneous	€	68,12	226,37	1678,54	396,82	316,71
Total						
	€	49806,43	157013,86	166329,33	105598,74	175756,14
Balance	€	155847,30	222563,03	279963,30	207153,70	31397,56

Appendices

A 1: Participants by country

<i>Number of participants from</i>		<i>ESF member organisation</i>	<i>Other (associated/overseas)</i>
Belgium	1	✓	
Czech Republic	1	✓	
Denmark	5	✓	
Finland	4	✓	
France	4	✓	
Germany	6	✓	
Italy	2	✓	
Ireland	2	✓	
Netherlands	7	✓	
Norway	5	✓	
Portugal	2	✓	
Sweden	10	✓	
Switzerland	1	✓	
United Kingdom	19	✓	
Canada	2		✓
Spain	1		✓
USA	6		✓
Total	78		

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A 5: ESF support

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B 1: Meetings

Date	Title of workshop	Venue	No. participants	Special guests	Reports: http://www.uni-duesseldorf.de/health/workshop.htm
November 23-24, 1999	1 st Meeting of the Steering Committee	London, UK	15	-	✓
December 15-16, 1999	Joint Workshop on Psychosocial Work Assessments of the National Institute for Psychosocial Factors and Health and Working Group II	Stockholm, Sweden	31	15 guests (workshop)	✓
March 31 - April 1, 2000	1 st Workshop of Working Group II	London, UK	33	3 guests	✓
May 12 - 13, 2000	1 st Workshop of Working Group I	Stockholm, Sweden	20	4 guests	✓
May 12 - 13, 2000	1 st Workshop of Working Group III	Stockholm, Sweden	22	-	✓
June 9, 2000	1 st Meeting of the Core Group	Middlesex, UK	7	-	✓
October 1, 2000	2 nd Workshop of Working Group II	Duesseldorf, Germany	22	2	✓
October 2, 2000	2 nd Meeting of the Core Group	Duesseldorf, Germany	6	-	✓
October 2-3, 2000	2 nd Meeting of the Steering Committee	Duesseldorf, Germany	13	-	✓
October 30, 2000	1 st meeting of the subgroup 'Work stress models: Clearing house activities on the ERI and JD-C model' Working Group II	Duesseldorf, Germany	7	-	✓
November 23 - 24, 2000	1 st meeting of the sub group 'Using established cohort and record-linkage studies to examine life course influences on health inequalities' Working Group I	London, UK	13	-	✓
December 15 - 16, 2000	1 st meeting of the sub group 'Gender and gender roles' Working Group II	Prague, Czech Republic	5	-	✓
March 23 -24, 2001	2 nd meeting of the sub group 'Gender and gender roles' Working Group II	Galway, Ireland	10	-	✓
April 9, 2001	2 nd meeting of the subgroup 'Work stress models: Clearing house activities on the ERI and JD-C model' Working Group II	Duesseldorf, Germany	7	-	✓
May 13-14, 2001	Joint Workshop: Working Group I	Duesseldorf, Germany	18	-	✓
May 13-14, 2001	Joint Workshop: Working Group II	Duesseldorf, Germany	25	-	✓

Appendices

Date	Title of workshop	Venue	No. participants	Special guests	Reports: http://www.uni-duesseldorf.de/health/w
May 13-14, 2001	Joint Workshop: Working Group III	Duesseldorf, Germany	21	-	✓
June 26, 2001	1 st meeting of the sub group 'Psychological factors' Working Group II	Geilo, Norway	4	-	✓
September 16-26, 2001	1 st International Summer School	Coimbra, Portugal	39		✓
October 4-5, 2001	2 nd meeting of the sub group 'Psychological factors' Working Group II	Bergen, Norway	6	2 guests (research students)	✓
October 11-12, 2001	3 rd Meeting of the Steering Committee	Strasbourg, France	14	-	✓
November 15, 2001	2 nd meeting of the sub group 'Using established cohort and record-linkage studies to examine life course influences on health inequalities' Working Group I	London, England	6	-	✓
November 16-17, 2001	Joint Workshop of Working Groups I and II 'Methodological issues'	London, England			✓
December 18 – 19, 2001	3 rd meeting of the sub group on 'Psychological factors' Working Group II	Linköping, Sweden			✓
January 10-11, 2002	1 st meeting of the sub group 'New cohort studies' Working Group I	London, England			✓
March 20-22, 2002	3 rd meeting of the subgroup 'Work stress models: Clearing house activities on the ERI and JD-C model' Working Group II (in combination with the 3 rd International Conference on Work Environment and Cardiovascular Diseases (ICOH))	Duesseldorf, Germany	22	10 guests (conference)	✓
April 26-28, 2002	3 rd meeting of the sub group 'Gender and gender roles' Working Group II	Prague, Czech Republic	4	-	✓
May 2-3, 2002	4 th meeting of the sub group 'Psychological factors' Working Group II	Geilo, Norway	4	1 guest (project member)	✓
May 22, 2002	3 rd meeting of the sub group 'Using established cohort and record-linkage studies to examine	London, United Kingdom	7	-	✓

Appendices

Date	Title of workshop	Venue	No. participants	Special guests	Reports: http://www.uni-duessel-dorf.de/health/w
	<i>life course influences on health inequalities'</i> Working Group I				
May 23-24, 2002	2 nd Joint meeting of WGI and WGII <i>'Methodological Issues II'</i>	London, United Kingdom	22	3 invited speakers, 1 guest (project member)	✓
May 30-31, 2002	2 nd Workshop of Working Group III	Rotterdam, The Netherlands	17	1 guest researcher, 3 research students	✓
September 6-12, 2002	2 nd International Summer School	Coimbra, Portugal	18		✓
September 19-20, 2002	Meeting of a collaboration <i>'Joint analyses and research on a Danish and a Scottish cohort'</i> Working Group I	Aberdeen, Scotland	11	6 guests (project members)	✓
October 10-11, 2002	4 th Meeting of the Steering Committee	Strasbourg, France	9	-	✓
December 5-6, 2002	4 th meeting of the sub group <i>'Using established cohort and record-linkage studies to examine life course influences on health inequalities'</i> Working Group I	London, England	7	-	✓
January 30-31, 2003	3 rd Meeting of WG III	Rotterdam, Netherlands	7	-	✓
February 7, 2003	4 th meeting of the subgroup <i>'Work stress models: Clearing house activities on the ERI and JD-C model'</i> Working Group II	Duesseldorf, Germany	13	5 guests (project members)	✓
October 10, 2003	5 th meeting of the Steering Committee	Dublin, Ireland		-	✓
October 10, 2003	5 th meeting of the sub group <i>'Using established cohort and record-linkage studies to examine life course influences on health inequalities'</i> Working Group I	Dublin, Ireland	7	-	✓
October 10, 2003	Final meeting of Working Group II	Dublin, Ireland	?	-	✓
October 10, 2003	Final meeting of Working Group III	Dublin, Ireland	?	-	✓

Appendices

Date	Title of workshop	Venue	No. participants	Special guests	Reports: http://www.uni-duessel-dorf.de/health/w
October 11, 2003	Final plenary meeting of Working Groups I, II and III	Dublin, Ireland	100	2 invited speakers, 10 health policy experts from participating countries, 10 guests (researchers)	not foreseen

B 2: Publications with acknowledgement

- Akerstedt T, Knutsson A, Westerholm P, Theorell T, Alfredsson L, Kecklund G (2002). Work organisation and unintentional sleep: results from the WOLF study. *Occupational Environmental Medicine* 59, 595 – 600
- Alfredsson L, Hammar N, Fransson E, Faire U de, Hallqvist J, Knutsson A, Nilsson T, Theorell T, Westerholm P (2002). Job strain and major risk factors for coronary heart disease among employed males and females in a Swedish study on work, lipids and fibrinogen. *Scandinavian Journal of Work Environment and Health* 28, 4, 238 – 248
- Ben-Shlomo B & Kuh D (2002). A lifecourse approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives, *International Journal of Epidemiology* 31, 2, 285 - 293
- Blomgren J, Martikainen P, Mäkelä P & Valkonen T (in press): The effects of regional characteristics on alcohol-related mortality - a register-based multilevel analysis of 1.1 million men. *Social Science & Medicine*
- Brunner EJ, Hemingway H, Walker BR, Page M, Clarke P, Juneja M, Shipley MJ, Kumari M, Andrew R, Seckl JR, Papadopoulos A, Checkley S, Rumley A, Lowe GDO, Stansfeld SA, and Marmot MG (2002). Adrenocortical, Autonomic, and Inflammatory Causes of the Metabolic Syndrome: Nested Case-Control Study. *Circulation* 106, 2659 - 2665
- Cardano M, Costa G & Demaria M (2004). Social mobility and health in The Turin Longitudinal Study. *Social Science & Medicine*, 58, 8, 1536-1574
- Chandola T, Britton A, Siegrist J, Marmot M (2003). Do changes in effort-reward imbalance at work contribute to an explanation of the social gradient in angina? (submitted)
- Chandola T, Kuper H, Singh-Manoux A, Bartley M & Marmot M (2004). The effect of control at home on CHD events in the Whitehall II study: gender differences in psychosocial domestic pathways to social inequalities in CHD. *Social Science & Medicine*, 58, 8, 1501-1509
- Claussen B & Næss Ø (2002). Dødelighet i Oslo etter uylikheter i yrkesklasse (Mortality in Oslo by inequalities in occupational class. In Norwegian with English summary). *Tidsskr Nor Lægeforen* 122, 1867-1869
- Claussen B, Davey Smith G & Thelle D (2003). Impact of childhood and adulthood socioeconomic position on cause specific mortality: the Oslo Mortality Study *Journal of Epidemiology and Community Health* 57, 40 - 45
- Davey Smith G & Lynch JW (2003). Socioeconomic differentials. In: Kuh D & Ben-Shlomo Y: A Lifecourse Approach to Chronic Disease Epidemiology (Vol 2), Oxford: Oxford University Press
- Elstad JI (2002). Childhood social stress and health in late adulthood: latent effects or pathways effects or both? Paper, presented at the 9th Conference of European Society of Health and Medical Sociology, Groningen, Netherlands, 29-31 August 2002
- Elstad JI (2002). Health and occupational achievement - the association between health and occupational careers from age 25 to age 55 among 330 Norwegian men with stable attachment to the labour market. Paper, presented at Nordic Sociological Conference, Reykjavik, Iceland, 15-17 August 2002
- Elstad JI (2002). Strategien mot sosioøkonomiske helseulikheter: Skal den innbefatte helsesrelatert seleksjon? [Should strategies to combat socioeconomic inequalities in health include health selection?] *Norsk Epidemiologi* [Norwegian Journal of Epidemiology], 12 (1), 39-42
- Eriksen HR, Hysing M, Sivertsen B and Kristenson M (2003). Socio-economic status and health - the mediating effect of psychosocial and lifestyle variables: a literature review (in preparation)
- Gaudemaris de R, Lang T, Chatellier G, Hamici L, Lauwers-Cancès V, Maître A, Diène E, for the IHPAF Working physicians group (2002). Socioeconomic Inequalities in Hypertension Prevalence and Care: The IHPAF Study. *Hypertension* 39, 1119 – 1125
- Godin I & Kittel F (2004). Differential economic stability and psychosocial stress at work: associations with psychosomatic complaints and absenteeism. *Social Science & Medicine*, 58, 8, 1543-1553

- Goldberg M, Melchior M, Leclerc A & Lert F (2003). Épidémiologie et déterminants sociaux des inégalités sociales de santé. *Revue d'Epidémiologie et de Santé Publique* (in press)
- Graham H (2002). Building an interdisciplinary science of health inequalities: the example of lifecourse research, *Social Science & Medicine* 55 (11), 2005 - 2016
- Hallqvist J, Lynch J, Bartley M, Lang T & Blane D (2004). Can we disentangle life course processes of accumulation, critical period and social mobility? An analysis of disadvantaged socioeconomic positions and myocardial infarction in the Stockholm Heart Epidemiology Programme (SHEEP). *Social Science & Medicine*, 58, 8, 1555-1562
- Jonge J de, Bosma H, Peter R, Siegrist J. (2000). Twee werkstress-modellen en psychische gezondheid: het Job Demand-Control Model en het Effort-Reward Imbalance Model (Two job stress models and mental health: the Job Demand-Control Model and the Effort-Reward Imbalance Model). *Gedrag en Gezondheid* 28, 106 - 122
- Jonge J de, Peeters MCW, Hamers JPH, Vegchel N van & Linden S van der (2003). Gender differences in the relationship between work-home interference, job characteristics and employee well-being in health care work. In: J Hellgren, K Näswall, M Sverke & M Söderfeldt (Eds.). *New Organizational Challenges for Human Service Work*. Mering: Rainer Hampp Verlag
- Kelleher CC, Friel S, Nic Gabhainn S & Tay JB (2003). Socio-demographic predictors of self-rated health in the Republic of Ireland: findings from the National Survey on Lifestyle, Attitudes and Nutrition, SLAN. *Soc Sci Med*, 57, 3, 477-86
- Knesebeck Ovd & Siegrist J (2003). Reported non reciprocity of social exchange and depressive symptoms. Extending the model of effort-reward imbalance beyond work. *Journal of Psychosomatic Research* (in press)
- Knesebeck Ovd, Lüschen G, Cockerham WC, Siegrist J (2003). Socioeconomic status and health among the aged in the United States and Germany: a comparative cross-sectional study. *Social Science and Medicine* (in press)
- Kristenson M, Eriksen HR, Sluiter JK, Starke D & Ursin H (2004). Psychobiological mechanisms of socioeconomic differences in health. *Social Science & Medicine*, 58, 8, 1511-1522
- Kudielka BM, Broderick JE, Kirschbaum, C. (2003): Compliance with saliva sampling protocols: electronic monitoring reveals invalid cortisol daytime profiles in noncompliant subjects. *Psychosomatic Medicine* 65, 313 – 319
- Kuh D, Ben-Shlomo Y, Lynch J & Hallqvist J (forthcoming): A glossary for lifecourse epidemiology, *Journal Epidemiol Community Health*
- Kunz-Ebrecht SR, Kirschbaum C & Steptoe A (2004). Work stress, socioeconomic status, and neuroendocrine activation over the working day. *Social Science & Medicine*, 58, 8, 1523-1530
- Lynch JW, Harper S, Davey Smith G, Ross N, Wolfson M & Dunn J (forthcoming). Is there a role for income inequality in understanding US regional mortality trends from 1968 to 1998? In: Shkolnikov V (Ed.) *Understanding Regional Mortality Trends*, IUSSP publication
- Martikainen P, Lahelma E, Marmot M, Sekine M, Nishi N & Kagamimori S (2003). A comparison of socioeconomic differences in physical functioning and perceived health among male and female employees in Britain, Finland and Japan (submitted)
- Niedhammer I, Teck ML, Starke D & Siegrist J (2004). Effort-Reward Imbalance Model and self reported health: Cross-sectional and prospective results from the GAZEL Cohort. *Social Science & Medicine*, 58, 8, 1531-1541
- Paterniti S, Niedhammer I, Lang T & Consoli SM (2002). Psychosocial factors at work, personality traits and depressive symptoms. Longitudinal results from the GAZEL Study. *British Journal of Psychiatry* 181, 111 – 117
- Pikhart H, Bobak M, Pajak A, Malyutina S, Kubinova R, Topor R, Sebakova H, Nikitin Y & Marmot M (2004). Psychosocial factors at work and depression in three countries of Central and Eastern Europe. *Social Science & Medicine*, 58, 8, 1475-1482
- Ribet C, Lang T, Zins M, Bingham A, Ferrières J, Arveiler D, Amouyel P, Bonenfant S, Chastang JF, Goldberg M, Ducimetière P (2001). Do cardiovascular risk factors in men depend on their spouses' occupational category? *European Journal of Epidemiology* 17, 347 - 56
- Santana P & Nogueira H (submitted). 'Avoidable' deaths as an assessment indicator for health and health care in Portugal in the 1990's

- Santana P, Vaz A & Fachada M (submitted). Measuring health inequalities in Portugal in 1990's. Presented to PFH2003; International Conference Poverty, Food & Health in Welfare. Current Issues, future perspectives, Lisbon, 4 July 2003 (PFH2003)
- Santana, P & Nogueira H (in press). A Geografia do Risco de morrer em Portugal por tumores malignos. Proceeding of III Colóquio de Coimbra: Territórios Desiguais. Culturas Globais, 2001
- Siegrist J & Marmot M (2004). Health inequalities and the psychosocial environment - two scientific challenges. *Social Science & Medicine*, 58, 8, 1463-1473
- Siegrist J (2000): Place, social exchange and health: proposed sociological framework. *Social Science & Medicine* 51, 1283 – 1294
- Siegrist J, Starke D, Chandola T, Godin I, Marmot M, Niedhammer I & Peter R (2004). The measurement of Effort-Reward Imbalance at work: European comparisons. *Social Science & Medicine*, 58, 8, 1483-1499
- Steptoe A, Siegrist J, Kirschbaum C & Marmot M (2004). Effort-reward imbalance, overcommitment, and measures of cortisol and blood pressure over the working day. *Psychosomatic Medicine* (in press)
- Stafford M & Marmot M (2003). Neighbourhood deprivation and health: does it affect us all equally? *Int J Epidemiology*, 32, 357-366
- Stafford M, Martikainen P, Lahelma E & Marmot M (submitted). Neighbourhoods and health: a comparison of London and Helsinki
- Steptoe A, Siegrist J, et al. (2003). Effort-reward imbalance, overcommitment, and measures of cortisol and blood pressure over the working day (submitted)
- Wamala S & Lynch J (2002) (Eds.). Gender and Social Inequities in Health. Lund: Studentlitteratur