Does relative deprivation exist in Denmark?
A community-level analysis of health inequalities

Introduction/Formulation of the Problem

It has been well demonstrated that area-level deprivation is significantly related to a population’s health status and health outcomes (e.g. Cummins et al, 2005; Cubbin et al, 2006; Eibner & Sturm, 2006). That is, the “social status” and level of resources of a particular region, neighbourhood or community have an effect on the health of its inhabitants which is above and beyond that of the inhabitants’ individual health risk behaviours (Pickett & Pearl, 2001; MacIntyre et al., 2002). The pathways through which area-level deprivation affect health remain unclear. However, it has been hypothesised that socially disadvantaged areas suffer from poor social and material infrastructure such as low quality and quantity of leisure facilities, transport, housing, and primary and secondary health services. Moreover, concentrated deprivation may also undermine civic engagement and increase crime (Cummins et al, 2005). These features may influence health directly or indirectly by influencing lifestyles and behaviour (Cummings et al. 2006). Research on studying the effects of area-level deprivation on health has begun to shift attention towards the structural and environmental aspects (e.g., demographic composition, location and number of services, shops, recreational facilities, etc.) of areas and how they influence health and health behaviour. Such knowledge is relevant for intervening at the area level which has become an important strategy to reduce health inequalities (Marmot, 1998). The policy implications of such research include the specification of indicators and indices of deprivation in order to identify areas that need special attention.

There is an extensive tradition in Great Britain of studying relative deprivation and its effect on health and mortality, where several indices have been developed to measure the construct (e.g., Carstairs, 1995; Jarman, 1984; Townsend, 1993). Recent efforts have been made in other countries to examine the effects of relative deprivation, but concerns have arisen regarding the appropriateness of British-based measures for use in other societies. Recently Eibner & Sturm (2006) have investigated British-based measures with various single indicators of deprivation for use in US research. Swedish research on the topic has used a measure developed for use in the Scandinavian context, where the social welfare structure of Nordic countries differs from that of Great Britain (Sundquist et al, 1999; Malström et al, 1998). Preliminary investigations of British-based deprivation indices on Danish data reveal the need for better specification of index items, as the Danish social welfare state is more similar to that of Sweden than to that of Great Britain.

Within this area of research is an emerging focus on youth and how such area-level conditions affect their health behaviour and health status. In investigating the influence of neighbourhood level factors on youth
health behaviours Lee & Cubbin (2002) found that low neighbourhood SES and high social disorganisation were associated with poor dietary habits.

This project thus has two purposes.

1. **Component 1.** The proposed project will address the question of whether relative deprivation exists in a country with a strong welfare state, such as Denmark, and to compare and develop appropriate measures of deprivation specific to the Danish context. This will be done with national registry data on all-cause as well as disease-specific mortality and with various indicators and indices for deprivation available at the parish level.

2. **Component 2.** The project will include a multi-level investigation of how neighbourhood and parish-level factors affect the individual health behaviour of Danish adolescents in the 7th through 9th grades.

Both the above analyses will include the use of Geographic Information Systems (GIS). The GIS technique allows for the analysis of new geographical variables and enables an excellent link to aggregate socioeconomic data based on an internationally unprecedented level of spatial precision. The proposed project will add new knowledge to existing research in Denmark by analysing the impact of area context on population health and youth health behaviour. In the context of international research it contributes to health and behavioural outcomes and population groups studied so far. Furthermore, as mentioned, context variables may have a different impact in more egalitarian countries such as Denmark than in Anglo-Saxon countries where most of the previous research has been conducted.

**Status of research**

Research on area effects on health has mainly been conducted in the United Kingdom where there has been a tradition at examining the relationship between relative deprivation and health since the 1980s. As mentioned, recent attempts have been undertaken in the USA to adapt British measures of area-level deprivation for domestic use (e.g., Eibner & Sturm, 2006), but few other countries have investigated such relationships.

This type of research, however, has recently become more appealing, partly due to the growing acceptance and use of multi-level statistical techniques to examine the separate contributions of the individual and context (or aggregate-level) variables to populations’ health, which thus make such analyses more meaningful than relying only on investigations at the aggregate level. There is evidence that area affects health and that these effects vary between places, health outcomes and population groups (Macintyre et al.,
1993; Sooman & Macintyre, 1995; Ellaway & Macintyre, 1996; Macintyre & Ellaway, 1998; Kawachi & Berkman, 2003; MacIntyre & Ellaway, 2003; Robert, 1999). In a review of multi-level studies of neighbourhood and health Picket and Pearl (2001) concluded that most studies show some associations between contextual factors and health outcomes but that these associations are smaller than associations between individual socioeconomic status and health. Several studies have shown an interaction between area and individual characteristics (such as age, gender, social class, and employment status) in predicting health. In Denmark, it was found that high local unemployment increases mortality risk even after adjustment for other social and behavioural factors (Osler et al., 2003). Beyond this study there is, to our knowledge, little research on the association of area-level deprivation and health in Denmark, and especially with respect to adolescents.

**Research design and methods**

**Component 1. Analysis and comparison of various indicators of relative deprivation in relation to all-cause mortality and disease-specific mortality.** Since indicators of social or relative deprivation are meant to exist on the aggregate level and because to date, no public-use data set yet exists in Denmark which has an adequately high number of individual cases with a neighbourhood or parish spatial distribution, this component will be carried out on the aggregate level with parish level variables.

The project investigators already have access to various indicators of community-level aggregate variables. These include, e.g., average age, educational level, household income, proportion rented housing, proportion of overcrowding, unemployment rate. The project, however, seeks to enlarge this list with other, more socially oriented variables which will help in the methodological comparison of the best competing measures of deprivation for Denmark (e.g., proportions of: older people living alone, children under 5, foreign-born persons, single parents, manual workers, highly mobile persons, etc.). Thus, the first months of the project for this component will consist of a review of current data available from private providers as well as Statistics Denmark, and of procuring these data for the conduct of the project. With the additional data, the component will then move to a next stage of comparing existing measures of deprivation with each other (e.g., Townsend, Jarman, Carstairs indexes) as well as with individual variables and new combinations of variables which would make theoretical and empirical sense as measures of deprivation for Denmark. After completion of this methodological stage, the first component of the project will inform the second component (i.e., investigating school neighbourhood and parish influences on adolescent health behaviour) by offering a suggested set of deprivation indices to be used in its multi-level analyses. The final stage of the first component’s work will be to conduct empirical analyses of the relation of social deprivation to mortality in Denmark with the best performing indicators. In addition to these statistical steps is the introduction of the spatial analysis via GIS which will aid in demonstrating the relationship of deprivation and mortality and
depicting where these two variables lie (and in which intensity) within the country. Such analyses will provide concrete and easily visible results that will lend themselves well to translation into public health policy targets.

**Component 2: Effects of social deprivation on adolescent health behaviour.** This part of the proposal will link individual quantitative data from a school-based, self-administered questionnaire survey on 7th grade pupils with registry data that characterises social context and neighbourhood structure. The *individual-level* data on youth health behaviour and their individual predictors come from the “Ungeshverdag Study”, which Morten Grønbæk and Tine Curtis from the National Institute of Public Health are conducting from 2004 to 2007. In this school-based cohort study pupils from schools in Denmark will be followed from the 7th to the 9th grades. The baseline sample of 7th graders consisting of 12,293 pupils from 521 schools, was completed in 2005 and forms an ideal quantitative database for the proposed study.

In a first step geographical neighbourhoods based on the school district borders will be constructed around all schools for the assessment of *neighbourhood-level* predictors. Using the methodology of geographical information systems (GIS) the description of the neighbourhoods will be based on data developed in cooperation between Statistics Denmark and the private company Geomatics. These data, conzoom®-factors, describe the Danish population through a number of socio-economic and demographic variables, and in a geographical resolution of 100x100m. For each of the squares aggregate data on age, education, employment status, household savings, and housing situation will be available. These census data will be used to describe the composition of the neighbourhood on an aggregate level.

**Measures**

*Individual level predictors*

The person level effects on behaviour will be evaluated by including the variables age, gender, parental education and occupation, parents’ health behaviours, social support, perceived school environment, family relationships, perceived health, and leisure time activities gathered from self-report in the “Ungeshverdag Study”.

*Smoking initiation, alcohol drinking initiation, and physical activity status*

The study will consider three different dependent variables measuring smoking, drinking initiation and physical activity using the questions from the “Ungeshverdag Study”.

*Neighbourhood level predictors*
The neighbourhood level variables utilised in this study will be the aggregate census data on age, education, employment status, household savings, and housing situation, ethnic groups and unemployment rate available for all neighbourhoods from Statistics Denmark and Geomatics.

**Statistical analyses**

**Component 1**

The analysis of the spatial variation of disease and its subsequent representation on a map is an important topic in epidemiological research. One important question in disease mapping is to test the hypothesis that the cases of disease occur at random within the study region presented on the map. An important mechanism deals with heterogeneity of disease risk, i.e. different levels of disease risk are present in the study region due to geographical variation of unknown or unobserved risk factors.

This leads to hierarchical models, where we allow for structural variability between areas.

The basic idea of a hierarchical model is to split the variation we observe among the area-specific estimates into the random variation within each area and the systematic variation between the areas. The later is frequently described by a normal distribution with a standard deviation $\tau$, which describes the variation of the true level of the areas, i.e. the level we would observe if we have thousands of patients in each area. This standard deviation $\tau$ can be estimated from our data, and the higher the value of $\tau$ the higher is the systematic variation. A value of $\tau$ close to 0 indicates that there is no variation among the areas.

The assumption of a normal distribution for the variation between areas may be true or not. Thus we employ alternatively semiparametric mixture models which do not rely on this assumption and which simply assume different subpopulations with different levels of disease risk within the study region. Statistically we need to estimate the level of risk for each subpopulation and the corresponding proportion of the overall population. One advantage of this method is the possibility to categorize the individual area (Schlattmann and Böhning, 1993). The method may be extended for covariates (Schlattmann et al, 1996).

**Component 2**

These ideas can be applied to individual level data as in component 2 as well. Since we are dealing with binary data e.g. smoking yes/no a logistic regression model with random effects will be applied. This is a so-called generalized linear mixed model (GLMM), allows for the analysis of hierarchically structured data, that is, data that are nested within at least two higher-level units. In the current case adolescents are nested in neighbourhoods. The statistical analysis will be performed with the whole sample of 12,293 7th graders nested in all 521 school neighbourhoods for the analysis of the aggregate neighbourhood level predictors and thus providing a high statistical power. The statistical packages R (2006) and WinBugs (Spiegelhalter et al., 2006) will be used for this analysis.
References


